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ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 45-2

“СВЧ диагностика”
(«Microwave Diagnostics»)

Публикации в трудах конференций

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ТЕМАТИЧЕСКИЙ РЕФЕРАТИВНЫЙ СБОРНИК № 45-2

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Публикации в трудах конференций

"Experimental study of spore etching of microorganisms in oxygen plasma using optical and mass spectroscopy"

Summary form only given. Utilizing plasma to achieve sterilization is an alternative to conventional sterilization means as far as sterilization of heat-sensitive materials and innocuity of sterilizing agents are concerned. Plasma sterilization is a surface sterilization process due to the limited ability of electrons and charged particles and/or VUV/UV emission generated during the plasma generation. However, plasma sterilization has the remarkable advantage that toxic residues are not produced on the sterilized objects after treatments. In addition, it is not only capable of killing bacteria and viruses, but also capable of removing the dead bacteria and viruses from the surface of the objects being sterilized. There are several mechanisms which may be responsible for the sterilization. These factors are the heat, UV radiation, plasma particles, and reactive neutral species. The extent of the influence of each factor depends on the plasma operating parameters such as power and gas mixture and flow rate. In our previous work, a six-log reduction in spores could be achieved only several minutes irradiation with low-pressure oxygen/air simulated surface-wave plasmas and the chemical etching reaction from the reactive oxygen radicals make more efficient inactivation rate [1-2]. In this work, we follow up to the previous studies[3-4], in order to investigate the contribution of various effects, especially the etching phenomena by the reactive oxygen radicals in the inactivation of spore forming bacteria. The experimental setup used for the sterilization tests consists of a stainless steel cylindrical vacuum chamber having a diameter of 400 mm and a height of 400 mm with a microwave launcher and 2.45 GHz microwave generator. The plasma is produced at a pressure of 13 Pa and a total gas flow of 200sccm by a microwave power source. The quadrupole mass spectroscopy and optical emission spectroscopy were used to diagnose the plasma parameters during plasma treatment of micr--oorganisms. [C1]

"Measurement of the azimuthal membrane voltage distribution at by-2 protoplasts exposed to ns pulsed electric fields"

Summary form only given. Theoretical calculations of the azimuthal membrane voltage distribution of spherical cells in suspension exposed to an external electric field, based on isolating shell models, predict a sinusoidal angular dependency along an undisturbed membrane. These typical waveforms can be measured by pulsed laser fluorescence microscopy, while exposing the cells, stained with a voltage sensitive dye (ANNINE-6), to a rectangular electric field pulse, 500 ns after pulse onset and at low external electric field amplitude.At earlier times and higher electric field amplitudes, a nontypical fluorescence response at the hyperpolarized cell hemisphere can be observed. Starting at the anodic pole region of the cell, a strong depolarization fluorescence response can be obtained. The fluorescence intensity decreases instead of increasing as theoretically expected. This fluorescence reversal appears more distinct and earlier at higher electric field amplitudes. Several 10 ns after the beginning of the electric field pulse, the fluorescence intensity increases again to theoretically expected values, indicating hyperpolarization of the membrane. After shortly introducing the experimental setup, the measurement results will be discussed against the background of current concepts of membrane-nsPEFinteraction. [C2]

"Structural modification of amino acids and peptides using low-pressure microwave plasma"

Summary form only given. The interaction of plasma with living organisms or biological materials has been extensively studied using low pressure plasmas or atmospheric pressure plasmas. Due to their properties the usefulness of low temperature plasmas could include the detoxification of some protein type molecules as toxins or prion abnormal molecules which cause Transmissible Spongiform Encephalopatie. Our research aims to prove the ability of low temperature microwave excited surface wave plasma to do this kind of modifications at low temperature and without involving any toxic substance. Also of great interest is revealing the mechanisms and the factors inside the plasma responsible for an eventual modification.The microwave plasma reactor was used in the present experiment. A 2.45 GHz microwave is introduced to the stainless chamber through a quartz window placed at the extremity of a rectangular waveguide. The plasma was excited at pressure 13.3 Pa. The

gas flow rate was kept constant at 100 seem. As samples, [Arg8]-Vasotocin molecules as peptide and cystine as amino acid were used. These have disulfide linkage in molecular structure. It is known that disulfide linkage has an important role in the biomolecules. It is a significant determinant of the tertiary structure of most proteins. The effect of Ar or oxygen plasma irradiation on amino acids or was studied by X-ray photoelectron spectroscopy(XPS), nuclear magnetic resonance(NMR) spectroscopy, and time-of -flight mass spectroscopy(TOF-MS). The present results show an apparent change of the molecular structure after plasma treatment. [C3]

"Laser induced fluorescence in a high power argon helicon plasma"

Summary form only given. A flowing argon helicon plasma is formed in a 10 cm diameter, 1.5 m long Pyrex chamber with an axial magnetic field in nozzle or flat configuration, variable up to 1 kG in the source region. Experimental upgrades including a new expansion chamber have been implemented and initial laser induced fluorescence (LIF) results including ion velocities and temperatures are presented. RF pulsing including frequency variation during the pulse (between 12 MHz and 15 MHz) is used to improve matching. Diagnostics including microwave interferometry, collisional radiative spectroscopic codes and diamagnetic loops are used to measure electron density and temperature. Electron temperature scaling with RF power is investigated at higher RF powers. The ion distribution function is examined and the effect of magnetic field expansion variation and system pressures as well as the axial variation of acceleration due to neutral depletion. Possible double layer creation and sustainment in the downstream (relative to the RF antenna) transition to the expansion chamber is also examined at low flow rates and high RF powers.Low-pressure discharge initiation results are also summarized [1] and new experiments at higher powers and lower flow rates (1-20 seem) are discussed. A static magnetic field threshold for discharge initiation is seen at low flow rates, where discharges will not start above a certain magnetic field value that depends on RF power and flow rate. This threshold is a consequence of the multipactor effect, which is the dominant mechanism for breakdown when the electron-neutral collisional mean free path is longer than the system dimensions. A magnetic field ramping technique for starting discharges at these low flow rates is described. [C4]

"Plasma modification of bulk niobium surface for SRF cavities"

Summary form only given. Particle accelerator performance, in particular the average accelerating field and the cavity quality factor, depends on the physical and chemical characteristics of the superconducting radio-frequency (SRF) cavity surface. Plasma based surface modification provides an excellent opportunity to eliminate non-superconductive pollutants in the penetration depth region and to remove the mechanically damaged surface layer, which improves the surface roughness. Here we show that the non-equilibrium plasma treatment of bulk polycrystalline Nb presents a viable surface preparation method due to possibility to use plasma-generated radicals and due to the inherent anisotropy of the etching action. We have optimized the experimental conditions in the microwave glow discharge system and their influence on the Nb removal rate on the flat samples and achieved etching rate of 1.7 μm/min using up to 3% Cl2in the reactive Ar/Cl2mixture. Combining a fast etching step with a moderate one, we have improved the surface roughness without exposing the fresh sample surface to the environment.The geometry of SRF cavities made of bulk polycrystalline Nb requires the use of asymmetric RF discharge configuration for plasma etching. The asymmetry in the surface area of a driven and grounded electrode creates a difference in the voltage drop over the plasma sheath attached to the driven electrode and the sheath attached to the cavity surface. The driven electrode geometry is optimized to achieve homogeneous sheath conditions at the surface. Specially designed single cell cavity is used to study these asymmetric discharges which contain 20 sample holder holes symmetrically placed over the cell. These sample holder holes can be used for both diagnostics and sample etching purposes. The approach is to combine radially and spectrally resolved profiles of optical intensity of the discharge with direct etched surface diagnostics to obtain an opt--imum combination of etching rates, roughness and homogeneity in a variety of discharge types, conditions and sequences. [C5]

"Comparison between metal wire grid and plasma wire grid"

Summary form only given. Metal wire grids has been used as polarizer in microwave and optical systems, as the spacing between wires d becomes smaller than the wavelength λ, the extinguish ratio between two polarization becomes large. In this experiment, the metal wire grid is replaced by Cold Cathode Florence Light (CCFL) tubes arranged in a tight formation, and the spacing between tube s is around 8 mm. Several metal wire grids of similar spacing are also constructed. Both kinds of grids are placed in an anechoic chamber and transmission measurements were conducted with a network analyzer.We found that even for metal wire grids, the S12measurement s differ considerably from the early theories [1,2]. For V-V-V polarization, deepest attenuation happens around 1 GHz at about -40 dB, and the next significant attenuation happens around 4 GHz when the spacing is changed from 12 mm to 8 mm. Overall, the transmission fluctuates around 10 dB. For metal wire grid

V-H-V polarization, there is no low frequency cutof f, but overall fluctuations increase. For the plasma wire grids, the general behavior behaves more like metal wire grids in V-H-V polarizations, there is no low frequency cutoff, and thee are enhancements of transmission at certain frequencies as high as 12 dB. These measurements suggests: a) the conductivity of the plasma is much lower than theory, b) The microscopic random motion of electrons in the plasma renders the macroscopic direction of the plasma tubes irrelevant, c) Enhancement in trans mission are caused by resonance from plasma. [C6]

"A microwave smith-purcell experiment-dependence on the beam parameters"

Summary form only given. Experimental studies on Smith-Purcell radiation have been conducted at CEA/CESTA since 2009. Initially, the main goal was to compare the results with the predictions of MAGIC simulations ' and with theory published by Andrews & Brau. At ICOPS 2009, we presented the first experimental results. Strong beam bunching, at the frequency of the evanescent mode of the grating, was measured along with a high emission level of coherent SP (CSP) emission at several harmonics of the fundamental frequency.We recently restarted the experiment in order to study CSP physics in more details. In particular we have measured the gain as a function of beam current, and also the value of the start current. They are of particular interest for THz CSP physics. Experimental results are compared with both existing theories and PIC simulations. Finally, we are studying the limits, in terms of flatness and thickness, of the electron beam. The aim is to increase the frequency of operation of our CSP experiment towards the THz range. We think our set-up could be used to produce a powerful tunable compact device at a frequency between 100 and 200 GHz. [C7]

"Diagnostics of submicron multi-element focused ion beams from an intense microwave plasma"

Focused ion beams (FIB) are highly important for applications in nanotechnology. Conventional Liquid Metal Ion Source (LMIS) based FIB systems provide primarily Gallium ions with undesirable contamination effects1. Plasma based FIB systems can provide a variety of ions that can be selectively utilized according to applications such as structuring, implantation, irradiation studies etc. The beam currents at the substrate are found to be several orders of magnitude (>103) larger than LMIS for a given solid angle of acceptance2. Important performance parameters for FIB are the beam spot size which determines the precision of the job to be performed, the image side brightness which decides the efficiency of operation and the ion energy spread which contributes to chromatic aberration in beam optics. [C8]

"Development and spectroscopic investigation of a microwave plasma source at atmospheric pressure"

Summary form only given.Microwave plasma sources at atmospheric pressure have a variety of different applications. On the one hand they can be used for the treatment of surfaces, for example the activation or cleaning, and on the other hand they can be applied for the conversion of gases, such as the abatement of waste gases or other chemical synthesis. The presented atmospheric plasma source is based on an axially cylindric resonator which is powered by 2.45 GHz microwaves. The plasma is confined in a quartz tube and the gas is supplied via a metallic nozzle. For a successful application in industrial processes an easy ignition as well as stable plasma operation are indispensable. To gurantee ignition of the plasma without any additional igniters, detailed information about the electric field is necessary. Simulations of the electric field distribution of different configuration with the commercial simulation software COMSOL Multiphysics™ were performed for this purpose. The simulation results could be verified by measurements with a network analyser and led to a configuration which provides an ignition of the plasma without any additional igniters as well as stable and efficient plasma operation.The characterisation of the plasma was carried out by means of optical emission spectroscopy. Overview spectra of a humid air plasma exhibit NO- and OH-bands in the UV range as well as atomic oxygen lines in the IR range. The OH-bands were used to obtain the gas rotational temperature Trot, which provides a good estimate of the gas temperature Tg. The electron temperature Te was estimated by the excitation temperature Tex, which was determined from a Boltzmann plot of the atomic oxygen lines. Maximum values of Trot of 3600 K and about 2200 K higher excitation temperatures of 5800 K were measured. Parametric studies of Trot and Tex in dependences of the gas flow and the supplied microwave power showed that the maximum temperatures are independent of these parameters--in the regarded range of an air flow of 10 sl/min to 70 sl/min and a supplied microwave power of 1 kW to 3 kW. However, the plasma volume depends on these parameters and increases with an increase of the microwave power and decreases when the gas flow is increased. [C9]

"The generation and characteristic study of large-volume microwave plasma produced with parellel rectangular waveguides"

A uniformity, high efficiency and large volume microwave plasma source has been developed, which consists of a 1-10 kW 2.45 GHz magnetron power supply, microwave transmission and monitoring system, microwave

power splitter, adjustable short-circuit plunger and two parallel rectangular waveguides with axial slots regularly positioned on its inner side. The design parameters and electric field existing modes of the microwave plasma source were optimized to produce high-amplitude and uniform electromagnetic field distribution. Various of gases including argon, helium, nitrogen, and air have been successfully used to generate a plasma for pressure range from 1000 to 2000 Pa and microwave power range from 800 W to 3000 W, which fills the entire discharge space. The simulation results are perfectly consistent with the experimental observation. The electron density was measured with a Mach-Zehnder interferometry and the electron temperature was obtained by use of atomic emission spectrometry. It can be seen from the interferograms at different microwave power that the distribution of the plasma electron density is stable and uniform. [C10]

"Investigation of multicomponent plasma parameters by microwave methods"

Investigations of plasma parameters in the pulsed reflex discharge were carried out at the facility having the following performance and operation conditions: mirror configuration with a pulsed magnetic field strength H0<;9 kOe; cathodes of 100 mm in diameter made of Cu with sputtered Ti; ignitor gas H2, Ar or gas mixture (Kr 88,89%; Xe 7%; N2 4%, Oζ 0,1%) was puffed into the chamber up to the pressure of 1-8 10"3 torr. Gas-metal plasma was formed as a result of the discharge at a voltage Ujis. = 3.5 kV (discharge duration ~ 1 ms, current Ijis, ~1.7 kA) in the medium of ignitor gas (mixture) and cathode sputtered material (Ti).The parameters of the gas-metal multicomponent plasma formed as a result of the pulsed reflex discharge (nρ ~ 1012-1014 cm"3) were investigated using a set of diagnostic methods and techniques. We have performed measurements of the following parameters and characteristics of the discharge-formed plasma: (1) time dependence of the average-density plasma in the range from 1012to 7 1013 cm"3; (2) electron density profile determined by the single wave reflection and the average-density change at a different frequency, and by the average density measurement at different chords; (3) rotational velocity of plasma in the poloidal direction determined by recording the fluctuations of signals reflected from equal-density layers spaced in the poloidal direction and by studying the autocorrelation function and the cross-correlation function of these signals; (4) electric strength determined by the value of a measured rotational velocity of plasma; (5) elemental composition of the plasma formed; (6) discharge current determined with the use of a Rogowski loop. [C11]

"Microwave ndt of exfoliation in a dielectric plate"

This paper presents microwave NDT of exfoliation of dielectric plate consisting of two identical plates of organic glass with air-gap between them. The material is described by its thickness, permittivity and loss-angle tangent. Experimental measurement of complex reflection coefficient of electromagnetic wave from dielectric plate is also performed on the automated stand for microwave diagnostics in frequency band 58....76 GHz. [C12]

"Compact millimeter-wave distance and speed measurement sensor for railway applications"

Radar sensor for use in automatic shunting system which executes remote control of track occupancy on hump yards and railroad switches and cut speed control passing along retarder position is developed. The sensors are equipped by systems of remote control and internal parameters diagnostics transmitting the radar and service information to the control point. The sensors could be applicable for use in the data nets. The main feature of the developed radar is the use of FMCW self-mixing transceiver with internal detection and digital control and spectral processing of the signal. [C13]

"Diagnostics of plasma of a flare on radiation in MM and ultra-violet ranges"

Solar flares are a phenomenon of extreme development of solar activity. They are a consequent of development of a broad spectrum of the physical processes happening in active area. The description of these processes is the important astrophysical problem. Radio-astronomical observations of solar flares help to understand essence of happening events more deeply. The important key for their understanding is diagnostics of a state of medium of flare. Its state can be characterized key parameters. It is temperature of plasma of flare in a pulsing phase of its development, an electron concentration, quantity of a magnetic field and the plasma parameter showing the relation of gas and magnetic pressures. The special role in definition of parameters of medium is played with radio-astronomical observations in mm range. On these waves the area of flare is optically thin and observable radiation immediately is connected to a nucleus of area of flare. [C14]

"Superconducting hot-electron nanobolometer-sensor arrays for supersensitive imaging radiometers of terahertz frequency range"

Development of various supersensitive detector arrays, based on superconducting bolometers for purpose of passive radio vision at terahertz frequencies including radiometers for ground-based and space astronomy security and medical diagnostics systems is in progress. One of the most popular detector devices are the hot-

electron bolometer-sensors operated at the superconducting transition edge (TES nanobolometers) and their arrays that include also the RF coupling circuits, electronic schemes for multiplexing and for read-out signals from the arrays.The antenna-coupled hot-electron nanobolometer-sensors with combined radiation absorbers and transition edge sensors (TES) are the most promising devices as opposed to bolometers, which employ suspended membranes. The membrane-type devices include the transition edge sensor attached to the radiation absorber, which is being warmed up, and than the heat is transferred to the sensor. [C15]

"Transmission line based microwave interferometers for plasma density measurements"

Summary form only given. Here we report the development of microwave interferometers based on transmission-line (TL) structures for monitoring of plasma density for applications in process monitoring or realtime feedback control of plasma based semiconductor fabrication tools, such plasma etchers or PECVDs. The principle of this technique is the same as the conventional microwave interferometers except that the sensing microwave propagates along a transmission-line structure, where microwave propagates at a phase velocity determined by the structure and the electron density of the surrounding plasma. Thus the variation of plasma density can be estimated from the phase shift of the transmitted microwave from one to the other end of the transmission-line. Compared to the conventional microwave interferometers where line averaged plasma density is measured, the transmission-line type microwave sensor will be less susceptive to the interference caused by multi-passes reflection/refraction effect resulting from nonuniformity of the plasma density profiles. Therefore, it provides a measurement of higher sensitivity and wider dynamic range. Several types of TL have been investigated, namely, a coaxial dielectric surface waveguide, a ridged microstrip line and a air-bridge microstrip line. The dispersion characteristics of the transmission-lines immersed in a plasma of different electron densities were first analyzed by numerical simulation using a commercial tool, High Frequency Structure Simulation code (Ansoft HFSS), a full-wave electromagnetic simulator using the finite element method. The simulation results show that the phase shift increases gradually with the plasma electron density with a sensitivity 10-20 degrees /1010cm-3, depending on the types of transmission-lines. The sensors as well as measurement have been constructed and experimental demonstration has been performed in an inductively coupled plasma etcher. The sensors were designed to--mount on the inner wall of plasma chamber. Measurement results show that the dependence of electron density of plasma source RF power predicted by the sensor agrees with the Hairpin probe measurements. [C16]

"Simulation and measurement of vacuum electron hop funnel IV characteristics and energy distribution"

Summary form only given. Electron hop funnel devices can be used to collect and spatially average electron emission current from field emission arrays (FEAs). At high enough operating voltage, the funnels provide unity gain of the injected emission current, and the resulting beams can be more uniform than from typical FEAs. We are using these devices to develop microwave amplifiers using FEAs. In the work described here, hop funnels have been fabricated from Low Temperature Co-fired Ceramic (LTCC), and the electron energy distribution of the hop funnel electron beam, as well as the IV characteristics, have been measured. The data has been compared against simulation using the particle trajectory code Lorentz. Convergence of the code has been demonstrated for a number of different parameters and, from which, the base parameters were determined and have been used to generate the numerical simulation results for the IV curve and electron energy distribution of the hop funnel exit beam. The results of the simulation and measurement will be used to estimate the maximum secondary electron yield and the corresponding maximum energy of the electron secondary yield curve of LTCC. [C17]

"Initial laser induced fluorescence measurements in the madhex expansion chamber and electron temperature scaling with pulsed RF power"

A flowing argon helicon plasma is formed in a 10 cm diameter, 1.5 m long Pyrex chamber with an axial magnetic field in nozzle or flat configuration, variable up to 1 kG in the source region. A new expansion chamber has been constructed and initial laser induced fluorescence (LIF) results including ion velocities and temperatures are presented. Microwave interferometry (105 GHz), collisional radiative spectroscopic codes and diamagnetic loops are used to measure electron density and temperature during pulsed (5 ms) RF operation. Calculated variation of the RF frequency (from 12 MHz to 15 MHz) during the pulse allows for low (<;3%) reflected powers during the gas breakdown and the approach to and formation of the steady state plasma. The scaling of electron temperature with RF power is also examined for high (>3 kW) RF powers. The effect of different flow rates, magnetic field expansion variation and pressures are measured to observe the variation of the ion distribution function via LIF and the axial variation of acceleration due to neutral depletion. Possible double layer creation and sustainment in the downstream (relative to the RF antenna) transition to the expansion chamber is also examined at low flow rates and high RF powers. [C18]

"Theoretical and experimental investigations of submillimeter CW gyrotrons"

This paper presents an overview of research activity for development of relatively low-power (10100 W) submillimeter CW gyrotrons at the IAP RAS. Those investigations were started in the 1970-80s and several tubes with unique parameters have been developed. This time at the IAP RAS were obtained recordbreaking results of power and frequency of radiation (1.5 kW for 0.3 THz CW gyrotron at the second harmonic of gyrofrequency). During the end of the 20-th century main efforts were concentrated on development of megawatt power level gyrotrons for nuclear fusion experiments and submillimeter wave activity was rather slackened. At present, interest to submillimeter devices has been strengthened since this frequency range is attractive for numerous applications, which include plasma diagnostics, electron-spin resonance spectroscopy, enhancement of NMR sensitivity using dynamic nuclear polarization, standoff detection and imaging of explosives and weapons, new medical technology, atmospheric monitoring, chemical technologies, production of high-purity materials, deep space and specialized satellite communication etc. [C19]

"Control and diagnostic system for the demonstrator of S Band active antenna"

In the paper, a Control and Diagnostic System designed for the Demonstrator of S Band Active Antenna is presented. Transmit and receive antenna radiation pattern is steered and controlled by a central computer. Diagnostic system is focused on transmit part of the demonstrator with solid state T/R modules. The key elements of diagnostic, amplitude and phase meters integrated with each transmit channel are presented. The system works in pulse condition. Real, transmit signal as reference for diagnostic system is used. Independent, built-in system of diagnostic for T/R modules are presented as well. It enables safe modules operation and failure location in service mode. The Control and Diagnostic System is based on CAN 2.0 bus what allows to operate with very high reliability and baud rate up to 1 Mb/s. [C20]

"Effect of plasma gases on OH radical generation in atmospheric pressure microwave plasma jet using UV cavity ring down spectroscopy"

Summary form only given. OH radical plays an important role in biomedical, material, and combustion processing as well as in many other applications. Quantification of OH radicals in atmospheric pressure microwave plasma jets can be useful for understanding of OH formation mechanism and plasma generation. As reported previously, OH radicals exist in the far downstream (distance / plasma column length > 3) of an atmospheric pressure argon plasma jet. So far, we have confirmed that the similar phenomenon also exits in helium plasma jets, N2or O2mixed with argon plasma jets, and N2 or O2mixed with helium plasma jets. Here, the plasma column, which was generated using a microwave plasma source of 2.45 GHz, was typically of 3 mm long. Effects of addition of nitrogen and oxygen gases to argon in different mixing ratios, such as Ar: N2= 56:1, Ar: N2= 24:1, Ar: N2= 13:1 and Ar: O2= 27:1, were studied in detail using CRDS, OES and visual imaging. With addition of N2in argon plasma, a plume tail appears in the plasma jet column while addition of O2makes the plasma column unstable and more like a plume instead of a jet shape. Spectral simulations of emission spectra observed under various circumstances and temperature measurements clearly indicate that the gas temperature of Ar + N2plasma is higher than that of Ar + O2plasma. Absolute number densities of OH (v" = 0, J" = 3.5) along the plasma jet column were measured in these plasma jets. Dependence of absolute number density of OH on plasma power and gas flow-rate (variation in mixing ratios of N2and O2) were also studied. The similar studies were carried out for addition of N2and O2in helium plasma jets with the mixing ratios of He: N2= 44:1 and He: O2= 41:1, respectively. As helium plasma jets are more stable, addition o--f N2or O2changes the jets into an unstable jet and a plume-like plasma, respectively. The results suggest that the addition of N2and O2in argon and helium plasma jets is helpful for OH radical generation but also makes the plasmas less stable. [C21]

"An integrated low power buck converter with a comparator controlled low-side switch"

Here the design of an integrated buck-converter leg is presented in which the free-wheeling diode is replaced by a comparator controlled N-MOSFET. This allows eliminating the efficiency reducing voltage drop at the diode while the discontinuous conducting mode (DCM) is still applicable. For this issue, besides the control block also a fast comparator with a special offset reduction circuit is presented. A layout for a converter bridge was done and simulated which is optimized for the best efficiency at a statistically often used point of operation (3.3 V output, 27.5% duty ratio, 1 MHz, 170 mA). [C22]

"Highly linear down-conversion mixer in 65nm CMOS for a high supply voltage of 2.5V"

A direct down conversion Gilbert-type mixer in combination with an active low-pass filter for 4MHz is presented. The Gilbert-type mixer is enhanced with a source degeneration to improve the linearity performance. The active filter is a linearity enhanced differential amplifier with feedback network. For the high supply voltage of 2.5V

additional over-voltage protection with cascodes is added to the circuit parts. The entire receiver part consumes 6.88mA from a 2.5V supply. A high gain of 26.6dB is achieved by the active mixer in combination with the active filter. The noise figure of the entire circuit is only 11.8dB. The input referred intercept point of 3rd-order is +18.6dBm. [C23]

"Validation of a narrowband signal processing system for beam position monitoring purposes in linear accelerators"

A new RF frontend for a beam position monitoring system for electron linear accelerators (Linacs) is discussed. The frontend applies a waveguide based input filter section for processing the pulse train, generated by non-interceptive pickups and selection of the desired beam harmonic. Due to increased accuracy, narrowband signal processing was chosen for further signal treatment. Therefore, a two-channel downconverter was designed incorporating two single-balanced diode mixer stages optimized for processing frequencies around 6 GHz, the second beam harmonic in S-Band Linacs. Device characteristics and component validation in a demonstrator with electro-magnetic excitation, simulating beam-induced fields are presented. [C24]

"Stroke detection using a broadband microwave antenna system"

In this paper we describe a microwave based measurement setup and a signal processing algorithm for stroke detection and diagnostics. [C25]

"Clinical diagnostics and treatment with electromagnetic fields"

There is a need for novel diagnostic and treatment systems to overcome the limitations with todays modalities. Microwave and THz based system has the potential to become both sensitive and specific in several applications. In this paper we discuss several applications that are currently being developed at the Chalmers University of Technology. [C26]

"EMC and wireless healthcare"

Electromagnetic compatibility (EMC) is a critical part of addressing the risks related to the effects of electromagnetic interference (EMI) on active medical devices exposed to emissions from wireless technology. In addition, for wireless technology in healthcare to be safe, effective, reliable, and secure specific wireless issues must also be addressed including quality of service, coexistence with other wireless equipment, data integrity, and wireless security. Unfortunately, these issues pose risks that are poorly addressed in present medical devices standards or other consensus documents. This paper discusses risks for wireless technology in healthcare with examples from research examining the effects of emissions from wireless technology such as RFID on implantable cardiac pacemakers and defibrillators and EMC with other emitters. The paper goes into ways that the risks, including EMI, can be addressed and makes the case for substantive engagement by stakeholders, including the IT community, wireless developers, and clinical organizations. There is clear need to develop unbiased, consensus information and tools that will set the pathways and tools needed to meet the risks and challenges for widespread incorporation of wireless technology in healthcare. [C27]

"Behavior of aquarial goldfish Carassius auratus as the diagnostic response to electromagnetic emission from cellular telephone communication units"

The subject of study is the experimental result of real human environment magnetic field distortion Bz on the example of high-frequency electro-magnetic emission in the cellular radiotelephone systems (EME). In the near-field zone of telephone receivers (TR) of various commercial models in different methods of operation the emission generates concurrental inductive fluctuations ΔHz in the frequency range ΔHz which is close to the cerebral biorhythms of humans and animals. The goldfish Carassius Auratus population, got by the consanguineous crossing during several years (strict inbreeding) for maintaining genetical purity of the material, was used to illustrate behavioral perception the effects of electro-magnetic emission (EME) by fish. The response of animals was registered motion activity alteration in vivo (MA) in the open aquarial ecosystem. The after-effects of long-term exposure of neuronal reactions to the modern cellular communication units EME can lead to pathological phenomena and processes. So the pathological behavioral parameters in vivo revealed in the experiments can be used in the medical practice and in working out the regulating principles of safety for the people. [C28]

"Implementation of a radar tester for air traffic control applications"

In this paper we present a method, and a fully implemented and tested hardware, for testing the operation of primary radars, may it be used in air traffic control or in military service. The realization of the radar tester was

based on the theory of controlled radar cross section (CRCS), this way creating spurious targets or clutters, with known parameters, on the screen of the radar. According to the difference between the created and the measured parameters (e.g. velocity, fluctuation and distance), any minor or major degradation or failure can be detected. The tester is capable of scanning the radar system from the antenna, via microwave hardware elements, all through to the digital signal processor (DSP) unit, achieving great diagnostic properties. Emphasis was put on the realisation of the hardware. The produced equipment was tested in real life using a primary ATC radar in Hungary, with satisfying results. [C29]

"A mixer-filter combination of a direct conversion receiver for DVB-H applications in 65nm CMOS"

A mixer and operational amplifier filter combination in 65 nm CMOS technology for DVB-H is presented. Special focus is laid on the design of the operational amplifier, which is a nested-Miller compensated, 3-stage feed-forward operational amplifier. Characteristic of the operational amplifier is the supply voltage of 2.5 V to enlarge the output signal swing of the operational amplifier. Cascodes are used avoiding the electrical destruction. The operational amplifier has a gain of 89 dB, a gain-bandwidth of 1.1 GHz, and phase margin of 53.3 deg at a load of 1 pF on each of the two differential outputs. The current consumption is 5.85 mA. This operational amplifier is used in a first-order low-pass filter after a passive mixer. This mixer-filter combination is characterized as well. A conversion gain of 24 dB and a bandwidth of 4 MHz are realized. Furthermore a noise figure of 16.1 dB and an IIP3 of +10dBm are achieved. [C30]

"A 12-bit fully differential 2MS/s successive approximation analog-to-digital converter with reduced power consumption"

This paper presents a 12-bit fully differential successive approximation register analog-to-digital converter (ADC) operating at 2MS/s and designed for an optoelectronic range sensor as a system-on-chip device. The realized ADC uses several improvements to lower the power consumption to 10mW at 5V power supply and, at the same time, to increase the conversion rate up to the limits offered by the used 0.6µm process. The proposed interpolation network consists of partially segmented R-2R resistors ladder instead of the commonly used serial array to achieve lower power consumption as well as smaller active area. The fabricated chip occupies an active area of ~1.1mm2excluding pads. Measurement data, resulting in an effective number of bits of 11.55 at 1MS/s and 11.2 at 2MS/s, conform to simulations. The maximum measured differential non-linearity and integral non-linearity accounts to +0.3/-0.6LSB and ±0.7LSB respectively. [C31]

"RF transmission characteristics in/through the human body"

In this paper, the RF transmission characteristics in/through human body are investigated experimentally and numerically. An experimental methodology to characterize the RF transmission of human body is presented. The proposed method addresses the challenge to characterize the RF transmission accurately and reliably without the body tissue effect on the antennas under test. The proposed methodology of using tissue-embedded antennas is validated at 403 MHz band (Medical Implant Communication Service, MICS). [C32]

"2.45 GHz waveguide plasma generation in cylindrical structures"

A surfaguide device was optimized, realized and used for the ignition of a plasma column to be used as a radiating structure. A plasma diagnostic technique was also developed to evaluate the plasma column length with respect to the power supplied. These measurements highlighted that plasma antenna properties are strongly affected by the pump signal and therefore this signal has to be optimized in order to have the highest conductivity. Finally, the efficiency of the column used as an antenna was evaluated. [C33]

"The design of intelligent fault diagnosis system for high power microwave systems"

Faults often cause serious damages on high power microwave system (HPMS). An intelligent diagnosis system is introduced in this paper. It helps operators in monitoring and diagnosing abnormal situations of HPMS. The HPMS architecture, the structure of the intelligent diagnosis system, the knowledge base, and the inference process are presented in detail. A diagnostic tree of HPMS is built by domain experts, and the diagnostic priorities of nodes in the tree are determined based on a fuzzy group multiple attribute decision making method. QNX operation system has been used in developing the proposed diagnosis system. Preliminary test has been carried out in actual engineering project, and satisfactory results were achieved. [C34]

"Biomedical applications and Rayleigh microwave diagnostic of atmospheric plasma jet"

Summary form only given. Parameters of helium atmospheric plasma jet are measured by means of Rayleigh microwave scattering, fast photographing and measuring of jet currents. The absolute values of plasma density

are determined from amplitude of output signal from microwave detecting system, visual observations of plasma jet size and proportionality coefficient determined using the calibration procedure accomplished using Rayleigh scatterers with known electrical properties. The scattering pattern from plasma jet was shown to be isotropic in plane perpendicular to jet direction indicating that plasma scatterer was close to Rayleigh regime. Streamer ("plasma bullet") propagating along with gas flow is generated immediately after the breakdown of the interelectrode gap. The post-streamer plasma column was detected on the way of streamer passing with plasma densities higher than 1013cm-3and decay times about 3-5 us.We show the effects induced in living cells due to treatment with cold atmospheric plasma jet on the cellular and subcellular levels. Cellular level effects include the detachment of cells from the extracellular matrix and the decreasing migration velocity of cells, while the subcellular level effect is the reduction of cell surface integrin expression (receptors responsible for the cell adhesion to extracellular matrix, determining cellular shape and mobility). We would like to acknowledge the technical assistance of Dr. Y. Raitses, through the PPPL Offsite University Research Program supported by the Office of Fusion Energy Sciences. [C35]

"Fast two-dimensional imaging of scattering centers using the nonuniform FFT"

Radar imaging of target scattering centers can be of great diagnostic utility. Conventionally, the radar image has been produced by a technique widely used in computer-aided tomography (CAT), e.g. the filtered backprojetion (FBP) algorithm. FBP reconstruction produces high quality images by handling the measured data directly in polar format. However, the FBP algorithm is more computationally complex than the direct Fourier methods. This paper develops fast two-dimensional (2-D) imaging of scattering centers using a nonuniform fast Fourier transform (NUFFT) algorithm. The proposed method is first compared to the conventional FBP approach on simulated data and then applied to real data sets measured on the RCS test range. Results suggest that the NUFFT method can produce more precise images and requires much less computational time than the FBP algorithm. [C36]

"Effects Evaluation of UHF RFID Systems on the Molecular Structure of Biological Drugs"

The growing counterfeiting problem and the significant fragmentation of the pharmaceutical market are resulting on an increase of difficulty to trace medicines. In these scenarios, where an item-level traceability is crucial, the Radio Frequency Identification (RFID) technology holds the promise to eliminate many of the previous problems. Unfortunately, there are still some technical and economic barriers that are retarding the deployment of these innovative technologies in large-scale application scenarios. For the pharmaceutical supply chain, there have been concerns raised regarding the potential effects on the quality of drugs due to exposure to electromagnetic fields. In this paper, some results, obtained by a recent experimental study focused on the evaluation of potential effects on biological drugs, have been reported. This work aimed to evaluate potential effects of tracing RFID systems on the molecular structure of biological drugs. In particular, some samples of a commercial human insulin preparation have been exposed for different periods to electromagnetic fields generated by RFID devices. In order to evaluate possible alterations on the molecular structure, the following diagnostic techniques have been used: High Pressure Liquid Chromatography (HPLC) and Nuclear Magnetic Resonance (NMR). The experimental results have shown that the electromagnetic field generated by UHF RFID readers does not cause any damage on the structure of the insulin molecule. [C37]

"Application Study of Using Ultrasonic Integral Backscatter to Monitor Microwave Coagulation Therapy"

Microwave (MW) ablation is a minimally invasive therapeutic strategy for the local treatment of solid malignancies that has received much attention over the past few years. It is very important to detect and evaluate lesions generated by MW during treatment procedures. This study describes one new ultrasonic imaging technique to characterize lesions based on estimation of relative changes in tissue properties derived from backscattered RF data. A single microwave heating antenna was used to produce coagulation in vitro pig liver tissues. The RF signals were recorded as outputs from a modified diagnostic ultrasound system. The integrated backscatter values, which can be used as an indicator of the microstructure and backscattering property of tissues, were calculated in water-bath experiment and MW treatment. The rule of change in integrated backscatter values with temperature has been analyzed by statistics through water-bath experiment. The integrated backscatter ratio values were subsequently used to form images revealing the lesion areas. It is possible using ultrasonic integral backscatter to monitor microwave coagulation. The result shows that this approach can be used to identify the normal and coagulated tissue caused by temperature rise and provide the information of tissue damage. [C38]

"Near-field microwave imaging based on planar aperture scanning"

A near-filed microwave imaging setup is investigated. The setup benefits from the high near-field directivity and

good efficiency of a recently proposed ultra-wide band TEM horn antenna. The setup employs planar aperture scanning. It consists of two antennas aligned along each other's boresight and moving together to scan two parallel apertures. The imaged object lies between the two apertures. With a blind de-convolution algorithm, the images are de-blurred. Simulation and experimental results confirm the satisfactory performance of this setup for near-field microwave imaging with possible application in breast cancer diagnosis. [C39]

"Sensor data transmission through passive RFID tags to feed wireless sensor networks"

The use of Radio Frequency Identification (RFID) technology for the automatic transmission of physical parameters in wireless sensor networks paves the way to a large class of attractive applications, ranging from healthcare to automotive, diagnostic systems, robotics and many others. Nevertheless, although some RFID tags capable to transmit sensor-like information are already on the market, only a limited number of sensors, such as those for temperature or pressure measurement, can be easily miniaturized and embedded in the RFID chip. The integration of more complex sensors, in fact, appears to be complicated and extremely expensive. In this paper, a cost-effective general-purpose multi-ID tag is proposed. It can be connected to generic sensors, regardless of the actual measured value, and it is capable to transmit, when interrogated by a standard RFID reader, a proper combination of ID codes that univocally codifies the sensor measured value. The functionalities of this device have been extensively validated under stressing conditions and the capability to transmit whatever kind of sensor data has been demonstrated. [C40]

"2.45 GHz waveguide plasma generation in cylindrical structures"

A surfaguide device was optimized, realized and used for the ignition of a plasma column to be used as a radiating structure. A plasma diagnostic technique was also developed to evaluate the plasma column length with respect to the power supplied. These measurements highlighted that plasma antenna properties are strongly affected by the pump signal and therefore this signal has to be optimized in order to have the highest conductivity. Finally, the efficiency of the column used as an antenna was evaluated. [C41]

"Non-faraday capacitance sensors based on nanoporous anodic aluminium oxide passivating films"

It is shown that the silanization of the surface assists enhancement of homogeneous polarization properties of the passivating cover on base of the nanoporous aluminum oxide in non-faraday capacitance sensors, usable for studying of the microorganisms' growth. A new immunochemical method of differentiated diagnostics of the A(H1N1) B influenza viruses is proposed. [C42]

"Limitations of diagnosis of cardiovascular system by means of representation of pulse waves in phase plane"

The procedure of sphygmic diacrisis on the basis of representation of cardiac beats in the phase plane and principles of formation of the phase portrait by means of orthogonal REX-transformations are considered. [C43]

"Two models of medical radio thermometer"

The problems of measurement of electromagnetic self-radiation of biological objects as well as the principles of design of medical diagnostic devices on their basis are discussed. Two models of a medical radio thermometer are described: for 8-cm and 25-cm wave lengths. [C44]

"Hardware-software complex for research of absorption spectrum of blood in decimetre band"

The breadboard model of the hardware-software complex for research of the absorption spectrum of blood in the decimetre band has been developed and produced. [C45]

"Aspects of application of microwave scanning microscopy for diagnosis of diseases"

The problem of application of microwave diagnostics in the field of medicine is considered. The basic tasks of such diacrisis have been analyzed. It has been shown that the application of microwave scanning microscopy (MSM) had been perspective for their solution. The research program of development of methods of MSM in the diagnosis of various diseases has been proposed. [C46]

"Doppler radar method for plasma structure investigation"

The stratified positive column of glowing discharge plasma was investigated using coherent homodyne measuring transmitter-receiver equipment. The estimation of absolute cross-section of stratified plasma creations

was carried out experimentally. Frequency dependencies of a reflected signal from plasma creation have been presented. [C47]

"Improving the efficiency of submillimeter gyrotrons by using various electrodynamic systems"

At present, interest to submillimeter devices, has been strengthened since this frequency range is attractive for numerous applications, which include plasma diagnostics, electron-spin resonance spectroscopy, enhancement of NMR sensitivity using dynamic nuclear polarization, standoff detection and imaging of explosives and weapons, new medical technology, atmospheric monitoring, chemical technologies, production of high-purity materials, deep space and specialized satellite communication etc. One of these devices is a gyrotron. The main problems of gyrotron optimization and development are mode competition between operating and parasitic modes and wideband frequency tuning. In this paper, some types of electrodynamic systems for creating submillimeter gyrotrons are investigated. For gyrotrons with the two-mirror cavity the possibility of wideband frequency tuning (50%), with and maintaining high efficiency (about 1%) is shown. Also the 2 THz gyrotron based on the using couple cavity was presented. Optimization of the cavity and the problem of mode selection were investigated and its efficiency were estimated. [C48]

"Express method of determination of the gas pressure optimal for microwave plasma chemical materials processing"

A method of rapid determination of gas pressure value, which provides the most favorable conditions for microwave plasma chemical processing at low vacuum, is developed. The method is based on the characteristic property of microwave plasma materials processing which consists in pulsation nature of microwave discharge. [C49]

"Medical optoelectronic equipment for new-born children"

A set of medical optoelectronic equipment, designed in order to perform medical procedures with new-born children such as medical examination, diagnostic routine, sanitation, medicine treatment, light therapy, massage and other physiotherapeutic procedures, is presented. The apparatus includes the metal support with a cradle for a baby, a multirange optical module, a temperature sensor, a micro-controller, a device of emergency alarm. The equipment has passed the sanitary-hygienic tests and has been implemented into the medical practice in a large number of Belarusian medical institutions. [C50]

"Electrodynamic processes in the electrically active mesosphere"

The MF radar developed for remotely probing the near-Earth space environment and the technique for diagnosing plasma parameters in the electrically active mesosphere have enabled the determination of the basic electrodynamic characteristics of this region, which are required for achieving the fundamental physical understanding and can be used in practical applications (Sun-Earth connections, modeling the ionosphere as well as natural and anthropogenic global disturbances, near-Earth environment monitoring, earthquake predictions, and radio propagation forecasting). In particular, the average daily electric fields intrinsic to the mesosphere have been determined for the first time. [C51]

"Medical applications of the Ultra Wideband technology"

In this paper the application of the Ultra Wideband technology in the medical field is investigated. This is done by presenting a mathematical description of the Ultra Wideband medical scenario and a model of the human body. Besides, the requirements of antennas for Ultra Wideband medical applications are discussed. The most important existing applications of the UWB technology in the medical field are shown and discussed. [C52]

"Time-frequency analysis of the thermoacoustic signals for early breast cancer detection"

The time-frequency(T-F) characteristics of the microwave-induced thermoacoustic signals generated from the tumors inside the breast are analyzed by Choi-Williams Distribution(CWD). The signals are simulated by finite-difference time-domain(FDTD) codes, with the semi-round breast model. The results indicate that round-shaped and ellipsoidal-shaped tumors with different sizes and shapes have different CWDs, and therefore, this T-F technique has the potential to detect different tumors and estimate its sizes and shapes, and become a new diagnostic method for early breast cancer. [C53]

"New dielectric heating under noninvasive temperature measurement using MR"

Recent development of Magnetic Resonance Imaging (MRI) equipment enables Interventional Radiology (IVR) as

diagnosis and treatment under MRI usage. In this paper, a new methodology for Magnetic Resonance (MR) scanner to apply not only as diagnostic equipment but as for treatment one is discussed. The temperature measuring procedure under MR is to measure phase shift of T1for the position inside a sample material with the application of pulsed RF for heating inside the sample as artificial dielectrics. The result shows the possibility to apply MR a temperature measuring equipment and as a heating equipment for applying such as hyperthermia heating modality. [C54]

"High power microwaves for plasma heating in fusion experiments: Gyrotron-Transmission system-Antenna"

In the wide range of applications of microwaves in plasma physics, the field of high power millimeter waves for electron cyclotron resonance heating (ECRH), electron cyclotron current drive (ECCD), stability control and diagnostics of magnetically confined plasmas for generation of energy by controlled thermonuclear fusion is one of the most complex and challenging in the last 30 years. The prosperous development of high power gyrotron oscillators and the successful achievements in the gained output power, efficiency and mode purity since 1980 has enrolled design and installation of ECRH and ECE systems in the most major experiments for fusion plasma investigation all over the world. The state of the art of gyrotron development, the review of transmission systems on selected experiments and a resume on different launching antenna systems implemented inside of the plasma vessel are presented. [C55]

"Fusion plasma diagnostics with microwaves"

An introductory overview is given on the established methods of probing magnetically confined hot fusion plasmas with microwaves in the mm and sub-mm wavelength regions. Since the plasma dielectric properties are mainly determined by the electron component of the plasma, primarily information on this component is being achieved. The methods can be divided into active and passive diagnostics. Applying the active ones, like interferometry, reflectometry, polarimetry, and wave scattering the changes in phase, time delay, polarization state, and spectrum of a launched electromagnetic wave are measured to yield information on the local electron density and temperature as well as the magnetic field and plasma currents respectively. The passive radiometry of the cyclotron emission of the electrons gives local information on the electron temperature, in general the electron energy distribution function. The physics basis of the various methods is well known since many years. However, the development of reliable microwave components, both sources and heterodyne detection systems, and recently also two dimensional detector arrays and the application of signal correlation techniques, makes multi-view phase and amplitude imaging applicable, delivering new insights into turbulent plasma structures most important in understanding plasma heat and particle transport properties. The paper gives in an elementary way the physics basis and describes the principles of the various active and passive techniques. [C56]

"Multi-channel ground penetrating radar: Hardware and software"

Current state of our multi-channel GPR elaboration is presented. GPR is designed for diagnostics of roads' coating, detection and recovery of subsurface infrastructure in soil down to 1.2 meters depth. Multi-channel architecture allows inspecting 1-m width strip of ground surface simultaneously. Designed GPR parameters, its hardware and software are discussed. 3D images of subsurface objects formed by GPR as well as results of objects geometry restoration are presented. Dedicated software enables estimating the geometry and electro-physical parameters of subsurface volume and objects inside of it. For this, so-called Computational diagnostics method, which is based on reverse problem solution, is implemented. [C57]

"Recovery of road coats and related objects parameters based on method of computation diagnostics-Dipole approximation ofground penetrating radar antennas"

Several approaches, which allow increasing the reliability of diagnostics of plane layered medium in Ground Penetrating Radar (GPR) applications, are considered. This increase is reached due to accurate account of parameters of transmit-receive antenna (via electrodynamic modeling) and radio frequency channel of GPR. [C58]

"On troposphere diagnostics of radio setting"

Results of numerical analysis of space (height and distant) attenuation factor gradients of the UHF radio signal in shadow and semi-shadow areas of the radio-occultation satellite path, as a function of elevation angle placed on a satellite radio source, are given. Possibility of using height attenuation factor gradients in shadow and semi-shadow areas of the radio-occultation satellite path for radio setting monitoring of troposphere is confirmed. [C59]

"Contents"

The following topics are dealt with: micro-nanophotonic device structure; optical communication; optical packet networking; tunable nonlinear metamaterials; plasmon nanofocusing; semiconductor photonic crystal device; coupled micro-ring resonator; holographic recording; photopolymers; holographic Bragg gratings; high power sum-frequency generation; quasi-continuous-wave diode-pumped Nd:YAG lasers; high power wavegude CO2lasers; vertical cavity surface emitting laser; nonlinear solitary waves; magneto-optical kerr effect; liquid crystal defects; water-cooled bimorph deformable mirror; lasing modes; metal waveguide resonator; linear polarization measurement; semiconductor optical amplifier; differential-phase measurements; semiconductor photoreceiver spectral responsivity; two-grating thin-wire bolometer; holographic Shack-Hartmann wavefront sensor; GaN-based light emitting diodes; high power Nd:glass lasers; fiber optical sensor; human tissue biochemistry; DNA; laser-induced photodissociation; hemoglobin complexes; thermosensor diagnostics; and THz-laser radiation pulse shape. [C60]

"High intensity laser beam wavefront diagnostics and correction at the Advanced Laser Light Source facility"

The Advanced Laser Light Source (ALLS) is a Canadian facility consisting of several high intensity laser systems based on Ti:Sapphire technology. These lasers deliver 25-35 fs laser pulse time duration, from 1 mJ up to 5 J energy per pulse, high repetition rate from 10 Hz to 5 kHz, and up to 200 TW of instantaneous power or 50 W of average power. The aim of this facility is, first to produce laser based radiation source ranging from THz up to the hard X-ray and acceleration of high energy particles; second to develop and optimize such laser based sources and study their potential applications in field such as biomedical imaging, time resolved X-ray spectroscopy or molecular imaging. We will present the laser beams wavefront diagnostics and the correction methods by means of deformable mirrors used at ALLS. [C61]

"Method of microwave scanning tomography of electrical properties of semiconductors"

The technique of microwave diagnostics of semiconductors with arbitrary distribution of electrical properties in depth has been developed. It has been proposed to conduct the scanning of the value of the air gap between the resonator sensor and the surface of the semiconductor. The one-dimensional reconstruction algorithm of distribution of electrical properties of the semi-conductor has been generated. It consists of solution of the integral equation for the intermediate function, which completely characterizes the properties of the object, and step-by-step algorithm for solution of the ill-posed inverse problem. [C62]

"Miniature double-ridged horn antennas composed of solid high-permittivity sintered ceramics for biomedical ultra-wideband radar applications"

Ultra-wideband (UWB) radar sensors are attracting more and more attention, e.g., for biomedical applications. In contrast to established techniques like X-ray tomography or invasive diagnostic approaches, UWB radar offers the potential for remote access and ultra-low power signal intensities. Inspired by promising studies of breast tumor imaging, we are continuing and extending our previous work on biomedical M-sequence radar and antenna techniques. We describe the development and the potential of innovative double-ridged horn antennas, based on high-permittivity sintered ceramics, which have been adapted to the envisaged biomedical applications. In this context, the miniaturization of UWB antennas, due to the restriction to small examination areas, without compromising the electromagnetic fidelity is the overall challenge. For the dielectric scaling of antennas with the potential to operate over wide bandwidths, we focus on nearly frequency independent, high-permittivity and low-loss materials. In what follows, we describe the arduous path from the first idea to functional laboratory versions of double-ridged horn antennas based on solid sintered ceramics. In this way, the paper illustrates the successful interdependence between microwave engineering and mechanical and material engineering. [C63]

"Slot spiral detector array for broadband THz imaging1"

In this work, we propose a broadband FPA pixel in form of a printed slot spiral antenna with an operation bandwidth of 500-900GHz. Moreover, the antenna impedance is carefully designed to match to that of the detector diode to exploit the maximum responsivity achievable. This broadband, high-sensitivity FPA will significantly speed-up the image acquisition times and allow THz imaging tools to be employed for real-time diagnostics of various tissue characteristics in the 500GHz-1THz range. [C64]

"Outlines on microwave imaging in breast cancer early detection"

The paper presents some recent advances concerning a non-invasive microwave technique which is

investigating living structures. A thermogram is plotted, obtained by microwave radiometry. Rigorous scientific studies have shown that the thermo-effect is accompanying growing tumors and atypical developing tissues. Early breast cancer structures are highlighted by this method, two cases being detected: (1) confirmed, existing breast cancer diagnoses that might be surveyed in their evolution and (2) revealing new cases with breast cancer suspicions, those persons being directed to further classical investigations. In order to better reconstruct the spatial shape of measured breast and tumor, an epipolar method may be employed. An overview on the main investigation methods in breast cancer are presented, as well as their classification. [C65]

"Analysis and Simulation of Propagation Model for Wireless Communication of Bio-Sensors"

It has become possible to implant a network of Bio sensor nodes inside human body for remote health monitoring, diagnostic and prosthetic purposes. For communication of these sensors the channel available is human tissue. The sensors communicate using wireless technology, by sending information as electromagnetic (EM) radio frequency (RF) waves. These signals encounter a significant loss during transmission because this communication channel contains a major portion of fluid. To find out this loss, a propagation loss model PMBA has already been developed. This paper investigates the appropriate distance between nodes for better communication. The frequency range of Radio spectrum (1GHz to 3.5GHz) is used for MATLAB simulation. It is observed that as frequency of transmitting signal is increased, the distance limit is decreased and Power loss is increased. Using radiation pattern it is shown that the electric field intensity decreases with increasing distance. [C66]

"Image enhancement for detection of early breast carcinoma by external irradiation"

Though it is very difficult to detect cancer at the early stage, it is of prime importance since it saves the lives and the normal life style of the patients. Breast cancer ranks the second most dangerous of all forms of cancers;the early it is diagnosed the higher is the survival rate. In this paper, a method of external irradiation by a suitable source for the breasts is proposed to increase the contrast between the thermal images of normal breast cells and the cancer cells. The experiment conducted with the phantom models showed that the temperature difference between the normal and cancerous breast cells is elevated by external irradiation. A normal breast thermogram is used to simulate the thermographic images of normal and cancerous breast cells based on these results. There is a definite possibility of early detection of breast carcinoma by the proposed method since the contrast in image between the normal and cancerous breast cells is enhanced considerably by this method. [C67]

"A Differential Evolution-based iterative multi-scaling algorithm for microwave imaging of dielectric structures"

Electromagnetic inverse scattering problems arise in several diagnostic applications, in which the objective is retrieving the physical and geometrical properties of the unknown targets under test starting from measured samples of the scattered electric field. Solving such problems is still a challenging task, due to the related ill-posedness and nonlinearity. In order to partially overcome such difficulties, the inverse scattering problem is often recast as a global optimization problem, which can be solved by using stochastic methods. In this paper a new approach, based on the Differential Evolution method and on an iterative multiscaling strategy is proposed. Some results, concerning the imaging of dielectric structures are reported and discussed. [C68]

"Diagnostics of refraction coefficient on results of meteorological parameters measurement in arbitrary points of area"

It is known the operating efficiency of radio technical systems of different function (navigation, radar, communication), to a great extent depend on condition of propagation of radio-waves is conditioned on atmosphere refraction state. It for one's turn is conditioned on spatial-temporal distribution of refraction coefficient n. And variation of mean refraction and numerous cases of so called anomalous propagation of radio-waves could lead to considerable increasing of signal level over the horizon or signal fading in the radio optical line of distance and influence on accuracy of radar and navigation measurements.At present for location the systems of global navigation is in wide application. The completely deployed GPS system of USA exists today. Russia realizes intense work on unwrapping of complete constellation of GLONAS satellites. In the Europe the development of Galileo system is finishes. To the utmost the troposphere influences on results of coordinate measurements. Ignoring of this fact leads to error of measuring of pseudo-range from 2,5 m. (in zenith) to 25 m. (while satellite elevation about 5 degrees). The possible way to decreasing of location error is taking into account troposphere influence while processing of information in the Ukrainian system of cosmic navigation provision (USCNP) [1, 2]. There are two main modes of correction: real-time and post session. For real-time processing we propose to use the data of meteorological stations are in the set of controlling-correcting stations (CCS)

USCNP. At that have to be provided accuracies of coordinates determination not worth of some meters. While post session processing corrections are forming on the base of phase observations by stations of USCNP net. The obtained errors of measurement are about some centimeters. Troposphere delays in the realtime the meteorological parameters are obtained in series of points of space are used for approximation. The meteorological parameters of functions approxi--mating dependence of temperature, pressure and humidity on latitude and longitude in the range of Ukraine are forming and giving for users on the base of these delays. Besides the parameters of functions approximating dependence of zenith troposphere delay on latitude and longitude in the range of Ukraine are forming and giving for users. Both these approaches are on the base of troposphere delays calculation using data of meteorological stations to the sea level. Truncation error of estimation is about 2.5%. The analyses is carried out [2] and shows the order of approximating model practically not influences on error of troposphere delay measurement and so we conclude about possibility of usage of zero order model, i.e. the mean data for Ukraine. We seem the bases for such conclusion is small accuracies of measurement of meteorological parameters. [C69]

"A low phase noise, wide range QVCO for MICS, and ISM applications"

A Quadrature Voltage Controlled Oscillator (QVCO) has been designed and simulated at 0.18µm technology, 1.8 V supply voltage. The design is aimed for MICS/ ISM devices. The design offers a small size, low power consumption, low phase noise, and wide frequency range (200-827 MHz) of operation. The obtained phase noise (at 37°C) @ 160 KHz offset for 404.7 MHz oscillation is -100dBc/Hz and for 433 MHz oscillation at 160KHZ offset is at -99.5 dBc/Hz with 0.9mW power consumption. [C70]

"Noninvasive microwave technique for hemodynamic assessments"

Pulmonary edema, accumulation of fluid in the lungs is often measured and analyzed after medical and surgical procedures, since pulmonary edema is commonly linked to cases of congestive heart failure (CHF) and kidney failures. Like pulmonary edema, hemodynamic assessments do not occur until after an acute cardiac episode. Early detection of pulmonary edema and routine monitoring of cardiac functions such as cardiac output (CO) the product of stroke volume and heart rate, would be beneficial for surgical patients as well as others suffering from acute cardiac and pulmonary illnesses. Available diagnostic tools such as the Pulmonary Artery Catheterization are invasive and diagnostic techniques such as Magnetic Resonance Imaging (MRI) or Computerized Active Tomography (CAT) Scans are expensive, cumbersome, and not suitable for continuous monitoring. In addition, techniques such as the double indicator dilution method, the electrical impedance plethysmography, and the re-breathing method are impractical for clinical use because of limitations on sensitivity, consistency, and simplicity [1]. To overcome difficulties with above conventional techniques, an electromagnetic (EM) method has been investigated for this application. Specifically, an EM energy coupler and the associated measurement method have been developed to simultaneously measure breathing rate in addition to the changes in lung water content [2,3]. Specifically, a two-port EM sensor has been developed for animal and phantom experiments [3-5]. In these phantom and animal experiments it is shown that variation of lung water contents and breathing rate can clearly be monitored by the proposed technique. [C71]

"Low-cost and small-sized medical microwave radiometer design"

In the past decades research in microwave radiometry has been conducted for use in medical applications. Detection of breast cancer, hyperthermia, and measurment the temperature brain temperature of newborn babies are areas here this technique have been used. Russian scientists have developed a radiometer which is sold under the name of RTM-01 for the detection of breast cancer. The technical details of this radiometer is not known, and are therefore difficult to be tested. The detection procedure is to make symmetrical point measurements for each breast. Total power radiometer consists of a high gain low noise amplifier followed by a square law detector and integrator. This radiometer is prone to amplification drift. Dicke radiometer uses a switch in front between the sensor antenna and a reference. Whitch can remove the system drift. The goal of the present design is to determine whether it is possible to create small sized frontstage to a radiometer, using inexpensive commercial surface mount device (SMD) components. The tradeoff between lowand high frequency radiometer band must also be considered, as the first in general requires a larger antenna, but can penetrate deeper into the body tissue. The emissivity and spatial resolution does also increases with higher frequency. [C72]

"Technology of adjustment of PAA with wide-angle scan"

This report submits the practical approach to the initial alignment of the phased-array antennas (PAA) with the wide-angle scan which ensures PAA performances close to potentially accessible. The conditions and methods required for PAA initial adjustment, measurements, automatic diagnostics and performance monitoring are

described. Some practical aspects of technology of alignment taking into account constructive peculiarities of PAA, measurement restrictions and results of simulation and the real measurements are presented to demonstrate the utility of the proposed technique. [C73]

"A new lifetime diagnostic system for photovoltaic materials"

We have developed an apparatus for measuring the minority-carrier or recombination lifetime in semiconductors. We have named the technique transmission modulated photoconductive decay (TMPCD). This is a contactless, non-invasive technique that produces transient photoconductive lifetime data. The measurement procedure is very sensitive to small signals and has a superior time response for measurement of short carrier lifetimes. This technology has several advantages over resonant coupled photoconductive decay (RCPCD) and transient microwave reflection photoconductive decay (μPCD). The sensitivity is comparable to that of RCPCD but considerably larger than that of μPCD. The response time advantage provides a capability to measure very short lifetimes in thin film materials, such as amorphous and nano-crystalline silicon films and nanowire composites. This is accomplished while maintaining a sensitivity that is at least comparable to RCPCD. We will show results of the application of this new technique to a wide range of photovoltaic materials. These include silicon wafers, compound semiconductor thin films, nano-crystalline silicon films, and II-VI nanowires. [C74]

"Built-in test systems of active phased-array antennas"

In the active phased array antennas, transmit and receive functions are distributed over the aperture using transmit and receive (T/R) modules. Active phased arrays are typically calibrated in the near-field antenna range on a factory. The performance of the active phased array antennas degrades over the course of time due to the changes in the characteristics of active devices and it requires recalibration in the field. The conditions and methods required for the measurements of the active phased-array antennas (APAA), the initial alignment, the automatic diagnostics and performance monitoring are described. Special attention is given to the constructive peculiarities of APAA and restrictions of measurements. A numerical model of a process of performance monitoring has been developed and a large number of test cases examined in order to isolate and characterize errors commonly occured in the built-in performance-monitoring systems (BPMS). The test methods used for APAA transmit or receive performance testing must be analyzed separately. During the alignment and testing of APAA, especially with high-power transmitting potential, it is necessary to fulfill some special requirements of measurement facilities and analytical software that are not encountered in other areas of applications of antenna measurements. Either simulation or measurement results are presented to demonstrate the utility of the proposed measuring and monitoring techniques. Future directions of investigation of application of BPMS are highlighted. [C75]

"Quality diagnostics of nonlinear models of elements at baseband pulse signals"

It is shown that an approach included investigation of the nonlinearity characteristics of signals transformation by an element is preferable to quality diagnostics of nonlinear models of elements. The software tools and measuring device which allow carrying out such diagnostics for baseband pulse signals are specified. [C76]

"Grid-service centre of telecommunication system of images recognition of medical objects"

The problem of establishment of Grid-centre linked up with medical institutions by means of data network that transmits and compresses images of medical and biological objects for further recognition is considered. Image recognition is realized upon terms and conditions of information-extreme intellectual technology of analysis and synthesis of the self-learning recognition systems. [C77]

"Phased array calibration and diagnostics utilizing a student-built planar near-field system"

A low-cost planar near-field system was designed, built, and programmed by students from the University of Rhode Island as a Capstone design project sponsored by Applied Radar, Inc. The objective of this paper is to explore the implementation of microwave holographic metrology (MHM) for the use of calibration and diagnosis of phased array performance on this near-field system. The simplest form of MHM is to analyze the near-field data on the collected planar surface, but this is not ideal because of a loss of resolution from the spreading introduced by the measurement distance. A more attractive approach is to project a focused planar "hologram" of the radiation pattern on the surface of the aperture of the antenna under test (AUT) through manipulation of the angular spectrum. The resulting hologram allows for the observation of amplitude and phase distributions on the aperture. This paper will provide insight into the design of the back-projection algorithm and present results for faulted and calibrated phased array scenarios to verify proper functionality of the algorithm. [C78]

"Multifrequency microwave tomography of absorbing inhomogeneities"

A method of the near-field scanning coherent tomography has been developed for the microwave diagnostics of the 3D subsurface structure of the complex permittivity. This method uses data of 2D scanning over lateral co-ordinates above the ground surface with the dipole emitter-receiver system. Multifrequency measurements provide the depth sensitivity. The regularization algorithm based on the Tikhonov's method of generalized discrepancy has been developed for Fredholm integral equations of the 1-st kind with complex-valued functions and applied for the solution of the corresponding inverse scattering problem. Results are presented for the tomography of 3D complex permittivity distribution originated by the melting ice sample buried in the sand. [C79]

"Coaxial antenna for microwave coagulation therapy in ex vivo swine breast tissue"

An early detection of small breast lesions by mammography screening may facilitate the cancer treatment by minimally or noninvasive techniques. Recently, new therapies than traditional surgery have been explored to satisfy these demands. Additionally ablative treatments have started to become viable alternative methods to treat patients who cannot be treated by surgery. Microwave energy is promising because it can preferentially heat and damage high-water-content breast carcinomas, compared with the lesser degrees of heating that occurs in lower-water-content adipose and breast glandular tissues. Furthermore the relatively high contrast between the electrical property of normal and cancerous tissues leads to preferential deposition of electromagnetic energy and selective thermal elevation within the tumor. The aim of this work was to analyze the Microwave Ablation radius lesion using an axisymmetric finite element method computer modeling with an experimental ablation in ex vivo swine adipose-dominated breast tissue. Our results show that advanced computer modeling and ex vivo experiments agree very good. [C80]

"Visualization of fusion plasma physics via millimeter wave imaging techniques"

Advances in microwave technology and innovative ideas have enabled visualization of complex physics of the high temperature plasmas in magnetic fusion devices. ECE Imaging system becomes a powerful tool for MHD physics in various devices and the potential of the MIR system has been reassessed and a system design for KSTAR is in progress. [C81]

"On the development of a low-cost real-time remote patient monitoring system using a novel non-invasive microwave vital signs sensor"

In this paper we describe the telemedicine related research and development efforts at Hawaii Center for Advanced Communications (HCAC). Our group has prototyped an interactive telemedicine system comprising of several medical sensors for remote diagnosis, and has design a novel non-invasive microwave vital signs sensor and associated digital signal processing (DSP) methods for continuous remote monitoring applications. The microwave sensor measures an integrated signal that when processed provides heart rate, respiration rate, changes in lung-fluid content, as well as the stroke volume. The developed low cost interactive telemedicine prototype, the design and measurements of the microwave sensor, as well as the signal analysis technique used to extract vital signs are described in the paper. [C82]

"Measurement of the effective length of laser-plasma channels by guided microwave backscattering"

Summary form only given. Laser triggered gas switches are critical components in many pulsed power driven systems, such as ZR at Sandia National Laboratories. Timing jitter is of concern is such systems, where power flow from multiple modules must be switched to a load simultaneously. Laser triggered gas switches utilize a laser-produced plasma channel (LPPC) to initiate breakdown between electrodes biased to ~80% of breakdown voltage. The effective length of the LPPC is an important parameter affecting the breakdown timing. Backscattering of microwaves inside a waveguide by an LPPC, introduced by focusing the trigger laser through holes in the broad wall, has been used to characterize effective length of the channel. Simulations indicate that the backscattering is sensitive to the LPPC conductor length both inside and outside the waveguide. A quarter wavelength stub has therefore been introduced outside of the waveguide, to short circuit the LPPC conductor to the waveguide wall, while still allowing laser access. Theoretical, computational, and initial plasma channel experimental results, as well as comparisons with other diagnostics, are presented. [C83]

"The emission spectra diagnosis in microwave argon and argon-air plasmas"

This paper diagnoses the emission spectra of the Ar plasmas, which are excited at different pressure from 0.1 to 0.8 atm, and Ar-air plasma in open air with a unique microwave plasma generator-APMPS+JET system. The results demonstrate that the previous excited atom stations die out obviously as air is added; various factors play

a part in the transform of atomic spectra lines, such as energy input, and voltage as well as the proportion of air input. With the decrease of pressure, the electron temperature and the intensity of spectrum increases in Ar plasma; the electron temperature is about 1.5~2eV at 0.8atm and rises to 4~5eV at 0.1 atm; the low wavelength components strengthen simultaneously. [C84]

"Solid-state sources, receivers and systems for plasma diagnostics and THz frequency extenders for VNAs"

Summary form only given.Higher power and more frequency agile sources and receivers are required for plasma diagnostics, both for fusion research and for industrial process control. VDI generates power in the 100 GHz-2 THz frequency range through the use of microwave power amplifiers and frequency multipliers based on GaAs Schottky barrier diodes. For example, VDI has demonstrated sources with -450 mW near 100 GHz and several microwatts at 1.9THz. For receivers, VDI has developed both direct diode detectors and heterodyne receivers. The direct detectors operate well across complete waveguide bands and achieve NEP of about lxl 0~lumleuro WIcirc/Hz at 300GHz and lxl0-10 WIcirc/Hz at 1.5 THz. Heterodyne receivers are achieved with Schottky barrier mixer diodes and their room temperature sensitivity matches the best that has been achieved. These receivers operate across broad frequency bands and VDI is developing full waveguide band systems throughout this frequency range. VDI is also using these components to develop advanced systems. These include a modular extension system for Vector Network Analyzers that will cover the full frequency range for 140 GHz to over 1 THz. This system will use a set of VDI multipliers and mixers in a re configurable fashion to cover each of the waveguide bands in this frequency range. For example, the WR2.2 (330-500GHz) system uses a source consisting of a W-Band amplifier and two doublers. Removing the last doubler yields the WR5.1 (140-220GHz) source. Replacing this doubler with a tripler yields the WR1.5 (500-750GHz) band. A similar modular system is used for the receiver local oscillators. The prototype WR2.2 system has yielded a dynamic range of ~90dB across the entire waveguide band. Similar performance is expected to 1 THz. This talk will focus on the performance and operation of these high frequency components and systems and their potential applications for plasma diagnostics. Particular emphasis will be placed on the VNA exten- ders, which will be invaluable tools for all manner of laboratory measurements in this frequency range. [C85]

"Theory of filamentary plasma array formation in microwave breakdown at near atmospheric pressure"

Summary form only given. Recently reported observations of filamentation during breakdown of near-atmospheric pressure gas by high power microwaves are explained using a one-dimensional fluid model coupled to a theoretical model of wave reflection, transmission, and absorption in an arbitrary profile plasma slab. Simulation results are consistent with experimental observation, showing the evolution of the plasma filaments spaced slightly less than one quarter wavelength (0.57 mm), the sequential discrete light emission propagating back toward the source, and the diffusion and decay of the plasma. Fig. 1 shows the normalized transverse electric field E2, the normalized excitation rate kexc, and the normalized electron density ne. The excitation starts at the location where the field strength is near maximum (Fig.1.(a)), a new plasma filament develops (Fig.1.(b)), and it starts to absorb the field (Fig.1.(c)). Finally the new filament reflects the field (Fig.1.(d)) due to its high density. The model allows examination of many features not easily obtained experimentally, including dependence on field strength and frequency, pressure, and gas composition, which influence electron temperature and control the breakdown and emission properties. [C86]

"Measurements of OH radicals in low temperature atmospheric plasmas using pulsed- and cw-CRDS techniques"

Summary form only given. OH radicals have electronic transitions in the UV and overtone spectra in the NIR. Absolute number density of OH radicals can be quantified by using high sensitivity pulsed-cavity ringdown spectroscopy (CRDS) and diode laser continuous wave (cw)-CRDS techniques. However, the applicability of these two sets of CRDS techniques to different plasma sources (including discharges) is plasma-type-dependent and has not been fully investigated. We have employed the pulsed- and cw-CRDS techniques to quantify OH radicals created in an atmospheric microwave induced plasma (MIP), an MIP-jet, and an AC discharge. We present the results and discuss for the first time on the topic of the applicability of CRDS to OH measurements in different plasmas. [C87]

"Development of a "smart" crossed-field amplifier"

Summary form only given. A "smart" crossed field amplifier (CFA) is being developed to look at the ability to control multiple inputs while monitoring diagnostic outputs and to adjust the amplifier operating parameters to improve device performance. The cathode will consist of spatially addressable arrays of gated field emitter arrays

(FEAs)s which will be distributed across the CFA so that the current and current density can be injected into the interaction space as needed in order to provide optimum interaction with the RF circuit locally rather than globally. A number of diagnostics for measurement of the rf power, the injected beam current, and the end collected current (in two dimensions) will be used to provide feedback information to a control system. This control system will be used to adjust the device operation to achieve the optimal performance for a given set of conditions. The cathode structure and slow wave circuit will be fabricated using a low temperature co-fired ceramic (LTCC) and thick film metal electrodes. Slits will be machined in an LTCC plate with the FEAs place below the slits to allow injection of the electrons while protecting the FEAs. A thick film metal layer provides the cathode (or sole electrode) voltage. Floating DC to DC converters will be used to adjust the injected beam current from the field emission arrays. The 1 GHz CFA will have an output power of -250 W with an expected gain of 15 dB. Preliminary experimental results from the CFA will be presented. The experimental results will be compared with simulation results using the electron trajectory code Lorentz and the Air Force 3D electromagnetic simulation ICEPIC2. [C88]

"The optical spectra analysis of free oxygenic radicals in atmospheric microwave plasmas"

Summary form only given. This paper analyzes the emission spectra of atmospheric microwave Ar-air plasma and He-air plasma at the range of 200 to 1000 nm; diagnoses the free oxygenic radicals of them. Results reveal that, free oxygenic radicals occupy large proportion of all elements in the spectra of Ar-air and He-air plasmas. OH free radicals are strong near the 309-314 nm band compared with He atomic spectra lines whose comparative intensity very low in He-air plasma. In opposition, NO free radicals and other nitrogen oxides are more than OH radicals in Ar-air plasma. The intensity of free oxygenic radicals in He-air plasma is obvious weaker than in Ar-air plasma, and it changes comply with input energy and gas flow rate. [C89]

"Characterization of a low temperature atmospheric-pressure argon microwave induced plasma using visual imaging, OES, and CRDS combined"

We employ a suite of optical techniques, visual imaging, optical emission spectroscopy (OES), and cavity ringdown spectroscopy (CRDS), to characterize a low power, low gas flow rates, atmospheric-pressure argon microwave induced plasma (MIP). A series of plasma images captured in a time resolution range of 10 mus-0.05 s shows that the converging point is a visual effect of integrating the image of a rapidly rotating conical helix. The plasma electronic excitation temperature Texc, vibrational temperature Tv, rotational temperature Tr, and gas temperature Tgat different locations along the axis of the plasma column are determined from the simulations of the emission spectra of OH, N2and N2+in the range of 200-450 nm. Thermal equilibrium properties of the plasma are discussed. OH radical concentrations along the plasma column axis are measured by CRDS and the effects of plasma gas compositions on the generation of OH radicals are investigated. An upper limit of electron density ne is estimated from the Lorentzian component of the broadened lineshape obtained by ringdown spectral scans of the rovibrational line S21of the OH A-X (0-0) band. [C90]

"Electron-beam produced air plasma: Electron density and momentumtransfer collision rate measurements"

Summary form only given. A 100-keV 5-mA electron beam is used to generate air plasma in a test cell with a pressure between 1 mTorr and 638 Torr. The beam propagates through a 12.7-IГ,ВїГ,Bjm thick aluminum transmission window into a 400-liter test cell. Microwave measurements at 10 GHz and nitrogen positive- ion emissions are observed on the optical midplane 12 in into the test cell. A 10-GHz in-phase and quadrature measurement system is used to measure the real and complex components of the wavenumber. The wavenumber is used to evaluate the electron number density and momentum-transfer collision rate. Optical emissions using eight telescopic collimators positioned perpendicular to the RF propagation path quantify the volumetric ionization rate. From this ionization rate and an iterative estimation of the electron density using an air- chemistry code, the electron-density profile along the RF propagation path is deduced. This profile is used to quantify the path length used for RF measurements. Representative electron density and momentum-transfer collision rate measurements for air plasma from 1 mTorr to 638 Torr will be discussed as well as the RF measurement technique, optical technique, and evaluation of the electron-density profile from the volumetric ionization rate. [C91]

"Transformed optical and electronic equipment kit for new-born babies and suckling infants"

The designed kit of the transformed optical and electronic equipment, ensuring creation of the pediatricians working place, securing the comfort conditions to perform the medical procedures with the newly-born children and suckling infants, including the medical examination, diagnostic procedures, sanitation and medicine treatment, light therapy, massage and other physiotherapeutic procedures, is presented. The kit comprises the

metal support with the cradle for a baby, a multi-range optical module, a temperature sensor, a microcontroller, a device of the emergency alarm. The kit has passed the hygienic and clinical tests and is implemented into the medical practice in a large number of Belarusian and Russian medical institutions. [C92]

"Laser diffraction diagnostics of liquid biological environments (fraungoffer's light diffraction on the particle of blood)"

The laser diagnostic technique of parameters of blood's particles is offered. The technique is based on registration and mathematical processing data on laser diffraction from specially obtained smears of blood. Mathematical processing is based on treatments of the theory of diffraction of light on disorder environments. Data of optical measurements are in good agreement with direct measurements of the sizes of blood particles. [C93]

"Quasi-optical spectral system for submm-wave radiometry of turbulent plasma"

We present the results of experimental development of the original multichannel quasi-optical radiometric system intended for fast-response spectral measurements of 210-530 GHz-emission from hot and turbulent plasma at the GOL-3 nuclear fusion plasma facility. The system employs a scheme with quasi-optical demultiplexing of the input radiation beam onto separate spatial channels with subsequent frequency filtering by quasi-optical metal mesh filters and spectral signal detection by calibrated Shottky-diode-based receivers. Experimental realization and testing is considered by the example of a four-channel system incorporating anisotropic-mesh-based band-pass filters with polarization-sensitive transmission bands (FWHM 35-50 GHz) that allows us to use only two hardware filters for selecting four spectral bands. [C94]

"Diagnostics of generalized synchronization in microwave range"

A new approach devoted to detect the generalized synchronization in the microwave range has been developed. The efficiency of this method is illustrated with the help of investigation of behavior of two coupled klystron oscillators. [C95]

"Non-linear effects and the use of network analyzer time domain"

While normally considered a tool for evaluating passive networks, vector network analyzer time domain can sometimes be of interest for active and semi-linear device analysis. The identification of sequential match compression in a multi-stage structure and the analysis of bias network-related delay anomalies are among the diagnostics available. The approach is not without its hazards, however, as defect shielding effects become more complicated and the VNA's own compression behavior can be critical. The effects of these behaviors will be analyzed semi-quantitatively and a number of example measurements will be presented. [C96]

"A compact microwave reentrant cavity applicator for plasma-assisted combustion"

Summary form only given: advantages of combining an electrical discharge with combustion include a faster process, higher intensities, leaner combustion, pollutant reduction by altering by-products of combustion, improved fuel efficiency by achieving more complete combustion, more reliable ignition of combustion, and combustion across a wider range of pressures, temperatures and mixture stoichiometries. The benefits may also include the operation of combustion processes at extreme limits, such as aerospace applications at high speeds and altitudes. Recently we developed an experimental microwave system that enabled the repeatable, controlled coupling of microwave energy into a premixed flame. Here we describe an improved experimental apparatus that employs a more efficient and more compact microwave applicator that positions the flame in a region of high microwave electric field strength. The applicator is a tunable, reentrant coaxial cavity that excites the flame in a small, variable gap in a high electric field region of the applicator. The applicator has a length of 12 cm and a diameter of 3.5 cm which represents a considerable reduction (about 100) in applicator coupling volume over the earlier experimental system. The experimental performance of the applicator is evaluated by coupling 2.45 GHz microwave energy into an atmospheric pressure, premixed, CH4/O2flame. The flame behavior is diagnosed by photography and optical emission spectroscopy measurements. The addition of only 2-15 Watt of microwave power alters the combustion process. This represents an improvement in coupling efficiency of a factor 3-5 over the earlier experiments. The addition of microwave energy extends the fuel lean burning limits, increases the flame length and intensity, and increases the number density and mixture of excited radical species in the flame vicinity. The downstream gas temperature also increases from 2200 to 3400 K as the coupled microwave energy incre- ases to 25 W. The applicator tuning and the improved microwave energy focus greatly enhances the flame coupling efficiency and thus allows the system to be excited with compact, low-power solid state power supplies and to be constructed with small coaxial cables resulting in a compact, portable microwave plasma-assisted combustion system. [C97]

"Diagnostics and forecasting of SCR protons flux using radio bursts parameters"

The purpose of the given work is the further increase of accuracy of diagnostic and forecast of a flux of protons of solar cosmic rays (SCR) and coronal mass ejection (CME) on the Earth's orbit by parameters of solar radio bursts registered by RT-22 radio telescope of the CrAO scientific research institute. [C98]

"Quasi Yagi-Uda antenna array for detecting targets in a dielectric substrate"

Confocal algorism using microwave propagation is a promising candidate for the early-stage breast cancer detection. In this paper, the dipole antenna and the quasi Yagi-Uda antenna were fabricated on printed circuit boards (PCB) for detecting targets in a dielectric substrate. The Yagi-Uda antenna showed the higher resolution of confocal imaging than the dipole antenna. [C99]

"A low power current reused quadrature VCO for biomedical applications"

This paper presents a low power current reusing quadrature voltage controlled oscillator for use in implantable electronics operating in the 402 MHz to 405 MHz medical implant communication service (MICS) frequency band. The oscillator was designed in IBM CMOS8RF 0.13 mum CMOS technology and simulated using Cadence IC5.141. The current reuse structure draws half the bias current as a conventional quadrature voltage controlled oscillator while exhibiting performance comparable to or exceeding that of previously published designs. Simulation results show that the oscillator phase noise is -127 dBc/Hz and consumes 1 mW of power from a 1 V supply. When the supply voltage is scaled to 0.65 V and biased for the same current consumption, the power consumption is reduced to 650 muW with phase noise of -111 dBc/Hz, which is almost 50% less power consumption when compared to oscillators in the same frequency band. The tuning range of the oscillator is 401.25 MHz to 407.5 MHz, enough to cover the MICS frequency band. [C100]

"BN Approach for Dimensional Variation Diagnosis in Assembly Process"

The assembly process with hundreds of compliant sheet metal components jointed in body shop is a complex process with uncertainty. One of the issues in mass manufacturing stage is fast diagnosis of dimensional variation root cause according to the fault symptoms. This paper presents a probabilistic fault diagnosis method based on Bayesian networks, replacing the traditional deterministic linear diagnostic model, to diagnose the root cause of dimensional variation. First, the BN structure is acquired based on the process knowledge and expert experience. Besides, according to the small sample measurement strategy of assembly process, the parameter learning method based on method of influence coefficients (MIC) is utilized and particular considerations are given to the diagnostic procedures for assembly process. [C101]

"Microwave diagnostics of some bio-medical solutions using cylindrical resonator"

The paper describes results of testing the microwave sensor designed for diagnostics of some bio-medical solutions. It consists of a resonator supporting quasi-TM010or TE111modes containing an axial glass tube filled with the solution under test. Concentrations of the tested ingredients in water solutions both organic and inorganic have been determined with high accuracy. Various solutions have been tested including: sodium chloride, magnesium sulfate, sodium bicarbonate, sodium bicarbonate, glucose, human cerebral spinal fluid-CSF etc. CST Microwave Studio simulator was used to design the sensor. The suggested sensor can be easily integrated with an on-line system controlling concentrations of various bio-medical solutions. [C102]

"Ultra-wideband antennas for combined magnetic resonance imaging and UWB radar applications"

Magnetic resonance imaging (MRI) is one of the most highly appreciated medical diagnostic techniques worldwide. Recent developments aim at adding the capability of creating focused images of moving objects. Among the potential navigator techniques required for such an improved MRI is ultra-wideband (UWB) radar. We have studied the performance of UWB antennas for biomedical imaging inside the 3-Tesla MRI system at PTB Berlin. The strong static and time variant magnetic fields give rise to severe mechanical and electrical interactions due to the induced electromagnetic forces. On the other side, the high magnetic field homogeneity required for MR scans can also be affected adversely by the presence of the UWB antennas. The requirements resulting for the design of MRI compatible antennas have been identified and implemented in terms of a novel type of double-ridged horn antenna. We describe the design of the antenna and its performance for magnetic resonance imaging. [C103]

"BIST assisted wideband digital compensation for MB-UWB transmitters"

The recent demand in wireless standards capable of providing short-range, high-speed data transfer has accelerated the growth of the Ultra-Wide Band (UWB) standard. MB-OFDM (Multi Band Orthogonal Frequency Division Multiplexing) UWB devices suffer from frequency dependent non-idealities due to extreme wideband operation (3.1 to 10.6 GHz). Further these characteristics are subjected to process variations when implemented in nanometer technologies. In this paper we propose two BIST assisted methodologies for estimation and compensation of these effects. The proposed solutions differ in hardware vs. software tradeoffs. The improvement in the linearity of the mixer over a set of process instances and the tradeoffs involved are presented to validate the proposed methodology. [C104]

"Embedded microwave system for monitoring of intracranial pressure"

Intracranial pressure is of increasing interest in the management of patients who are suffering from various neurological disorders such as hydrocephalus, traumatic brain injury, and blast injury. Long-term monitoring of intracranial pressure may be desirable in these conditions to aid in determining the outcome of any treatment. A completely implantable microwave device for monitoring of intracranial pressure has been designed and characterized. The application of an embedded Planar Inverted-F antenna in this implant is also investigated. [C105]

"Antenna diagnostic applications"

There are several methods to calculate the antenna aperture excitation from measured near- or far-field data. The usefulness of an iterative back projection technique has been demonstrated for both theoretical and real measured test cases. Other applications for antenna diagnostic tools, such as phased array calibration and position error correction, are also discussed. [C106]

"Broadband microwave based diagnostics and treatment"

An efficient 3D microwave tomography system based on wide band antennas and detailed modelling using the finite difference time domain methods is presented together with a microwave system design study and a novel microwave hyperthermia cancer treatment system based on a time reversal algorithms. [C107]

"Millimeter-wave bi-polar planar phaseless measurements and diagnostics: Characterization of a Ka-band patch array"

In this paper, for the first time, the effectiveness of phaseless measurements and diagnostics for millimeter-wave antennas will be demonstrated using a Ka-band planar rectangular patch array. Using a newly constructed millimeter-wave bi-polar planar antenna measurement system at UCLA, we will show the viability and advantages of using phaseless techniques to facilitate millimeter-wave antenna measurement. To achieve this, a Ka-band patch array was designed, fabricated, and measured with the system at an operating frequency of 31.2 GHz. Two measurements, a full (amplitude and phase) measurement and a phaseless (amplitude only) measurement, were then conducted and processed to produce far-field patterns. These results were compared to verify the accuracy of the technique. [C108]

"Pressure limitation of electron density measurement using a wave-cutoff method in weakly ionized plasmas"

Summary form only given: Wave-cutoff method using microwave provides capabilities for diagnostics of various processing plasmas, and can give the precise absolute electron densities. In this study, pressure limitation of electron density measurement using a wave- cutoff method is presented. As gas pressure increases, the wave-cutoff signal disappears. The disappearance of signal happens when the electron-neutral collision frequency is over the plasma frequency. At that time, the electron motion cannot catch up to the movement of the electromagnetic wave, and the electromagnetic waves begin to penetrate into plasma. In result, the wave-cutoff signal disappears. In this work, the pressure limitation of wave-cutoff method is shown by using an impedance analysis of the probe system, and using commercial microwave simulator, CST Micro-Wave Studio. [C109]

"Copyright"

The following topics are dealt with: basic processes in fully and partially ionized plasmas; microwave generation and plasma interaction; charged particle beams and sources; high energy density plasmas and their interactions; industrial, commercial, and medical applications of plasmas; plasma diagnostics; and pulsed power and other plasma applications. [C110]

"Measurements of neutral depletion effects and techniques for initiating low pressure, high power helicon plasmas"

Summary form only given. A flowing argon helicon plasma is formed in a 10 cm diameter, 1.5 m long Pyrex chamber with an axial magnetic field in nozzle or flat configuration, variable up to 1 kG in the source region. Experimental upgrades have allowed for operation at high, pulsed RF powers (up to 10 kW at 13.56 MHz) and low flow rates and pressures (as low as 1 seem and 10-5Torr). Neutral-collisional plasma exists upstream of the half-turn, double helix antenna and neutral-collisionless plasma exists downstream, leading to bulk plasma acceleration due to reduced neutral drag. Calculated variation of the RF frequency (from 12 MHz to 15 MHz) during the 5 ms pulse allows for low (< 3%) reflected powers during the gas breakdown and the approach to and formation of the steady state plasma. Microwave interferometry (105 GHz), collisional radiative spectroscopic codes and diamagnetic loops are used to measure electron density and temperature. An initial transient high-density peak (> 1014/cc) is observed followed by the development of a neutrally depleted steady state plasma (> 1012/cc). Neutral depletion is observed along with substantial plasma acceleration. We also present results from AntenaII and MAXEB 1 and 2-D finite difference modeling of the helicon wave coupling from the antenna in collisional and collisionless wave regimes to determine the spatial absorption profile of the wave and compare with experimental observations. A static magnetic field threshold for discharge initiation is seen at low flow rates, where discharges will not start above a certain magnetic field value that depends on RF power and flow rate. This threshold is a consequence of the multipactor effect, which is the dominant mechanism for breakdown when the electron-neutral collisional mean free path is longer than the system dimensions. A magnetic field ramping technique for starting discharges at low flow rates is described. [C111]

"Plasma diagnostics to study cathodes used to drive long-pulse magnetrons"

Summary form only given. Conventional long-pulse magnetrons use a heated cathode for thermionic emission of electrons, but short cathode lifespan and the necessity of providing a power supply to provide this heat are undesirable aspects of these devices. There is ongoing research to develop field emission cathodes with performance comparable to that of thermionic cathodes. One concern with these field emission cathodes is the possible evolution of surface plasmas over the fairly large surface areas of 10-100cm2. This presentation describes a plasma diagnostics capability we have assembled to apply to this research. A visible and UV spectrum fast CCD camera and a McPhereson 2M spectrometer capable of 2xl0"3nm resolution is used to determine the temporal and spatial evolution of both anode and cathode plasma regions of a square patch of material. Specifically, the electron energy distribution, sub- eV ion temperature (through Doppler broadening), plasma composition, and impurity abundance are determined. Plasma evolution similar to that achieved by the thermionic cathode must be demonstrated in order to avoid premature plasma closure and shorting of the magnetron resonant cavity used to produce microwaves. MAGIC PIC code simulations are also used to extrapolate the capability of novel field emission cathodes to provide near space-charge-limited current flow and optimize future cathode design using the spectroscopic data obtained. [C112]

"Dipole-dipole interactions experiment with a few cold Rb Rydberg atoms"

The aim of this paper is to realize excitation in a small volume, development of diagnostic methods for cold Rydberg atoms, spectroscopy of the microwave transitions between Rydberg states in the presence of the magneto-optical trap (MOT) quadrupole magnetic field, as well as observation of dipole-dipole interaction of a small number of Rydberg atoms. [C113]

"Development of metamaterials to optimize the focusing properties of a brain hybrid monitoring and treatment system"

The present paper aims at the development of a metamaterial to optimize the focusing properties of an intracranial monitoring and hyperthermia treatment device through negative refraction. The design parameters of the proposed metamaterial are presented and the structure is analyzed using analytical methods as well as a 3D full wave simulation verifying theoretical results. [C114]

"X-band power transmitting module based on waveguide spatial power combining"

The paper comprises the design and structure of 60 Watt X-band power amplifier module. The module consists of amplifying, diagnostics, cooling and driving submodules. The four-way structure is proposed together with the application of a spatial power combiner based on a four-probe waveguide power splitter. The measurements results are very promising and show scalability of this solution towards higher power and good switching characteristics as well as very compact structure and simple mechanical manufacturing. [C115]

"Waveguide system for high-power microwave pulse compression"

X-band passive microwave pulse compression is an interesting area of research in vacuum electronics. Applications include radar technology, plasma diagnostics etc. The scientific study of producing high-power nanosecond microwave pulses, using passive sweep-frequency compression, was undertaken. Two novel helically corrugated waveguides were investigated; 3-fold and 5-fold, respectively. The 3-fold structure couples a TE1.1travelling wave with a near cut-off TE2.1wave producing a region far from cut-off with a large change in group velocity as a function of frequency. A 2.08 metre long copper helical waveguide was used to compress a 80 ns, 5.5 kW frequency-swept pulse from a high power TWT (TMD PTC6321), driven by an arbitrary waveform generator and vector signal generator, to a 1.5 ns, 135 kW pulse containing -75% of the energy of the input pulse. To enhance the power capabilities of the microwave pulse compressor a more overmoded larger diameter 5-fold helical waveguide structure which adiabatically couples a TE3.1traveling wave and a near cut-off TE2.2wave was studied. Analysis of the dispersion characteristics carried out using CST MWS will be presented. [C116]

"MR temperature mapping with a new heating methodology for artificial dielectrics using open type MR scanner"

Recent development of magnetic resonance (MR) imaging equipment enables interventional radiology (IVR) as diagnosis and treatment under MRI usage. In this paper, a new methodology for MR scanner to apply not only as diagnostic equipment but as for treatment one is discussed. The temperature measuring procedure for MR is to measure phase shift of T1for the position inside a sample material with the application of pulsed RF for heating inside the sample as artificial dielectrics. The result shows the possibility to apply MR a temperature measuring equipment and as a heating equipment for applying such as hyperthermia heating modality. [C117]

"Development of non-uniform breast phantom and its microwave imaging for tumor detection by CP-MCT"

Phantom model of the breast which has actual shape and size has been developed for evaluation of microwave imaging by Chirp Pulse Microwave Computed Tomography (CP-MCT). This phantom model will also be successfully used for hyperthermia experiments using microwaves. This phantom model is consisted of four kinds of tissue mimicking materials, that is, the skin-, breast fat-, muscle-, and tumor-simulators. The principal ingredients of the phantom are water, liquid paraffin, super stuff (TX-150), sugar, and salt. It is easy to simulate permittivity of the real breasts in addition to the shape and size. This is the advantage of this non-homogeneous phantom. CP-MCT is a modality for microwave imaging of a human body using chirp pulse microwaves to extract the component which transmits the straight path between two antennas. Possibility of tumor detection by CP-MCT has been demonstrated by using the higher frequency model of CP-MCT and the non-homogeneous breast phantom. [C118]

"Report on a cancer cluster in an antenna ranges facility"

A cancer cluster which occurred among young workers in an antenna ranges facility is reported. Five out of about 30 workers were diagnosed with cancer. The calculated odds ratio (OR) was 8.3 with confidence interval (CI 95%) of 2.3 to 19. Since this is a single cluster no definite conclusions can be drawn from it by itself, however together with other similar cases reported elsewhere it tends to indicate a severe cancer risk for groups of young people exposed repetitively and over years to non-ionizing radio-frequency radiation at levels limited only by the ICNIRP thermal limits. [C119]

"A new and highly flexible dual array electron cyclotron emission imaging diagnostic for DIII-D"

A new electron cyclotron emission imaging (ECEI) diagnostic system is implemented on the DIII-D tokamak. This design makes use of technologies successfully demonstrated on the TEXTOR and ASDEX-UG tokamaks, while incorporating new features to provide enhanced flexibility and improved operation. The diagnostic makes use of a dual array configuration, allowing for simultaneous imaging of both the low and high field sides of the plasma, and is fully operational during electron cyclotron resonance heating (ECRH). Additionally, the highly flexible optical design allows for automated remote control of the vertical plasma coverage and resolution, focal plane location, and radial plasma coverage. [C120]

"A comparison of interpolation methods for breast microwave radar imaging"

In recent years, breast microwave imaging (BMI) has shown its potential as a promising breast cancer detection technique. This imaging technology is based on the electrical characteristic differences that exist between normal and malignant breast tissues at the microwave frequency range. A promising image formation technique for BMI

radar based approaches is wavefront reconstruction. In this approach, the image quality and execution time of this image formation technique is strongly affected by the interpolation method that is used. In this paper, a performance study between three popular interpolation techniques, nearest neighbor, linear and cubic splines, for breast microwave radar imaging is presented. The performance of the evaluated techniques was assessed using numeric phantoms obtained from Magnetic Resonance Imaging (MRI) data sets. The results of this study indicate that linear interpolation techniques are the most suitable choices based on their computational cost, and the focal quality and signal to noise of their resulting images. [C121]

"Heating properties of the needle type applicator made of shape memory alloy by 3-D anatomical human head model"

Since the human brain is protected by the skull, it is not easy to non-invasively heat deep brain tumors with electromagnetic energy for hyperthermia treatments. Generally, needle type applicators were used in clinical practice to heat brain tumors. To expand the heating area of needle type applicators, we have developed a new type of needle made of a shape memory alloy (SMA). In this paper, heating properties of the proposed SMA needle type applicator were discussed. Here, in order to apply the SMA needle type applicator clinically. First, we constructed an anatomical 3-D FEM model from MRI and X-ray CT images using 3D-CAD software. Second, we estimated electric and temperature distributions to confirm the SMA needle type applicator using the FEM soft were JMAG-Studio. From these results, it was confirmed that the proposed method can expand the heating area and control the heating of various sizes of brain tumors. [C122]

"A heterogeneous breast phantom for microwave breast imaging"

Recently there has been significant attention given to imaging biological tissues using microwave radiation. In order to verify microwave imaging algorithms, realistic body models are needed to measure and simulate the penetration of microwave energy into the tissue and to reconstruct the image. We have created a phantom which has dielectric properties that are close to the properties of the real breast tissue. The phantom includes materials that accurately simulate the dielectric properties of skin, fat, gland and tumor tissues while providing good contrast of conductivity. The phantom is fabricated from materials that are widely available and is easy to make. In addition the elasticity of the materials enables the phantom to be shaped into two dimensional (2D) or three dimensional (3D) forms. [C123]

"A comparison of data-independent microwave beamforming algorithms for the early detection of breast cancer"

Ultrawideband (UWB) radar is one of the most promising alternatives to X-ray mammography as an imaging modality for the early detection of breast cancer. Several beamforming algorithms have been developed which exploit the dielectric contrast between normal and cancerous tissue at microwave frequencies in order to detect tumors. Dielectric heterogeneity within the breast greatly effects the ability of a beamformer to detect very small tumors, therefore the design of an effective beamformer for this application represents a significant challenge. This paper analyzes and compares 3 data-independent beamforming algorithms, testing each system on an anatomically correct, MRI derived breast model which incorporates recently-published data on dielectric properties. [C124]

"Microwave imaging of artificially induced magnetic anomalies: a feasibility study"

The demand of effective, low cost and portable diagnostic tools for large scale preventive screening has addressed a huge interest in microwave imaging techniques. Moreover, the recently demonstrated capability of selectively targeting magnetic nanoparticles opens the way for new imaging strategies, that exploit nanoparticles as contrast agent. As a matter of fact, due to the nonmagnetic nature of human tissues, this artificially induced magnetic contrast can be exploited to enhance the response of small and hardly detectable anomalies. In this respect, two microwave imaging strategies, devoted to characterize magnetic targets embedded into an electric scenario, are proposed and a preliminary assessment of their reconstruction capabilities is given. [C125]

"Measurement of the effective length of laser-plasma channels in a laser triggered gas switch by guided microwave backscattering in SF6 and N2 /SF6"

Backscattering of guided microwaves has been utilized to measure the effective electrical length of laser produced plasma channels (LPPC's) in a laser triggered gas switch configuration. The LPPC was introduced into the waveguide by focusing the UV trigger laser beam through small holes in the broad wall. By translating the laser-focusing lens, the plasma channel could be scanned through the waveguide. A measure of the channel length was obtained by determination of the limits over which scattering is observed. Backscattering channel

length measurements were compared with three other measurements (D-dot probe, visible imaging, Schlieren imaging). It was found that visible and Schlieren imaging significantly underestimate the plasma length. Additionally, the plasma length has been studied as a function of lens focal length, laser energy, and neutral gas fill pressure in both pure SF6and an N2/SF6mixture (90%/10%). [C126]

"Microwave reflectometry: a sensitive diagnostic for electron density property measurement in Tore-Supra fusion plasmas"

Based on radar principle reflectometry measures the electron density in magnetic fusion plasma. On Tore-Supra, six reflectometers measure the density profiles and the properties of density fluctuations with good temporal and spatial resolution. Four swept reflectometers from 33 to 155 GHz provide reliable and accurate measurements of the whole density profile from the edge on the outer side up to the inner side. The sweeping time was recently decreased from 20 to 4 μs. Fast profile evolution can be followed owing to high repetition rate. Density fluctuations are measured with three different techniques. The classical fixed frequency method looks at large scale density fluctuations. Properties of density fluctuations can also be recovered from consecutive frequency sweeps. Doppler reflectometry is based on wave back scattering on small scale density fluctuations. It measures the poloidal rotation and fluctuations amplitude at different wave numbers. Recent numerical simulation of plasma turbulence have recovered the wave number spectrum obtained from Doppler and fast sweep reflectometry. Reflectometry is also sensitive to the density fluctuations induced by magneto hydrodynamic perturbations. Low frequency modes can be localized by fast sweep profile reflectometry. High frequency modes excited by energetic particles accelerated by the plasma heating system are observed with fixed frequency fluctuation reflectometry. [C127]

"The art and engineering of modern antenna near-field measurements"

This paper reviews the development of the antenna near-field measurement techniques and highlights some of the key features of these methods. The introduction of the near-field technique has opened a venue for accurate, stable and highly controllable indoor antenna measurements. Many interesting variations are developed in taking the near-field data on different surfaces which has further fostered the implementation of the near-field techniques. The planar, cylindrical and spherical chambers are nowadays very well-known and widely used for different applications. The researchers have also used many novel schemes in sampling the near-field data over the desired surfaces. For instance, plane-polar, bi-polar and spiral techniques have each provided unique characteristics or benefits to the art of near-field measurements. The notable fact regarding all of these techniques is that; they need a reasonably accurate measurement of both amplitude and phase of the near-field. Recently a very appealing alternative approach is introduced. These methods rely only on the amplitude measurement of near-field and are called phaseless techniques. They are capable of extracting the near-field phase merely based on amplitude-only measurements. The difficulties of measuring phase at higher frequencies have made them a unique solution for the needs of modern near-field facilities. This paper will also cover a typical application of this method in extracting the far-field of directive antennas in UCLA bi-polar facility and performs diagnostic processing using the phaseless techniques. [C128]

"Short pulse High Power Microwave surface flashover"

High power microwave (HPM) induced surface flashover is investigated in order to gain a better understanding of this phenomenon and reduce the limitations it imposes on transmitted power levels. This work builds on previous testing using a magnetron producing 5 MW for 4 Г‚Вїs at 2.85 GHz. Both the previous and current experimental setups are designed to produce a flashover on the high pressure side of a transmission window without the influence of a triple point. Limitations of the previous experiment included a maximum power of 5 MW and a pulse rise time of 50 ns. The current HPM source is an experimental virtual cathode oscillator (vircator), the output of which has been extensively characterized. The vircator is capable of producing 50 MW peak for 100 ns with an adjustable frequency from 3 to 5 GHz and a rise time of < 4 ns. The dominant modes of the vircator and magnetron are the circular TE11and rectangular TE10modes respectively, with the major electric field component in both setups normal to the direction of propagation, yielding comparable field geometries at the transmission window. The experimental setup permits the study of factors including gas pressure, composition, temperature, and air speed. Diagnostic equipment allows the analysis of power levels and flashover luminosity with sub-nanosecond resolution. [C129]

"Use of radiation sources to provide seed electrons in high power microwave surface flashover"

Delay times of high power microwave surface flashover are affected by radiation illuminating the dielectric. A controlled environment of pure Argon at a range of low pressures as compared to normal atmospheric pressure was used with 2 mW/cm2UV-radiation illuminating the test window. Argon was chosen due to its relatively small

number of processes involved such as inelastic electron collisions and due to the well-known cross-sections for these processes. Delay times in the presence of UV are significantly shorter than without UV illumination. The initial electron density contribution due the UV source is very roughly estimated to be ~106cm-3. A small admixture of radioactive krypton-85 showed only marginal changes in the observed delay times, likely due to an insufficient concentration of Kr-85 producing ionization events only every few microseconds and the high energy distribution associated with the emitted electrons. A detailed discussion of experimental breakdown delay data, along with theoretical expectations and discussion of the statistically dependent mechanisms and analysis, will be given. The ultimate goal is to develop a model for HPM window breakdown in a UV environment, to describe the role of discharge initiating electrons, and to quantify breakdown at high altitudes. [C130]

"Relativistic magnetron operation with explosive emission and ferroelectric plasma source cathodes"

In this report we present results of comparison of experimental research of the relativistic magnetron operation with commonly used explosive emission plasma cathode and novel ferroelectric plasma source (FPS) cathode. The experiments were carried with relativistic S-band magnetron powered by linear induction accelerator (LIA) (~350 kV, 4 kA, 200 ns). Using time- and space-resolved electrical, optical and spectroscopic diagnostics plasma parameters (density, temperature and expansion velocity) were studied during the accelerating pulse. In the case of explosive emission plasma it was found that the plasma is not uniform and consists of separate plasma spots whose number increases during the accelerating pulse. It was shown that the microwave generation is accompanied by a significant increase in plasma density and ion temperature, up to ~5Г‚В·1016cm-3and ~8 eV, respectively. The plasma electron temperature was found to be ~8 eV. It was shown that the plasma expansion velocity in the axial direction reaches ~107cm/s and Г‚Вї2Г‚В·105cm/s in the radial direction. Investigation of the plasma parameters during the magnetron operation with FPS cathode showed also increase of the plasma density up to ~7Г‚В·1014cm-3electron and ion temperature up to ~7 eV and ~4 eV respectively. It was shown that the application of the ferroelectric plasma cathode allows one to avoid a time delay in the appearance of the electron emission, to achieve better matching between the magnetron and LIA impedances, and to increase significantly (~30%) the duration of the microwave pulse with a ~10% increase in the microwave power. The latter results in generation of microwave radiation to be 30% more efficient than with the use of explosive emission cathode where the efficiency Г‚Вї20%. [C131]

"A miniature high-power pos driven BY A 300 kV Tesla-charged PFL generator"

A pulsed power generator based on a high-voltage Tesla transformer charging a 3.8 Г‚Вї/53 ns water-filled pulse forming line (PFL) to 300 kV has been developed at Loughborough University as a training tool for pulsed-power students. The generator uses all forms of insulation specific to pulsed power technology-liquid (oil and water), gas (SF6) and vacuum, a series of fast voltage and current sensors, and is able to produce multi-GW pulses on a simple x-ray diode load. Recently, a miniature (cm-size) plasma opening switch (POS) using protons (H+ions) has been coupled to the output of the Tesla-charged PFL generator, with the overall system constituting the first phase of a programme aimed at the development of a novel repetitive, table-top generator capable of producing 15 GW pulses for high power microwave loads. Experimental results demonstrating the performance of the POS in reducing the rise time of the input current while increasing the load power are presented, together with constructional details and diagnostic techniques. Future plans are outlined. [C132]

"Experimental 3D imaging of metallic small spheres by a linear distributional approach"

The problem of determining the number and the locations of "small" metallic spheres from scattered field measurements is addressed. The problem is casted as the inversion of a linear integral operator by means of the distributional approach based on truncated singular value decomposition (TSVD). The performance of the inversion scheme are analyzed for the case of a multi-view/single-frequency configuration by exploiting experimental scattered field data collected in controlled conditions at the Electromagnetic Diagnostics Laboratory of the Second University of Naples. [C133]

"Microwave tomography for GPR diagnostics of reinforced concrete"

In recent years, innovative strategies such as inverse-scattering or data fusion have been suggested for the processing of GPR datasets in complex scenarios. In this framework, high-resolution concrete inspections are a challenge regarding the treatment of radar data because of the size of the datasets and the complex structures involved. In addition, the achievable depth of inspection is in many cases restricted to unacceptable limits because of the material properties of concrete and the "masking effect" of the upper layers of rebar. Thus, the application of innovative approaches to high-resolution concrete data seems to suggest itself. In this framework, this work deals with the processing of a high-resolution, dataset acquired on a concrete retaining wall via an

inverse scattering technique. In particular, we show how the adoption of a strategy based on signal processing techniques and an inverse scattering approach is able to provide the mapping of the two layers of rebar. [C134]

"Microwave deflectors for high energy beam diagnostic"

Microwave deflectors are periodic structures where a periodic electromagnetic field interacts with ultra relativistic electron beams, in order to analyze the beam properties. Deflectors will be realized and used in the FERMI@Elettra project, that is a soft X-ray fourth generation light source under development at the ELETTRA laboratory (Trieste, Italy). In this paper we present the study performed to satisfy the RF requirements of the high energy deflector, considering both traveling wave and standing wave devices. For the traveling wave case we describe an efficient mode optimization process discussing three different modes, the 2pi/3, 5pi/6 and the quasi-pi. Then we will present a 11 cells standing wave deflector, providing a complete RF design with coupling procedure, sensitivities and other technical parameters. [C135]

"Clinical microwave breast imaging-2D results and the evolution to 3D"

The incidence of breast cancer and associated deaths are a recognized world health problem. Conventional screening approaches such as x-ray mammography, ultrasound and increasingly contrast-enhanced MRI are life saving to many women. However, the sensitivity and specificity of these modalities are still limited and there is clearly room for alternatives. Microwave imaging is a potentially important approach in this area because the tissue dielectric properties present important functional information which can be exploited to improve overall sensitivity and specificity in breast imaging. At Dartmouth College, our microwave breast imaging system is currently being used in pilot clinical studies for both tumor diagnosis and for monitoring treatment response during neoadjuvant chemotherapy. These early 2D imaging studies have demonstrated significance with respect to distinguishing tumors from normal tissue in the diagnostic mode and an ability to predict treatment response at a relatively early stage of treatment. The associated innovations and clinical results set a solid foundation as we advance towards full 3D imaging. [C136]

"A new approach for an embedded Wi-Fi controller in a C band phased array antenna"

Modern phased array antennas in radar systems are composed of several thousands of transmit/receive modules (TRM). Performance of radars are strongly related to the correct functioning of the control chain for such modules. It is therefore fundamental to perform diagnostic and monitoring of main characteristics of active array components; in this way, system performance may be checked and, if necessary, suitable actions to guarantee them may be actuated. [C137]

"Linear sampling method for time-lapse qualitative through-the-wall imaging"

The development of effective diagnostic tools for fast and non-invasive through-the-wall imaging (TWI) is an important topic, also motivated by the increasing public concern on security issues. In this framework, the main challenges are the detection of targets located on the other side of a wall and the monitoring of their motion. To pursue these aims, we propose an imaging strategy based on the linear sampling method (LSM), a computationally effective tool to determine the targets' morphology from multiview, multistatic and monochromatic data. In particular, by relying on the physical interpretation of LSM, we give its formulation for TWI and propose its use for motion tracking purposes by means of a simple post-processing strategy. A numerical example is given to assess the performances of the approach. [C138]

"A fast and efficient microwave method for detecting dielectric and conducting bodies inside complex structures"

This contribution presents a fast and efficient method for the inspection of dielectric and conducting bodies located inside arbitrary structures by using microwaves. The presented procedure is able to retrieve both the dielectric permittivity and electric conductivity of arbitrarily shaped targets embedded in inhomogeneous backgrounds and so it is an useful tool for diagnostics in several scenarios. The applications which can mostly benefit from it are non-destructive testing and evaluation of products and the imaging of objects hidden in bags or suitcases. [C139]

"Use of bio-resonance effects for medical diagnostics and therapy"

Novel possibilities of medical diagnostics and therapy on the basis of bio-resonance effects have been described. These effects take place in the frequency range of 30-100 GHz. Within this range there is a so called human individual characteristic frequency (ICF). The methodic of its determination has been described. The diagnostics of possible diseases is based on the correlation tie between human ICF and the large numbers of

medical observations. Effect of therapy is achieved during its correction to a patient ICF with use of the electromagnetic irradiation of low intensity (less than 10 mWcm-2). [C140]

"RF diagnostic methods for two nanostructured polymer applications"

Different diagnostic methods to be used in the early stages of new materials conception are proposed. A two-step method for the design of foamed nanocomposite polymers for electromagnetic interferences (EMI) shielding applications is first presented. An original method more suited to thin nanostructured films and nanocomposite polymer membranes for fuel cell applications is then detailed. Finally the methods are compared to one another and their choice for each sample family is explained. [C141]

"Application of multi-channel IF system for ECE radiometer on KSTAR and LHD"

We have developed an electron cyclotron emission (ECE) radiometer to measure the radial electron temperature profiles. Before installation of this system on KSTAR, we installed a part of this system on LHD, and confirmed that acquired signals are in good agreement with those provided by the Michelson spectrometer. [C142]

"Study of dual-dipole antenna array for millimeter wave imaging"

Millimeter wave imaging diagnostics such as electron cyclotron emission imaging (ECEI) and microwave imaging reflectometry (MIR) are advanced technology to investigate electron temperature/density profiles and their fluctuations in magnetically confined plasmas. We have installed an ECEI system in the large helical device (LHD) at National Institute for Fusion Science (NIFS). The optimization of a receiving antenna array is essential for the imaging diagnostics. We have designed and fabricated dual-dipole antenna array. In this paper, the design and fabrication process of dual-dipole antennas are described. The characterizations of the antennas are also reported by comparing simulation and experimental results. [C143]

"MM-wave absorption of in-vessel mirrors for plasma fusion experiments"

In-vessel mirror components for electron cyclotron resonance heating in plasma fusion experiments are exposed to high heat loads. For the specification of the cooling requirements for reflectors the microwave absorption due to material, structure and roughness has to be taken into account. In this paper the results of measurements on different samples considering these features are discussed. [C144]

"Guiding and radiating properties of a metamaterial-based Resonant-Slot coupled cavity chain"

Application of the resonant-slot coupled cavity chain as a Composite Right-handed-Left-handed transmission line (CRLH line) at microwave wavelengths is discussed. Design strategies for both the CRLH guiding structure and the backward-forward scanning leaky-wave antenna are reported. First theoretical valuations point to high power ability of such type of antenna, consisting of slotted waveguide with resonator-based filling. Applications in experimental plasma physics are intended. Theoretical background, numerical simulations and first experimental results are presented. [C145]

"In-situ IR diagnostics for the mmWave/microwave material heating"

Two topics of IR-diagnostics performed in the fundamental experiment of microwave iron making will be presented. One is tunable diode laser absorption spectroscopy for both CO and CO2gas generated during microwave irradiation. The other is spectroscopic thermography for iron oxide powder of which surface would be metalized by microwave carbothermic reduction. [C146]

"Wireless sensing applications in the mining and minerals industry"

This paper discusses and outlines applications of wireless sensing technology in the mining and minerals industry to provide enhanced assistance to mining machines. Three major applications can be performed by radar systems, such as surface profiling, positioning and collision avoidance. Radar sensors offer significant advantages compared to laser and ultrasonic in tough environments like rain, dust, fog and snow. The information received from the sensors can be used to increase the automation level and to advance the safety in the mine plus furthermore increase the turnover of mining companies. Underground communication systems and machine diagnostics are also discussed in this paper. Several applications were determined as highly feasible and are now completed respectively in the implementation stage. The authors are giving an insight into the experimental results, the implementation and an outlook of further use for this technology. [C147]

"Linear Sampling Method for time-lapse qualitative through-the-wall imaging"

The development of effective diagnostic tools for fast and non-invasive through-the-wall imaging (TWI) is an important topic, also motivated by the increasing public concern on security issues. In this framework, the main challenges are the detection of targets located on the other side of a wall and the monitoring of their motion. To pursue these aims, we propose an imaging strategy based on the linear sampling method (LSM), a computationally effective tool to determine the targets' morphology from multiview, multistatic and monochromatic data. In particular, by relying on the physical interpretation of LSM, we give its formulation for TWI and propose its use for motion tracking purposes by means of a simple post-processing strategy. A numerical example is given to assess the performances of the approach. [C148]

"Measurements of 193 NM laser air breakdown and scaling to the microwave regime"

We report the measurements and analysis of air breakdown process by focusing 193 nm, 200 mJ, 10 MW high power UV laser radiation onto a 20-60 mum spot size that produces a maximum laser intensity of 1012-1013W/cm2, well above the threshold flux for air ionization. The breakdown threshold is measured and compared with theoretical models including classical (collisional cascade) and quantum (multi-photon) ionization analyses. The air breakdown threshold is measured for a wide range of pressures ranging from 90 torr to 5 atmospheres. Higher pressure enhances the effective electric field due to the increased collisional frequency relative to the high laser frequency (1015Hz). Multiphoton ionization (MPI) (n = 3) processes play a substantial role at 193 nm due to the high photon energy (6.4 eV). We examine regimes for which substantial MPI is present and analyze the plasma temperature and density evolution. The breakdown threshold data for air at 193 nm is correlated with the microwave breakdown regime using the concept of universal scaling, for which extensive microwave breakdown data is available as well as current microwave and mm wave breakdown experiments at Texas Tech University and MIT. An extensive range of optical and spectroscopic diagnostics with 5 ns time scale gating and 13 mum ICCD resolution has been constructed to characterize the plasma. The spatial and temporal evolution of the laser focused plasma is measured using shadowgraphy and two- color laser interferometry techniques. The plasma temperatures are obtained by measuring the velocity of the shock wave front and also by using optical emission spectroscopy. Optical emission spectroscopy is performed to diagnose the plasma temperature using the emission lines of O II ranging from 372.3 to 470.4 nm and the band of the N2second positive system N2(2+) (0,0) at 337.1 nm. Measurements of the core laser plasma density (ne= 8time--s1017/cc) and electron temperature (25 eV) decay are compared with a dominant two- and three-body recombination model with good correlation. [C149]

"An experimental verification of a microwave backscatter tag for recording neural signals"

The ability to record neuro-signals by implantable microsystem in real-time is a highly challenging task in modern neuro-engineering. The critical information about the bioelectric activity of the nervous system is essential to the fields of medical diagnostic, therapeutics, rehabilitation and to the relatively new field of man-machine interface. This information can lead to the development of new neural prosthesis and provide an insight in the treatment of many disorders related to the nervous system. [C150]

"A THz interferometer for measurement of plasma density in high intensity discharge lamps"

Summary form only given. A THz interferometer has been constructed with the goal of directly measuring plasma electron densities in HID lamp plasmas. The system utilizes a 600 GHz source, capable of measuring plasma densities up to 4times1015cm-3. Due to the short wavelength of 600 GHz radiation, the focal spot size can be less than a millimeter in diameter. These advantages will allow a THz interferometer to measure electron densities in plasmas previously unavailable to interferometric methods. In addition to the use of THz radiation for interferometry, a significant departure from typical microwave measurement will be made in the elimination of heterodyning from the system. Due to the high density and AC nature of HID lamp plasmas, the plasma is expected to recombine twice per cycle when the discharge current is equal to zero. The effect on the beam will change over time as the discharge current passes through its full AC range, allowing calculation of the density as a function of time with zero-points contained within the measurement itself. The only limitation of such a method is the bandwidth of the detector, in that the bandwidth must be higher than the frequency of the AC current in the plasma. Sensors with bandwidths of 1 kHz or greater are available and should prove sufficient for a self-heterodyning interferometer. This self-heterodyning system can eliminate the complexity associated with traditional heterodyne systems, while simultaneously providing time-dependent information on the behavior of electrons in HID plasmas, and eliminating the need for separate measurements of zero-density points for calibration. [C151]

"Millimeter-wave sources for plasma diagnostics"

Higher power and more frequency agile sources are required for plasma diagnostics, both for fusion research

and for industrial process control. For example, reflectometers are planned for the ITER program that must generate of order 150 milliwatts of transmit power that can be rapidly scanned from 75 GHz through 230 GHz. In this frequency band the most successful solid-state source technology uses diode based frequency multipliers to extend the range of microwave amplifiers. For example, VDI has demonstrated a 300 mW source at 100 GHz that uses a high-power amplifier at 25 GHz and a cascaded pair of varactor doublers. The varactor doublers rely on a voltage-variable capacitance and large diode breakdown voltage to achieve large conversion efficiency and power handling. Unfortunately, these same device characteristics result in the very restricted tuning band of the doublers, and the typical 3dB bandwidth is of order 10% of the center frequency. Using this style of doubler would require an array of nearly a dozen sources to achieve the frequency bandwidth desired for ITER (75-230 GHz). This is technologically challenging and cost prohibitive. Additionally, the power available is reduced at higher frequencies and the requirement for rapid frequency tuning, even in these smaller tuning bands, often creates reliability problems. VDI is investigating the causes of these problems and possible solutions. Specifically, the performance of varactor and varistor frequency multipliers is under study, with the goal of improving the performance of cascaded multiplier chains and thereby reducing the number of channels required to cover the desired frequency range. Further, the reliability of these systems is being investigated, with the goal of understanding failures that occur during rapid frequency tuning and developing methods to alleviate these problems. Finally, VDI is developing prototype sources based on the results of these studies for use throughout the 75-300 GHz frequen--cy band. This talk will focus on the performance and operation of these all-solid-state sources of millimeter-wave power, with emphasis on the improved power handling of the multipliers, efforts to increase tuning bandwidth and techniques that have been developed to achieve rapid frequency tuning with high system reliability. The performance of prototype systems throughout the frequency band will be presented at the conference. [C152]

"Comparison of Langmuir probe and hairpin methods to characterise microwave cool plasma"

As plasma consists of particles, number of these particles refers to plasma density which is the main diagnostic problem, therefore different methods have been developed to measure the plasma density as well as its temperature. Langmuir probe underestimate the density measurements because the accuracy of an I-V curve depends on different factors such as instability in the plasma erosion of the probe tip due to sputtering by the microwave field. To improve the results we used a filtered Langmuir probe. To eliminate the difficulties of Langmuir probe we used hairpin method to determine the plasma density. This technique measures the electron density with a very high accuracy and reproducibility as compared to Langmuir probes. The hairpin probe is a U-shaped resonant structure which works based on measuring the plasma dielectric constant. The results from both methods have been compared in this paper. [C153]

"Spectroscopic analysis of microwave generated plasmas"

Microwave generated plasmas present a simple and versatile tool for numerous plasma-technological applications. Detailed analysis of the plasma properties and of their temporal and spatial distributions is an important prerequisite for optimizing the process technology and the quality of the application as well. Examples among many others are the homogeneity, the permeability and the mechanical and electrical properties of deposited thin layers on numerous surfaces. Spectroscopy is offered to be a diagnostic method that does not disturb or change the plasma. From diagnosing absolute spectral line and continuum intensities or simply line intensity ratios many of the important plasma parameters as kind of species, species densities, electron density, temperatures of neutrals, ions and electrons can be explored. Among these the species ground state density as an important quantity can quantitatively be determined by "passive" emission and absorption spectroscopy of spectral lines with self absorption. This was first developed for the silicon ground state density in a plasma target interaction experiment by the spectral analysis of the silicon multiplet 3p23P-3p4s 3P0in the ultraviolet spectral range at 251.611 nm. Because of the importance of carbon in plasma technological processes and their applications and in the boundary layers of magnetic fusion devices this method was also applied for the carbon ground state determination by analyzing the multiplet 2s22p2-2s22p(2P0)3s of carbon in the spectral range of 165.7 nm in the near VUV. The investigations of plasmas generated and heated by electron cyclotron resonance (ECR) with microwaves of a frequency of 2.45 GHz at a power of 800 W resulted in ground state densities of about 1018m-3of carbon. Several further spectroscopic results for the different analyses of temperatures and densities in micro--wave generated plasmas and torches will be presented. [C154]

"Microwave interferometry for high pressure non-thermal pulsed plasma"

Summary form only given. Atmospheric pressure non-equilibrium plasmas are now used in many applications including those where low-pressure plasmas have traditionally been used. However, measurements of key plasma parameters in the highly collisional regime exhibited at atmospheric pressure offer challenges, which usually have to satisfy requirements that are different than those found at low pressures. In this paper, a

millimeter (mm) wave interferometer system is used to measure the electron density and temperature of a low temperature atmospheric pressure helium plasma driven by nanoseconds pulses1. The plasma is generated by a modified dielectric barrier discharge where one of the electrodes is made of an aluminum plate covered by an alumina sheet while the second electrode is made of a copper disc (diameter of 5.7 cm) with several holes through which the operating gas is injected. The diameter of the holes is about 1 mm while the distance between nearby holes is 5 mm. The peak electron density and electron-neutral collision frequency are found to reach up to 8xl012cm"3 and 2.1x10 s", respectively. Based on the electron-helium collision cross-section and the measured electron-neutral collision frequency, the electron temperature of the plasma is estimated to reach a peak value of about 8.7 eV. [C155]

"Hybrid approach to the inverse scattering problem by using ant colony optimization and no-sampling linear sampling"

A hybrid approach to microwave imaging has been presented by combining the computational effectiveness of the nLSM with the global optimization capabilities of ACO. The reported numerical results validate the ability of the method to satisfactorily solve diagnostic problems by exploiting strengths of the two ones. [C156]

"Robust approach to skin location estimation for radar-based breast imaging systems"

Increasingly complex breast models are being used to test emerging microwave imaging modalities. With the increased complexity, waveforms received from skin reflections may consist of contributions from multiple locations, resulting in signatures not examined with simpler models. For example, antennas placed near the chest wall or at significant distances from the breast have been found to receive multiple skin reflections. With these received signals, simple methods used to estimate skin location, such as peak detection, do not provide reliable results. In this paper, we apply a deconvolution technique to find the impulse response with respect to a known reflected signal. Results demonstrate that this method provides more reliable estimates of skin location and shows the ability to estimate two skin locations from a waveform exhibiting two dominant skin reflections. [C157]

"The use of microwave, millimeter wave and terahertz spectroscopy for the detection, diagnostics and prognosis of breast cancer"

We have analyzed the broadband dielectric properties of cancerous and non-cancerous tissues were analyzed at the microwave, millimeter wave, and terahertz frequencies. In-vitro measurements were obtained using the vector network analyzer-based coaxial probe (2-50 GHz), backward-wave oscillator-based free space quasi-optical spectroscopy (30-120 GHz), and dispersive Fourier transform spectroscopy methods (60 -1.5 THz). All three techniques were modified to yield the complex real and imaginary permittivity, absorption coefficient, refractive index, and transmission data over an extended frequency range from 2 GHz to 1,500 GHz. The results reveal the characteristic signatures of breast tissues and display a significant difference in the electromagnetic response of cancerous (malignant) and non-cancerous (benign) tissues. All three techniques provide prospects for extending in-vitro measurements to in-vivo breast cancer detection and diagnostics. [C158]

"Case study of Near Field Signature Analysis (NFSA) as a diagnostic tool for high frequency circuits"

A presentation of the method of Near Field Signature Analysis as a tool for diagnostic failure localization in high frequency circuit assemblies will be given. Traditional techniques of localizing faults in RF circuits rely heavily on manual methods and ATE approaches have limitations based on how much intelligence can be embedded into the software. Following the trends of robotic application, this method combines precise mechanical positioning and non-contact probing with local synthetic measurement technology. The technique can shorten the time to diagnosis by augmenting the ATE with more positional information and save manual labor by creating an automated parallel operation for failed RF assemblies. It also may generate data of a prognostic value. A case study will be used to demonstrate quantitatively the possibilities and limitations of the technology. Multiple units of a typical microwave circuit assembly will be examined with this method at several measurement points. A following set of measurements on failing assemblies will be then be presented and compared with the reference measurements and their respective known-good measurements. [C159]

"Reduction of skin reflections in radar-based microwave breast imaging"

Radar-based microwave breast imaging is a prospective complementary imaging method that relies on dielectric property differences. One of the main challenges is removing the overwhelming reflection associated with the skin. In this paper, a skin subtraction method that can be applied to data generated with a realistic three

dimensional breast model is presented. The method estimates the skin response of the target antenna as a filtered combination of its neighbors with the use of a modified recursive least squares algorithm and a generalized cross validation technique. The neighbors are selected based on their proximity and their spatial correlation to the target antenna. The method's ability to subtract the skin response and preserve the tumor response is demonstrated. [C160]

"Wave diffraction for nondestructive analysis"

Some aspects of engineering materials non-destructive testing (NDT) are represented in terms of its application to the fracture mechanics. The active NDT methods which utilize of the sounding or stimulated physical fields as well as the acoustic emission analysis of materialpsilas space damaging and the inspection information processing are considered briefly. The modern concept of the NDT methods development for the purposes of technical diagnostics is formulated. [C161]

"Terahertz waves and perspectives of terahertz biomedical technologies development"

The diagram of comparative development of frequency bands and powers by modern radioelectronic means and apparatus for biomedical technologies has been made up. Terminology and physical basis of selection of the terahertz band of electromagnetic waves are given. Comparative energy characteristics of terahertz and extremely-high frequencies waves are presented, tables of molecular spectrums of atmospheric gases, metabolites, air pollutants, some macro- and microbiological structures, frequency bands of relic background and some substances in the terahertz band are given. It is paid attention to some effects of terahertz waves interaction with biological and physical mediums. The perspective trends of investigations for creation of novel terahertz biomedical technologies are founded. The results of Daphnia magna Strauspsila functional state investigation depending on influence of atmospheric air, exposed to terahertz electromagnetic irradiation, on Daphnia water environment are presented. Also, the investigation results of Daphnia heartbeats frequency change during simultaneous effect of phenol, alternating magnetic field and electromagnetic radiation are given. [C162]

"A diagnostic system for active antenna transmit channels"

In this paper, an on-line diagnostic system design for active antenna transmit channels is presented. The system is based on cheap gain and phase solid-state meters, integrated with the transmit channels, for amplitude and phase pulse measurements during real transmit pulse. The measurement data analysis by comparison with the calibration data, at the level of a single detector is performed. [C163]

"Simulation of Doppler reflectometry in turbulent plasmas"

The absolute plasma density fluctuation strength and its dependence on the fluctuation wave number is determined using Doppler reflectometry as plasma diagnostic. Finite difference time domain code IPF-FD3D is used to investigate the dependence of the returned power from the various plasma conditions. [C164]

"Applicator for In-vivo Experiments on Mice with Melanoma Tumour"

The use of electromagnetic fields in biomedicine for cancer treatment and diagnostics, nowadays begin to be quite widespread. This paper describes the design and the evaluation of a microwave applicator for treatment of small subcutaneous tumours implanted on animal model. The support of computer simulations was used to evaluate and optimise the fundamental parameters of the applicator and the SAR distribution in the biological tissue. The Results give the prospective to use this applicator for the study of the effects of hyperthermia treatment in relation with the characteristics of the treated tumour. [C165]

"Prospective Applications of Microwaves in Medicine"

Medical applications of microwaves (i.e. a possibility to use microwave energy and/or microwave technique and technology for therapeutical purposes) are a quite new and a very rapidly developing field. Microwave thermotherapy is being used in medicine for the cancer treatment and treatment of some other diseases since early eighties. In this contribution we would like to offer general overview of present activities in the Czech Republic, i.e. clinical applications and results, technical aspects of thermotherapeutic equipment and last but not least, prospective diagnostics based on microwave principals ant technology and instrumentation. [C166]

"Direct broadband microwave characterization of biological tissues using the coaxial probe technique"

A key advantage of using coaxial probe for microwave characterization of biological media is the non-invasive nature of the technique. The complex permittivities of normal tissues from animals and both normal and cancerous tissues from human bodies were measured over a broadband microwave region with this technique. The biological tissue measurements showed that the complex permittivities measured by this technique are in good agreement with other investigations. This is a cost effective, non invasive and easy to use technique which makes it very suitable for diagnostic and therapeutic applications of microwaves in biomedicine. [C167]

"Diagnostic of phased arrays with fault elements using the mutual coupling method"

This paper has shown that the mutual coupling method (MCM) calibration technique is very sensitive to faulty elements due to its error propagation effect to elements following the faulty element. This calibration error affects the phased array radiation patterns and degrades its sidelobe topology. The effect was demonstrated on sum and difference patterns in different scenarios. A method for detecting and bypassing faulty elements was presented. The method uses the same principles as the MCM and therefore is very suitable for industrial use. [C168]

"A Spread-Spectrum Clock Generator Using Fractional-N PLL Controlled Delta-Sigma Modulator for Serial-ATA III"

In this paper, a 6GHz spread-spectrum clock generator (SSCG) for Serial AT Attachment Generations 3 (SATA-III) is presented. By utilizing frequency modulation which employs digital MASH delta-sigma modulator and 33KHz triangular profile address generator, the SSCG achieves an output clock of 6GHz and 5000ppm down spread with a triangular waveform. The SSCG was designed based on TSMC 0.13μm 1p8m CMOS process. The power dissipation is 48mW under a 1.2V supply voltage. The peak-to-peak jitter of non spread-spectrum clock is 8ps, and the EMI reduction is 15dB with normal frequency spread modulation from 6GHz to 5.97GHz. [C169]

"Breast cancer detection by time reversal imaging"

This paper examines a time reversal beamforming imager for detecting early stage breast cancer tumors. We use numerical simulations and electromagnetic tissue experiments to validate the imager. Microwave radiation is known to be a potential diagnostic imaging tool for breast cancer detection that could complement the standard X-ray mammography. Electromagnetic radiation waves undergo multiple scattering due to the inhomogeneities of biological tissues. In this paper, we demonstrate that our proposed time reversal imager exploits successfully the multiple path electromagnetic scattering to achieve higher resolution and robustness than the direct subtraction beamforming imager. [C170]

"Temperature Measurement by Microwave Radiometry"

Temperature is an important parameter in the industrial world. For example, temperature control is of a greater concern in food processing industry for safety reasons as well as for product quality. Recently, microwave processing of powder metallurgical bodies has been shown to be very promising. Fully dense bodies with improved mechanical properties could be produced due to finer grain size. In the field of the sintering of materials, a control of the temperature inside heated parts is necessary to avoid local melting or distortions. The medical field is another sector particularly interested in non invasive techniques for the measurement of human temperature. In fact, the corporal temperature is proved to be a pertinent parameter in the scope of diagnosis, monitoring of many pathologies and for the posology of some medicines. None of the current methods for measuring temperature (thermocouples, optic fibers, infrared, etc...) give by a non-invasive way continuous temperature information. So, microwave radiometry brings a neat solution to measure and control non-invasively temperature inside a dissipative material. This paper is concerning the design and the realization of specific radiometric sensors in order to measure and control temperatures from a non-invasive way by microwave radiometry either in industrial or in medical applications. [C171]

"Complex Polarization Angle: Basic properties and applications in microwave plasma diagnostics"

Evolution of electromagnetic waves in weakly anisotropic media can be described adequately by quasi-isotropic approximation (QIA) of geometrical optics method. At this paper, QIA equations are presented in a compact form by involving the complex polarization angle (CPA). Relations between CPA and traditional parameters of polarization ellipse are established. Besides, equations for CPA and for traditional polarization parameters are derived for EM waves, propagating in the inhomogeneous magnetized plasma accounting both Faraday and Cotton-Mouton effects. [C172]

"Development of THz gyrotrons in FIR FU for application to high power THz technologies"

Recently, a gyrotron in FIR FU with a 21 T pulse magnet achieved the breakthrough of 1 THz. In the gyrotron, a demountable gyrotron tube is installed on the center axis of 21 T pulse magnet. In the operation test, a high voltage pulse is applied to electron gun installed in the region of the additional coils for controlling the injection point of electron beam in the cavity region. When B in the cavity region is changed, many cavity modes are excited at the fundamentals and second harmonics of electron cyclotron frequency. The second harmonic radiation is separated from the fundamental by using a high pass filter. Observed frequencies range from 395 GHz to 1,016 GHz. The maximum frequency 1,016 GHz is achieved by the second harmonic operation of TE4.12cavity mode. Corresponding field intensity B is 19.1 T. Now we are trying to increase the frequency by increasing B. For the convenience of the application, CW gyrotrons (Gyrotron FU CW Series) are being developed. Gyrotron FU CW I has been developed and succeeded in the CW operation at 300 GHz under high power of 2.2 kW. The next gyrotrons, Gyrotron FU CW II and III have also been developed. The parameters are as follows: around 400 GHz, 100 W for Gyrotron FU CW II and 1 THz, 100 W for Gyrotron FU CW III under CW operation. These gyrotrons will be used for development of high power THz technologies, for example, Plasma diagnostics, DNP-NMR for protein research, etc. [C173]

"High pressure microwave plasma assisted CVD synthesis of diamond"

Summary form only given. Microwave plasma assisted CVD (MPACVD) of diamond has received renewed attention during the past several years. The recent experiments by Yan et al. (2002) have demonstrated the synthesis of high quality single crystal diamond with growth rates from 10 to over 100 mum/hr with operating pressures of 110-180 torr. High pressure operation allows higher reaction species concentrations and increase deposition rates. Currently, most commercial microwave plasma deposition reactors are designed for operation up to 120 torr and thus this reactor technology is not optimally designed for operation in the 120-300 torr pressure regime. High pressure operation allows higher reaction species concentrations and increase deposition rates. Hence, the objective of this research is to explore the behavior of microwave discharges between 180-300 torr and to learn how to control and efficiently couple to them to enable high pressure MPACVD diamond synthesis. This investigation explores the performance of a microwave cavity reactor (K. P. Kuo and Jes Asmussen, 1997) that has been modified to operate in the higher pressure regime. Major modification of the reactor include the redesign of the substrate holder, cooling stage and gas flow patterns to enhance the plasma power density, stability and also to enable operation from 180-300 torr. The polycrystalline and single crystal diamond films are synthesized using methane/hydrogen gas mixtures. The microwave input power ranges from 1.5-3 kW, gas chemistry 2-10% CH4/H2, and operating pressure from 180 to 300 torr. The substrate holder is water cooled to maintain the deposition temperature of 950-1250degC. The substrate materials are either a one inch silicon wafer or HPHT single crystal diamond seeds. Experimentally measured deposition rates, plasma power densities, optical emission spectroscopy measurements of the discharge temperature and radical species densities versus operating pressure, inpu--t power, and gas chemistry are presented. Measured discharge absorbed power densities range from 160-500 W/cm3as the operating pressure increases and the diamond growth rate increases with increasing power density, operating pressure and higher methane concentration. Depending on the input experimental conditions, the diamond growth rate ranges from 3-50 mum/hr. Methods of achieving deposition uniformity, plasma stability, and long term operation of the reactor will be presented. [C174]

"Greener steel maldng process by microwave irradiation with discharges"

Highly pure pig irons were produced from powdered iron ores and carbons in a multimode microwave reactor. Microwaves create two different steps that enhance chemical reactions at the grain boundaries very rapidly to finish the reduction process. The visible light spectroscopic monitored the progress of the reactions. The powders absolve and radiate the continuous spectrum of blackbody emission under the temperature of 650degC. The magnetic fields couples directly and heats to the ores in this process. At above 650degC, the small hot spots rise, move and finally the microscopic arcing spots burst in to all over the surface emitting with brighter line spectrums. Carbon nitride molecules and Fe (I) atoms were identified in the recorded spectrum. These bursts are similar to the "ignition propagation" that is observed in chemical reactions. The line spectra originated from CO molecules have not been detected yet. The solid-solid reaction could be expected between the iron oxides and carbon to produce CO2directly. A loss in the sample weight was accelerated during the excess-emission. These are the clear evidence that microwaves cause thermally non-equilibrium state and accelerate reduction process. The electric field of microwave plays an important role in the second step. Microwave energy penetrated into the powder matrix and made small arcing between the powders. The electrons got kinetic energy from the microwave electric field and the accelerated electrons gave the kinetic energy to the powders. It looks similar process to the electric arc furnace. However, the difference was that the microwave carried the electric field energy directly in to the powder matrix and created high temperature electrons just in the powders. The conversion efficiency from the plasma electrons to ores could be expected to be 100% theoretically. The reduction of iron ore is completed at 1380degC and very pure pig iron was remained. The impurity level of Mg,

S, Si, P and Ti was on--ly 5-10% of what was found in the pig irons produced by modern conventional blast. The amount of carbon was half to produce the unit weight of pig iron in comparison to conventional blast. If we applied renewable energy or nuclear power plants to generate the microwaves, we can save 6% of carbon exhaust in the steel making industries. Several hundreds megawatts microwave systems will be required to replace all the existing classic blast furnaces all in the worlds. [C175]

"How to avoid excitation of parasitic modes in MW-class gyrotrons?"

Megawatt-class, millimeter-wave gyrotrons for plasma heating in controlled fusion reactors operate either in very long pulses or in continuous-wave regimes. Therefore, to handle ohmic losses of microwave power in the cavity walls, these gyrotrons are designed for operation at high-order modes with a very dense frequency spectrum. In such conditions, to provide excitation of the desired mode and then its high-efficiency operation, it is necessary to carefully analyze the gyrotron start-up scenario. All gyrotrons operate either with diode or triode-type magnetron electron guns. Although it is simpler for users to operate with gyrotrons having diode-type guns, in such gyrotrons the excitation of a lower frequency parasitic mode prior to excitation of the desired mode is practically unavoidable. Therefore, even when the desired mode is excited later, when the beam voltage approaches its nominal value, there is a time interval during which the gyrotron generates MW-level radiation of the parasitic mode which can destroy many plasma diagnostics tools in tokamaks and stellarators. Our simulations show that when the voltage rise is short enough this excitation of parasitic modes can be avoided. It is also shown that in gyrotrons with triode-type electron guns it is even much simpler to avoid this parasitic mode excitation. To do this one can use one high-voltage supply with a slowly growing beam voltage but utilize for the mod-anode, which can be treated as a currentless electrode, another supply providing fast voltage rise. [C176]

"Observations of neutral depletion and ion acceleration in a high-power argon helicon plasma"

Summary form only given as follows. Measurements are performed on an argon helicon plasma with an axial magnetic field (with and without a magnetic nozzle) of up to 1 kG in the antenna source region and 1.5 kG at the nozzle peak. Discharges are produced for pressures between 0.15 and 5 mtorr with incident 13.56 MHz RF power levels of between 300 and 3000 W. The electron density is determined with microwave interferometer as the fill pressure and the magnetic field strength and geometry are varied. The plasma density and electron temperature are measured using a double Langmuir probe. 488 nm Ar II emission calibrated for the measured electron temperature is used to determine the axial plasma density profile. Collisional-radiative models for Ar II and Ar I are used to determine the electron temperature and neutral density respectively by comparing excited-level population densities obtained with experimental spectra with densities predicted computationally. Axial variations of plasma density, electron temperature, and neutral density are measured and discussed for a wide range of fill pressures and magnetic field strengths for the uniform and nozzle configurations. Effects of neutral depletion are observed, including an increase in the electron temperature and a maximum plasma density limit that is a function of fill pressure and the magnetic field. Observations of substantial localized plasma density reduction as the magnetic field and coupled RF power are increased are observed. Additionally, the axial ion velocity distribution function is measured using tunable diode laser-induced fluorescence (LIF) to determine the effect of neutral depletion on the axial ion flux. [C177]

"A microstrip-line microwave interferometer for monitoring of plasma density of processing plasmas"

Summary form only given. We developed a planar transmission-line microwave interferometer for monitoring of electron density for applications in process real-time feedback control of plasma based semiconductor fabrication tools, such plasma etchers or PECVDs. The principle of this technique is the same as the conventional microwave interferometers except that the sensing microwave propagates along a transmission line structure. In this study, the sensor was a microstrip transmission-line where microwave propagates at a phase velocity determined by the structure and the electron density of the surrounding plasma. Thus the variation of plasma density can be estimated from the phase shift of the transmitted microwave from one to the other end of the transmission-line. Compared to the conventional microwave interferometers where line-averaged plasma density is measured, the transmission-line type microwave sensor will be less susceptive to the interference caused by multi-passes reflection/refraction effect resulting from nonuniformity of the plasma density profiles. Therefore, it provides a measurement of higher sensitivity and wider dynamic range. In this work, an U-shaped transmission line with 3 mm in width and 86 mm in length, the quartz based substrate thickness is 3.5 mm, and the distance between input and output ports is 23 mm. The dispersion characteristics of this microstrip line immersed in a plasma of different electron densities was simulated by using a commercial tool, High Frequency Structure Simulation code (Ansoft HFSS), a full- wave electromagnetic simulator using the finite element method. The simulation results show that the phase shift increases gradually with the plasma electron density with a

sensitivity 12 degree / 1010 cm"3. Experimental demonstration has been performed with an inductively coupled plasma. The sensor was mounted on the inner wall of plasma chamber. Measurement results show that the dependence of electron density of plasma source-- RF power predicted by the sensor agrees with the Hairpin probe measurements. [C178]

"Microwave atmospheric discharge for materials processing"

Summary form only given. Microwave atmospheric plasma system using TM011mode is successfully designed and built for materials processing applications. The microwave applicator and chamber were specifically designed to maximize microwave coupling into the plasma at resonant frequency. The system consists of a magnetron power supply, a circulator, a directional coupler, a three-stub tuner, a dummy load, a coaxial cavity, and a central cavity. Azimuthal slots were placed between the coaxial and the central cavity for efficient magnetic coupling. The plasma was reliably sustained at atmospheric pressure with good uniformity. Design and construction of the plasma system and diagnostics of atmospheric pressure plasma are presented for various ranges of pressure and gas types. [C179]

"Microwave Medical Imaging and Diagnostics"

Future trends in medical applications of microwave technique and technology can be seen in development of new diagnostic and imaging methods based on high frequency EM field. A significant importance for the future can be identified for the following methods: Microwave tomography, Microwave radiometry, Measurement of complex permittivity, Imaging in the Terahertz waves band and Microwave diagnostic radars. [C180]

"Compact HV-DC Power Supply"

We are reporting on a compact high voltage (HV) power supply that can be used in the mobile or airborne generation of high power microwave generators. The charger uses rectified AC mains input voltages of 480 V three phase and produces output voltages of more than 55 kV with HV output power levels of 100's of kW continuously. Major advancements over a previous design are the design of the secondary winding of the HV nano-crystalline transformer, the control of the primary inverter and the thermal management and diagnostic of the HV-DC rectifier. [C181]

"Gaussian optics lens antenna (GOLA) system for plasma diagnostics"

A Gaussian optics lens antenna system has been designed, fabricated and tested for the plasma diagnostic systems on the Aditya Tokamak. The performance of the designed antenna system is compared with our own designed conventional conical horn antenna in Ka-band spectrum. A gain improvement of 11 dB has been achieved in GOLA system, having gain about 33 dB and half power beam width 1.6deg, compared to conical horn, which has gain about 22-dB and half power beam width 12deg respectively.The performance of indigenously designed and fabricated antenna system has also been simulated using CST Microwave Studio and ZEMAX optical designing software. The simulated findings of gain and 3 dB bandwidth of both antenna systems are well matched with experimental findings. [C182]

"Using Coaxial Probe for Broadband Microwave Characterization of Biological Tissues"

A key advantage of using coaxial probe for microwave characterization of biological media is the non-invasive nature of the technique. It is being used extensively for the complex permittivity measurements of materials in the microwave region. Usually, coaxial probe measurements require electromagnetic full-wave analysis or a calibrated reflection coefficient, S11, of the material under test. In this paper, we present a new coaxial probe technique for the microwave characterization of biological tissues based on the calibrated reflection coefficient S11of a know dielectric constant. This technique only needs the well known distilled water as a reference material for the broadband microwave characterization of biological tissues. The complex permittivities of normal tissues from animals and both normal and cancerous tissues from human bodies were measured over a broadband microwave region with this technique. The biological tissue measurements showed that the complex permittivities measured by this technique are in good agreement with other investigations. This is a cost effective, non invasive and easy to use technique which makes it very suitable for diagnostic and therapeutic applications of microwaves in biomedicine. [C183]

"Phaseless antenna diagnostics by propagation diversity via a slab"

This paper deals with the first results of a novel technique to determine the far field of a radiating system from near-field intensity data. In particular, the approach requires an unique scanning plane where to measure the intensity of the near field. The diversity between the two intensity data sets is achieved by exploiting a dielectric

slab with known properties that fills partially the domain between the aperture and the measurement plane. Then a phase retrieval algorithm is exploited by assuming as unknown the antenna plane wave spectrum (PWS). The feasibility of the novel approach is compared to the usual near field phase retrieval technique exploiting measurements over two scanning planes. [C184]

"Development of planar devices using low-loss materials"

As the importance of advanced microwave and millimeter-wave diagnostics increases, the fabrications of high-performance planar devices become essential. This paper describes the development of planar devices such as antennas using low-loss fluorine materials. The problems to be solved for the present purpose are the low degree of adhesion between copper foil and fluorine substrate and the accuracy of device pattern using conventional fabrication techniques. In order to solve these problems, surface treatment of fluorine films and a fabrication method using Electro-Fine-Forming (EF2) are proposed. The peel adhesion strength between the metal and the fluorine films and the value of dielectric constant of the fluorine films before and after grafting are reported. In order to confirm the performance of the treated films, microstrip lines are fabricated on the conventional fluorine substrates and on the grafted-PTFE (Polytetrafluoroethylene) films. The prototype antennas using fluorine substrates with EF2 fabrication technique are also introduced. [C185]

"A simulator to improve waiting times at a Medical Imaging Center"

Medical Imaging Centers (MIC) are critical units in every hospital or medical center because they are an important step in generating a patientГ‚Вїs diagnostic. This paper shows a simulator designed to facilitate the development of simulation studies of MIC, which departs from traditional modeling because it uses a pull paradigm for the patients. A group technology approach was used to minimize the number of objects in the simulator, which includes objects that have the functionality of the equipments and processes found in these facilities, so that the analyst only needs to provide the parameters of the center. All the data is provided to the simulator through a Graphic User Interface (GUI), requiring no programming capacities. As an application of the simulator, an example is provided where the simulator is used to improve the waiting times and equipment rate of utilization at a research hospital in Chile. [C186]

"The microwave interferometer on J-TEXT tokamak"

A 2 mm microwave interferometer is developed to measure plasma electron density for the J-TEXT tokamak. The interferometer views the plasma vertically through a set of large diagnostic ports and the system is configured as a frequency-modulated interferometer. The interferometer routinely provides real-time feedback control for the gas injection system. [C187]

"Inversion of phaseless total field data by reconstructing the equivalent radiating currents"

The inverse electromagnetic scattering problem has been researched for years for its academic significations and widely applications in medical imaging, industrial diagnostics, remote sensing, application geophysics, etc. Recently, one of the research interests in this field is on how to inverse without the phase information of the measured field data, because such information is hard to be measured or easy to be corrupted by noise when the measure system is working on a high frequency rang. Indeed, an amplitude-only measurement can decrease the system cost also. [C188]

"Design and THz characteristics of hexagonal and cubic SiC based photo-irradiated IMPATT oscillators"

The millimeter and sub-millimeter wavelength range for a long time has been used in many research applications. This frequency range has been utilized in spectroscopy, radio astronomy, plasma diagnostics, and the study of the earth's atmosphere. Even millimeter waves are now used in commercial applications as well, particularly in the security sector. An example of a solid-state source of this range is IMPATT diodes. This paper reports on comparative analysis of photosensitivity of 4H-SiC, 6H-SiC, and 3C-SiC based IMPATT diodes at THz regime. Results show that 4H-SiC based IMPATT at THz regime is far better than its other counterparts. Also, this device is found to be more photosensitive than 6H-SiC and 3C-SiC based ones under similar operating conditions. [C189]

"Domain mechanism of electrical pulse breakdown"

By means of electron-optical and electrotechnical methods of diagnostics an electrical pulse breakdown was investigated at the dielectric surface. It was found out experimentally that at the initial breakdown stage in the field of an active electrode a domain with a strong electrical field. Its birth is accompanied by generation of

microwave radiation and a flow of fast particles in direction perpendicular to that of electrical field intensity in an interelecrode space. Domain appearance is caused by difference in electron and ion mobility at the high voltage supply to electrodes. Fast electron energy is ten-fold higher than a value pertinent to voltage applied (8.3 kV). As a result of fast electron energy dissipation a luminous field of an excessive negative charge-a ball lightning kernel appears in a near electrode field. Due to an intensive field between a kernel and the ambient air there appears a field of an excessive positive charge-an external ring layer practically simultaneously. The data obtained allow to explain generation of abnormal structures type ball lightning and Г‚Вїred devilГ‚Вї generated during electrical discharges in the atmosphere. In the major part of pulse duration there were also discovered spokes and hot points. [C190]

"Plasma decay in air and N2 :O2 :CO2 mixtures at high gas temperatures"

Plasma decay after a high-voltage nanosecond discharge has been studied experimentally and numerically behind an incident or reflected shock wave in high temperature (600-2400 K) air and N2:O2:CO2mixtures for pressures between 0.05 and 0.9 atm. Time -resolved electron density history was measured by a microwave interferometer for initial electron densities in the range (1-3) Г‚В— 1012cm-3and the effective eeffective electron-ion recombination coefficientlectron-ion recombination coefficient was determined. A numerical simulation was carried out to describe the temporal evolution of the densities of charged and neutral particles under the conditions considered. It was shown that the loss of electrons in this case is determined by dissociative recombination with O2+ions. Electron attachment to O2to form negative ions is not important because of fast electron detachment in collisions with O atoms produced in the discharge. [C191]

"Design of X-band Waveguide attenuator"

Microwave has been largely recognized in todaypsilas world of communications and technology. In fusion reactors various diagnostics like reflectometer, interferometer and radiometer help in getting information regarding various plasma parameters such as density, temperature, plasma fluctuations etc. Various active and passive devices combine to produce such large diagnostic systems and attenuator is one such small component, which is been used, in all the above-mentioned diagnostics since it has a strong capability to reduce microwave power. In the present study design, development and characterization of X-Band waveguide variable attenuator has been done. The designed results match with the experimental results. [C192]

"Microwave Reflectometer to measure radial profile of the plasma density on SST-1 Tokamak"

Ka-Band scanning frequency microwave Reflectometer is designed and developed to measure the plasma density profile in steady state plasma. It scans the full band (24-36 GHz) in 10 mus. It measures the density profile from minor radius r = 14 to 17.34 cm in SST-1 plasma. Single antenna and optics is used for transmitting and receiving purpose. Quadrature phase detector is used for absolute phase determination. 40 m long oversized waveguide of X- Band and Mitre Bends are used to reduce the losses in plasma path. The design and working of Reflectometer are discussed in this paper. [C193]

"ZigBee WiMAX nursery system for patient monitoring"

This paper has proposed a remote nursery monitoring system (RMNS) which combines ZigBee and WiMAX network. Within small-range area, ZigBee mesh network are established and medical devices embedded ZigBee module get access into the network. Through ZigBee network, the typical physical parameters are gathered in health information center (e.g. laptop and PDA) for doctors to monitor and control. To extend the coverage of the system, the hybrid infrastructure is developed by integrating wireless broadband access-WiMAX, which is good at transmitting signal in a long range no matter line of sight (LOS)or none line of sight (NLOS). Therefore, the reliability of the whole monitoring system is guaranteed. For people live in remote area, they can also be accommodated in the proposed RMNS system. Moreover, medical staffs are allowed to reserve their time for dealing with emergency issues. [C194]

"Increased reliability of AlGaN/GaN HEMTs versus temperature using deuterium"

Low frequency noise (LFN) is a reliable diagnostic tool to evaluate and locate the defects of a technology. In this study, LFN is used to assess effects of deuterium (H+ions) in diffusion condition on the robustness of 0.25 *2*75 mum2gate area AlGaN/GaN high electron mobility transistors (HEMT) grown on Si substrate. H+ions are diffused from the above AlGaN/GaN layer through the AlGaN/GaN interface and GaN layer, notably under the gated channel where the defects are located. Two batches of devices are stressed under high temperature condition at 400degC during 5 minutes (step 1) and 500degC during 15 minutes (step 2). The first batch is composed with 8 deuterated transistors while the second batch is composed with 8 non deuterated transistors. Static measurements and low frequency noise spectral density measurements of the drain current (SID) are examined

after each step of temperature. The first step does not reveal any degradation, while the second step highlights significative differences between the deuterated and non deuterated devices: LFN of deuterated devices remains constant, whereas LFN of non deuterated devices increases (GR superimposed with 1/f flicker noise). The deuteration of the devices can open the way to robust temperature devices, as AlGaN/GaN HEMT are dedicated to applications at high power and high temperature. [C195]

"Keynote Address III Advancements of microwave diagnostics and their industrial applications"

Summary form only given. Progress of microwave and millimeter-wave technologies has made possible advanced diagnostics for application to various fields, such as, plasma diagnostics, radio astronomy, alien substance detection, airborne and spaceborne imaging radars called as synthetic aperture radars, living body measurements, and automobile radars for collision avoidance and adaptive cruise control. Transmission, reflection, scattering, and radiation processes of electromagnetic waves are utilized as diagnostic tools which are classified to active and passive diagnostic systems. In the active system, microwave/millimeter-wave reflectometry (radar) is thought to be essential and most prospective, since it has higher perception accuracy and robustness under the conditions of rain, fog, and snow than conventional technique using laser radar devices. In this report we focus on the technology advances in microwave/millimeter-wave region and the application results of diagnostic systems, specifically by use of imaging technique and ultra-wide band radar technique. [C196]

"Measuring-modelling complexes for alignment and antennas measurements"

Special automated complexes which allow integrating the processes of modeling, designing, evaluation of the phased-array antenna (PAA) parameters for further aligning and conducting acceptance tests and field trials are considered in this report. It is shown that for comprehensive evaluation of multifunction PAA technical state and parameters it is necessary to combine simulation, complete diagnostic, initial alignment and further auto-tuning of multi channel PAA, with statistical approach to antenna measurements, taking into account constructive peculiarities and restrictions. [C197]

"System for radiowave diagnostics of oncological skin diseases"

The system for radiowave diagnostics of oncological skin diseases is developed. The system is based on registration of electromagnetic emission from a human body in mm range. The algorithm of analysis and classification of functional condition of tissue in dependence on the parameters of its own electromagnetic radiation in mm range is developed. The system for radiowave diagnostics allows detecting oncological skin disease at the early stage. [C198]

"Contactless methods of eyes pathology diagnostics with use of optical diapason radiation"

The results of use of electromagnetic radiation of optical diapason for diagnostics of structurally functional abnormalities and intraocular pressure pathology is given. The possibility of use of alive eyepsilas cornea optical anisotropy, which can be observed in polarized light, is shown. [C199]

"Computer microwave diagnostic system for measurement of parameters of sandwich-like micro- and nano-structures"

The Computer Diagnostic System for measurement of parameters of sandwich-like metal-dielectric and metal-semiconductor micro- and nano-structures from the reflection and transmission microwave spectra, developed in Saratov State University, is presented. [C200]

"Quasi-optical notch filters for plasma imaging applications"

Quasi-optical notch filters are employed to protect plasma imaging arrays from stray radiation from high power electron cyclotron resonance heating (ECRH) sources. A new imaging arrangement permits stacking of multiple filters to maximize ECRH rejection. Simulations indicate that a stack of three filters can provide a notch depth of >60 dB at 140 GHz, and retain this high rejection over an incident angle range of plusmn8deg. [C201]

"All-optical RF spectrum analysis of ultra-high speed optical signals"

We experimentally demonstrate an all-optical technique for monitoring the radio-frequency (RF) spectrum of ultra-high bit-rate signals, with bandwidths exceeding 1 THz. This monitoring scheme exploits the ultra-fast response time of the optical Kerr nonlinear effect, such that the instantaneous intensity of the signal is translated to a phase modulation of a co-propagating probe, which can be measured as a frequency modulation on a

standard optical spectrum analyzer, without the need for high-speed electronics. This scheme is applied to measure the optical RF spectrum of ultra-high bit-rate 160 and 320 Gb/s optical signals, and shows that impairments caused by either chromatic dispersion or amplitude modulation can be effectively monitored, thereby providing a useful diagnostic tool. The advantages of ultra-high bandwidth (up to terahertz), very fast response time and simple setup are highlighted. [C202]

"The diagnostics of heteroepitaxial structures GaAs/AlGaAs/GaAs based on technique of selective etching"

The technique of level-by-level etching of heterostructures GaAs/AlGaAs/GaAs with use of selective etchants is developed. Typical nomograms for definition of thickness of layers of a structure and also the estimation of electrophysical parameters of two-dimension electron gas are executed. [C203]

"Diagnostics of the troposphere refraction by means of the radio settings of the satellites"

Proposes a method of estimation of land troposphere refraction using radio setting of navigation satellites of the GPS. Presented design ratio that tie together satellite viewing angle and effective gradients of refraction coefficient in raying troposphere layer is obtained for the equivalent of an Earth radius model. The results of calculation are compared to experimental data which were obtained by satellite setting angles. [C204]

"Telecommunication Methods for Implementation of Telemedicine Systems in Crisis"

Disaster management utilizes diverse technologies to accomplish a complex set of tasks. Despite a decade of experience, few published reports have reviewed application of telemedicine (clinical care at a distance enabled by telecommunication) in disaster situations. Appropriate new telemedicine applications can improve future disaster medicine outcomes based on lessons learned from a decade of civilian and military disaster (wide-area) telemedicine deployments. Emergency care providers must begin to plan effectively to utilize disaster specific telemedicine applications to improve future outcomes. Telemedicine encompasses the diagnosis, treatment, monitoring, and education of patients, and provides convenient, site independent access to expert advice and patient information. Transmission modalities include direct wired connections over standard phone lines and specialized data lines, and wireless communications using infrared, radio, television, microwave, and satellite-based linkages. This paper reviews the history of telemedicine activities in actual disasters and similar scenarios, as well telemedicine innovations that may be applicable to disaster situations in the future. [C205]

"Excited state distributions of hydrogen atoms and molecules in microwave discharge hydrogen plasma and effect of EEDF"

We measured electron temperature and density by an electrostatic probe, and dissociation degree, number density of electronically excited states, and rot-vibrational temperatures of 2.45 GHz-microwave discharge hydrogen plasma at several torr in a cylindrical discharge quartz tube by spectroscopic observation. The electron temperature and density are found to be 3.0-4.5 eV and 7.0 times 1010- 3.6 times 1010cm-3, respectively. From Fulcher-alpha band spectroscopy, we find that the vibrational temperature ranges from 0.65 to 0.74 eV, and the rotational temperature from 0.055 to 0.083 eV. The actinometry measurement shows that the dissociation degree of hydrogen molecule ranges from 4.0 to 5.0%. We calculate excited state population densities of hydrogen atoms using the hydrogen C-R model with measured data as input parameters. In the calculation, we find that the calculated population densities become about one order larger than those measured by OES if we assume Maxwellian EEDF. On the other hand, population densities with non-Maxwellian EEDF as a solution of the Boltzmann equation agree well with the experimentally measured values. In consequence, we confirmed significant effect due to non-Maxwellian EEDF on the excited states populations. [C206]

"Diagnostics of the troposphere refraction by the signals of TV centers and satellite radiation"

Comparison of signals from TV centers on over the horizon route in a penumbra region and radiation from satellites of a global navigation system is carried out. Classification signatures are proposed which allow forecasting troposphere refraction state on propagation route at a signal change receiving from TV center or a satellite. [C207]

"Diagnostics of a propagation medium of GPS signals by single-frequency receivers"

The application of GPS single-frequency receivers for diagnostics of a propagation medium of the satellite navigational system (SNS) signals founded on determination of the sloping ionospheric correction by measurement of a phase paths difference of navigational signals from two satellites is represented. [C208]

"Zebra-structure of solar microwave bursts"

The dynamic spectrum of radio emission is used for diagnostics of geo-affectivity of solar flares. But sometimes the spectrum contains many stripes of radiation named as zebra-pattern, the origin of which is not clear. The great number of hypotheses of its origin is published but all of them do not take into account the change of signal during its propagation through a corona. The presented analysis showed that the effects of propagation can form the dynamic spectrum containing zebra-patterns. The properties of designed spectrum coincide with basic properties of the observed spectrum. It is found out that a ldquospikerdquo structure of strips is a natural property of radio wave interference and its existence indicates the interference nature of formation of a zebra-pattern. Consequently the zebra pattern can be formed not in a source of emission, but can arise up as a result of radio wave propagation through the inhomogeneous refractive coronal medium. [C209]

"Troposphere diagnostics on satellite radiosetting"

Work contains the analysis of possibilities of determination of troposphere refraction index gradient on the height and distant attenuation factor gradients of UHF radio signal in shadow or half-shadow area of the radio-occultation satellite path. The simplified relations are used for calculation. It is determined, that diagnostics on the height attenuation factor gradient is more effective. [C210]

"Design of Portable UHF Differential Diagnostic Reflectometer"

MMW-range differential reflectometry method proposed allows to detect the new index of organism habitability-anisotropy factor AF. Advantages of the differential reflectometry: AF definition in the single antenna position; high-speed measurement defined by the measuring circuit resources; high sensitivity compared with existing methods. [C211]

"Development of Nonstantionary Gas Spectroscopy Method for Noninvasive Medical Diagnostics"

The possibilities of using of the microwave gas spectroscopy method for investigation and analysis of exhaled air are considered. The results of tests measurements in 2-mm range are presented. The prospects of investigations in teraherz and subteraherz ranges are shown. [C212]

"Diagnostics of Skin Diseases using the Methods of Near-Field Microwave Sounding"

We have studied the possibility of using near-field resonant microwave sounding for diagnostics of various dermatoses and control of the applied treatment efficiency. Such diseases as psoriasis, atopic dermatitis and lichen ruber planus are analyzed. [C213]

"New trends in medical applications of electromagnetic fields"

This presentation gives an overview of new trends in the use of electromagnetic fields for medical applications for diagnostics and treatment. [C214]

"Diagnosis of antenna-arrays using near-field antenna measurements and A {itpriori} information"

Nowadays antenna measurements are often carried out by exploiting the benefits of near-field transformation techniques. However, as spherical near-field measurements are very time consuming it is desirable to use the near-field data being measured in order to determine an antenna's far-field characteristic also for diagnostic purposes, especially if the far-field characteristic differs from the expected one. This paper explains how to gain diagnostic information from measured near-field data. For this purpose, the standard microwave holography as well as the limits of its spatial resolution are discussed. Following this a new equivalent-source method is introduced allowing the reconstruction of electromagnetic near-fields with enhanced resolution as compared to the holographic approach. The quality of the reconstructed near-field data will be significantly enhanced when applying the proposed diagnostic algorithm. [C215]

"Microwave-induced thermoacoustic imaging enhanced with a microwave contrast agent"

Nanoparticles have drawn great attention as targeted imaging and therapeutic agents recently. However, so far, no research on radio-frequency absorption contrast agents in soft tissues has been reported. A microstructure agent, carbonyl iron, which has strong microwave absorption, is applied to microwave-induced thermoacoustic imaging. The size of this microsphere is approximately 2mum that is safe for biological and medical application. The carbonyl iron emulsion is prepared by the Sol-Gel process which makes carbonyl iron particles more hydrophilic and with good electromagnetic properties. A 320-element linear transducer array with a centre

frequency of 3.5 MHz was adopted to capture thermoacoustic signals within limited field around the sample. Using phase-controlled focus technique to collect thermoacoustic signals, the data need not be averaged because of a high signal-to-noise ratio, resulting in a data acquisition time of less than 5 s at each step. The collected data was utilized to reconstruct the geometrical details based on limited-field-filtered back-projection algorithm. The effect of solid particles for enhancing thermoacoustic grey scale images was successfully investigated in tissue phantoms, the image brightness, i.e., mean grey scale level, increased with particle concentration. This particle may have potential to improve sensitivity and specificity for structural and functional thermoacoustic imaging and broadly expand the thermoacoustic imaging capability as a powerful medical diagnostic tool. This paper provides the first demonstration of a microwave contrast enhancing agent for thermoacoustic imaging. [C216]

"Time Reversal Beamforming for Microwave Breast Cancer Detection"

Microwave radiation is well known as a diagnostic imaging method for many medical applications, for example, early stage breast cancer detection. Microwave detection of breast tumors is a non-ionising, potentially low cost, in vivo modality that relies on the dielectric contrast between healthy and malignant breast tissues. The scattering environment in a breast often appears to be inhomogeneous due to changing dielectric properties of the breast tissues. Time reversal (TR) is an adaptive waveform transmission scheme that utilizes the rich scattering medium to best match to the target response. In this paper, we develop the microwave time reversal beamformer for breast tumor detection. The TR beamforming scheme is examined based upon a breast model using the two-dimensional finite-difference time-domain (FDTD) method. We show that time reversal microwave beamforming is a more robust, higher resolution imaging scheme than conventional beamforming schemes. [C217]

"Modeling the effective complex permittivity of heterogeneous breast tissue and comparison with relaxation models at millimeters wave frequencies"

The contrast in dielectric properties between normal and malignant tissues is a basis for diagnostic applications using microwave devices. The study of normal tissues has been widely reviewed. Experimentally determined permittivity values tend to have larger inaccuracies as frequency increases due to the increased complexity of the measurement. Furthermore, it is anticipated that most tissues, especially those of high water content, will be increasingly lossy at the mm (millimeter) wave band. The goal of this paper is to model the heterogeneity of breast tissues using computer aided design so that dielectric properties at higher frequencies could be compared to the measurements. This goal will be achieved by designing and simulating a model that mimics the human breast tissue. The proposal is timely because of recent advances in software for finite element modeling of any system, coupled with greatly improved computing speeds and hence accurate results. We will start by introducing an electromagnetic model for the human breast tissue based on water content and compute its effective dielectric permittivity followed by a comparison of our results with prediction of relaxation models and available experimental results. [C218]

"Suggestions for Usage of RFID to Support Extraction, Controlling and Tracking of Information During the Application of Clinical Pathways"

RFID can be used for extracting, controlling and tracking of relevant information during medical attendance conforming to defined clinical pathways. Based on obtained information clinical pathways can be improved and a higher capacity utilisation of medical resources can be achieved. Problems result out of financial, security and psychological aspects. [C219]

"Impedance of Skin Layer of Plasma Jet Generated by Explosive Method"

Analytical expressions describing the frequency dependence of complex impedance of plasma jet skin layer have been obtained. The characteristics measured are used for calculation of resistance and reactance. [C220]

"Experimental Investigation of Filamentary Arrays in a Breakdown Plasma Generated by a 1.5 MW, 110 GHz Gyrotron"

Summary form only given. We present detailed experimental results of surface flashover (or breakdown) at a dielectric window transmitting a focused Gaussian beam of high-power millimeter waves. The experiments have been conducted using a 110 GHz gyrotron with maximum output power of 1.5 MW and pulse length of 3 microseconds. Results so far have been at atmospheric pressure. Diagnostics include optical emission measurements using photodiodes and a camera and microwave transmission measurements. We find a highly periodic, near-hexagonal structure in the time-integrated images of breakdown plasma columns. These plasma

filament arrays are an unexpected outcome of these studies. Present research concentrates on a study of the evolution of the structured plasma by using photodiodes directed at different regions of the plasma. These results along with more accurate threshold power measurements for different dielectric window materials such as polycarbonate, high-density polyethylene, and Teflon, will be presented. [C221]

"Operation of Free-Electron Maser Based on a Two-Dimensional Distributed Feedback"

Summary form only given. Intensive studies of operation of a coaxial high-power Free-Electron Maser (FEM) based on a two-dimensional distributed feedback are currently taking place at the University of Strathclyde. It has been demonstrated that highest output power and efficiency was achieved if the FEM two-mirror cavity was formed by a 2D Bragg (input mirror) and 1D Bragg structure (output mirror) (2D-1D cavity) in comparison with the case when 2D-2D two-mirror cavity was installed. The input mirror provides two-dimensional (2D) distributed feedback and ensures mode selection over the wave azimuthal index. The use of a 1D Bragg structure as an output mirror reduces the cavity Q-factor, improves the RF field profiles inside the cavity and decreases the power losses inside the output mirror as compared to a 2D Bragg output mirror. The FEM has been driven by an oversized high-current, mildly relativistic thin (0.2 cm wall thickness) annular (7 cm diameter) electron beam of 200 ns pulse duration. The electron beam was guided thorough a coaxial transmission line of length ~2m with the diameters of inner and outer conductors of 6 and 8 cm respectively. The directional mode pattern of the microwave radiation launched from the output horn was measured. The output power measured at the detector was integrated over the radiation pattern resulting in an FEM output power of ~60MW corresponding to an efficiency of ~10%. To study the frequency of the output radiation first the cut-off filters were used and it has been established that the 2D Bragg FEM operated within the 36 GHz and 39 GHz. The frequency was also measured using a heterodyne frequency diagnostic. Microwave radiation from the FEM was mixed in a non-linear waveguide balanced mixer and the resultant intermediate signal captured on a LeCroy digitizing oscilloscope. By taking the FFT of the recorded signal and knowing accurately the local oscillator frequency the radiation spectrum was measured and the main maximum coi- ncided with 37.3 GHz which is in good agreement with theoretical predictions. [C222]

"General Theory of Microwave Semiconductors and Dielectrics Diagnostics using Ideal Single Mode Resonator Measuring Converters"

The principles of development general theory of plane sample interaction with electromagnetic field of resonator measuring converters are developed. Differences of the fundamental measuring information signals RMC with E and H modes at perturbation of the field of the resonator sample are considered. The dependencies fundamental measuring information signals from parameter sample RMC are explored. [C223]

"Diagnostics of Microwave Low-Barrier Detector Diodes"

The technique based on analysis of differential contact resistance/voltage dependence was developed in order to characterize low-barrier Mott diodes. The main parameters of low-barrier Mott diodes with sub-surface delta-doping have been determined. [C224]

"Measurements of Air Breakdown Process using 193 NM Focused Laser Radiation"

Summary form only given. We report the measurements and analysis of air breakdown process by focusing 193 nm, 200 mJ, 10 MW high power UV laser radiation on to a 10-20 mum spot size that can produce a maximum laser intensity of 1012-1013W/cm2, and well above the threshold flux for air ionization. The breakdown threshold is measured and compared with the theoretical models such as classical and quantum analyses. The air breakdown threshold is measured for wide pressures range from 90 Torr to 5 atmosphere pressures. Above atmospheric pressures are required to increase the collisional frequency comparative to the high laser frequency (1015Hz). Multiphoton ionization processes are also expected to play a substantial role at 193 nm due to the high photon energy (6.4 eV). The breakdown threshold data for air at 193 nm is correlated with the microwave breakdown using the concept of universal scaling, for which extensive microwave breakdown data is available at frequencies of 0.99, 2.8 and 9.4 GHz and current microwave breakdown results obtained at Texas Tech University. An extensive range of optical and spectroscopy diagnostics with 5 ns time scale gating and 13 mum ICCD resolution has been constructed to characterize the plasma. The spatial and temporal evolution of the laser focused plasma is measured using the shadowgraphy technique. The plasma temperatures can be obtained by measuring the velocity of the shock wave front and also by using optical emission spectroscopy. Optical emission spectroscopy is performed to diagnose the plasma temperature using the emission lines of the N2second positive system N2(2+) (0,0) at 337.1 nm. Plasma density is measured using two color laser interferometry. Phase shift produced by the laser focused plasma for two different probe laser wavelengths such as red (632 nm) and green (532 nm) wavelengths will be measured, which is used to measure the plasma

density. [C225]

"Diagnostics of Layered Medium Parameters: The Influence of Vector Space-Time Time Response of Transceiving Antenna"

Electro-physical restoration of layered medium parameters is considered. The method is based on UWB electromagnetic sounding of the medium, scattered field reception, transceiving antenna influence compensation, and estimation of medium reflection function. The method includes: measurement (or numerical calculation) of electric field component on the plane surface close to the transmitting antenna; field approximation by the superposition of elementary E and H plane waves; determination of antenna vector effective height; estimation of sufficient number of plane waves which is necessary for finding reflection function of the medium; transformation of scattered field back to the receiving antenna port. The accuracy of electromagnetic field approximation by the limited number of plane waves is investigated. [C226]

"Stacked implantable rectenna for wireless powering the medical implants"

An implantable rectenna with stacked PIFA structure has been developed for wireless power transmission for medical implants in 402-405 MHz (MICS Band). The antenna has dimension of 450 mm3measured operating frequency of 402 MHz with broad bandwidth of 50 MHz at return loss -10 dB. Experimental prototype of the compact stacked rectenna was fabricated on Roger 3210 substrate. The rectenna has a conversion efficiency of 80% is achieved when 2dBm microwave power is received at 402 MHz with 20K- Omega load. [C227]

"Wide bandwidth mixer array development in millimeter wave imaging systems for plasma diagnostics"

The development of imaging arrays on dielectric lens antennas for use in millimeter wave imaging systems is described. The 24-element 140-170 GHz and 22-element 110-140 GHz imaging mixer array are comprised of Schottky diodes and double dipole antenna arrays placed on an elliptical lens. This paper first describes the antenna development and then the characterization of the off-axis performance of the elliptical lens. The unequal spacing between antennas and channel number of the antenna arrays are determined based on the theoretically calculated off-axis far field patterns. A wide bandwidth balun used to reduce the mixer IF loss is also described. [C228]

"2-D Passive Millimeter Wave Imaging System for Plasma Diagnostics"

Technology advances have made possible the visualization of electron temperature profiles and fluctuations inside the core of high temperature plasmas via a two-dimensional passive millimeter wave imaging system. The electron cyclotron emission imaging (ECEI) system concept and configuration are briefly described. Advanced technologies such as frequency selective surfaces band-stop filter, planar Schottky diode mixer arrays, wide bandwidth IF electronics, and imaging optics are presented. [C229]

"Advances in millimeter wave/THZ plasma diagnostics instrumentation"

Significant advances in millimeter wave and THz receiver and array technology have led to new approaches for the visualization of density and temperature fluctuations inside the core of high temperature plasmas. Electron cyclotron emission imaging collects millimeter wave electron cyclotron emission from the plasma and images it onto a planar mixer array to form 2-D images of electron temperature fluctuations. Illuminating the plasma with millimeter waves, microwave imaging reflectometry images the plasma cutoff layer onto a planar mixer array and thereby spatially resolves density fluctuations on the extended plasma cutoff surface; the use of multiple frequency illumination results in the formation of 2-D density fluctuation images. Collective scattering approaches at THz frequencies can resolve density fluctuations deep into the plasma core that are not accessible via reflectometry. [C230]

"Filamentary arrays in breakdown plasmas generated by a 1.5 MW, 110 GHz Gyrotron"

We present the observation, for the first time, of large, regular arrays of plasma filaments during surface and volume breakdown in air at atmospheric pressure using a focused, linearly polarized Gaussian output beam of a pulsed gyrotron. Both volume breakdown in free space and surface breakdown at/near a dielectric window have been studied. A gyrotron with an internal mode converter that emits 110 GHz microwave pulses with up to 1.5 MW peak power and pulse length of 3 microseconds has been used as the source of the microwave beam. Diagnostics include optical emission measurements using photodiodes and a camera, and microwave transmission measurement. The formation of the observed regular filamentary array can be explained by field enhancement approximately a quarter wavelength upstream of each existing filament due to diffraction from the

filament. [C231]

"Probe diagnostics of high-pressure microwave plasmas for shock wave propagation study"

High pressure (1 Torr) microwave plasmas in argon are investigated in the range of gas pressures from 400-1000 mTorr for microwave (MW) power levels of 1300-1600 W by means of electrical probes. Electron number density, electron temperature, and plasma potential obtained from single Langmuir probe (SP), floating double probe (DP), and emissive probe (EP) are compared with one another. Standard analyses for the single and double probe characteristics are performed, whereas the inflection point method is used for determining the plasma potential from the emissive probe. Averaged over all power levels, the range of values for the plasma parameters are determined to be (i) 3.5-4.9 eV from the SP and 2.0-2.4 eV from the DP method for electron temperatures, (ii) 0.92-3.5 Ч 1011cm−3from the SP and 1.2-2.7 Ч 1011 cm−3from the DP method for electron densities, and (iii) 17.5-22.6 V from the SP and 12.4-36.6 V from the EP method for the plasma potentials. [C232]

"Short pulse High Power Microwave surface flashover"

High Power Microwave (HPM) surface flashover is investigated in order to gain a better understanding of this phenomenon and reduce the limitations it imposes on transmitted power levels. The experimental setup is designed to produce window flashover without the influence of a triple point. The HPM source for this testing is an experimental virtual cathode oscillator (vircator) capable of producing greater than 50 MW for 100 ns with an adjustable frequency from 3 to 5 GHz. This work builds on previous testing using a magnetron producing 5 MW for 4 μs at 2.85 GHz. The dominant modes of the vircator and magnetron are the circular TE11and rectangular TE10modes respectively, with the major electric field component in both setups normal to the direction of propagation, yielding comparable conditions. Due to the large differences in output power and pulse length, the two setups operate in different regimes and mechanisms may take on differing degrees of importance. The experimental setup permits study of factors including gas pressure, composition, temperature, and air speed. Diagnostic equipment allows the analysis of power levels with sub-nanosecond resolution. Experimental results are compared with data from literature, previous testing, and Monte Carlo simulations. [C233]

"Spatial Filtering of Optical Scattered Waves in Bio-Medical Media By Inhomogeneous Waveguide Grids For Optical CT"

Medical image diagnosis and computer aided diagnosis are modern important medical techniques developed with computer technology. Particularly, medical image diagnosis using optical waves of lasers is very important technical tools for physiological examination of human body. Image responses of optical transmitted projection include optical scattering characteristics that disturb transmission properties through biological structures depending on optical absorption effects due to biological characteristics consisting of atomic and molecular structure. In this paper, technical methods of spatial filtering for optical scattering superposed on transmitted and attenuated waves are discussed to improve image diagnosis. Statistical theory of optical waves is described for optical propagation, attenuation and scattering in random inhomogeneous biological media. Spatial filtering characteristics of grid structure are shown for exact image optical projection excluding scattering effects through physiological media. Spatial filtering characteristics for off-axial scattering optical waves are discussed by mode propagation properties with large attenuation for higher order modes in inhomogeneous waveguide-type grids. [C234]

"A Flexible UWB Elliptical Slot Antenna with a Tuning Uneven U-shape Stub on LCP for Microwave Tumor Detection"

In recent years, pulsed microwave imaging in the gigahertz range has been suggested as a promising complementing methodology to the currently existing detection and imaging techniques. This technique is based on significant electrical contrast between the cancerous and healthy breast tissue in the microwave range. In this paper, we investigate tumor detection capabilities of the CPW-fed elliptical slot antenna with a tuning uneven U-shape stub on flexible liquid crystal polymer (LCP) in the UWB Microwave range of frequencies. This topology features excellent capabilities to detect tumors of different sizes and orientations and could potentially revolutionize the detection of ultra-small tumors through the use of antenna-array conformal diagnostic "pouches". [C235]

"Expert system for the operative environmental diagnostics"

Expert system for the operative environment diagnostics (ESOED) that is here proposed realizes GIMS-technology (GIS+Model) combining the methodic and algorithms of mathematical modeling with the land and

remote observations of the environment. Links between experiments, algorithms, and models of environmental processes and subsystems are developed to realize effective procedure for the operative control and diagnostics of the environment. The objective of this report is threefold: 1) To present a working methodology for the combined use of modeling technology and microwave remote sensing measurements in the assessment of environmental processes and biospheric subsystems dynamics. 2) To illustrate this methodology with computer calculations of global change dynamics for the various scenarios. [C236]

"Simulation and analysis of microwave transmission through an electron cloud, a comparison of results"

Simulation studies for transmission of microwaves through electron clouds show good agreement with analytic results. The electron cloud produces a shift in phase of the microwave. Experimental observation of this phenomena would lead to a useful diagnostic tool for accessing the local density of electron clouds in an accelerator. These experiments are being carried out at the CERN SPS and the PEP-II LER at SLAC and is proposed to be done at the Fermilab main injector. In this study, a brief analysis of the phase shift is provided and the results are compared with that obtained from simulations. [C237]

"Non-ionizing radiation-specific biomarker research at the united states air force research laboratory"

Military communication, detection and ranging, and recent weapons technologies involve various forms of directed energy (DE) that are considered nonionizing, such as radio waves, microwaves, Terahertz-and optical radiation. Severe overexposure to DE is known to cause damage to living tissue through either photochemical or thermal mechanisms. However, below the standard-defined damage thresholds of DE, biological changes are more difficult to ascertain. Past experimentation has shown that DE induces hyperthermia, localized or systemic, that will resolve itself over time. No mutagenic effects, tumor promotion, or changes in fertility and longevity have been observed. Owing to the relatively low photon energies produced by DE devices, the biological effects at the molecular level involve multiple markers that exhibit only moderate changes. For this reason, new approaches to DE-induced biomarker detection and analysis need to be taken, which meet required sensitivity, sampling scope, depth of analysis, and accessibility. Technology development efforts need to focus on harnessing the gamut of biomedical knowledge to maximize diagnostic power and deliver appropriate answers in real-time to the end user. This vision of instant diagnosis is shared by the biomedical community as well as the Department of Defense. The Air Force Research Laboratory and medical research detachments of the US Army and Navy are jointly performing DE-related bioeffects research, characterizing the impact of exposure on humans, protecting the war-fighter on the battlefield, assuring the safe operation of DE devices, evaluating exposure-related health issues, and contributing to safety standards. [C238]

"An antenna for medical implant communications system"

Tissue implanted devices are of great interest for wireless medical applications due to the promise of different clinical usages in order to promote a patient's independence. A key component of wireless implanted device is an antenna, and there are several issues to consider while designing an in-body antenna, including power consumption, size, frequency, biocompatibility and the unique RF transmission challenges posed by the human body. This paper mainly deals with an implantable antenna designing for the frequency range of 402-405 MHz. [C239]

"Diagnostics of the SMOS Radiometer Antenna System at the DTU-ESA Spherical Near-Field Antenna Test Facility"

The recently developed Spherical Wave Expansion-to-Plane Wave Expansion (SWE-to-PWE) antenna diagnostics technique is employed in an investigation of the antenna system in the Microwave Imaging Radiometer using Aperture Synthesis (MIRAS) for ESA's Soil Moisture and Ocean Salinity (SMOS) mission. The SWE-to-PWE antenna diagnostics technique successfully identifies the sources of the anomalies detected in 2 of the 138 MIRAS antenna far- field patterns that were measured during the on-ground calibration at the DTU-ESA Spherical Near-Field Antenna Test Facility in 2006. In addition to its obvious value for the SMOS mission, this investigation also provides an experimental validation of the SWE-to-PWE antenna diagnostics technique. [C240]

"Small Antenna Measurements in Spherical Nearfield Systems"

Small antennas and other modern antenna applications are using increasingly higher frequencies while demanding very rapid development and testing cycles. A fast, reliable and accurate way to exhaustively

determine antenna performance is based on spherical near field measurement techniques combined with probe array technology.The StarLab spherical near field measurement system has recently evolved to cover the entire frequency band from 800 MHz to 18 GHz as discussed in [1, 2, 3]. The system is based on patented probe array technology and advanced modulated scattering technique, A-MST [4, 5]. The measurement system is mainly aimed at the characterization of wireless terminals for development, pre-qualification or pass/fail production purposes. It is flexible, with functionalities that can be easily extended depending on the needs of the user. The equipment can be interfaced with different RF measurement devices in order to perform either passive or active measurements. This paper describes the innovative design aspects of the evolved measurement system and present results from the validation campaign. The use of diagnostic and analysis software modules for efficient antenna testing is also presented. [C241]

"Improvements to the Aladdin synchrotron light source"

Aladdin is an IR to soft x-ray synchrotron light source operated by the University of Wisconsin at Madison. As part of the ongoing program of upgrades and improvements, several changes have recently been made to the ring. It had previously been determined that physical apertures (BPMs) at the QF quadrupoles were limiting beam lifetime when the ring was operated in its low emittance configuration. Increasing the size of these apertures has resulted in a significant increase in lifetime. Also as part of the aperture opening process, a number of ring components were redesigned and replaced, lowering the ring impedance. This has led to an increase in the threshold beam current for microwave instability. An insertion device for EUV lithography has been incorporated into one of the Aladdin short straight sections, and an elliptically polarizing undulator will be installed in another short straight section for a new VLS- PGM beamline. An innovative infrared beamline is under construction, which will extract 320 (H) times 25 (V) mrad2from a bending magnet by as 12 beamlets, which are combined in an IR microscope. Another modification to Aladdin was the design and installation of discrete trim coils on the quadrupole pole-tips to facilitate using the quads as steering correctors. Details of these improvements are presented. [C242]

"Installation and commissioning of the new 150 KW plant for the elettra RF system upgrade"

Elettra is the Italian third generation light source in operation in Trieste since 1993. The project of upgrade of the Elettra RF system has become necessary to provide the needed operating margins when all the insertion devices are operational and in view of possible increases in beam current and energy. The first phase of the project regards one of the four plants, which has been upgraded from 60 to 150 kW cw. The power amplifier has been built combining two 80 kW IOTs (inductive output tubes) by means of a switchless combiner. The amplifier and the power plant components have been installed in the second half of year 2006. A coaxial to waveguide transition has been specially designed to interface the coaxial coupler of the cavity to the waveguide power transmission system, taking into account the risks connected to power from the higher order modes excited by the beam in the cavity. After giving an overview of the project, this paper discusses the technical choices adopted, the tests performed during the installation phase and the commissioning of the new system with beam during machine operation. [C243]

"The Experimental Tests of THz Range Gyrotron with Pulsed Magnetic Field"

Summary form only given. Development of compact, simple and reliable sources of submillimeter wave radiation is important for numerous applications, which include plasma diagnostics, spectroscopy, new medical technology, atmospheric monitoring, chemical technologies, and production of high-purity materials. A demountable THz gyrotron tube with a pulse magnet has been designed, constructed and tested at IAP RAS. This work is based on the previous results obtained with gyrotrons using pulsed solenoids and on the development of an improved pulsed solenoid, producing up to 40 T magnetic field. The solenoid is made of a composite cable consisting of a Nb-60%Ti alloy mechanically reinforced in an outer copper shell. For reducing ohmic heating and stabilizing the operation, the solenoid is cooled by liquid nitrogen, which reduces the resistance by a factor of 7 in comparison with the room temperature resistance. The cable is wired directly on a thin stainless steel gyrotron body. This allows for significant reduction of the solenoid clearing hole diameter (up to 6 mm) and the energy required for obtaining the necessary magnetic field. Magnetic field is produced in the course of discharge of a bank of capacitors. The voltage and the coil current in 1.5 ms pulses did not exceed 2.5 kV and 6 kA, respectively (total storage energy was about 5.6 kJ). The pulse-to-pulse reproducibility of the magnetic field was within 0.05%. The pulses were repeated one in a minute. After more than 1000 pulses no signs of solenoid deterioration had been observed. Gyrotron components included the simplest cylindrical cavity (3 mm diameter) and diode type magnetron injection gun (accelerating voltage 20-25 kV, beam current 4-5 A, pulse duration 50 microseconds). First experimental results were obtained for high frequency operation at the fundamental cyclotron harmonic. Frequency measurements of single pulse submillimeter wavelength radiation were based on the mixing of the gyrotron signal with the- signal from a millimeter-wave frequency synthesizer. The measured frequency is close

to the cyclotron frequency defined by the magnetic field. The detection of microwave power was made by the semiconductor detector and by the dummy load. At several modes with frequencies near 1 THz, the output power close to 10 kW with the efficiency 8-10% was observed. [C244]

"The Real-Time Phasemetric Microwave Navigation System for Position Detection and Drive Control of High-Speed Objects"

The concept of construction of navigation system for high-speed ground transport on the base of a phase metric method is grounded. It is shown, that the system provides high accuracy of position fixing of high-speed objects (of the order of one-two decimeters at speeds of moving up to 500 km/h and own linear dimensions about 100 m), sufficient for control of the linear engine and also allows to process the information going from measuring sensors and to give out control commands on executive units in a real time mode. The requirements to stability of frequency of basic and mobile microwaves-generators are determined. The offered built-in subsystem of diagnostic of working state of radio-navigation system promotes higher reliability of control system of high-speed transport mean and so higher safety of the all high-speed transportations. [C245]

"Status of Collective Thomson Scattering Experiment at Frascati Tokamak Upgrade (FTU)"

A diagnostic experiment of collective Thomson scattering (CTS) on thermal density fluctuations designed to provide spatially-resolved measurements of the ion temperature is since long being carried out in the high-field tokamak FTU using a high-power 140 GHz gyrotron as a source of probing radiation. A peculiar feature of CTS experiment on FTU is that the propagation at 140 GHz is below the fundamental electron cyclotron (EC) harmonic (195 GHz-220 GHz). With the only exception of the low-power experiment attempted in TFTR, this is the first proof-of-principle experiment of CTS below the EC resonance, hence with accessibility from the low-field side of both ordinary and extraordinary plasma modes. Thus, this is the only experiment capable for an exhaustive demonstration of CTS in the configuration relevant for alpha CTS in ITER, in which the extraordinary mode at 50-60 GHz propagating below the EC resonance is assumed as most liable candidate. In spite of long lasting efforts to detect CTS from thermal density fluctuations, strong anomalous spectra including spectral lines were systematically detected both in aligned- and in misaligned-antenna conditions at spectral power densities orders-of-magnitude higher than those predicted for the thermal CTS spectra. In the present communication, we report on the interpretation of the anomalous spectra observed at FTU following the results of two experimental campaigns of 2004 and 2005 expressly performed to investigate the anomalous spectra. [C246]

"Detecting Defects of Leather Material on the Base of Radiometric Method in MM-Wave Band"

Leather material blemish zone detection and registration of areas suitable for next utilization are actual tasks in leather manufacturing branch. Ultra-high frequency (UHF) radiometric method of leather material diagnostic should be applied as a prospective solution on this way. With the aim of radiometric method potential abilities evaluation in leather materials diagnostic, a set of laboratory measurements of radiothermal radiation total loss factor was realized in microwave and millimeter wave bands for prime product of leather material, which is ordinarily obtained in the initial stage of cattle skin treatment. It is possible to declare that radiation optimal wavelength, which will be correlated with maximum brightness contrasts between defect and condition areas in inspecting leather material will be gradually drifted towards to shorter millimeter wavelength for observed diagnostic method. [C247]

"Grounding, DC Supplies, and Controlling Signal Issues for a Tunable Reflectometry System"

Reflectometry, which uses the microwave radar technique to probe the magnetically confined fusion plasmas, is a very powerful tool to observe the density fluctuations in the fusion plasmas. Typically, two or more microwave beams of different frequencies are used for this purpose. If the intention is to study the plasma density correlations in real time, a tunable microwave source of finite bandwidth with real time control system will be desired. Because the tunable microwave source assembly and other sources as well as amplifiers in the system usually require multiple dc voltage supplies, different grounding schemes and filtering to break the ground loops have to be implemented in order to guarantee the system performance. In this paper, these grounding problems and the system performance impacts will be discussed while designing a new reflectometer with a tunable YIG oscillator for the Alcator C-Mod experiments. [C248]

"3D Breast Shape Reconstruction for a Non-Invasive Early Cancer Diagnosis System"

Early breast cancer diagnosis becomes a must in nowadays society, related to the fact that this osteophyl neoplasia is the most frequent cancer in the world. The environment, solar radiations, weather changes, the increasing number of endocrine modifications, iatrogen agression, stress, or even fashion, have undoubtful effects on women's breasts health, too. Long term negative influence may appear due to invasive or even minim

invasive cancer investigation techniques, so, alternative methods are continuously researched. As a stage in the implementation of a non-invasive microwaves technique for breast cancer diagnosis under research, meant to early uncover the developing malignant processes, we designed a 3D reconstruction process that we are extensively presenting in this paper. This reconstruction is a compulsory step previous to the tumor volumetric shape reconstruction, in order to be well positioned for further breast surgery, where our results could find a field of application. I. [C249]

"An innovative on-board processor for the real-time GPR monitoring of railway substructure conditions"

The SAFE-RAIL system and the relevant processing unit are hereafter described as a success case for the solution of an electromagnetic inverse problem in real-time applications. The SAFE-RAIL system on-board processing unit is conceived for providing functionalities for real-time exploitation of raw data deriving from microwave sensing action through innovative GPR equipment. In particular, the main objective, as per European STREP project SAFE-RAIL statements, is focused on automatic interpretation of microwave sensed data relevant to rail-track subsurface, aiming at characterizing the ballast and sub-ballast layer properties with consequent extraction in real-time of geophysical parameters. A neural network based approach has been exploited as an efficient way for solving the inverse problem through a "learning-by-examples" approach. The capability of the SAFE-RAIL system in matching real-time performance requirements has been investigated. System operability and cost-effective implementation issues have also been deeply addressed. [C250]

"IST 2007 Technical Program Tracks and Sessions"

First Page of the Article [C251]

"H F W Diagnostic of the Microwave Phased Arrays"

The uniform linear array in a transfer mode is investigated. On a measuring platform are present echo in the form of re-reflected probing signal from the ground and local subjects. It is required to define: transfer ratio of phase shifters (PS) in all of them conditions and changes of reflectance in emitters track, caused by mutual coupling of emitters, at scanning a beam of phased array . [C252]

"Method of Magnetic Simulation Applied to Gliding Arc Diagnostics"

In this paper, it was proposed using a magnetic diagnostic method, to determine the variation of the length and the dynamic of gliding arc. This method, which is not intrusive, uses the hypothesis that the plasma and the reactor elements are similar to threadlike current segments. The magnetic induction created by the plasma and the circuit elements is measured in different sites outside of the reactor. To estimate the plasma shape and position, the measured magnetic inductions is compared to the one calculated using Biot-Savart law. [C253]

"The Signal Digital Processing in the Millimeter Band FMCW Radar"

The frequency-modulated continuous wave-radars-(FMCW-radars) are widely applied in the car road safety systems, the aircraft altimeters, the fusion plasma microwave diagnostics and in other ranging systems of different usage. The most optimal choice in terms of the "cost-quality" criterion for the radars that function at tens of meters distances is a transceiving set homodyne circuitry preference. The Gunn oscillators and Schottky diode barrier mixers usage in such radar sets let one create solid-state midget microwave detectors of different purposes. However, designing the transceiving set-based measuring system, one is confronted with a number of difficulties, depended on the high requirements over the transmitted waveshape and the generator and reception path gain frequency responses linearity. [C254]

"Equivalent Scheme of a Detector Using the Hot Electron Effect"

Summary form only given. Microwave solid-state detectors and mixers based on the hot electron effect are widely used in relativistic high frequency electronics as a convenient means of diagnostics. These devices are used for measuring short high power pulses for frequencies ranging from hundreds of megahertz to hundreds of gigahertz. They have wide dynamic range and, importantly, are not adversely affected by overloading. Sensitivity in such detectors is easily controlled within a wide range without recalibration. The present work proposes a simple equivalent scheme of a semiconducting probe, which allows us to realize a correct algorithm for analyzing basic processes of transformation of the spectrum of signals and their filtration, and also to tackle issues associated with embedding the detector in a circuit for measurement. Operating regimes of waveguide and coaxial detectors are studied using the suggested scheme. In particular, we analyze possible sources of measurement error due to high harmonics in the spectrum of received radiation and frequency-dependence of

the detector's electrodynamic system. [C255]

"A Microstrip Line Microwave Interferometer for Monitoring of Plasma Electron Density"

Summary form only given. We developed a planar transmission-line microwave interferometer for monitoring of electron density for applications in process real-time feedback control of plasma based semiconductor fabrication tools, such plasma etchers or PECVDs. The principle of this technique is the same as the conventional microwave interferometers except that the sensing microwave propagates along a transmission line structure. In this study, the sensor was a microstrip transmission-line where microwave propagates at a phase velocity determined by the structure and the electron density of the surrounding plasma. Thus the variation of plasma density can be estimated from the phase shift of the transmitted microwave from one to the other end of the transmission-line. [C256]

"Measurements of Air Breakdown and Scaling to Microwaves Using 193 nm Focused Laser Radiation"

Summary form only given. The measurements and analysis of air breakdown processes by focusing 193 nm, 200 mJ, 10 MW high power UV laser radiation on to a 10-20 mum spot size that produces laser power densities up to 1012-1013W/cm2, well above the threshold power flux for air ionization will be presented. The breakdown threshold is measured and compared with classical and quantum theoretical models. A universal scaling analysis of these results allows one to predict some aspects of high power microwave breakdown based on measured laser breakdown observations. The air breakdown threshold is being measured for a wide pressure range from 90 torr to 5 atmospheres. Above atmospheric pressures and their increased collisional frequencies relative to the high laser frequency (1015Hz) allow enhanced ionization and plasma formation. Multi-photon ionization processes can also play a substantial role at 193 nm due to the high photon energies (6.4 eV). The laser breakdown threshold data for air at 193 nm is correlated with corresponding microwave breakdown values using the concept of universal scaling, for which extensive microwave data is available [1-2] and current microwave breakdown measurements are being obtained at TexasTech University. An extensive range of optical and spectroscopic diagnostics with ns fast gating and 13 mum ICCD resolution is utilized to characterize the plasma. Laser shadowgraphy technique is used to characterize the spatial and temporal evolution of the laser focused plasma ionization shockwave. Plasma temperature is measure using optical emission spectroscopy method of the N2second positive system N2(2+) (0,0) at 337.1 nm band. Initial measurements of vibrational temperatures obtained from nitrogen lines at 500 mus are found to be 0.22 eV with electronic temperatures of 0.8 eV and rotational temperatures of 0.1 eV. Plasma density and neutral pressure variations are measured using two- color laser interferometry. Phase shifts produced by the laser focused plasma for red (632 nm) and green (532 nm) wavelengths are being measured, which is used to measure the plasma and neutral pressure densities. The peak plasma densities are anticipated to be in the 1016-18/cc range. A comparison of the laser breakdown case to the microwave breakdown case utilizing the universal scaling law is being carried out and was presented. [C257]

"Cathode Materials Characteristics of CsI Coated Carbon Fiber"

Summary form only given. CsI coated carbon fiber cathodes have shown promise as a cold cathode for microwave and x-ray devices. In particular, the cathodes have demonstrated over 1 million shots lifetime at operating voltages at or in excess of 165 kV and current densities greater than 50 A/cm2. Further, the materials have also operated in a DC mode. While the vacuum emission characteristics have been well-studied1, the materials characteristics of the cathodes themselves, particularly after operation have not received great attention. Furthermore, while researchers at University of Wisconsin" have demonstrated a reduction in work function due to the CsI coating, the emission mechanism remains poorly understood. This paper gives results of a series of materials diagnostics investigating the cathode surface morphology as well as the changes in the carbon fiber structure with cathode shot history. We rely principally upon SEM images and Raman microscopy for this data. Finally, we present a basic model for electron emission from CsI coated carbon fibers that begins to satisfy some of the experimental results. [C258]

"Electron density measurement for microwave-induced atmospheric pressure plasmas using laser deflection method"

Summary form only given. A laser beam passing through plasma deflects due to a change in the line-integrated refractive index, which is attributed to an electron density gradient along the chord. By measuring the deflection angle of the laser beam, the electron density was obtained for an atmospheric pressure microwave-induced torch plasma generated in the ambient air. The diagnostic set-up, consisting of a low power He-Ne laser, a four channel segmented position-sensitive photodiode detector, and some relevant optical components, demands

modest requirements of laser quality and optics alignments. The measured electron density was compared with that obtained by optical emission spectroscopy based on the measured Stark broadening width of the Balmer H-beta line emitted from the plasma. Both the multi channel deflection method and the optical emission method showed the same order of magnitude (~1015cm-3) electron density values. Comparison of the detailed results will be presented. [C259]

"Plasma-Assisted Combustion in a Coaxial Re-Entrant Microwave Cavity"

Summary form only given. Potential advantages of combining electrical energy with combustion include a faster process, higher intensities, leaner combustion, pollutant reduction, improved fuel efficiency, more reliable ignition and combustion across a wider range of pressures, temperatures and stoichiometries. Recently we developed an experimental system that enabled the repeatable, controlled coupling of microwave energy into a premixed flame. In this experimental system microwave energy was coupled into a flame that was located inside tunable microwave cavity applicator. We describe an improved experimental microwave plasma-assisted combustion employing a new, more efficient, and compact microwave applicator. The applicator consists of a tunable system, re-entrant coaxial cavity that has been modified to allow a combustion flame to be located inside the applicator. This newly modified system has the potential to greatly reduce the system size and because of the improved microwave focus; to improve the microwave flame coupling efficiency. The re-entrant applicator employs a 2.54 cm diameter cylindrical coaxial cavity with a hollow 1.11 cm diameter center conductor. The flame is placed in the vicinity of the cavity applicator "gap region" at the end of a 5 mm diameter gas feed tube that has been placed axially within the center conductor. Microwave power at 2.45 GHz is coupled into the re-entrant cavity via a coaxial coupling loop antenna at power levels of 3-30 Watts. The flame is ignited at atmospheric pressure and the feed gas flows through a nozzle hole of 200-400 mum diameter located at the end of the center conductor. This flame applicator system is experimentally evaluated with a variety of feed gas mixtures including argon with nitrogen, methane and oxygen, and other hydrocarbon gases. Diagnostic measurements performed include (1) fuel lean extinction/flammability limits (2) discharge luminosity and power densities (3) discharge volume and size (4) spatial g- as temperature distribution measured by optical emission spectroscopy and (5) atomic radical species produced by the plasma-assisted combustion mode. These measurements are made versus absorbed microwave power, gas flow rate, and gas mixture composition. Experimental results indicate that the applicator system can be reduced by a factor of ten with an associated order of magnitude improvement in microwave/flame coupling efficiency. [C260]

"Particle-Microplasma Interactions"

Summary form only given. We demonstrate that the potential gradients created within microplasmas are capable of trapping micro-and nanoparticles in a three-dimensional space. The microplasma is generated within a microwave-excited discharge gap. The gap is typically 150 microns across and a symmetric 900 MHz voltage is applied across the gap to initiate and sustain the microplasma [1]. Although the plasma is in direct contact with microwave-driven electrodes, the ion plasma frequency and the natural frequency of the particles are orders of magnitude less than the drive frequency. Therefore, the particles suspended in the microplasma only respond to the internal, time-average plasma potential and externally applied potentials. To demonstrate the particle trapping phenomena, melamine formaldehyde particles are released 1 cm from the microplasma. The particles acquire a negative charge and are captured within the localized potential well of the microplasma. The residence time of particles is several minutes in flowing argon at 300 Pa. The particles are illuminated by HeNe laser and are observed to form "plasma crystals" with a periodicity of 120 microns. The particle positions allow for the visualization of the microplasma's internal potential structure. We also manipulate the internal electric fields using auxiliary electrodes consisting of quarter-wave microstrip transmission lines. By designing and microfabricating appropriate electrode structures, particles can lie systematically expelled from the microplasma trap. Time-of-flight measurements of expelled particles allow for the determination of particle size distributions. Application of these principles to nanoparticle sensing and diagnostics will be discussed. [C261]

"Development and Diagnostic of a Localized Microwave/rf Plasma for Shock Wave Propagation Study"

The current research effort extends the previous shock wave propagation measurements into localized microwave/rf plasmas with a greater ionization fraction compared to glow discharges. The electrodeless microwave configuration is suited for the high altitude supersonic flight application of plasmas. The research has a strong high-speed aerodynamics component. The decrease in shock strength in plasma presents a means of aerodynamic drag reduction, and thus improving supersonic flight characteristics by modifying the gas fluid through which the flight occurs. If an electronically conducting medium could be introduced upstream of a vehicle's bow shock wave, this will have a potential for improved high speed flight. [C262]

"Short Pulse High Power Microwave Surface Flashover"

Summary form only given. High power microwave (HPM) surface flashover is investigated in order to gain a better understanding of this phenomenon and reduce the limitations it imposes on transmitted power levels. The experimental setup is designed to produce window flashover without the influence of a triple point. The HPM source for this testing is an experimental virtual cathode oscillator (vircator) capable of producing greater than 50 MW for 100 ns with an adjustable frequency from 3 to 5 GHz. This work builds on previous testing using a magnetron producing 5 MW for 4 mus at 2.85 GHz. The dominant modes of the vircator and magnetron are the circular TE11and rectangular TE10modes respectively, with the electric field component in both setups normal to the direction of propagation, yielding comparable conditions. Due to the large differences in output power and pulse length, the two setups operate in different regimes and mechanisms take on differing degrees of importance. Additional factors under investigation include gas pressure, composition, temperature, and air speed. Diagnostic equipment permits the analysis of power levels with sub-nanosecond resolution. Experimental results are compared with data from literature, previous testing, and Monte Carlo simulations. [C263]

"Generation and Diagnostics of an Electron Beam in a Plasma Cathode Electron (PCE) Source"

Summary form only given. An electron beam source is under development at Los Alamos National Laboratory. We outline the generation of the electron beam in a plasma cathode electron (PCE) source. Our PCE source was created using 1.5 kW of microwave power at 2.45 GHz delivered in a static magnetic field of 875 Gauss. We were able to drive electron beams of greater than 100 A in our source with very high beam efficiencies by biasing the ECR source chamber to -140V. Diagnosis of the beam was done using spectroscopy and electric probes. We discuss both the generation method and the diagnostics we used in this experiment. [C264]

"Radiowave Method of Internal Combustion Engines' Condition Estimation"

The basic opportunity of use of the radio wave method for diagnostics of a condition of internal combustion engines is shown. Use of the offered method allows differentiating without disassembly of the engine malfunction cylinder-piston groups and making decision on necessity of repair or cleaning of cylinders of the engine from products of combustion [C265]

"Application of Radiolocation Methods in Radio Frequency and Optical Bands to Detect Human Living Tissue Pathologies"

Noninvasive methods of functional diagnostics of the human living tissues based on passive and active radiolocation procedures in radio frequency and optical bands are considered [C266]

"Quick Diagnostics of Human Blood Condition by Means of Gas-Discharge Visualization Method"

In this paper, method of quick diagnostics of human blood condition by means of gas-discharge visualization (GDV) is proposed. This method is based on Kirlian's effect. The possible variant of the generator building for GDV and basis of making of GDV-images with use computer system were also discussed [C267]

"Orotrons and gyrodevices at terahertz waves"

Summary form only given. Electron vacuum sources of coherent terahertz radiation are being now intensively developed at the Institute of Applied Physics (IAP). These devices are intended for wide-spread utilizing in many research and technical applications including spectroscopy, diagnostics of different media, communications, material processing etc. In this presentation, two types of promising THz electron oscillators, namely orotrons and gyrotrons, will be discussed. The orotrons have been realized at the IAP in collaboration with the Institute of Metrology for Time and Space and Institute of Spectroscopy. The operation of the orotron (or diffraction radiation generator) is based on the stimulated Smith-Purcell radiation of a rectilinear electron beam in a selective open cavity which has a periodic structure on one of its mirrors. At the moment, a series of the low-voltage (0.5-5 kV) orotrons developed generate in the frequency range of 0.1-0.4 THz with output power of 1.0-0.1 W and typical electrical-mechanical frequency tuning within an octave. Using same voltage, orotrons can enable higher power and frequency stability than BWOs that are most widespread devices within entire terahertz range. Orotrons with relativistic electron beams, which are studied at the IAP, are capable to provide significantly higher pulse THz power (up to MW level at ns pulse duration). Both conventional and large-orbit gyrotrons (LOGs) are also under development at the IAP The LOGs are based on the same mechanism of stimulated cyclotron radiation of electrons as conventional gyrotrons, but they are more selective when operating at higher cyclotron harmonics. Correspondingly, they work at lower magnetic fields. At the same time significantly more complicated electron guns are needed for the LOGs to provide appropriate axis-encircling electron beams. Such beams with electron energy 50-250 keV and very high compression have been obtained and powerful selective generation at 1st-5th

cyclot--ron harmonics have been demonstrated in the IAP at millimeter and submillimeter waves. When operating at the third cyclotron harmonic generation with power level of 10-20 kW has been obtained in the range of 0.3-0.42 THz. Another prospective way for developing THz sources, that will be also presented, is realization of gyro-multipliers with self-exciting LF sections and HF sections operating at high cyclotron harmonics [C268]

"Inverse Problem of Scattering in Scanning Near-Field Tomography"

A new tomography method of the inhomogeneous half-space is proposed that can be realized in the scanning probe microscopy and other kinds of electromagnetic diagnostics of media. In this method the 2D scanning of variations of the signal related to inhomogeneities in a medium are in use. The scanning should be done at various values of a parameter that determines the effective depth of the formation of the received signal [C269]

"Diagnostic of the Boiling Bed using A Resonance Microwave Probe based on the Two-Wire Line Section"

Dynamics of variations of loose-medium density in a gas flow is studied using a resonance microwave probe based on a section of the two-wire line. An industrial high-temperature sensor measuring the boiling-bed density in a dehydrogenation reactor has been developed and manufactured [C270]

"Diagnostics of the Body Condition by Thermal Fields Distribution"

In this paper, to form requirements for the methods of temperature measurements of biological objects (BO), human body behavior as a dynamic open system has been observed based on stability theory [C271]

"Microwave Interferometric Measurements of the Electron Density Generated by Sub-Picosecond 100 GW KrF Laser Pulses in Air"

Time-resolved measurements of the electron density produced by sub-picosecond ~100 GW KrF laser lambda=248 nm) pulses in air have been made at pressures between ~10-2and 103Torr with a microwave interferometer operating at 9.5 GHz [C272]

"Short-Range Microwave Imaging Technique Based on an Inexact-Newton Method for the Nondestructive Inspection of Dielectric Objects"

In this paper a short range microwave imaging algorithm is presented for non invasive diagnostic purposes related to security applications. The algorithm can be used in imaging systems where the presence of dielectric targets is detected by the "inversion" of measured samples of the scattered electric field. In particular, the proposed approach is based on the electromagnetic scattering equations in the spatial domain. In fact, despite frequency domain methods, such formulation allows a resolution which is ideally not affected by the wavelength. More specifically, an inexact Newton method is proposed and analysed as a regularizing tool to solve the nonlinear and highly ill-posed inverse scattering problem arising in imaging problems. The theory underlying these approach is provided and the results of some numerical simulations in noisy environments are reported [C273]

"Modelling and Characterisation of Radio Propagation from Wireless Implants at Different Frequencies"

Transmitting data, images and videos from inside the body taken by a radio system of a size of a pill seems to be the way to the future with capabilities of tracking the system, delivering drugs to specified organs and entering the body in non-invasive way. The paper introduces numerical and experimental investigations to study the radio channel characteristics of communication links inside and outside the body with transmitter placed in body organs. The study covers commonly used frequencies in medical communications, ultra high frequency (UHF) 402 MHz, 868 MHz and microwave frequency at 2.4 GHz. Initial models and analyses show that the choice of optimum frequency will directly affect radio range, device size and power consumption [C274]

"Method of Complex Diagnostics of Biotechnical Objects' Condition"

The basic directions of complex researches of organism conditions for subsequent diagnostics and its treatment are determined. Results of research of own object fields are given at realization of procedure noninvasive irradiations by low-intensive laser radiation (LILR) [C275]

"Subminiature Oscillator Modules for Millimeter-Wave Therapy and Technology for their

Manufacturing"

Presented in this paper is the unique design and engineering solutions, which have made it possible to create subminiature oscillator modules for millimeter-wave therapy. The feasibility of the electroforming-based manufacturing and assembly of quasimonolithic waveguide devices without butt joints is demonstrated [C276]

"Application of EHF EM-Wave Reflectometers in Medical Diagnostics"

A recently developed technique of MM-wave differential reflectometry allows for a new indicator of vital activity-the anisotropy factor-to be registered. Its values are shown to be related to dynamic condition of patients and to indicate various diseases [C277]

"Hafnium oxide production via laser ablation plasma deposition"

Summary form only given. This research investigates the feasibility of synthesizing thin films of hafnium oxide via ablation plasma ion implantation (APII). HfO2is of great interest as a high-dielectric-constant material in the semiconductor fabrication industry and may also have applications to high power microwave windows or cathodes. Experiments are underway at UM to deposit and implant films of hafnium and hafnium-oxide on silicon substrates. A KrF laser (400 mJ @ 248 nm) ablates solid Hf foils or sintered pellets of hafnium-oxide. Silicon substrates can be biased (- or +, either pulsed or DC) by voltages up to 10 kV for ion implantation and deposition. The experiments will study correlations among parameters such as laser energy, film thickness, background gas pressure, film composition, and ion energy. Ablation plasma plumes are characterized by optical emission spectroscopy. Composition and morphology of deposited films are analyzed by scanning electron microscopy, transmission electron microscopy, X-ray energy dispersive spectroscopy, X-ray photoelectron spectroscopy and atomic force microscopy. Thin film adhesion is also being tested. X-ray diffraction is being used to determine if the Hf films are amorphous or crystalline. Deposition rates are estimated to be on the order of 0.055 nm/pulse at a laser repetition rate of 20 pulses [C278]

"Progress on the MET (microwave electrothermal) thruster with water propellant"

Summary form only given. Progress on the MET thruster using water vapor propellant is reported. The MET heats gas in a vortex stabilized, electrodeless, microwave discharge for propulsion. In this research the start-up and asymptotic behavior of the MET specific impulse with increasing run time is investigated. It is found that after a run time of approximately thirty seconds, that the MET thruster running on water vapor achieved a specific impulse of approximately 900 seconds, in agreement with previous research. Chemical physics code runs with, have confirmed the high specific impulse numbers for water as being due to rapid hydrogen-oxygen recombination in the nozzle during expansion and the high source temperature in the electrodeless microwave discharge of approximately 8000 K. Models and diagnostics for this high performance on water vapor will be discussed [C279]

"Measurements of plasma temperatures in H/sub 2//carbon/AR microwave plasma by UV emission spectroscopy"

Summary form only given. We have developed a microwave plasma at atmospheric pressure in the mixtures of hydrogen, carbon, and argon in order to study the hydrogasification reaction of coal. A coal gasification is a newly highlighted research field because coal is abundant energy source for methane or hydrogen. However, the coal gasification process has encountered technical barriers because no reliable sulfur-tolerant chemical catalysts exist. Los Alamos National Laboratory has proposed a plasma catalyzed coal gasification concept, where plasma turns coal and reactant gases into highly reactive free radicals and excited species, which are believed to promote gasification reactions. Preliminary results showed that small amounts of CH4, C2H2, and C2H4are detected through the hydrogasification reaction. One of issues to be investigated is how a non-equilibrium property of the microwave plasma affects gasification reactions of coal. The excitation and rotational temperatures are obtained with measuring an Ar and C2emission lines, respectively. Hydrogen atoms will be measured with NO 2titration techniques. In this presentation, we will emphasize the mechanism of coal hydrogasification with characterizing the plasma properties and correlating these to hydrogasification reactivity [C280]

"Biological radhazards-An overview"

This paper gives an overview of the problems connected with Biological Radiation Hazards. The sources of electromagnetic energy from devices which are commonly used by Human beings in their daily life, the environment in which they live both in and outside buildings, the transportation vehicles they use and environment in their work place and those diagnostic equipments used to identify the causes of diseases are

considered. This paper also discusses about the standards in this regard and suggests actions to be initiated to take care of the possible hazards that may be encountered by many in their daily life. [C281]

"Alternate loop-back diagnostic tests for wafer-level diagnosis of modern wireless transceivers using spectral signatures"

"Wafer-level diagnosis" of RF systems at production test sites is difficult and incurs high investment cost. One possible solution for integrated RF transceivers is to loop-back the transmitted RF signal to the receiver input thereby enabling source and measure capabilities at lower frequencies using DC probe cards integrated to standard low cost test platforms. The design innovations in modern wireless transceivers limit the previously proposed loop-back methods for continuous wave signals for most GSM, ISM, WLAN and Bluetooth applications. To overcome these limitations, a novel loop-back DFT approach is proposed. When used in conjunction with "alternate diagnosis", transmit and receive subsystem specifications can be decoupled from the final looped-back spectral signature. The key highlight of this work is that: measurements made on commercially available TI ISM microwave transceiver TRF6903 are used to demonstrate the production worthiness of the proposed approach for RF systems [C282]

"Observation of structures and striations in atmospheric pressure helium surface glow discharge"

Summary form only given. The uniformity and stability of the surface glow discharge produced at atmospheric pressure is a basic requirement to use it for microwave absorption and drag reduction on moving objects. The experimental study has been performed to map the instability regime of the discharge with the variation of discharge operating parameters such as applied voltage and operating pressure. The experimental observation of glow discharge instabilities in the form of plasma spots and striations is reported. The uniform surface glow discharge was produced in helium gas at atmospheric pressure. The discharge panel was a double-sided circuit board (12 cm times 12 cm) whose fully cladded side was used as ground and the other side with multiple strips etched was stressed with high voltage (~2 kV) of audio frequency (~10 kHz) signal. The spatio-temporal discharge events were recorded using CCD camera with 25 frames per second. On reducing the applied voltage to 1.4 kV, the discharge becomes unstable and displays localized structures like stationary plasma spots. Simultaneously other phenomenon like spot-pair formation and low frequency fluctuation of few spots were also observed. Further increase in the applied voltage presents fluctuation of the spots and they interact with other spots to merge. At sufficiently high voltage, all the spots coalesce and the discharge covers the entire electrode area that indicates a uniform glow discharge. On reducing the operating pressure (~600 torr) with applied voltage 1.1 kV, the small plasma spots grow in size and arrange themselves to form a regular discharge pattern. The individual plasma spot fluctuates about their mean position. Upon further reducing the pressure to ~400 torr, the spot length increases and finally they mix with other spots. This is attributed to the plasma diffusion at low pressure operation. After few minutes of the discharge operation at atmospheric pressure, the moving striations similar to low frequenc--y (few Hz) acoustic fluctuations were observed at applied voltage ~2-3 kV. Increase in applied voltage increases the propagation speed. The coherent oscillation excited at low voltage becomes turbulent at higher voltages ~3-3.4 kV. Further increase of applied voltage diminishes the acoustic striations and uniformity of the discharge was achieved at ~3.8 kV. Upon examining the upper surface of discharge panel, the etching of base material was found adjacent to powered metallic strips. The characterization of these experimental observations is presented. Theoretical arguments were used to understand the destabilization mechanism of the discharge [C283]

"Plasma-assisted combustion in a miniature microwave plasma torch applicator"

Summary form only given. A compact microwave plasma torch has been designed and experimentally evaluated for operation in both plasma-only and plasma-assisted combustion modes. The torch is designed to be light and to operate at atmospheric pressure with a torch discharge size of less than 0.5 mm in diameter. The potential applications of the torch are materials synthesis, material cutting and welding, and various surface treatments. The operation of the torch in a combustion mode with hydrocarbon gases burning with oxygen is investigated with microwave power applied to modify the combustion process. The objective of this investigation is to quantify the changes in the combustion process as microwave power is applied to create or intensify the discharge. This torch employs an open-ended coaxial structure with the discharge located at the 12 mm outer diameter tip of the 5 mm diameter center conductor. Microwave power at 2.45 GHz is coupled into the torch applicator at power levels of 10-100 watts. The discharge is formed at atmospheric pressure where the feed gas flows through a nozzle hole of 200-500 mum diameter located at the end of the center conductor. The torch is experimentally evaluated with a variety of feed gas mixtures including argon, mixtures of argon with hydrogen, argon with nitrogen, methane and oxygen, and selected other hydrocarbon gases mixed with oxygen. This torch maintains discharges over a wide range of flows from diffusion flow for gentle surface processing to high velocity flow approaching supersonic velocities. Diagnostic measurements performed include (1) gas temperature measured

by optical emission spectroscopy, (2) discharge power densities (3) discharge volume and size, and (4) atomic radical species produced by the plasma-assisted combustion mode. These measurements are made versus absorbed microwave power, gas flow rate, and gas mixture composition [C284]

"Progress of the Cesta RKA experiment"

Summary form only given. During the ICOPS 2005 conference, we presented the preparation of a relativistic-klystron amplifier experiment (RKA) at CESTA. Our purpose is to understand the physics of such a device by using a large number of diagnostics and to compare the results they give with the predictions from the PIC code MAGIC. We present here the first experimental results where only two pill-box cavities are installed in the RKA. The first cavity is fed by a small part of the microwave emission produced by an external vircator. An alternating voltage at 2.28 GHz is then induced in the gap of this cavity which then modulates the 2 kA, 400 keV annular e-beam emitted by the RK cathode. The second cavity enhances this beam current modulation which is observed using B-dot probes. The measurement of the emission of the vircator enables us to monitor the power level entering the first cavity, both in time and frequency. We compare the observed bunching modulation at various positions on the RKA beam propagation line with the MAGIC predictions [C285]

"Dissipation of microwaves propagating through atmospheric pressure glow discharge plasma"

Summary form only given. The atmospheric pressure glow discharge (APGD) is a cold collisional, non-equilibrium plasma that explores wide applicability of plasma for modifying aerodynamic properties specially the drag reduction and also for radar cross-section (RCS) reduction by microwave invisibility. The experimental study has been carried out to develop some information for microwave dissipation in the plasma to cease the radar function. The cold plasma produced at atmospheric pressure can absorb the microwave power because of its complex dielectric constant and diffuse density profile. The attenuation of microwaves in the plasma depends on the discharge operating parameters to create sufficient plasma density and thickness, incident wave frequency and electron-neutral collision frequency for momentum transfer etc. The uniform glow discharge was ignited between parallel-plate dielectric covered electrodes as well as on a planar surface in helium gas at atmospheric pressure. The first experiment was performed with the measurements in parallel-plate electrode geometry. The electron plasma density has been measured using optical emission spectroscopy with helium line intensity ratio method that was verified by electron density obtained by microwave attenuation measurements. Hence, the measurement of microwave attenuation was also used as a diagnostic method to estimate the electron plasma density. The microwave signal was launched to the plasma by a Gunn oscillator (X-band) and transmitted signal was detected by high sensitivity microwave detector. The attenuation in transmitted signal was measured for various operating parameters. The measured attenuation was in good agreement with the theoretical prediction for defined plasma parameters. Further experiments are in progress to measure the microwave attenuation in planar surface discharge at various plasma and wave parameters. The details of the experimental setup and results of these studies will be presented [C286]

"Particle trapping by dusty microplasmas"

Summary form only given. The highly localized potential gradients created within microplasma are capable of trapping micro- and nanoparticles. In this work, microplasma is generated within a 150 mum gap formed in a microstrip transmission line split-ring resonator. The resonator operates at 900 MHz and consumes 300 mW of power from 100 Pa to 1 atm in argon. Melamine (ML) particles are released 1 cm from the microplasma. The particles acquire a negative charge and are captured within the localized potential well of the microplasma. The residence time of particles is several minutes in flowing argon at 300 Pa. The particles are illuminated by HeNe laser and are observed to form "plasma crystals" with a periodicity of 120 microns. At low concentrations, particles are also found to move in non-decaying circular orbits with orbital radii of ~100 microns. The particle positions allow for the visualization of the microplasma sheath and can be used as a plasma diagnostic. Auxiliary electrodes consisting of quarter-wave microstrip transmission lines are used to directly modify the DC potential within the microplasma without affecting the microwave impedance within the discharge. These electrodes are used to electrostatically manipulate the suspended particles. Application of these principles to nanoparticle sensing and diagnostics will be discussed [C287]

"Optical diagnostics of laser initiated, RF sustained high pressure seeded plasmas"

Summary form only given. High-pressure, inductively-coupled plasmas (ICP) have been used for variety of scientific and industrial applications over a large gas pressure range from 50-760 torr. High density ~1011-1014cm-3, large (500-2500 cc) volume, atmospheric plasmas are of great interest in applications such as material processing, biological decontamination, radar and stealth antennas. We present a technique for producing these plasmas and measuring their excitation temperature, density and plasma evolution from a seed

gas by means of optical emission and millimeter wave interferometry. The plasma is produced by utilizing a seed (15 mtorr) organic gas, tetrakis (dimethyl-amino) ethylene (TMAE), in high-pressure argon or nitrogen gas is pre-ionized by a 193 nm excimer laser (300 mJ), 20 ns pulse width. The seed plasma is then sustained by the efficient absorption of the pulsed 13.56 MHz radio frequency (RF) power (1-25 kW) through inductive coupling of the wave fields, which reduces the RF power requirement for plasma initiation to a great extent. Optical emission spectroscopy is used to characterize the temporal evolution of the plasma and measuring the excitation temperature. The optically emitted spectral lines illustrate the temporal plasma evolution from a TMAE seed plasma initiated by the laser and early RF power to the steady-state RF plasma of neutral background gases such as argon and nitrogen. A three channel, wide band (200-850 nm) ST2000 Ocean optics spectrometer is used to record the plasma spectral emission perpendicular to the plasma column axis. Each channel is connected to a separate grating spectrometer (1200 lines/mm, with an optical resolution of 0.3 nm), which counts photons using a linear CCD array (2048 pixels). Samples are taken over the following wavelength ranges; 200-500 nm, 400-700 nm, and 600-850 nm. The results show that the laser ionization of the TMAE seed gas and transition to argon plasma is read--ily accomplished with our system. The spectroscopic measurements can also provide highly localized measurements of the plasma conditions in regions that are less accessible to interferometer measurements. We also present initial spectroscopic measurements of a high power UV laser focused in air near a dielectric microwave window [C288]

"Diagnostics and simulation of highpressure argon and nitrogen plasma"

Summary form only given. Experiments are performed using 193 nm ultraviolet (UV) laser pre-ionization of a seed gas in atmospheric pressure range argon or nitrogen to initiate a discharge that is sustained by 13.56 MHz radiofrequency (RF) power using efficient inductive wave coupling. High-density (1012-1013/cm3), large-volume (~500 cm 3) 760 torr argon plasma is initiated and maintained for 300 ms with less than 3 kW of net RF power. Using the same technique, a 50 torr nitrogen plasma with average electron densities greater than 1011/cm3is obtained. The nitrogen plasma volume of 1000 cm3is initiated by the laser and maintained by a net RF power of 5.5 kW for 300 ms. Measurements of the time-varying plasma load impedance and optimization of the RF matching for the transition from laser-initiated to RF-sustained plasma are carried out. Millimeter wave interferometry is used to determine the electron density and effective electron collision frequency. A new diagnostic technique based on interferometry is developed to measure the electron temperature in high pressure plasmas. Broadband plasma emission spectroscopy is used to illustrate the changes in the broad ionized species character immediately after the laser pulse and later during the RF pulse. Advanced RF impedance measurement and RF tuning techniques are developed to enhance RF matching of the inductively coupled plasma source to the RF system. Computer simulation of the interferometry diagnostics of plasma density and collision rate is performed. Results of a new focused-laser generated plasma near a microwave dielectric window are also presented [C289]

"Recent diagonostic results for the steady state-DC atmospheric pressure plasma discharge"

Summary form only given. We have made the following advances for our DC, steady state atmospheric pressure plasma discharge in air. We have measured the free electron concentration in our discharge by converting the 1/2 cm. gap, parallel-plate discharge into a parallel-plate transmission line. The frequency used was 6 GHz, corresponding to a free-space wavelength of 15 cm. The path length for the microwaves in the plasma was about 15 cm. The discharge was pulsed to high current (about 50 mA) using a capacitor bank and a spark gap. Under these conditions, a collisional attenuation of 20% was observed, yielding a free electron concentration of about 1 exp 12 electrons per cc. Extrapolating to the usual steady-state discharge operating conditions of 10 mA, we conclude that the normal operating free electron density is about 2 exp 11 electrons per cc, agreeing with earlier probe estimates. Note that at atmospheric pressure and the frequency used, the plasma is resistive, not reactive. We note that the attenuation decays in time on the order of 10 microseconds after each pulse. We attribute this decay of the attenuation to the recombination of the free electrons to form negative ions. Previous probe experiments reveal negative-positive ion plasma of 1 exp 12 ions per cc. We have replaced the water in our water-loaded conducting ceramic electrode with a 30% hydrogen peroxide solution. The net result is that a multisecond second exposure completely eliminates all E-coli bacteria on our test Petri dishes, although we have increased the initial bacteria concentration by a factor of one million (over one hundred million initial bacteria per plate). We have found that the sterilizing effect penetrates through normally sealed mailing envelopes. In conclusion, we have found that the free electron density in DC atmospheric pressure air plasma can be measured easily using a transmission line technique. Also using hydrogen peroxide instead of water in the moistened ceramic electrod--e can enhance the sterilizing effect of the DC atmospheric pressure discharge [C290]

"Noise Robust Vocoding at 2400 bps"

We describe a 2400 bps noise robust vocoder (NRV) developed under the sponsorship of the United States Defense Advanced Research Projects Agency (DARPA) Advanced Speech Encoding (ASE) program. The NRV dramatically improves diagnostic rhyme test (DRT) intelligibility performance, as compared to the NATO-standard 2400 bps MELPe vocoder, in each of 3 harsh military noise environments exceeding 110 dBC SPL [C291]

"Microwave Reflectometry Based On Amplitude Modulation"

Reflectometry is a technique, based on the radar principle, with a response mainly sensitive to the plasma regions where the microwaves are reflected. The reflectometry technique used in plasma devices measures the phase of a wave reflected by a plasma cut-off layer at a given electron density. It has become a promising experimental technique for the measurement of the electron density profile in plasma devices, due to its good spatial and temporal resolution, together with the moderate access requirements and its ability to perform profile inversion along a single line of sight. Since its first implementation on a plasma device for electron density profile measurement, the high cut-off X-mode polarization has convinced many scientists to use this technique on most of the main devices, such as ASDEX, DIII-D, Gamma 10, TJII, TFTR, W7AS etc, and it is planned for edge and scrape of layer profile determination on ITER. [C292]

"Microwave tomography of breast cancer: A feasibility study"

Medical researches have appointed breast cancer as the primary cause of death in women and early detection as an essential part of effective treatments. X-ray mammography, which is currently the gold-standard method for breast screening, has some limitations hence development of new diagnostic techniques appear of great interest. In the framework of Microwave Tomography, we investigate how the performances of the imaging procedures may be improved by properly acting on the electrical features of the hosting medium and on the working frequencies. Fixed the optimal parameters of the measurement set up, the Contrast Source inversion approach is exploited. Numerical analysis shows that the permittivity profile of the inclusions can be accurately retrieved. [C293]

"Development of the Millimeter Wave Diagnostics on HL-2A"

Millimeter-wave technology is widely used in the controlled fusion experiments. In this paper the new diagnostic systems on the HL-2A tokamak, including microwave reflectometry, electron cyclotron emission, was presented. The new methods for plasma particle transport and the experiments on HL-2 A tokamak was shown. The plans of the diagnostic development in next step are also presented. [C294]

"Millimeter Wave Imaging on the KSTAR Tokamak via Simultaneous ECET/MIR"

A millimeter wave plasma diagnostic instrument is being developed for the KSTAR tokamak to image electron density fluctuations via microwave imaging reflectometry (MIR), and electron temperature profiles and fluctuations via electron cyclotron emission imaging (ECEI). The 2-D active and passive MMW imaging systems will be capable of simultaneously imaging fluctuations over an extended portion of the KSTAR plasma. System details, including preliminary optical and electronics designs, FSS notch filter, and antenna prototypes, are presented along with a discussion of a number of implementation options which include plasma coverage, spatial resolution, channel numbers, IF and RF bandwidths. [C295]

"Planar Antenna Development for Plasma Imaging Application"

Dual dipole antennas have been developed in the frequency range of 33-50 GHz and 105-135 GHz for use as imaging array elements in an electron cyclotron emission imaging (ECEI) and microwave imaging reflectometry (MIR) plasma diagnostic system respectively. A wideband balun with less than 3 dB back to back insertion loss was achieved in the frequency range of 1.7 GHz-19.8 GHz (1:11.7) for convert IF signals from the balanced antenna to the unbalanced transmission line/connector. [C296]

"Fusion of Vibro-acoustography Images and X-ray Mammography"

Image fusion, or combination of two images obtained by different techniques, has been widely used in medical imaging. Vibro-acoustography (VA) is a new imaging modality that has been applied to both medical and industrial imaging. Combining unique diagnostic information of VA with other medical imaging is one of our research interests. In this work, we studied the VA and X-ray image pairs and adopted two methods for fusing the registered VA and X-ray image. In the first method, the fused image is defined as a linear combination of the VA and X-ray images. Moreover, a color-based fusion technique was employed to combine the images for better visualization of structural information. By combining the information from X-ray mammogram and VA modalities into a single image, the accuracy of mammography interpretation which is important for women's

health can be increased [C297]

"True Time Delay Beam Steering/Shaping Phased Array Antenna System for Plasma Diagnostics"

An electronically controlled beam focusing/ defocusing Phased Array Antenna (PAA) system is proposed for use in Microwave Imaging Reflectometry (MIR) systems, which are being developed to measure plasma density fluctuations. The design, construction and performance of a Ka-band 1times8 true time delay E-plane beam scanning and broadening phased array system based on piezoelectric transducer controlled delay line technology using antipodal elliptically-tapered slot antennas are presented. The beam is steered from -21degto +24degand the 3 dB beamwidth is widened by about 10deg, the latter being the requirement for the target MIR system. [C298]

"A Diagnostic Subsystem for Array Transmit Antenna Control-Concept, Realization and Measurements"

In the paper, a diagnostic subsystem to control radar antenna system parameters with transmit pulse power up to several hundreds KW is described. The proposed BITE subsystem is used to control power level at the input and all outputs of Transmit Beam Forming Network with 24 radiating structures. The subsystem controls the reflected power from antenna rows, as well. Antenna parameters are controlled at nominal power level in ON LINE mode of radar operation. Realization of diagnostic subsystem is presented in details. The results of measurements of Passive Antenna System obtained by BITE subsystem are shown. [C299]

"The Diagnoses System for Performance of Absorbing Materials on Large Target"

A new method measuring and diagnosing the performance of absorbing materials on a large target is presented. Then a system based on the method was created. The measuring results of cones which are partially covered with absorbing materials indicate that the system is suitable for prompt and complete testing performance of absorbing materials on a large target. [C300]

"C-Band TWTA for Multi-Function Mobile Radar"

The paper describes the design of an C-band microwave unit which consist two-stage preamplifier and a control and diagnostic monitoring system. The main building blocks of this amplifier are: solid state amplifier and helix delay line TWT with proper HV power supply. The necessary input power is ~5 m W, output power min. 9 kW and duty 5%. The total gain of both stage is 63 dB. [C301]

"Microwave Reflectometry as a Novel Diagnostic Method for Detection of Skin Cancers"

More than one million people are diagnosed with skin cancer each year in the United States and more than ten thousand people die from the disease. Currently, there are some methods for early detection of skin cancers, like visual inspection, but improvements are needed. This paper presents a method involving microwave reflectometry as a diagnostic tool for detection of skin cancers. The results of measurements and simulations for normal and wet skin have been shown to distinguish among skin samples with different properties. Microwave measurements from lesions have also been presented which are used to distinguish between cancerous and benign lesions [C302]

"Ultra-wide band spiral shaped small antenna for the biomedical telemetry"

In this paper, the ultra-wide band spiral shaped small antenna for the implantable micro systems is proposed. Among these implantable systems, the capsule endoscope system operates inside the human body. The human body tissues which have effects on the antenna propagation characteristics are considered. To transmit the diagnostic real-time image data of high resolution at high speed, the system with larger bandwidth is needed. Thus, the bandwidth enhancement of the antenna is needed. To encase the system in the capsule module and to obtain ultra-wide band characteristics, the small sized spiral antenna is designed. The proposed antenna has the bandwidth of 400-510 MHz for VSWR [C303]

"Development of a functional quasi-optical system for gyrotron application as a radiation source"

Functional quasi-optical systems to treat a Gaussian beam converted from gyrotron output are necessary to the application of gyrotron as a radiation source. The necessary characteristics are compatibility with tunability of output beam waist size, which enables us to ensure the effective coupling of beam to sample and waveguide. [C304]

"3D Metallic Lattices for Accelerator Applications"

We present the results of our recent research on 3D metallic lattices operating at microwave frequencies, with applications to advanced accelerating structures, radiation sources based on the Smith-Purcell (SP) effect, and SP-based microbunch diagnostics. Electromagnetic waves in a simple 3D cubic lattice formed by metal wires are investigated using HFSS. The bulk modes in the lattice are determined using single cell calculations, with phase advances in all three directions. The Brillouin diagram for the bulk modes of the cubic wire lattice is calculated. The recently predicted "plasmon" and "photon" modes are identified in the simulations. Surface modes at the vacuum/wire lattice interface are identified, and their dispersion relation (the frequency vs. the wave number along the interface) is studied. The surface mode profiles clearly demonstrate that the wire lattice acts as a negative dielectric constant material. [C305]

"Medical and dental diagnosis using millimeter-waves"

Human tissues are generally very lossy to millimeter-waves. To diagnose human health condition using millimeter-waves, measuring the reflection coefficient may be useful. In such the case, low loss part is applicable to obtain the information from deeper area of human body. Some parts of human body, which are relatively low loss for millimeter-waves, for example a fingertip with nail and a tooth, can be applied as a part for diagnosis. In this paper, a new technique is proposed to obtain blood sugar level by measuring reflection coefficient to be applied to these parts using millimetre-waves. In the measuring blood sugar level, the reflection change can be referred as the change of blood glucose level. Furthermore, in order to diagnose dental caries noninvasively, reflection coefficient in millimetre-waves is measured and compared to that of sound tooth. The reflection change from the tooth in time domain shows that the caries can be detected by millimetre-waves. [C306]

"Automated calibration and diagnostics for synthetic instruments"

This paper describes the automated software based calibration and diagnostics tools used to maintain a "real world", high speed/high performance synthetic instrument based RF test system targeted for a moderate to high quantity manufacturing environment. [C307]

"Visualization of the breast tumor by the integrated use of CP-MCT and chirp pulse microwave breast radar"

Chirp pulse microwave computed tomography (CP-MCT) is a modality for microwave imaging of biological objects. By using the high-resolution model, which uses the chirp pulse signal from 2 GHz to 3 GHz, diagnosis of an early stage breast tumor has been attempted mainly by numerical simulation. However, the FDTD-based numerical simulation showed that only diagnostic information provided by the tomographic images was not sufficient for localizing the tumor in the breast fat tissues. This is mainly due to the strong scattering at the surface of the breast and the boundary between the tumor and surrounding fat tissues because of the big difference in those permittivity values. To gain the compensative information, we have investigated feasibility of the breast radar, which provides the dosimetric image according to the same measurement principle as CP-MCT. The chirp pulse microwave breast radar (CP-MBR) can provide tumor information projected onto the imaging plane of CP-MCT. The numerical simulation of the breast radar shows that the integrated use of those microwave imaging systems is useful for localizing the early stage tumors in the breast. [C308]

"Non-destructive methods and devices for the inspection of key parameters of semiconductor materials"

Diagnostics of semiconductor materials electrophysical parameters is a necessary part of the "know-how" both for semiconductor materials, and for various devices on their basis. The contactless, non-destroying quality monitoring is most suitable for these purposes for devices and installations. [C309]

"AUTOTESTCON 2005"

The following topics are dealt with: ATE systems; software tools and approaches; advanced instrument networking LXI; diagnostics design; systems engineering; ATML and related standards; synthetic instruments; lifecycle management; advanced electro optical test systems; instrument bus interfaces; TPS design and development; microwave technologies; knowledge management; ATS management and modernization; system software considerations; organizational-level/field testing; instrument capability with embedded processing; modeling approaches; advanced test methods; commercial technologies in system design; diagnostics and repair approaches; managing legacy requirements in a modern architecture; ATE system design and support; ATS software technologies; system hardware and interconnections; TPS software design/architecture; innovative

design techniques; net-centric data; test techniques using PXI; circuit board testing techniques; software interfaces and standards; using diagnostic results; PXI test solutions [C310]

"Analysis of characteristics of electrode system EEG"

In this paper, the analysis of electric circuit of the electrode system used at EEG is presented. Registration of cerebral cortex signals, or EEG, allows to carry out monitoring of brain activity and is the best diagnostic method for revealing pathological conditions of a brain, for example, epilepsy. Frequency dependence of transfer function of electrode system is determined by character of circuit impedances and essentially depends on electrode type. The opportunity of use of non-gel contact system is also shown [C311]

"Dual dipole imaging array for MIR and ECE imaging"

Two dual dipole antennas have been designed in the frequency range of 85-95 GHz and 100-135 GHz for use as imaging array elements for magnetic fusion plasma microwave imaging reflectometry (MIR) and electron cyclotron emission imaging (ECEI) diagnostics, respectively. The antenna pattern is of primary importance for these applications, with emphasis on clean antenna patterns and low sidelobe levels for low interchannel crosstalk, tight channel spacing to minimize interchannel spacing in the plasma, and wide instantaneous bandwidth for real time 2D imaging. The extremely high temperature of the imaged plasma (>10 million degrees), means that a low receiver noise temperature is not critical as long as it is sufficiently low (≤20000 degrees) to facilitate absolute calibration. The simulated and measured antenna patterns are presented in this paper. [C312]

"Upgrade of the data acquisition and control system of the ASDEX upgrade microwave reflectometer"

Microwave reflectometry is an important diagnostic to characterize the plasma electron density in fusion experiments. The broadband frequency swept microwave reflectometry system of the ASDEX upgrade tokamak covers the frequency range of 16 to 100 GHz. In order to fully exploit the diagnostic capabilities it is mandatory to upgrade the data acquisition and control system. It should comply with faster frequency sweep times and improved time resolution as well as accuracy allowing, for example, plasma position and shape measurements for control purposes, as it is foreseen for ITER. A new PCI-based system is under development based on a digitizer card with 2 channels, 12-bit resolution and a waveform generator with one channel, 16-bit resolution. Both cards have 512 Mbytes of memory, a digital signal processor (DSP) for advanced processing modes and a field programmable gate array (FPGA) for real-time algorithms and complex trigger managing modes. The system is able to support multiple cards (digitizers and signal generators) operating synchronously at a maximum rate of 210 MSamples/second [C313]

"Resonator probe for near-field scanning microwave microscope"

Resonator probe, operating at 35.7 GHz and based on the connected cavity and coaxial resonators, has been developed. Sample insertion in a field of the probe results in simultaneous change of resonance frequency and Q-factor of the resonator that allows to determine characteristics of the sample analyzed. On the basis of described resonator probe the model prototype of a near-field scanning microwave microscope for local contactless micro-diagnostics of physicomechanical, electric and photo-electric properties of substances, including semiconductors, dielectric materials, conductors and superconducting materials, and also sandwich structures on their basis has been created [C314]

"Scanning near-field optical microscope probes: fabrication and properties"

The method of scanning near-field optical microscope (SNOM) probe fabrication with high transmission coefficients on the base of tapered single-mode optical fiber are studied. The various methods of improvement of resolution of SNOM and application for modification and diagnostics of sample surface are discussed [C315]

"MICS transceivers: regulatory standards and applications [Cmedical implant communications service]"

The medical implant communications service (MICS) is an ultra-low power, unlicensed, mobile radio service for transmitting data in support of diagnostic or therapeutic functions associated with implanted medical devices. The US Federal Communications Commission (FCC) allocated the 402-405 MHz frequency band for MICS operations on a shared, secondary basis in 1999. Although it is a fairly new standard, its usage is rapidly increasing in medical implant devices such as cardiac pacemakers, implantable cardioverter defibrillators, neurostimulators, hearing aids and automated drug delivery systems. This paper reviews the regulatory standards and the characteristics of MICS transceivers. [C316]

"A Tool for Static and Dynamic Model Extraction and Impact Analysis"

Planning changes is often an imprecise task and implementing changes is often time consuming and error prone. One reason for these problems is inadequate support for efficient analysis of the impacts of the performed changes. The paper presents a technique, and associated tool, that uses a mixed static and dynamic model extraction for supporting the analysis of the impacts of changes. [C317]

"Microwave devices with active resonators for diagnostics of dielectrics"

The paper is dedicated to research and development of a method of the analysis, synthesis and optimization. Perspective microwave devices on the basis of active resonators used for radiophysical diagnostics of hard dielectrics. At used the method of a matrix algebra was applied. [C318]

"Relationship of recombination lifetime to dark current in silicon p-n junctions"

Measurement of recombination and minority-carrier lifetimes has become a central activity in photovoltaic technology. The primary measurement techniques for silicon technologies are based on photoconductive decay (PCD) and microwave reflectance (mPCD). The measurement of the correct recombination lifetime depends on the carriers being confined to a given spatial region of a diagnostic structure. The electric field of the PN junction separates the charges, and the measured decay time does not represent the real minority-carrier lifetime. In these cases, the measured quantity is a function of the true lifetime and the sample structure. Here, we examine these effects, both experimentally and theoretically, for the n+-p device structure common to terrestrial photovoltaics. [C319]

"Computerized system for functional status of electronics operators diagnostics"

The computerized system allowing to determine the functional state of operators of radioelectronic stations is designed. The system consists of 4 channels: skin resistance, tremor, voice and NIB (not known earlier phenomenon). The diagnostic time is about 2 min. The developed system does not require special sensors and is very simple in use [C320]

"The model for a lipid being in the liquid-crystalline phase of blood plasma in human body"

In this paper, the mathematical model for a lipid being in the liquid-crystalline phase is proposed. The temperature dependence of a free energy and the lipid order parameter was obtained. Formulas for the lipid dielectric anisotropy and for the order parameter determination in vivo by means of the anisotropy coefficient measurement by the method of reflectometry in mm-range were derived. The developed method of mm-range differential reflectometry makes it possible that electromagnetic waves, permeating the surface skin layers and reflecting from the surface of vessels may carry information about phase states of the lipids in the blood plasma. The results of the work can use in biological and medical researches and also in medical practice for the noninvasive diagnostics [C321]

"Noninvasive method for definition of blood viscosity properties using parameters of pulse wave"

The purpose of the given paper is the development of mathematical model, which would define the viscosity of blood behind parameters of last front of pulse wave. The received results have good presentation and can be used for diagnostics in a direct kind, as this model enables definitions of viscosity properties of blood by noninvasive method, and also opportunity of the continuous control behind the patient [C322]

"The results of polarized light use for research of tensely-deformed eye state"

The optical anisotropy of alive eye cornea has the photoelastic nature and is caused by stretching action of oculomotor muscles and intraocular pressure. In this paper, the results of eye tensely-deformed conditions model for using in differential diagnostics of oculomotor muscles pathology are presented [C323]

"Contactless methods and the equipment for measurement of semiconductor electrophysical parameters"

Diagnostics of electrophysical parameters of semiconductor materials is a necessary part of the manufacture technology both semi-conductor materials, and various devices on their basis. Contactless not destroying checking methods of the devices and installations are most suitable for these purposes. Installations and measuring resonators of the microwave range for contact determination of electrophysical parameters of semi-

conductor materials (type of conductivity, specific resistance, and time of non-equilibrium charge carrier's life) in 80-3000 K temperature interval are offered. At high localness of measurements at the microwave range with the use of the resonator method the influence of zones bends arising on a semi-conductor surface at cooling, on results of definition of specific resistance volumetric and time of photo carriers life are described. Results of an experimental research of electrophysical and recombination characteristics of semiconductor materials are given [C324]

"Diagnostics of dielectric parameters of two-layer structures by means of open resonators in the millimeter wave-band"

The principles of measurement of UHF parameters of two-layer structures: the dielectric permittivity (epsiv) and the loss tangent (tgdelta) using open resonators are presented. These principles are based on the measurement of open resonator characteristics-the Q-factor and the resonance frequency-when putting the sample under investigation into the resonance volume [C325]

"Snap analysis of cardiovascular system based on inductance-capacitance heart model"

The goal of this paper is to discuss cardiac electrogenesis means of inductance-capacitance model and to show the importance of electric Q cardiac parameters in the studies and diagnostics of cardiovascular system. Based on the obtained results, the developed model along with ECGs may be used for snap analyses of the population's health condition [C326]

"Near-field microwave resonant diagnostics of biological tissues"

This paper describes about the method for non-invasive diagnostics of pathological changes in biological tissues. The method is based on studying of measuring system resonance characteristics, depending on the probe parameters and its position relative to investigated biological object [C327]

"Modeling and Experimental Studies of Magnetron Injection Locking"

Summary form only given. A set of differential equations has been developed from an equivalent-circuit model for a general oscillator, to explain qualitatively the lock-in process observed during an injection locking experiment between two standard oven magnetrons in a master-slave configuration. Both time- and frequency-domain solutions of the system are considered. The time-domain solution yields growth and saturation behaviors of the signal, as well as the familiar Adler's condition with a small modification by the frequency pushing effect. The frequency-domain solution gives the frequency response as the driver's frequency is tuned around the oscillating frequency. The injection-locking experiment is built using two CW microwave oven magnetrons. The driver and the oscillator are 2.45 GHz, 800 W, National Electronics magnetrons, operated using two ASTEX power supplies. The main part of the microwave power produced by the driver magnetron is dissipated into a water load, while a small fraction, controlled using tuning stubs, is injected into the oscillator magnetron for phase and frequency locking. Experimental diagnostics include power, microwave spectra and phase noise measurements. The injection locking mechanism observed experimentally by varying the injected power level was recovered qualitatively in our numerical results, from general oscillator theory. In addition, experimental injection locking has been demonstrated at drive power levels in accordance with those suggested by Adler's condition [C328]

"Conductivity of the Plasmas in Electrode Less HID Lamps"

Summary form only given. Recently we demonstrated rotating plasma discharges using circularly polarized microwaves in electrodeless high intensity discharge (ELS-HID) lamps, including di-sulfur or InBr vapors. In the design of such lamps, the plasma conductivity is one of the important parameters for optimal coupling of the microwaves and the plasma containing a radiator gas or vapor. The measurement of the plasma conductivity in high pressure HID lamps is difficult because no metallic probe can be inserted in the lamp that is operated at pressures higher than atmospheric pressure in a completely sealed bulb. This paper describes what we call the noninvasive inversion technique to measure the effective plasma conductivity of the radiant plasma exciting the radiator gas or vapor in any electrodeless HID lamps. Using an improved measurement system, we have constructed a number of ELS-HID lamps with excellent microwave-plasma coupling efficiency. We will show some of the results of the photometric characteristics of the lamps constructed using the measured values of the plasma conductivities [C329]

"Development of Optical Diagnostics for Bismuth Plasma Propulsion Devices"

Summary form only given. As the goals of space flight push toward faster missions to the outer planets, issues of spacecraft mass, efficiency, and flight time become increasingly important. Electric propulsion systems in

general have shown significant benefits in these respects over conventional chemical propulsion methods; however, state-of-the-art systems are still lacking in the efficiency and power handling required for the development of feasible nuclear-electric propulsion (NEP) missions to the outer planets. Present ion engine technology limits power to less than 10 kW, while such future missions would require several times that amount. In order to accommodate the requirements of mid- and far-term NEP missions, NASA recently selected a bismuth-fueled two-stage Hall thruster with anode layer (TAL) for further development. Current TAL thrusters have been demonstrated to perform at 25-140 kW and have the potential to scale up to greater than 500 kW for very high power NEP systems. Additionally, the bismuth propellant offers advantages in cost, availability, thrust efficiency, and spacecraft tankage fraction over the xenon propellant used in current ion thrusters. As the thruster is developed, there will be a need for non-intrusive diagnostic methods to optimize the geometry and operating conditions, as well as to make predictions of the potential for spacecraft contamination. Such optical diagnostic methods as laser induced fluorescence (LIF) and absorption spectroscopy for analyzing the velocity, energy, and number densities of BiI and BiII will be discussed. Candidate transitions, chosen on the basis of relative strength, hyperfine splitting data availability, and accessibility to tunable diode lasers, will be presented and their lineshapes modeled with respect to hyperfine splitting and broadening mechanisms. Experimental measurements of these transitions in both a bismuth microwave discharge (Evenson cavity) and a bismuth metal vapor lamp will also be discus- sed. Measurements will include both absorption and LIF data and will be used to validate the lineshape models of the candidate transitions, as well as to further advance the diagnostic methods for the developing thruster [C330]

"Measurement of Toroidal Structure of Electron Temperature with Electron Cyclotron Emission Diagnostic in JT-60U"

A new transmission line for electron cyclotron emission (ECE) diagnostic has been introduced in order to improve a signal-to-noise ratio and to observe the structure of electron temperature in the toroidal direction. Installation and calibration have been finished as planned. It is found that a signal-to-noise ratio of a heterodyne radiometer is improved by a factor of >5, and that toroidal mode number can be identified by comparing ECE signal from the new transmission line with that from the existing transmission line located 60 degrees apart in the toroidal direction. Also, both toroidal and poloidal structures have been observed during a large collapse in a reversed shear discharge by the simultaneous measurement [C331]

"Millimeter Wave Imaging and Visualization of Plasma Waves and Instabilities"

{no data available} [C332]

"Decontamination of Bacterial Spores by a Microwave Plasma Torch"

Summary form only given. Air plasma in a highly energized state, contains radicals such as atomic oxygen, excited oxygen molecules and ozone that are highly reactive. These reactive oxygen species (ROS) can destroy just about all kinds of organic contaminants more effectively than the thermal method. This non-thermal destruction mechanism primarily involves the chemical reactions of ROS with nucleic acids, lipids, proteins and sugars. These chemical modifications result in protein cleavage, aggregation and loss of catalytic and structural function by distorting secondary and tertiary protein structures. These oxidative proteins are irreversibly modified and cannot be repaired. This occurrence is known as protein degradation. Through these chemical reactions, most contaminants are converted by ROS to carbon dioxide and water. The emission spectroscopy of an arc-seed microwave plasma torch (MPT) was examined and the spectral line of O I (777.194 nm) indicating relatively high atomic oxygen content in the torch was detected. This torch was applied to demonstrate this oxidation process for the decontamination of biological warfare agents. In the decontamination experiments, Bacillus cereus was chosen as a simulant of Bacillus anthracis spores for biological agent and the airflow rate was fixed at 0.393 l/s that leads to the maximum concentration of atomic oxygen produced by the torch as well as a good torch size. The results of experiments using dry samples showed that all spores were killed in less than 8 seconds at 3 cm distance, 12 seconds at 4 cm distance, and 16 seconds at 5 cm distance away from the nozzle of the torch. We now extend the experimental effort to decontaminate wet samples. The results will be presented and discussed [C333]

"Atmospheric Pressure Resistive Barrier Cold Plasma for Biological Decontamination"

Summary form only given. We have investigated the non thermal resistive barrier gas discharge at atmospheric pressure for low temperature sterilization purposes. We have carried out electrical, chemical, optical, and biological studies on the discharge, with the intent of identifying the chemically and biologically active species produced. We have also demonstrated that effective decontamination can be achieved without causing any damage to the active media. The figure shows a photograph of a business envelope immersed in a large volume

of plasma; it shows the plasma is penetrating the envelope. There were no damages done to the envelope during or after the process. The biological studies indicate that effective decontamination can be achieved within minutes when bacteria are exposed to ionized gases in close contact to the contaminating surface. The optical studies results show us that there is no presence of ultraviolet light in the discharge. We have measured the free electron density and the electron recombination time by microwave absorption measurements in the frequency region, 1.5-2.5 GHz. The reactor works on both AC and DC. It is considered to be an advantage of flexibility of its operation especially in distant and/or isolated locations. The running and maintenance costs are far less compared to other conventional plasma reactors [C334]

"2005 IEEE International Conference on Plasma Science"

The following topics are dealt with: space and astrophysical plasmas; plasma, ion and electron sources; high energy density matter; non-equilibrium plasma materials processing; fast-wave devices; optical, FIR, X-ray, millimetre-wave imaging and particle diagnostics; plasma thrusters and torches; plasmas for lighting; X and Z pinches; ICF capsule implosions; microwave generation; slow-wave devices; plasma simulation and computational plasma physics; vacuum microelectronics; medical, biological and environmental applications of plasmas; plasma X-ray sources; plasma waves and instabilities; dusty plasmas; flat-panel displays; charged particle diagnostics; pulsed power supplies and switches; and microwave- and particle beam-plasma interactions. [C335]

"Comparison Between Experimental and Numerical Studies of a Reflex Triode"

This paper presents a comparison of experimental and simulated results of a reflex triode driven by a compact Marx system. The experimental setup consists of a Marx system and a reflex triode together with a short output waveguide. A parametric study has been performed. The diagnostics used include current and voltage measurements and measurement of the magnetic field component of the microwave pulses using a B-dot probe. The 3-dimensional particle-in-cell simulation code MAGIC is used to numerically study the system described above. A ID model of the Marx system has been designed and this is connected to a 3D model of the reflex triode. Also included in this model is the output waveguide and part of the anechoic chamber used in the experiments. The simulated current, voltage and microwave radiation are compared to the experimental results and close qualitative agreements are usually found. Parameters like generated microwave power and microwave energy are also studied and presented in this paper. [C336]

"A 10 GW Pulsed Power Supply for HPM Sources"

A research activity involving the detailed consideration of novel high voltage transformers (HVTs) for pulsed-power applications has recently begun at Loughborough University (LU). Although the main goal is the demonstration of a compact and lightweight unit employing magnetic self insulation under vacuum conditions, the initial stage of the work is directed towards the development of a conventional air-cored HVT as a main component in a compact power supply for HPM sources. In cooperation with the Swedish Defence Research Agency (FOI), the power supply has been tested with a HPM source of the vircator type. The power source for the system uses a 70 kJ/25 kV capacitor bank and an exploding wire array to generate a 150 kV voltage pulse in the primary circuit of the HVT. A pressurised SF6spark gap in the secondary circuit sharpens the high-voltage output, so that pulses approaching 500 kV and with a rise time below 100 ns are generated on a 20 Omega high-power resistor. The peak power produced by the power supply is in excess of 10 GW. Measurements provided by various diagnostic techniques are analysed with the aid of a detailed numerical code. Experimental results are presented from final testing of the system, where a reflex triode vircator replaces the 20 Omega resistor. Measurements made of the microwave emission using free-field sensors are presented for various electrode configurations. Comments are made with the microwave emission from the same vircator powered by a Marx generator at FOI. [C337]

"Laser Plasma Interaction Experiments at Utsunomiya University"

Summary form only given. At Utsunomiya University, the radiation generation experiments and the laser guiding experiments with capillary discharge plasma using a short and ultra high intense laser (1 TW/100 fs) have been carried out. When the laser is tightly focused in the neutral gas, we observe the strong radiation in the microwave regime. The radiation generated from the focal region is strongly polarized and emitted in the conical direction. The frequency of the radiation is 200 ps and its frequency is broad in the microwave region (~100 GHz). Diagnostics used are by the horn antenna, waveguide and a microwave detector and time-of-flight method for the frequency measurement. This radiation can be explained by the Cherenkov theory, assuming the propagation of the ionization front created by the laser is close to the speed of light in the media. On the other hand, the capillary discharge experiment is carried out using a pulsed discharge power supply (30 kV, 300 A, 10

Hz). When the high voltage pulse is applied to gas-filled capillary (1 mm dia./1 cm long), the surface discharge occurs and the plasma is created inside of the capillary. The working gas is argon. The plasma density is measured to be 1016-1017cm-3by the interferometer technique and it depends on the gas density and the applied voltage. When the long pulse Nd-YAG laser (6 ns) is introduced to the capillary, the laser guiding is observed. The laser diameter is changed when the plasma density changed. The optimum plasma density for the guiding is observed [C338]

"Characteristics of VHF Capacitively Coupled Plasmas in a 300 mm Etch Chamber"

Summary form only given. We have investigated the characteristics of VHF capacitively coupled plasmas produced in a modified applied materials chamber. The chamber had a 14-inch diameter upper electrode (source) that was driven at 10 to 160 MHz and a 300 mm diameter electrostatic chuck with a ceramic process kit that was driven at 13.56 MHz (bias). Diagnostics employed include RF diagnostics to measure the voltage and current, Bdot probes to measure the spatial magnetic fields, a microwave interferometer to measure the line-integrated electron density, a hairpin microwave resonator to measure the spatially resolved electron density, absorption spectroscopy to determine the argon metastable temperature and density, laser induced fluorescence (LIF) to determine the spatial distribution of the excited species, and spatially resolved optical emission. Scaling of the plasma parameters with frequency, power and pressure, and implications to energy deposition models will be discussed [C339]

"Millimeter Wave Imaging and Visualization of Plasma Waves and Instabilities"

Summary form only given. The microwave and millimeter wave region of the electromagnetic spectrum is ideally suited for the determination of plasma parameters such as electron density and temperature as well as more subtle phenomena such as collective waves and instabilities through exploitation of the frequency dependent properties of this dielectric medium. This spectral region is witnessing intensive activity through the recent microwave and millimeter wave technology advances which have made possible the development of novel imaging and visualization diagnostics for hot plasmas. These include imaging scattering systems and imaging interferometer/polarimeter systems as well as electron cyclotron emission imaging (ECEI) systems and microwave imaging reflectometry (MIR) systems. For example, a novel 2-D ECEI on the TEXTOR tokamak provides 2-D images with high spatial resolution [128 pixels covering 8 cm (radial) x 16 cm (vertical)], and high temporal resolution (up to ~5 microsec) which have revealed the details of 2-D images of the electron temperature fluctuations during the precursor phase and the crash time of m=1 (sawtooth) oscillations, with a level of detail that is not accessible through conventional methods (1-D ECE and/or tomography). Also on TEXTOR, a 16-channel MIR system, that can measure multiple poloidal wavenumbers up to ~3 cm-1, has been designed and installed for plasma experiments. These and other imaging diagnostics implementations will be described. [C340]

"Circuit Design to Stabilize the Reflectometer Local Oscillator Signals"

Reflectometry, which uses the microwave radar technique to probe the magnetically confined fusion plasmas, is a very powerful tool to observe the density fluctuations in the fusion plasmas. Typically, two or more microwave beams of different frequencies are used to study the plasma density fluctuations. The frequency separation between these two beams of the PPPL designed reflectometer system upgrade on the DIII-D tokamak can be varied over 18 GHz. Due to the performance of the associated electronics, the local oscillator (LO) power level at the LO port of the I/Q demodulator suffers more than 12 dB of power fluctuations when the frequency separation is varied. Thus, the I/Q demodulator performance is impaired. In order to correct this problem, a power leveling circuit is introduced in the PPPL upgrade. According to the test results, the LO power fluctuation was regulated to be within 1 dB for greater than 16 dB of input power variation over the full dynamic bandwidth of the receiver [C341]

"Co-Axial Free-Electron Maser Based on Two-Dimensional Distributed Feedback"

Summary form only given. First measurements of microwave radiation from a co-axial free-electron maser (FEM) based on two-dimensional (2D) distributed feedback are presented. To drive the FEM a high current accelerator (HCA) based on a magnetically insulated explosive emission carbon cathode was used. A driving electron beam voltage (Vhsa) of 450 kV and pulse duration of ~200 ns was applied to the HCA resulting in the generation of a thin (0.2 cm) annular electron beam of current 500 A and mean diameter of 7.0 cm. The electron beam was guided through a co-axial transmission line of length ~2 m with the diameters of inner and outer conductors of 6 and 8 cm respectively. A guide solenoid of length 2.55 m and diameter 30 cm surrounded the co-axial electron gun, undulator and co-axial transmission line interaction region. A two-mirror cavity of length 81 cm (input 2D Bragg mirror 10.4 cm, output 2D Bragg mirror 5.6 cm both defined by 'chessboard' corrugations on the inner

conductor) was located inside the transmission line along the uniform part of the undulator. The frequency of the output radiation of the FEM was measured to be 37.3 GHz using a heterodyne frequency diagnostic. The mode pattern measured in the 'hot' experiments (when an electron beam was present) was compared with the radiation pattern measured in cold microwave experiments when the horn was excited by a TEM wave of frequency 37.3 GHz. The output power of the FEM was measured by integrating the power densities over space and was calculated to be (14plusmn0.15) MW (efficiency of 6%). Additional evidence of the high peak power was obtained from the observation of the illumination of a neon bulb panel located at a distance of 20 cm from the output window. To reduce amplitude of the RF field of the TEM wave on the surface of inner conductor a new 2D Bragg reflector has been constructed using copper electroforming technology, which has smooth sinusoidal corrugations on the inner surface of th- e outer conductor. Good agreement has been obtained between theory and cold microwave measurements. To investigate an increase FEM output power and efficiency a new cavity configuration based on the copper 2D Bragg reflector will be studied. [C342]

"Investigation of Pulsed Corona Discharges in Water by Fast Imaging Diagnostics"

Summary form only given. Pulsed underwater corona discharges are considered to be an effective method for killing bacteria, yeasts, and other microorganisms. Nevertheless, many of the physical phenomena causal to the initiation and propagation of the streamers and to the production of oxidants are not well understood yet. This is why we are investigating various properties of positive streamers in point-plate geometry by fast imaging techniques. Two high-resolution intensified CCD-cameras with minimum gate times of 3 ns are used to record light emission, shadowgraph, and schlieren pictures, and Mach-Zehnder interferograms. By imaging streamers using an intermediate 300 L/mm reflective grating we were able to take temporally and spatially resolved emission spectra covering the 280 nm to 800 nm wavelength range. Limiting the voltage to just above the inception level delays the formation of secondary streamers (SS) and allows to observe the development of primary streamers (PS). These bush-like structures start from a single root-point and consecutively branch to ~100 individual tips spanning perfect hemispheres with diameters reaching up to 1 mm. The propagation velocity is about 2-3 km/s. Compared with the ohmic current no clear current signal could be assigned to the PS. Light emission is weak compared with SS and limited to a few main branches. The continuum-like emission spectrum could be due to extreme broadening of hydrogen Lyman lines. Intense light emission by the SS starts at one of the tips at the periphery of the PS. A single luminous channel advances in the direction of the root-point whereas a bush-like structure of ~10 branches develops into the hemisphere towards the cathode at 30-40 km/s. Thereof, only 2-3 persist for several microseconds until the end of the discharge. Light emission lasts a few 10 ns per branch switching alternately between the branches at repetition rates of 5-100 MHz. The light bursts can be assigned to current peaks of 1-2 A. The-diameter of the active branches increases for about 100 mus up to 0.5 mm. Then the channels collapse. The initial radial expansion rate is 300 m/s suggesting driving pressures in the channel of ~5 kbar. Schlieren images reveal many faint, short-lived (100 ns) ~1 mm-long twigs growing out of the branches. From interferograms, pressure pulse durations of 20-30 ns, peak pressures of a few kbar, and channel diameters <10 mum could be derived for these small channels. Spectrally resolved images show extreme broadening of the hydrogen lines and distinct broadening of OI-lines indicating electron densities ne>1019cm-3at the propagating tips of the SS. As the channel expands, densities drop to ~1015cm-3, the luminous channel remaining limited to a fairly narrow central zone. Hydroxyl emission in the 309 nm-band shows ~300 ns. [C343]

"Spatially Localized mm-WVE Backscattering Measurements of High-k turbulence in the DIII-D Tokamak"

Summary form only given. A collective Thomson backscattering system has recently been installed on the DIII-D tokamak with the goal of measuring high-k turbulence such as expected from electron temperature gradient driven drift waves. The diagnostic is based on microwave backscattering in X-mode polarization at 96 GHz to probe wavenumbers in the range of ~30-40 cm-1. The second harmonic cyclotron resonance layer is used as an incident beam dump and to absorb radiation scattered in the forward direction from long wavelength turbulence. This system utilizes a DIII-D steerable ECH antenna for launching and complements a similar system located at the tokamak midplane as well as an array of other turbulence diagnostics. Fluctuation localization, beyond that typically achievable through collective scattering, is accomplished by taking advantage of wavenumber matching criteria. By continuously changing the position along the ray path at which the incident wavevector is aligned to the plane in which turbulent fluctuations are occurring, the radial distribution of ~35 cm-1turbulence in an ohmic L-mode plasma is obtained. Application of a genetic algorithm to de-convolve the spatial distribution of fluctuations from scattered power measurements using a calculated instrument function will also be discussed and preliminary results presented. [C344]

"Plasma-Assisted Combustion in a Miniature Microwave Plasma Torch Applicator"

Summary form only given. A compact microwave plasma torch has been designed and experimentally evaluated for operation in both plasma-only and plasma-assisted combustion modes. The torch is designed to be light and to operate at atmospheric pressure with a torch discharge size of less than 1 mm in diameter. The potential applications of the torch are for materials synthesis, material cutting and welding, and various surface treatments. The operation of the torch in a combustion mode with hydrocarbon gases burning with oxygen or air is investigated with microwave power applied to modify the combustion process. The objective of this investigation is to quantify the changes in the combustion process as microwave power is applied to create or intensify the discharge. This torch employs an open ended coaxial structure of 12 mm outer diameter with the discharge located at the tip of the center conductor that is 5 mm in diameter. Microwave power at 2.45 GHz is coupled into the torch applicator at power levels of 10's to 100's of watts. The discharge is formed at atmospheric pressure where the feed gas flows through a nozzle hole of 200-500 mum diameter located at the end of the applicator center conductor. Two nozzle configurations studied include a water-cooled brass nozzle and a ceramic nozzle. The microwave plasma torch is experimentally evaluated with a variety of feed gas mixtures including argon, mixtures of argon with hydrogen, argon with nitrogen, methane and oxygen, and selected other hydrocarbon gases mixed with oxygen and air. This torch maintains discharges over a wide range of flows from diffusional flow for gentle surface processing to high velocity flow approaching supersonic velocities. Diagnostic measurements performed include (1) gas temperature measured by optical emission spectroscopy (OES), (2) discharge power densities and, (3) discharge volume and size. These measurements are performed versus absorbed microwave power, gas flow rate and gas mixture-composition. By using spatially resolved OES measurements, the temperature profile of the discharge is determined. The discharge size for absorbed microwave powers of 10-30 watts using a plasma-only mode of operation (i.e. argon) is 0.4-0.5 mm in diameter and 2-4 mm long for a nozzle diameter of 0.25 mm. When the torch is operated in a plasma-assisted combustion mode the flame (discharge) volume and intensity increase as the microwave power is applied to the flame. Data quantifying the influence of microwave power on the flame will be presented. [C345]

"Measurement and control of the radiated emission of the mobile phone"

The radiated emission of the mobile phone is a very important EMC evaluating performance. In this paper a method and a setup to measure the radiated emission of the handset and its accessories according to related standards have been presented. Moreover, we introduce the test results of the popular mobile phone. Aiming at the excess radiated emission from a developing handset, we analyzed and found the source of that by means of measurements and other EMC diagnostic technologies, and eventually we put forward the method of controlling the radiated emission. [C346]

"Design and developrnent of a broadband real-time 100-175 GHz frequency measuremnent systen for gyrotron diagnostics"

A broadband real-time frequency measurement system for frequency diagnostics on megawatt gyrotrons has been developed. It is based on a broadband superheterodyne receiver operating between 100 GHz and 175 GHz. The aim is to determine the oscillating cavity mode. The concept is introduced and first measurement results are presented [C347]

"High-resolution passive microwave-imaging concept for ocean studies"

A passive microwave-imaging technique is developed for advanced ocean remote sensing. The study contains the following stages: high-resolution multiband polarimetric radiometer scanning measurements, digital image processing, evaluation of 2D radiometric features, correlation and spectral analyses, and complimentary image modeling. Such a combined approach allows us to explore radio-brightness characteristics of the ocean images providing selections and specifications of radiometric signatures of interest. Image features are revealed in the form of brightness texture mosaics and distinct objects (spots). Under certain conditions, the signatures may reflect environmental dynamics of the ocean surface including roughness change, variations of wind, wave breaking, and foam/whitecap activities. We suppose that high-resolution passive microwave imagery has potential capabilities for diagnostics of ocean variables and localized hydrodynamic phenomena. In the paper, related results are presented and discussed. [C348]

"Experimental Study of Pellet Delivery to the ITER Inner Wall through a Curved Guide Tube at Steady-State Pressure"

Injection of solid hydrogen pellets from the magnetic high-field side will be the primary technique for depositing fuel particles into the core of International Thermonuclear Experimental Reactor (ITER) burning plasmas. This injection scheme will require the use of a curved guide tube to route the pellets from the acceleration device, under the divertor, and to the inside wall launch location. In an initial series of pellet tests in support of ITER,

single 5.3-mm-diam cylindrical D2pellets were shot through a mock-up of the planned ITER curved guide tube. Those data showed that the pellet speed had to be limited to ap300 m/s for reliable delivery of intact pellets. Also, microwave cavity mass detectors located upstream and downstream of the test tube indicated that ap10% of the pellet mass was lost in the guide tube at 300 m/s. The tube base pressure for that test series was ap10-4torr. However, for steady-state pellet fueling on ITER, the guide tube will operate at an elevated pressure due to the pellet erosion in the tube. Assuming the present design values for ITER pellet fueling rates/vacuum pumping and a 10% pellet mass loss during flight in the tube, calculations suggest a steady-state operating pressure in the range of 10-20 torr. Thus, experiments to ascertain the pellet integrity and mass loss under these conditions have been carried out. Also, some limited test data were collected at a tube pressure of ap100 torr. No significant detrimental effects have been observed at the higher tube pressures. The new test results are presented and compared to the baseline data previously reported [C349]

"Conceptual Design Studies of the KSTAR Bay-Nm Cassette and Thomson Scattering Optics"

A multi-channel Thomson scattering system viewing the edge and core of the KSTAR plasma will be installed at the midplane port Bay-N. An engineering design study was undertaken at PPPL in collaboration with the Korea Basic Science Institute (KB Si to determine the optimal optics and cassette design. Design criteria included environmental, mechanical and optical factors. All of the optical design options have common design features; the Thomson scattering laser, an in-vacuum shutter, a quartz heat shield and primary vacuum window, a set of optical elements and a fiber optic bundle. Neutron radiation damage was a major factor in the choice of competing lens-based and mirror-based optical designs. Both the mirror based design and the lens design are constrained by physical limits of the Bay-N cassette and interference with the Bay-N micro-wave launcher. The cassette will contain the optics and a rail system for maintenance of the optics [C350]

"Development of Quasi-Optical Technology for Microwave Diagnostics in LHD"

This paper presents development of quasioptical microwave technology for ECE and reflectometry diagnostics in the Large Helical Device (LHD). The ECE for the electron temperature measurement is transmitted with the corrugated wave guide system. Technology for Microwave imaging, such as imaging reflectometry and ECE imaging, has been developed to visualize 3D view of turbulence [C351]

"Measurements of the Plasma Characteristics of the Trips Source at INFN-LNS"

Summary form only given. The TRASCO (TRAsmutazione SCOrie) project is an R&D program whose goal is the design of an accelerator driving system (ADS) for nuclear waste transmutation. The high current CW proton linear accelerator will drive a sub critical system devoted to the transmutation of nuclear wastes. The TRasco intense proton source (TRIPS) is a high intensity 2.45 GHz microwave source whose goal is the injection of a maximum proton current of 35 mA in the following RFQ, with a rms normalized emittance lower than 0.2 mmrad; the operating voltage is 80 kV. Current measurements with the 8 mm hole plasma electrode have given results largely exceeding the TRASCO design current: up to 61 mA were extracted at 80 kV and about 90% of this current was transported to the beam stop. Such result was obtained by means of an accurate RF matching: the microwave coupling with the matching transformer and the automatic tuning unit allows to operate with low values of reflected power (below 5%) and a high electric field on the axis, thus increasing either the proton fraction and the current density, up to 200 mA/cm2, close to the Child-Langmuir limit. Today the TRIPS source routinely produces a proton beam of 40 mA with a 6 mm extraction hole at full voltage. In order to verify the possibility of further improvements, a series of measurements of plasma characteristics with a Langmuir probe have been carried out and are described in the paper. An overview of the possible upgrade and of the application of some other diagnostics tools will be presented [C352]

"Microwave Plasma Torch Abatement of NF3 and SF6"

Summary form only given. Fluorinated compounds (FCs) are essential to the semiconductor manufacturing process for plasma chamber cleaning and plasma etching. Because FCs have extremely long atmospheric lifetimes and are strong infrared absorbers, efforts have been undertaken to identify methods to reduce atmospheric emissions. Many methods for FC abatement have been suggested, such as wet and burning scrubber, and low-pressure plasma device. In this work, an atmospheric pressure microwave plasma torch as a new method for PFC abatement was presented. Detailed experiments were conducted on abatement of NF3and SF6in terms of destruction and removal efficiency (DRE) using Fourier transform infrared (FTIR). Swirl gas, compressed air, for stable plasma was injected with main mixture of N2, NF3or SF6, and C2H4as an additive gas into the microwave plasma torch. Destruction and removal efficiencies of up to 99.1% for NF3were achieved without an additive gas by applying microwave powers from 0.8 to 1.2 kW. Also, DRE determined from FTIR data for SF6was obtained 90.1% using applied microwave power of 1.4 kW. Experimental results indicate that

the microwave plasma abatement device for PFC destruction can successfully eliminate FCs in the semiconductor industry. [C353]

"Korean ITER Participation and Activities in ITER Transitional Arrangements"

Korean ITER participation impacts huge things on her fusion research as an energy development program. The ITER Transitional Arrangements (ITA) is conducted by the International Team with supports from participant teams. The Korean participant team (KO-PT) has contributed to the ITA by sharing several technical tasks to verify feasibilities of fabrication and quality control method in procuring ITER equipments and facilities. Technical data to confirm validity of the present design have also been developed on some issues. Completing these technical preparations will make it possible to finalize the specification of ITER procurements. This presentation provides an overview focusing on critical activities needed for the successes of ITER project and fusion energy development [C354]

"Propagation of intrasubband plasmons in a finite array of quantum wires placed into an external magnetic field"

We calculated the intrasubband plasmon spectrum of the finite weakly disordered array of QWs placed into an external magnetic field. It should be emphasized that the above-mentioned features of plasmon spectra can be used for the diagnostics of defects in QW structures. Hence, the LPM properties can be applied to determine the electron density in the defect QW. At the same time the properties of usual plasmon modes can be used to define the position of the defect QW in the array. [C355]

"Plasma scattering measurement by using a submillimeter wave gyrotron as a radiation source"

An FU II gyrotron was applied as a submillimeter wave radiation source for plasma scattering measurements of the compact helical system (CHS) in the National Institute for Fusion Science (NIFS) in Japan. The stabilization of the gyrotron output and the high quality probe beam are required to improve the performance of the measurements. The outputs (cw operation, f=301 GHz, P 20 W) of the FU IV gyrotron are stabilized (ΔP/P 1%, Δf 10 kHz) by decreasing the fluctuations of the potentials (ΔVk 0.6 V, ΔVa 0.2 V), by introducing smoothing circuits consisting of a resistor, an induction coil and a capacitor. Further stabilization of output frequency (Δf [C356]

"Quasi-optical interferometers with enhanced phase sensitivity"

MW interferometers are widely used for the investigation of a plasma. These interferometers permit determining electron density by the measurement of the phase shift of a wave probing of the plasma relative to the wave passing over the free space. In case of measurement of a small phase shift, the high phase sensitivity and small phase noise of interferometers are required, the phase sensitivity is meant as the ratio between the phase shift of a probing wave and the change of electron density which caused it. One of methods of increasing the phase sensitivity of interferometers is a multiple transition of probing radiation across the plasma. For this purpose in the submillimeter wavelength range it is expedient to apply a hollow dielectric waveguide as a quasi-optical waveguide structure and radiomeasuring quasi-optical devices. The scheme of a reflecting type quasi-optical interferometer, that provides the quadruple transition of a wave across plasma, is presented. [C357]

"Numerical features of phase objects 3D images reconstruction via microinterferograms"

In our report some features of computing aided algorithms for reconstruction of three-dimensional images of penetrable dielectric (phase) objects are considered by the example of human blood cells visualization. The initial data has been obtained with the help of interference holographic microscope and a digital camera. Also, we develop a specialized computer code which made processing of the received matrix and calculates physical and geometrical characteristics of the object under investigation (volume, the surface area, sphericity factor, etc.). On the next stage the three-dimensional virtual image of investigated object is displayed to the computer screen with simultaneous displaying of some additional information. An obtained result seems to be actual for development of modern biomedicine, in particular for early stages diagnostics of some diseases, and can be of interest for other areas of science and technique. [C358]

"Physics and applications of the Gliding Arc discharge"

Summary form only given. Gliding Arc is a transitional type of atmospheric pressure arc discharges, which can provide relatively high levels of electron density, current and power-typical for thermal plasmas, together with relatively low temperature and elevated electric field-typical for cold non-equilibrium plasmas. This "hybrid thermal/non-thermal" plasma of the Gliding Arc combines features and advantages (sometimes unfortunately

disadvantages as well) of the so different discharges as thermal arc and low temperature glow or corona discharges. The Gliding Arc discharge finds already interesting and successful practical applications in fuel and waste treatment, in environmental control. The Gliding Arc discharge in the transitional ENE mode was successfully applied in particular for hydrogen and syngas production by partial oxidation and steam reforming of methane, and for exhaust gas cleaning from different volatile organic compounds. The Gliding Arc plasma parameters in the case of fast linear propagation and rotation was characterized and quantified by the high speed image intensified spectrally resolved video and ICCD diagnostics, synchronized voltage-current measurements, and also by microwave interferometry and infrared spectroscopy. [C359]

"Progress on turbulence imaging and visualization diagnostics for high temperature plasmas in toroidal devices"

Summary form only given. Diagnostic systems for fluctuation measurements in plasmas have, of necessity, evolved from simple 1-D systems to multi-dimensional systems due to the complexity of turbulence physics of plasmas in toroidal devices illustrated by advanced numerical simulations. Using the significant advancements in millimeter wave imaging technology, Microwave Imaging Reflectometry (MIR) and Electron Cyclotron Emission Imaging (ECEI), capable of simultaneously measuring density and temperature fluctuations are developed. Since both systems require large collection optics for the reflected waves from the "cut-off layer" in the MIR system and vertically (poloidally) extended emissions in ECEI system and since both systems operate in a similar microwave range in most of toroidal devices (e.g. the MIR frequency range is 89 GHz and ECEI ranges from 95 to 130 GHz for TEXTOR), it is feasible to combine the two systems which utilize state-of-the-art millimeter-wave planar imaging arrays positioned at the focal point of the detection system to form an image. The detailed testing of the optical system for MIR/ECEI was established with known targets (corrugated metal surfaces). The new 2-D ECE Imaging system (with a total of 128 channels), installed on TEXTOR in December, 2003, combines both techniques to provide a true 2-D imaging of Tefluctuation such as "sawtooth crash" near q 1 surface. In this paper, a brief review of the imaging diagnostics for turbulence study, combined MIR/ECEI system design description, laboratory testing details of the MIR/ECEI system and multichannel wideband IF technology are presented, together with the progress of subsequent experimental campaigns on TEXTOR plasmas. [C360]

"The method of UHF reflectometry for investigation of plasma fluctuations in the torsatron Uragan-3M"

Plasma density fluctuations, n˜e, play an important role in the energy balance, particle and heat transport, and, in the long run, in the confinement of a thermonuclear plasma. In this paper we present the experimental results on study of the spatial structure of n˜e, in the plasma confinement region of the l=3 torsatron Uragan-3M. These data were obtained by means of a multi-channel UHF reflectometry with the homodyne detection. [C361]

"Computer simulation in design of built-in performance monitoring and alignment systems for phased array antennas"

Special automated complexes, which allow integrating the processes of modeling, designing, evaluation of the phased-array antenna (PAA) parameters for further aligning and conducting of acceptance tests and field trials are considered in this report. It is shown that for comprehensive evaluation of multifunction PAA technical state and parameters it is necessary to combine simulation, statistical approach to antenna measurements, complete diagnostic, initial alignment and further auto-tuning of multichannel PAA, taking into account their constructive peculiarities and restrictions. [C362]

"About capabilities of objects location using microwave radiometer"

Microwave thermal radiation of various objects can be used for their location and identification. Thermovision in the infrared range enables to find temperature distribution on the object surface while microwave radiometers allow to recognize hot objects placed for instance, behind thermal shields. In the paper the authors present selected results of the research on passive system for discovering live creatures based on microwave radiometer. Performed experiments showed that assumptions were correct and the radiometer is very useful for such applications. [C363]

"Studies of fluctuating plasma rotation by means of correlation and Doppler microwave reflectometry"

A new approach to plasma rotation observation is microwave reflectometry. Poloidal correlation reflectometry uses cross-correlation analysis of microwaves reflected by 2 poloidally shifted parts of surface of toroidal fluctuating plasma. The reflected microwave signal is being modulated on amplitude and phase; this modulation

contains information about time/space properties of perturbed reflecting surface. These perturbations are the result of plasma density perturbations in unstable plasmas. Poloidal plasma rotation will change temporal behavior of reflected signals. This change will be reflected in change of cross-correlation function of microwave detector signals. Doppler microwave reflectometry is another method of poloidal rotation velocity measurement. In this method the Doppler shift of microwaves reflected by fluctuating plasma is measured if probing antenna is tilted to the reflecting surface normal. This work is devoted to comparison of data coming from poloidal correlation and Doppler reflectometry for rotating plasma. [C364]

"The automatized computer workbench for complex multi-frequency measurement at the 5 millimeter wave band"

To carry out the electromagnetic super-high frequency diagnostics of dielectrics on a base of the inverse problem solution it is necessary to provide the automated high-precision measurement of the complex reflection factor (CRF) for electromagnetic field at a set of frequencies. From this point of view the methods of bridge-scheme measurements have some advantages: the competitive simplicity of the bridge construction and measurement scheme, easy calibration, wide frequency range, measurement's high precision, which in principia depends only from the precision of the calibrated loading. The structure of the automated workbench for multi-frequency measurements of CRF in SHF wave band is considered. The method for CRF measurement with employing of circuit model is proposed. That allows to automate the measurements and avoid the procedure of the joint balancing. [C365]

"Up-to-date approaches to the development of therapeutic and diagnostic systems using millimeter-wave electromagnetic radiation"

A high sensitivity of living bodies to electromagnetic radiation and the dependence of biologic effects on the signal frequency and spectrum not only form specific requirements for millimeter-wave therapeutic devices, but also open up a great number of unexplored and unrealized opportunities for correcting the bioenergo-informational status of the human body. The use of radically new millimeter-wave therapeutic devices gives the doctor wider possibilities of influencing the regulatory and metabolic processes in the patient's body with due regard for its individual features by acting on its intricate multidimensional structure using some specified space-time organization of the millimeter-wave signal. [C366]

"Methodological approaches for construction of therapeuto-diagnostic apparatus with the use of the own electromagnetic fields of organism of man"

The therapeuto-diagnostic devices on the basis of the high-stable generator modules with the use of diodes on intervalley transfer of electrons providing the generation of high-coherent oscillations, were tested in laboratory and clinical conditions as functioning in the mode with an autodyne response. It was obtained, that there are such charts of construction of low-frequency contours for the selection of resonance frequencies in the circuits of diodes supply, which surmount difficulties of reception of weak signals in autodyne transformers, conditioned by the own noises of indicated diodes. Possibilities of mono-frequency and multi-frequency influence are considered, here the multi-frequency mode was realized as a line spectrum with an interval between the spectrum constituents, equal or multiple to frequency of the chosen biorhythm. The clinical tests were conducted at diagnostics and therapy of gastroenterology and stomatology diseases. [C367]

"Microwave beam focusing/shaping phased antenna arrays"

A newly proposed 1Ч8, 18 GHz beam focusing/shaping PAA has been designed, constructed and tested. The true time delay (TTD) approach employs a piezoelectric bending motor to perturb the EM field in the vicinity of the transmission line, thereby generating the required time delay. Several different transmission media have been investigated and tested based on this technology. Array beam focusing capabilities have been experimentally demonstrated with 10° 3-dB beam width variation and 12 cm focal distance change. [C368]

"Control of uniformity of plasma-surface modification inside of small-diameter polyethylene tubing using microplasma diagnostics"

Summary form only given. The realization of small scale biomedical devices will be closely related to the non-fouling/biocompatible properties of the exposed surfaces and the uniformity of the surface treatment throughout the device. The use of biomaterials for vascular grafts to replace diseased human blood vessels has increased tremendously over the past 30 years. In contrast to large-diameter vascular grafts (i.e., larger than 5 mm) which remain excellent for more than 10 years after implantation, small-diameter vascular grafts occlude rapidly after implantation. In this work, we apply a new approach for treating small-diameter polymer tubing and we make use

of two microplasma diagnostics to monitor the plasma properties during the treatment process. A hollow-cathode microplasma was used to modified the lumenal surface of small-diameter polyethylene (PE) tubing. A microwave-cavity diagnostic was used to measure the plasma density of the microplasma. Emitted light from the plasma was fed into a monochromator at various positions along the PE tube to assess uniformity of the microplasma. Effectiveness of oxygen and argon plasma treatments were evaluated using the capillary rise method at various positions along the tubing. We are able to show a correlation between the properties of the inner surface of the PE tubing and the light emitted from the plasma. Thrombus formation and embolization are significant problems for blood-contacting biomedical devices. To minimize these affects, a Poly(ethylene oxide) (PEO) surfactant was immobilized to the lumenal surface of the PE tubing. The plasma immobilization technique consists of a two-step process; first, a surfactant is coated to the inner surface of the PE tubing followed by exposing the precoated surface to an argon gas discharge. To test hematocompatibility, a blood flow loop circulated heparinized human blood through both a plasma-treated and untreated PE tubes, simultaneously. After blood exposure, the tubes were examined with a scanning electron microscope to assess the density of adhering platelets along the length of the tubes. The plasma-treated tubing showed fewer blood adherents than the untreated tubing. By modifying the plasma parameters, the uniformity of the microplasma treatment along the-tubing can be optimized. [C369]

"Wave driven Ar-N2 -O2 discharges as sources of active species"

Summary form only given. Surface wave sustained, flowing Ar-N2-O2discharges attract attention as sources of nitrogen and oxygen atoms for polymer activation and, in particular, for cold plasma sterilization of medical instruments. The self-consistent model is based on a set of equations including Maxwell's equations, homogeneous electron Boltzmann equation, rate balance equations The axial transport of neutral species due to the presence of gas flow is taken into account. The calculations are performed for optimized medical sterilization conditions: pressure p=5 Torr, flow rates in the range Q=500-1000 sccm and microwave powers between 100 and 150 watts. The concentrations of various active species are investigated as a function of the spatial position and mixture composition. Emission spectroscopy measurements of the N2(1+,2+,1-) and NO(γ,β) band intensities, and measurements of N and O by actinometry and NO titration are used to validate the theoretical results. This model is shown to provide a satisfactory interpretation of the experimental data. [C370]

"Terahertz technology in biology and medicine"

Terahertz irradiation and sensing is being applied for the first time to a wide range of fields outside the traditional niches of space science, molecular line spectroscopy and plasma diagnostics. This short summary serves as an introduction to a special focused session of the IEEE IMS 2004 and surveys some of the terahertz measurements and applications of interest in the biology and medical sciences. A more complete paper has been submitted to the special issue of MTT Transactions. [C371]

"Packaging of disposable chips for bioanalytical applications [Cmicrofluidics]"

In this paper, the realization of microfluidic packages by bonding several stacked layers of microstructured polymer films in a reel-to-reel manufacturing system is shown to be a promising approach. The smart division between disposable and reusable system parts as well as the careful selection of materials, based on microstructuring, bonding, biocompatibility and auto fluorescence criteria may lead to bioanalytical devices with a very competitive cost of ownership per test. For the realization of such microfluidic disposables, microstructuring technologies based on UV laser micromachining, bonding technologies based on thermal diffusion, adhesives and microwave sealing using conductive polymers, and surface modification approaches for the reduction of non-specific protein binding are discussed. [C372]

"Tele-medicine network employing P-P mini-microwave system with high capacity for rural and remote areas in developing countries"

This paper introduces a good solution for providing a tele-medicine system that will contribute greatly to the availability of medical aid for inhabitants in rural/remote areas of developing countries. The features of this tele-medicine system are to employ a point-to-point [P-P] mini-microwave system and to provide a remote community with a medical office and a multi-purpose community telecenter [MCT] if necessary. The network configurations of the mini-microwave system will be illustrated and several advantages are mentioned such as high capacity, long propagation hop length, wide range of frequency bands, ethernet interface for LAN connections and low cost due to mass-production. The tele-medicine configurations in the medical office and the MCT connections are illustrated in two ways: an EI and an IP network. The paramedical staffer nurse(s) attending the medical office will have basic roles and actions that are to give first aid, doctor's diagnosis and instructions to patients through the tele-medicine system. [C373]

"Simultaneous far-field and aperture phase measurements of a 25 element coupled oscillator based phased array"

A five by five element array designed to operate at S-band was built and tested. The author reviews the array and diagnostic system designs, describes a few modifications of the diagnostic system and the addition of a radiating aperture using microstrip patch elements, and presents some of the results of an antenna range assessment of the fully assembled array. [C374]

"Miniature microwave plasma torch applicator and its characteristics"

Summary form only given. A compact microwave plasma torch has been designed and experimentally evaluated. The torch is designed to be light weight and to operate at atmospheric pressure with a torch discharge size of less than 1 mm in diameter. The potential applications of the torch are for materials synthesis, material cutting and welding, and various surface treatments. This torch employs an open ended coaxial structure of 12 mm outer diameter with the discharge located at the tip of the center conductor that is 5 mm in diameter. The discharge is formed at atmospheric pressure where the feed gas flows through a nozzle hole of 200-500 μm in diameter located at the end of the center conductor of the applicator. The microwave plasma torch is experimentally evaluated over a range of input power and a variety of feed gas mixtures including argon, mixtures of argon with hydrogen and selected hydrocarbon gases, nitrogen, and air. This torch operates from 10's to 100's of watts of 2.45 GHz input microwave power and is able to maintain discharges over a wide range of flows from diffusional flow of radicals for gentle surface processing to high velocity flow approaching supersonic velocities. Diagnostic measurements performed include (1) gas temperature measured by optical emission spectroscopy (OES), (2) discharge power densities and, (3) discharge volume and size. These measurements are done versus absorbed microwave power and gas flow rate. The discharge size for absorbed microwave powers of 10-30 watts is about 0.7 mm in diameter and 2-4 mm long for a nozzle diameter of 0.4 mm. By using spatially resolved OES measurements, the temperature profile of the discharge is determined. [C375]

"Diagnostics in a high-density plasma generated by a pulsed electron beam"

Summary form only given. At NRL, a 'Large Area Plasma Processing System' has been developed based on the high-energy electron beam (e-beam) ionization process, with the goal of modifying the surface properties of materials over large areas (1 square meter). The plasmas produced are high density (ne=109-1012cm-3) with low electron temperatures (Te≈0.5 eV) and subsequently low plasma potentials at gas pressures of 10-150 mtorr. The plasmas well defined locally and temporally by the e-beam. In this presentation, temporally resolved measurements from Langmuir probes, microwave transmission, [energy resolved] ion mass spectrometry, and optical emission spectroscopy presented from plasmas formed by 2 keV e-beams operated for 1-6 milliseconds at 10-20% duty factors. Plasma parameters are correlated to e-beam energy and density measurements using a differentially pumped retarding field analyzer. A strong emphasis is placed on the experimental details of these measurements such as probe surface and chamber contamination, necessary support electronics, as well as the relevant physics associated with the wall or electrode placement in these low temperature high-density plasmas. [C376]

"Energy characterization of a high-density plume using a directional micro-Retarding Potential Analyzer"

Summary form only given. A single-orifice Retarding Potential Analyzer (RPA) has been coupled with a microchannel plate (MCP) of 0.315% transparency to produce viable ion energy measurements within plasma plumes of density greater than 1Ч1018m-3. Consisting of several variably biased electrodes, an RPA sensor allows ions with sufficient energy access to a collection plate while repelling electrons and low energy ions. This paper addresses the experimental validation of a Directional micro-Retarding Potential Analyzer (DμRPA) to a similar single-orifice RPA without a microchannel plate in the plume of a high-powered Hall Thruster. Single-orifice RPAs have previously been designed for Hall thruster plume characterization, with particle number densities of approximately 1Ч1016m-3. Investigations into the validity of the MCP design concept, specifically the ability to eliminate space charge limitations and potential breakdown phenomena between electrodes, are also described. This paper also demonstrates the segmented current collection theory and the unstructured 3D particle in cell (PIC) simulations developed for the DμRPA channel flow. [C377]

"Recent activities on plasma focus experiment at IPR"

Summary form only given. Plasma focus is important tool for plasma physicists for understanding dense magnetized plasma. Recently Plasma focus attracted the attention of the plasma research community for its use

in pulsed radiation applications. The emitted neutrons can be applied to perform radiographs and substance analysis, taking advantage of the penetration and activation properties of neutron radiation. A 20 kJ (28.4 μF, 30 kV) Mather type squirrel cage plasma focus is operational at our institute. Electrodes of this device are made of stainless steel with glass as insulator. The focus is housed in a chamber filled with hydrogen or deuterium gas. The maximum neutron yield obtained so far is 109per discharge, detected by using bubble detector. Time resolved neutron and X-ray emission was measured by a time of flight detector. Emission of microwaves from Plasma focus is the least studied subject worldwide. We are planning to use microwave detectors together with other diagnostics to study microwave emission from plasma focus. [C378]

"Ambient pressure resistive barrier cold plasma discharge for biological and environmental applications"

Summary form only given. We have carried out electrical, chemical, optical, and biological studies on both He and atmospheric air plasma. A microwave absorption method was used for average electron density measurements. The ion measurements were done by collecting the ion current over an interval in time in a capacitor, and measuring the collected charge with a nanometer after the discharge was turned off. This method prevents RF noise from the discharge from jamming the nanometer. The measurements indicated that an ion density of 1012ions per cubic centimeter was present in the discharge. The results of both He and atmospheric air plasma show that the overwhelming production was of ozone. A trace of NO was found. The analysis of optical characteristics shows that the far ultraviolet light production was negligible as compared to that of a 150 Watt mercury arc in a quartz tube. Biological studies have been carried out with samples of XL-1BlueTM, E. coli and attained promising results. [C379]

"Production of high power microwaves with a compact Marx generator"

Summary form only given. A compact pulsed power system has been built at CESTA to drive low impedance high power microwave (HPM) sources. This system stores 10 kJ and is capable of delivering a current up to 50 kA at 800 kV to a matched load. The rise time of the current is less than 100 ns. We have coupled the Marx generator with a vircator tube that produces HPM in S-band. In this paper we describe the experimental setup, the associated HPM measurements and the results obtained with the simulation code MAGIC. The utilization of a fast oscilloscope (3 GHz bandwidth) enables us to examine in detail the frequency spectrum of the Vircator radiation. The spectra are time resolved with a window-shifted finite Fourier transform method. Standard calibrated horns are placed at appropriate locations in the far-field radiation pattern. Precise knowledge of the attenuation of the diagnostic lines associated with the variation with frequency of the radiation pattern allows us to measure the radiated power. The low efficiency generally observed in a basic Vircator configuration can be improved by placing a frequency-matched cavity downstream from the anode. The corresponding TM01 mode can then be made preponderant by a correct choice of the length and radius of the beam pipe that precedes the large conical radiating horn. [C380]

"Vircator efficiency enhancement at plasma assistance"

Summary form only given. The experimental researches of generation of microwave radiation produced in a system of a relativistic electron beam (REB) with a supercritical current and external plasma source have been carried out. The pulsed electron accelerator has been put into operation that produces high-current relativistic electron beam with parameters: energy 280 keV, current 4.4 kA, pulse duration 0.8 msec. The generator of pulsed voltage supplied magnetically insolated diode of magnetron type by voltage impulse of 300 kV and duration 1 μsec at diode impedance 64 Ohm. The diode was manufactured with cylindrical cathode from stainless steel of diameter 38 mm and emission edge width 0.1 mm. Anode has a conical form that transform into cylindrical liner of inner diameter 50 mm for transportation of tubular electron beam with diameter 32 mm and thickness 1 mm. Virtual cathode in magnetically insolated diode was realized by means of jump of the electrodynamics structure, namely sharp change of anode (drift tube) diameter from 40 mm, for which vacuum limiting current is 4.4 kA, to 50 mm, for which vacuum limiting current is 3.4 kA. The availability of the virtual cathode is confirmed by the measurements of input and output current of electron beam and also by registration of high-frequency radiation (vircator operation). The outer plasma was created by plasma source that consists of 4 plasma guns placed uniformly over azimuth of the drift tube for radial injection into virtual cathode region. The measured plasma parameters were: density 1012cm-3, temperature 3.6 eV, directed velocity 2.3Ч106cm/sec. Microwave radiation was measured by detector ≪DK-J2M≫ from the horn antenna. The results of investigations have shown that at presence of external plasma in electrodynamics' structure of the vircator-generator the power of microwave radiation is essentially increased in comparison to the vacuum case. [C381]

"Fusion plasma diagnostics with mm-waves-basic principles and recent developments"

Microwave techniques play an important role in modern fusion plasma diagnostics. Both passive radiometry as well as active probing techniques are in use. Basically the confining magnetic field and the electron density of the plasma determine its dielectric properties and resonances. The probing wavelength in interferometry are in the infrared range without changing the basic principles of the microwave diagnostic techniques. The determination of the electron density and the electron temperature and their fluctuations both in the plasma core and the edge and gradient regions. [C382]

"Millimeter wave imaging diagnostic for simultaneous density and temperature fluctuation measurements on the TEXTOR Tokamak"

A millimeter wave imaging diagnostic for simultaneous density and temperature fluctuation measurements has been developed for operation on the TEXTOR Tokamak. The system is based on the quasi-optical imaging of the radiation from the plasma onto state-of-the-art millimeter wave mixer/receiver arrays. The temperature (fluctuation) measurements are based on the observation of electron cyclotron emission from a 2D plasma area with 8Ч16 sample volumes of about 1 cm3. The density fluctuation measurements are based on active probing by means of reflectometry. In this case reflections from 16 sample volumes, arranged along the cutoff surfaces are diagnosed. The combined millimeter wave imaging diagnostic offers distinct advantages above the commonly used non-imaging diagnostics. [C383]

"MISTM: medical imager for sub-surface temperature mapping"

MISTM is a 94 GHz passive mm-wave imager designed to produce high resolution thermal images of medical subjects. The ultimate aim is to detect shallow subcutaneous thermal emission as a diagnostic indicator of disease. The imager is currently undergoing hospital data gathering trials to evaluate its performance against other imaging techniques. [C384]

"The Smart Tele-emergency Project: a mobile telemedicine unit based on Mobile IPv6 and mobile ad-hoc network for Sabah areas"

The paper proposes a mobile telemedicine system delivering medical health care services in Sabah areas under the Smart Tele-emergency Project. The system uses Mobile Internet Protocol version 6 (MIPv6) combined with a rapidly deployable network based on mobile ad-hoc network (MANET) and IEEE 802.11 wireless LAN (WLAN) technology. The primary objective of the Smart project is to create a prototype mobile telemedicine system, including hardware and software, that can be rapidly deployed in rural areas or in disaster conditions where telecommunication infrastructures are lacking or destroyed. We propose the integration of MIPv6, MANET and WLAN to provide telemedicine. This project is currently under refinement for simulation and implementation. The project is funded by IRPA (RM 445,000.00) for three years. [C385]

"Dynamic characteristics of conical supersonic flow under microwave conditions"

By means of Onsager potential differential equations of irreversible process thermodynamics, dynamic behaviors of a cone (such as a probe) in supersonic flow radiated by microwaves has been researched mathematically. Experience has shown that sufficient accuracy is obtained if the sector between the cone contour and shock front contains subdivisions at intervals of not more than one degree. The result is useful to research parameters of the plasma by an ultrasonic method for plasma diagnostics. [C386]

"A new design method for swept-frequency interferometers"

In this paper a new design method is described for a swept frequency interferometer. A system of diagnosis for plasma electron density has been designed based on the condition $\Delta f \cdot \tau = 1$. A simulation has been made for the RF circuit. The simulation results validate the analysis of the theory of swept-frequency interferometer system. [C387]

"Plasma turbulence studies using correlation Doppler reflectometry on the ASDEX upgrade tokamak"

The correlation Doppler reflectometer system consists of two 50-75 GHz reflectometers with a selectable O/X-mode polarization. Launching from the same tilted antenna allows the measurement of the radial electric field shear dEr/dr and radial correlation lengths Lr, important parameters characterizing plasma turbulence. The reflectometer hardware is described and example measurements presented. [C388]

"Approaches to semantic interoperability for advanced diagnostics architectures"

The goal of developing advanced diagnostic architectures is to provide a computing infrastructure that can support integration of open, modular software components that maximize reuse of not only static local data but results of dynamic information processing at other nodes in the network-centric architecture as well. Emerging technologies in the support system environment address the development, integration and maturation of complex software systems. This paper will discuss approaches to semantic interoperability that enable the construction of interoperable applications in support of integrated diagnostics objectives. It will investigate existing computing infrastructure constructs that provide support for these goals, as well as current attempts to provide standardized approaches to semantic interoperability. [C389]

"Design and simulation of beam position monitor for 200 MeV linac in HLS"

In order to improve injection efficiency of HLS (Hefei Light Source), an appropriate BPM (beam position monitor) is needed to provide the transverse positions and longitudinal phases of linac and transfer line beam. The original stripline BPM for HLS Linac, which is 20.8 degrees in azimuthal angle and has a poor performance in coupling signals on electrodes, is redesigned and calculated through Mafia and CST Microwave Studio. The new stripline BPM structure, which is 60 degrees and 183.8 mm long, has a better performance in time response, spectrum, linearity and sensitivity when a beam passes by. Lastly, the position resolution and time resolution of the new structure is theoretically calculated, which meets the requirement of HLS Linac and transfer line. [C390]

"Experimental estimation of functional capabilities and temperature error of microwave sensors of combustion processes."

Temperature regime of the sensors, controlling flame electron density Nein chambers of thermal power engines, has been investigated in this work. By detailed analysis of electrical and thermal processes, suggestions, improving thermal regime of the sensors, reducing temperature error and increasing their life time, were made. Experiment has proved the opportunity of using microwave sensors for advanced flame diagnostics in all air get engines and other thermal power engines (TPE). [C391]

"Millimeter wave imaging applied in reflectometry and radiometry to diagnose thermonuclear plasmas"

The application of large collection optics to image millimeter waves on a detector array improves the spatial resolution and enables the recovery of small-scale structures and fluctuation characteristics of the plasma electron temperature and density from radiometer and reflectometer measurements. Both diagnostic techniques are combined into a single instrument on the TEXTOR tokamak. [C392]

"Doppler radar to investigate turbulence and its sheared flow-velocity in a fusion plasma"

Doppler reflectometry is a radar-type diagnostic for fusion plasmas which was developed to study the interplay between the sheared propagation velocity of the turbulence and the turbulence spectrum. The shear-flow decorrelation of transport carrying turbulent eddies is the main candidate as it is responsible for the occurrence of transport barriers in the plasma. The frequency shift spectra of the returning microwave signal was shown. [C393]

"Breakdown characteristics and conditioning of carbon and refractory metal surfaces"

{no data available} [C394]

"Applicatory aerial for microwave radiometry"

We show an opportunity for using a wave conductor for creation of a small-sized applicatory aerial for the measurement of human body temperature. The accounts of aerial parameters are carried out on the basis of oscillatory equations. [C395]

"Retrieval of scanning Auger microscopy images"

The development of micro- and nanoelectronics needs chemical diagnostics of structures with nanometre resolution. The progress in scanning probe microscopy, in particular, in the method of scanning Auger microscopy (SAM) (S.T. Purcell et al, Nanotechnology, vol. 12, pp. 168-172, 2001; F.A. Stevie et al, J. Vac. Sci. Technol. B, vol. 17, no. 6, pp. 2476-2482, 1999), could solve this problem. The depth resolution of this method achieves by now a sub-nanometer barrier (S. Hofmann, Rep. Prog. Phys., vol. 61, pp. 827-888, 1998), but the lateral resolution amounts to no better than tens of nanometers. The goal of this work is to improve the lateral resolution of SAM by image processing using Tikhonov's method of deconvolution that takes into account the

probe transfer function. [C396]

"Source of overbroadband noise oscillations to diagnostics of electronic devices"

Sources of broadband or overbroadband noise oscillations are required for diagnostics of various electronic devices. We propose that use of deterministic chaos is a perspective way to generate these sources. Signals are generated on a mixer from two autooscillators. One generator has a fixed frequency of generation. The second is frequency-modulated by a signal from a low-frequency chaotic source in a specified interval. The mixer output possesses a signal covering the frequency range from zero to several GHz. [C397]

"Control and diagnostic unit of X-band radar transmitter"

The functional description, design and performance of a quad-microprocessor module, provided for controlling the X-band radar transmitter with a travelling wave tube are presented in detail. [C398]

"Metrics for the quality of footprint-matched passive microwave measurements"

In developing footprint matching schemes for the NPOESS (National Polar-orbiting Operational Satellite System) CMIS (Conical-scanning Microwave Imager Sounder) and ATMS (Advanced Technology Microwave Sounder) instruments, we have set up an array of tests for evaluating spatial weighting patterns, radiometric fidelity, and retrieval skill for composite passive microwave measurements. The purpose of the tests is two-fold. First, footprint-matching methods can be tuned to adjust both the degree of match to a target pattern and the level of composite measurement radiometric noise. Useful measures of each of these factors are needed in order to trade-off the benefits of each, complete the matching algorithm design, and run retrieval algorithms that use measurement error characteristics as a constraint. Second, environmental parameter retrieval skill depends on the quality of the footprint matching design, and we need to be able to evaluate what radiometric and spatial quality levels are optimal with respect to retrieval performance. To evaluate the diagnostic parameters, we simulated composite footprints from sensor patterns projected on a spherical-Earth from a fixed satellite altitude. Spatial quality metrics include measures of fit to the target pattern, 3dB contour size, side-lobe level, proportional weight within the 3dB contour, and weight beyond specified linear boundaries (e.g., X km from center) [C399]

"The development of methods of the improvement of the metrological characteristics of high-sensitivity MM-range radiometric equipment"

The development of methods of the improvement of the metrological characteristics of high-sensitivity MM-range radiometric equipment is proposed in This work. The electromagnetic radiation of biological objects, inclusive of the humans, has been actively studied. Diagnostics of the state of an organism is carried out proceeding from the values of radiation parameters. Thus they allow us to reach the higher accuracy and by the removal of preliminary microwave amplifier at quadrature detector input substantially expands the reception band of a radiometer and reduces the fluctuation threshold of sensitivity. [C400]

"Dynamics of lipid properties as a possible factor in improving mm-wave diagnostics of atherosclerosis"

Atherosclerosis usually results from lipid deposition on artery walls with subsequent enlargement of intima connective tissue and atherosclerotic plaque formation. Investigations into piezo- and ferroelectric properties of the lipids have revealed the impact of phase transformations on the process of atherosclerotic plaque formation. The conceptual framework of the physics of living organisms considers EM mm waves to be immanent to all living things. In view of this, the dynamics of the lipid properties (bearing in mind their diagnostic applications) should be studied with the aid of these waves, making the most of their principal properties, including polarization and its effects. [C401]

"Comparison of fibroglandular tissue distributions for microwave tomographic breast images with complementary MR T2 weighted images"

We have recently demonstrated good correlation between the recovered permittivity from microwave imaging (MIS) and the recovered water content from near infrared imaging (NIR) for a common set of normal patients undergoing associated breast examinations. We have subsequently conducted a small sample of comparison breast examinations between microwave imaging and MR to assess possible correlation between the location and extent of the fibroglandular as seen on MR images with increased permittivity zones of the microwave images. From various physiological and MR breast studies, it has been shown that the fibroglandular regions are generally comprised of significantly higher levels of water than the more dominant adipose tissue. The initial results of this study are quite encouraging and demonstrate obvious correlations between the permittivity and

MR-recovered fibroglandular regions for a set of patients with widely varying tissue type variations. In addition, they illustrate the value of extracting diagnostic information from multiple modalities especially where the amount of direct in vivo property measurements is limited or nonexistent. [C402]

"Imaging capability of an early stage breast tumor by CP-MCT"

Capability of diagnostic imaging of an early stage breast tumor using microwaves has been investigated by means of FDTD-based numerical simulations. More than ten years ago, we developed chirp pulse microwave computed tomography (CP-MCT) for microwave imaging of a human body. In this study, we'll show that CP-MCT provides useful information on the tumor region in the breast. To specify the exact location of an early stage tumor inside the breast, image restoration has been attempted by computing the point spread function (PSF) of CP-MCT in two- or three-dimensional ways by assuming the function is linear. Another solution is given by using radar imaging system simultaneously with CP-MCT. [C403]

"The effects of transverse static magnetic field on microwave absorption properties of some TPNR composites [Cthermoplastic natural rubber]"

In this paper, we report the microwave dielectric, magnetic and absorption properties of some composites containing polypropylene (PP), natural rubber (NR), magnetite (Fe3O4) and yttrium iron garnet (YIG). The effects of incorporating Fe3O4and YIG into the matrix of the TPNR (PP/NR) on the absorption characteristics of the material with and without the presence of a 1 T external transverse magnetic field are examined and discussed. [C404]

"New approaches to instant diagnostics and monitoring of therapeutic process dynamics"

A new approach to instant diagnostics and monitoring of therapeutic process dynamics for various pathological and functional changes in the human body is proposed. Clinical investigations into the complex admittance variations at biologically active points in the course of therapeutic procedures using EHF electromagnetic radiation have been conducted. [C405]

"Investigation into the interaction of microwave radiation with live blood cells"

MM waves are known to influence metabolic processes in biological systems (for example, ATP synthesis, ion transport through cell membranes, regulatory processes, etc.) and to have therapeutic effects on certain diseases. At the same time, the understanding of the physical mechanisms behind the interaction of weak electromagnetic waves with live cells falls behind practical applications of MM waves in medicine. The mechanisms behind the effect of MM waves on animal cells remain uninvestigated, while techniques and biological models for their research are still to be developed. Investigations into a model cell system have allowed for recommendations to be developed for the stimulation or inhibition of certain cell functions occurring in various impairments. A possibility of developing a conceptually new microwave diagnostics technique with the goal of increasing the resistance of biological cells has been shown. [C406]

"Observation, properties and applications of microwave radiation negative fluxes"

Results of experiments in observing and medically applying mm-wave negative fluxes are presented suggesting their high therapeutic efficiency. Negative fluxes enable investigations into the properties of a biological object eliminating the need for its additional irradiation and using only its intrinsic radiation. This is critical for the research of biological objects in their native state, as well as for investigating living systems (including human organism) in natural environments. It has been shown that mm-wave negative fluxes possess high therapeutic efficiency. Positive results of clinical investigations suggest that medical applications of mm-wave negative fluxes look quite promising within the framework of studying the origin of pain, as well as in developing new methods for pain syndrome relief. All this gives grounds for optimistic forecasts regarding mm-wave negative flux applications in physical experiments, as well as in medical diagnostics and practice. [C407]

"Application of ultrashort-pulse reflectometry to Large Helical Device"

The ultrashort-pulse reflectometer (USRM) system is being prepared to apply to Large Helical Device (LHD). At the present time, we preliminary applied this USRM system to a metal plate as a target, and confirmed that detection time of the reflected pulse is delayed proportionally as increasing in double path length. Recently, we are constructing the USRM system at National Institute for Fusion Science (NIFS). The experiment using this USRM system will be performed since February this year. The USRM system for LHD is as follows. The system utilize an impulse generator as a source, which can transmit an impulse with a pulse width of 22 ps and a voltage amplitude of 3 V. The impulse is fed to an active frequency doubler via a WD-750 waveguide and a low

loss coaxial cable to produce higher frequency component suitable for high density plasma such as LHD plasma. The chirped millimeter wave is amplified by a wide band power amplifier and transmitted by a conical horn in ordinary (O) mode. We utilize optical lenses in front of the transmitter and the receiver. The reflected wave is received by the receiver horn and amplified by low-noise amplifiers. The signal is recorded directly by a high-speed sampling scope (50 GSample/s). The repetition rate of impulse transmission is fixed at 1GHz, and data acquisition is completed for 10 ms. [C408]

"Millimeter wave beam shaping phased antenna array proposed for imaging reflectometry"

A millimeter wave phased antenna array (PAA) has been proposed for use in plasma imaging reflectometric diagnostics and is currently under design and fabrication. To account for the rapid changes of the cutoff layer with plasma density variation, a true time delay (TTD) controlled phased antenna array (PAA) is being developed as an artificial lens with controllable focal length for launching the illumination beam of the microwave imaging reflectometry (MIR) system. The beam shaping concept illustrates that programming the PAA generates concave (focusing/beam narrow) or convex (defocusing/beam broaden) wavefronts by properly arranging the time delay (or phase shift), therefore, the PAA functions like a real optical lens. The focal properties can be easily changed by different time delay arrangement at high speed so that real time control is possible on time scales significantly faster than plasma changes. The operation frequencies for the first implementation of beam shaping antenna array are set as 45-55 GHz based on the NSTX MIR system requirements. The time delay unit utilizes a piezoelectric translator (PET)-driven perturber to vary the propagation velocity along low loss microstrip lines. Tapered slot antenna will be used in the system as array element. To overcome the system loss and scattering loss from the plasma, the beam shaping array system is designed with an output power of at least 50 mW, and with a desired variable 3-dB beam width extending from 15° to 25°. [C409]

"Development of microwave imaging reflectometer with tapered slot antenna array"

The purpose of this research is to develop a microwave imaging reflectometer by use of a tapered slot antenna(TSA) array on the focal plane. The tapered slot antenna has advantages such as a broad bandwidth, low cost and a compact, light-weight In addition, manufacturing of the array antenna is easy for its planer shape. A TAS have a nearly-symmetrical radiation pattern compared to that of a bowtie antenna TSA has good property of a high directivity. This antenna research has been active especially in the communication fields. We designed a LTSA(Linearly Tapered Slot Antenna) with corrugated structure for X-band. The corrugated structure improves radiation patterns of LTSA. The input impedance can be tuned over a wide range of frequency by adjusting the element dimensions, leading to a good matching condition without complex matching circuit. The impedance matching condition is calculated by an equivalent circuit model. By optimizing the strip-line dimensions, the bandwidth of 7-14GHz with VSRW [C410]

"Continued hot-electron plasma studies in the Hanbit tandem mirror plug"

Additional microwave power has been installed at Hanbit in an attempt to increase the beta of the hot-electron ring plasma created in the plug section. Two VA-806 series klystrons with a frequency of 8 kW have been installed to operate in conjunction with an existing 2-kW 14-GHz klystron already, used in previous experiments. A hot-electron ring is created in the plug in order to provide a high-beta ring to stabilize the Hanbit central cell plasma against ballooning instabilities. Previous experiments had shown that a hot-electron ring plasma had been created with the 14-GHz klystron. The hot-electron ring was in a favorable location to stabilize the CC plasmas but the plasma beta was too low and could not provide stability. The present experiments were designed to increase the beta with additional microwave power. In addition, diagnostics were installed to determine the length of the plasma New diagnostic techniques and measurements will be presented. [C411]

"Hybrid antenna imaging arrays for plasma imaging"

Slot bowtie antennas have been previously utilized as array elements in both microwave electron cyclotron emission imaging (ECEI) and microwave imaging reflectometer (MIR) diagnostics for imaging electron temperature (Te) profiles and fluctuations, and density (ne) fluctuations, respectively, in tokamak magnetic fusion plasmas. Recently, planar dual dipole antennas have been successfully developed to replace slot bowtie antennas. These antennas offer a number of advantages over the slot bowtie antennas, including increased sensitivity, reduced sidelobe levels, and reduced interchannel spacings which allow for higher resolution imaging. Antenna development activities have proceeded in four stages. First, detailed computer simulations were made using IE3D, a full wave method of moments electromagnetic simulation code. Here, the effects of antenna lead lengths, widths and spacing were studied with and without insitu RF filters. Successful designs were then fabricated on hybrid printed circuit boards employing millimeter-wave beamlead diodes. Here, subarrays consisting of four array elements in close proximity were characterized over a large RF bandwidth to determine

antenna patterns and crosstalk levels between adjacent channels. In this paper, details regarding the simulations and laboratory characterization are presented. Full 16 channel arrays optimized for MIR at 88 GHz and ECEI at 120-130 GHz have been designed, fabricated and installed on the TEXTOR tokamak. Photographs of these arrays together with focal plane patterns measured both in the laboratory and on site on TEXTOR, will also be presented. [C412]

"Diagnostical-therapeutical applications of microwaves"

Diagnostic, therapeutic and some special applications of microwaves are discussed. A brief description of methods and devices and their approximate evaluation are given. It is shown that the most interesting prospect is a combined diagnostic and therapeutic method, which permits execution of a procedure on a patient simultaneously with monitoring to avoid the unwanted influence of microwaves. [C413]

"Crack generation and removal in cleaved air-silica structured optical fibres"

The damage caused by cleaving various air-silica (AS) structured fibers is investigated as a function of cleaving force. Comparisons are made with standard optical fibers and tapered fibers. Optimum cleaving forces are determined for a number of air fractions and fiber diameters. A simple technique for removing cleave damage is also presented. Atomic force microscopy proves to be an efficient diagnostic tool for the characterisation of this damage and treatment. [C414]

"Fluctuation measurements of the ultrashort pulse reflectometry system on SSPX"

Summary form only given. New physics understanding of the ultrashort pulse reflectometry (USPR) diagnostic technique has been achieved with a series of receiver bandwidth studies on the Sustained Spheromak Physics Experiment (SSPX) device at the Lawrence Livermore National Laboratory. This new understanding, together with a number of transmitter and receiver modifications suggested by this new understanding, has resulted in significant increases in both dynamic range and signal-to-noise ratios of the USPR signals. This in turn has translated to a significant reduction in receiver timing jitter and the number of "lost" signals in which the received power has dropped below the detection threshold USPR involves the propagation of short duration (2-3 ns) chirps of moderate frequency bandwidth. These chirps axe upconverted to millimeter-wave frequencies, reflected from the plasma, and downconverted for detection and analysis. Each received chirp is analyzed at a number of simultaneous frequencies, with multiple chirps required to provide broad frequency coverage. Commercial time-to-amplitude converters convert the receiver time delays into easily acquired analog voltages with 25 ps resolution. On SSPX, four mixers (LO frequencies are 27, 44, 57 and 75 GHz) are utilized to up- and down-convert 7-16 GHz chirped waveforms to millimeter-wave frequencies (34-91 GHz). Four mixer operation provides 32 frequency channels of timing data with 12 μs resolution, while operation with only the lowest frequency mixer provides 8 frequency data with 3 μs resolution. In addition to edge density profile information, the system is also capable of simultaneously monitoring density fluctuations on as many as 32 distinct density layers. Details of the upgraded USPR system axe described together with USPR profile and fluctuation data. [C415]

"Fluctuation measurements on TEXTOR using microwave imaging techniques"

A new instrument for measuring turbulent density and temperature fluctuations has been developed for the TEXTOR tokamak. This is a,combined Microwave Imaging Reflectometer (MIR) and Electron Cyclotron Emission Imaging (ECEI) system, and is expected to extend the range and detail of turbulence measurement capability in fusion plasmas. Both the MIR and ECEI techniques take advantage of large aperture optics to form an image of the reflecting/emitting layer onto an array of detector located at the image plane, enabling localized sampling of small plasma areas. The instrument design evolved from a prototype apparatus previously implemented on TEXTOR, and has been fully characterized in the laboratory using a series of corrugated reflecting, targets. [C416]

"Breast tumor characterization via complex natural resonances"

The research described in this paper is aimed at modeling tumors in breast tissue as buried dielectric targets so that their complex natural resonances (CNR) can be identified and correlated with clinically useful properties. FDTD simulation and Prony's method are used to demonstrate the approach numerically. The technique is proposed as a modality complementary to ultrasound tumor detection. [C417]

"A broadband microwave breast imaging system"

A liquid-coupled, non-contacting, broadband (0.5-3 GHz) microwave imaging system has been designed and fabricated to exploit new clinical information for breast cancer diagnosis. Ultimately this system may complement

conventional X-ray mammography by reducing the number of false negatives and false positives, especially in challenging cases such as patients with radiographically dense breast tissue. [C418]

"Thermal analysis of sealed enclosure for over the ocean application [Cmarine applications]"

RF communication sub-systems, used in marine applications, are deployed on the mast of vessels to achieve reliable reception of microwave signals. They are housed in sealed enclosures to protect against the corrosive sea environment. Natural convection is the preferred method of cooling in such enclosures for ease of maintenance. Conducting verification tests on such enclosures in the actual environment is difficult due to logistic problems. Also, laboratory test conditions may not be representative of the actual operating scenario. This can be avoided by numerical analysis of the sub-system thermal model in the intended environment, resulting in prediction of the temperature. This paper demonstrates detailed analysis of a typical system for marine applications. The unit was modeled and transient analysis was conducted using CFD techniques for various sea ambient and sea states. The analysis results show that the component temperatures are lower in the simulated sea environment and thermal shut off may not take place, even though it has failed previously during verification tests under lab conditions. This case study demonstrates that CAD simulation and CFD analysis can provide diagnostic information and guide the development of a good cooling solution with less "cut and try" effort. [C419]

"Experimental investigation of microwave imaging via space-time beamforming for breast cancer detection"

We investigate the experimental feasibility of detecting small malignant breast tumors using a recently proposed method of microwave imaging via space-time beamforming. A microwave sensor comprised of a planar synthetic array of compact ultrawideband (1-11 GHz) antennas is placed above a breast tissue phantom-a tank of homogeneous normal breast tissue simulant covered by a thin layer of skin simulant. A small ([C420]

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"Experimental results of a 2 GW vircator"

Summary form only given. Experimental findings on the coaxial virtual cathode oscillator (vircator) at Texas Tech University are reported. Recent modifications to the system include extending the pulse forming line that now provides an applied diode voltage of 600 kV for 70 nanoseconds at 60 kA. Other modifications include diode voltage, current, and radiated field diagnostics. In this initial phase of experiments, copper reflectors were installed within the diode to provide a simple means of microwave feedback to assist in the e-beam modulation. Thus far we have observed microwave peak power output with feedback reflectors as high as 2 GW corresponding to an efficiency of -6%. The mode observed at these high efficiencies is almost entirely TE11. At lower efficiencies, both TM01, and TE11modes are observed. These results suggest mode competition at lower efficiencies. [C422]

"A millimeter wave beam shaping phased antenna array proposed for imaging reflectometry"

A millimeter wave phased antenna array has been proposed for use in plasma imaging reflectometric diagnostics and is currently under design and fabrication. To account for the rapid changes of the cutoff layer with plasma density variation, a true time delay controlled phased antenna array (PAA) is being developed as an artificial lens with controllable, focal length,for launching the illumination beam of the microwave imaging reflectometry (MIR) system. The beam shaping concept illustrates that programming the PAA generates concave (focusing/beam narrow) or convex (defocusing/beam broaden) wavefronts by properly arranging the time delay (or phase shift), therefore, the PAA functions like a real optical lens. The focal properties can be easily changed by different time delay arrangement at high speed so that real time control is possible on time scales significantly faster than plasma changes. [C423]

"Characterization of a new dielectric barrier discharge plasma using spectral data"

In the last 30 years, a wide range of diagnostic techniques has been developed for discharge and plasma study. These include electric and magnetic probes, optical fiber sensors, optical and mass spectroscopy, laser scattering, optical and microwave interferometer, and schlieren analysis. However, most of these measuring techniques have limitation with either their range of application, their spatial resolution or their disturbance of the discharge environment. Spectral data used for diagnosing plasma is one of the simplest and the most useful methods because of its high resolution and indirect-contact in measurement. [C424]

"Measurements of the electron density and collision frequency of a one atmosphere uniform glow discharge plasma (OAUGDP™) generated in a parallel plate reactor"

The One Atmosphere Uniform Glow Discharge Plasma (OAUGDP™) is capable of operating at one atmosphere in air and other gases. The applications of OAUGDP™ include surface sterilization and decontamination, plasma etching at one atmosphere, and aerodynamic flow control. The OAUGDP™ can be produced in a wide range of geometrical configurations, ranging from slab plasma between parallel plates to surface plasma that can cover a flat or curved surface. We introduce a new and simple diagnostic technique to measure the electron number density and the collision frequency of the OAUGDP™ in a quantitative and non-perturbing way. The key idea is using a microwave network analyzer to simultaneously measure the attenuation and the phase shift of a microwave signal when the signal propagates through the plasma. [C425]

"Study of a low impedance beam position monitor for short bunches"

A low coupling impedance beam position monitor based on microwave spectroscopy is proposed. A coaxial cavity is coupled to a circular beam pipe through four small longitudinal slots. Displaced beams excite TE cavity modes that can be detected by two antennas. Applying the modified Bethe's theory, the TE111mode power has been derived as a function of the beam displacement. An aluminium prototype has been constructed with the support of numerical (HFSS) simulations. Bench measurements using a coaxial wire excitation show good agreement with both theoretical and numerical expectations. [C426]

"First high-power experiments on a two-channel X-band active rf pulse compressor"

A brief report is presented on experiments carried out at the NRL X-band magnicon facility on a two-channel X-band active rf pulse compressor that employs plasma switches. Experimental evidence is shown to validate the basic goals of the project, which include: simultaneous firing of plasma switches in both channels of the rf circuit, operation of quasi-optical 3-dB hybrid directional coupler, coherent superposition of rf compressed pulses from both channels, and operation of the X-band magnicon directly into the rf pulse compressor. For incident 1.2 μsec pulses in the range 0.63-1.35 MW, compressed pulses of 5.7-11.3 MW were obtained, corresponding to power gain ratios of 8.3-9.3. Insufficient bakeout and conditioning of the high-power rf circuit prevented experiments from being conducted at higher rf input power levels. [C427]

"Simulation and analysis of the performance of magnetrons"

Current research efforts in the area of magnetrons and CFA's make extensive use of computer simulation to reduce design time, investigate new design concepts, and examine the performance envelope. Using MAGIC (electromagnetic-PIC simulation software), we have modeled several magnetrons. This includes the cooker magnetron, the industrial heating magnetron, a rising sun magnetron, and an x-band magnetron. We will outline the procedures for obtaining high quality simulation results in an engineering and research environment. Emphasis will be placed on diagnostic procedures, which have exact or close analogs in physical engineering measurement and practice. We will compare the simulation results with the operating results of these production tubes. We will outline the procedures for making cold test measurement in the simulation environment (cavity resonance, Q factor, return loss, insertion loss, etc,) For hot tests, we will compare tube efficiency and performance. [C428]

"Theory and observations of microbunching instability in electron machines"

Over the last years there have been several reports of quasiperiodic bursts of coherent synchrotron radiation (CSR) in electron rings in the microwave and far-infrared range. The observations were made on synchrotron radiation light sources which include the Synchrotron Ultraviolet Radiation Facility SURF II, VUV ring at the National Synchrotron Light Source at BNL, second generation light source MAX-I, BESSY II, and the Advanced Light Source at the Berkeley National Laboratory. General features of those observations can be summarized as follows. Above a threshold current, there is a strongly increased radiation of the beam in the range of wavelengths shorter than the bunch length, λ 2. At large currents, this radiation is observed as a sequence of random bursts. In the bursting regime, intensity of the radiation scales approximately as square of the number of particles in the bunch, indicating a coherent nature of the phenomenon. [C429]

"Use of acoustic emission to diagnose breakdown in accelerator RF structures"

Accelerator structures of a wide variety have been damaged by RF breakdowns. Very little is known about the mechanisms that cause the breakdown and the damage although there has been theoretical work. Using an array of ultrasonic acoustic emission sensors we have been able to locate and classify breakdown events more

accurately than possible using microwave techniques. Data from the technique has led to improvements in the design of the NLC X-band RF structure. We report results of acoustic emission studies at the DESY TESLA Test Facility and the SLAC NLC Test Accelerator. [C430]

"The blood sugar estimation through measurement of dielectric constant by using microwaves"

Summary form only given. The microwave region of electromagnetic spectrum has many advantages as a choice of radiant energy for the interrogation of biological systems. The measurement of dielectric properties at microwave frequencies allows inferences to be made concerning the tertiary structure of biomolecules, at least with respect to hydration and their associated functions. At microwave frequencies the dominant molecular species contributing to the dielectric constant of bio-systems is water. Likewise, water and electrolytes dominate the dielectric losses in bio-systems. Electromagnetic radiation and propagation characteristics in media (fluid) depends upon the propagation constant γ. The propagation constant reveals the nature of the media in which the wave is propagating, which is a complex number. The real part of it is attenuation constant α, and the imaginary part of it is phase shift constant. The parameters α, β, and γ are generally related to the medium constants. One can estimate the media constants by measuring these parameters in the fluid by electromagnetic radiation and propagation. Microwave measurements of the parameters complex dielectric constant ε' attenuation constant α, phase shift constant β, electron (ion) density ηe, collision frequency ν are sufficient to estimate the characteristics and constituents of the fluid under test. With the help of these parameters, diagnostics of the fluid can be easily performed. In the present work it is proposed to diagnose the blood using microwaves. The medical laboratories perform biochemical measurement in order to confirm the disease of a patient and a report containing the clinical parameters is given which depend on the type of disease. In the present work an experimental procedure, using microwave measurement is conducted for the dielectric constant of the blood sample of diabetic disease by radiating 10 GHz microwave signal. The biochemical measurement and the dielectric constant of blood are compared in order to obtain a relation. [C431]

"Opportunities for microwaves and photonics in medical diagnostics and therapy"

Part I of this presentation discusses topics on RF/microwaves and optics in therapeutic medicine. The advances in the areas of RF/microwave cardiac ablation, RF/microwave treatment of benign prostatic hyperplasia (BPH), microwave balloon technology, RF in the treatment of sleep apnea, LED array for neonatal phototherapy and endoscopic light sources for photodynamic therapy (PDT) are specifically addressed. Part II presents various techniques available for breast cancer detection. Current limitations are discussed and future research trends are enumerated. [C432]

"Longitudinal coupling impedance of the APS storage ring"

The three-dimensional wake potentials of the APS storage ring have been reconstructed according to the impedance database concept. Every wakefield-generating component in the ring was considered including small-gap insertion device (ID) chambers, rf cavities, shielded bellows, beam position monitors, synchrotron radiation absorbers, scrapers, flags, various chamber transitions, septum chambers, and pulsed kickers. In this paper the result for the longitudinal wake potentials and its impedance are presented. The total impedance is not model-based but the direct sum of numerical functions. The fit parameters for the broadband resonator model are also included as a convenient representation. We used this impedance model to investigate the observed microwave instability, namely bunch lengthening, anomalous energy spread, and coherent excitation at high synchrotron sideband. [C433]

"Longitudinal microwave instability in lepton bunches"

The stability criterion for the longitudinal microwave instability in bunched lepton beams is derived using the mode-coupling formalism and taking into account the potential-well distortion. The new formula yields an intensity threshold which can be higher than the one given by the Keil-Schnell-Boussard approximation by a large factor. This result may explain why the classical instability threshold has been exceeded in some lepton machines. [C434]

"Portable device for electrophysical monitoring and EHF reflexophoretic correction of homeostasis disturbances"

The paper discusses the available techniques and equipment for electrophysical monitoring of human stress. The portable device comprises a microwave oscillator, electric reflex therapy and phoretic equipment used to influence skin BAPs for the purposes of treatment and diagnostics. A comprehensive approach provides for efficient triggering of adaptive reactions of human body to stress. Basic principles behind the design of this device are analyzed. [C435]

"A model for interpreting the results of electropuncture diagnostics in the course of EHF therapy"

A medico-biologic model for interpreting the results of acupuncture electrometry is proposed. The model reflects the pathologic process at the level of morphofunctional systems and functional units and makes it possible to trace the dynamics of a pathologic process both by the affection severity and by stages of the disease, as well as to reveal the 'nucleus' of the pathology and to determine efficiently the impact zones for various methods of therapy, including the EHF therapy. [C436]

"Direct measurements of resonance peaks of DNA's and proteins using widely-tunable monochromatic THz source"

This paper presents results of direct measurements of resonance peaks of DNA's and proteins by using a widely-tunable THz source. Direct measurements of transmission and absorption spectra may eventually become a valuable tool for identifying DNA's and proteins based on their unique resonance peaks in the range of 1-3 THz. Probing resonance peaks for DNA's and proteins can be used to monitor changes in DNA-encoded chain in patient's blood for early diagnostic of diseases or gene therapy, and to search for specific signatures of viruses and bacteria or messenger RNA for analysis of metabolic processes. [C437]

"EHF EM-wave reflection anisotropy in the substantiation of atherosclerosis formation"

The lipids deposited on the artery wall with subsequent excrescence of intima connective tissue and formation of atherosclerotic plaques result in atherosclerosis. In studying piezo- and segnetoelectric properties of lipids it was noticed that phase transitions affect the process of atherosclerotic plaques formation, i.e. certain physical properties of plasma blood lipids may influence the atherogenic process. To avoid this problem, a new method was proposed, mm-wave technique of differential reflectometry, which introduces a new indicator of human health: the anisotropy factor (AF). This technique integrates both reflectometry and interferometry in the mm-wave range. The experimental data allowed for numerical evaluation of the model parameters. Continued research into the influence of external fields on blood plasma would contribute to the emergence of new methods to prevent the development of atherosclerosis and would also improve the available methods of diagnostics. [C438]

"SHF study of free radical state of melanin in biopolymers"

The results of investigating the behaviour of melanin pigment system and chitin-melanin complexes under the SHF influence are presented. The possibility of removing the melanin component from the chitin-melanin complexes was studied. The analysis of the efficiency of SHF diagnostics for free radical polymer systems is given. The feasibility of further studying antioxygenic action of melanin and chitin-melanin complexes is shown. [C439]

"Generation, propagation and diagnostics of a long pulse annular electron beam for an HPM source"

We are in the process of re-assembling the injection-locked relativistic Klystron oscillator to increase the duration of the high power microwave pulse. This HPM source is designed to use a 500 kV, 10 kA annular electron beam and generate 1.5 GW microwave pulse. Previously we published that the microwave pulse length was experimentally observed to be limited to a finite change in the beam current. These initial experiments focus on controlling the total variation of the emitted beam current. That is, our goal is to have the vacuum diode behave as a resistive load at the desired voltage. We will be presenting results of experiments on the materials used to fabricate the cathode and its emission surface, results from X-ray and optical diagnostics of the unmodulated electron beam position and thickness, and finally results from X-ray and optical diagnostics of the modulated electron beam position and thickness. These results will be compared with different time dependent and steady state computational tools. [C440]

"The diagnostics of high-power microwave from virtual cathode oscillator with the coupled line band pass filter"

The research of high-power microwave generation has been studied a lot by several methods. virtual cathode oscillator (vircator) can be one of the most promising high-power microwave sources due to its conceptual simplicity and high-output power capability. It is also noted that the frequency bandwidth of vircator is known to be wide. In this experiment, a high-power microwave generator has been obtained from the intense relativistic electron beam pulser, "Chundoong" (Maximum voltage: 600 kV, maximum current 85 kA, and pulse duration of

60 ns). It is of great importance to investigate the measurement of high power microwave frequency, along with the improvement of its output power. For the purpose of accurate measurement of high power microwave frequency, the coupled line band pass filters have been designed and fabricated in this experiment. The frequency spectrum of high power microwave generated from the virtual cathode oscillator based on the "Chundoong" system has been investigated by the coupled line band pass filter. With the use of several coupled line band pass filters swept from 4 to 8 GHz with band resolution of 1 GHz, the microwave frequency and its power have been investigated under A-K gap distance of 4, 6 and 8 mm. It is found that the microwave frequency has been measured to be 5.2 GHz by the dispersive delay line method under the A-K gap distance 6 mm, which is well agreed with that obtained from the coupled line band pass filter. [C441]

"Efficiency results from a coaxial vircator using a simple feedback technique"

Experimental findings on the coaxial virtual cathode oscillator (vircator) at Texas Tech University are reported. A major modification to the system extended the pulse forming line several meters. The pulsed power system now delivers up to 750 kV and 60 kA for at least 70 nsec. Additional modifications include diagnostics to measure the diode voltage, current, and radiated field pattern of the output microwaves. In this initial phase of experiments copper reflectors were installed within the diode to provide a simple means of microwave feedback to assist in the e-beam modulation. Thus far we have observed microwave peak power output with feedback reflectors as high as 3.5 GW corresponding to an efficiency of 9.5%. Measured radiated field patterns show evidence of multimode operation. [C442]

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"Miniature microwave plasma sources based on microstripline designs"

In the past, the challenge in microwave plasma research was to develop techniques that provide high ion and free radical densities uniformly, over large and ever increasing process areas. Since scale-up was usually an important issue when considering industrial applications, the study of very small microwave plasmas, on the order of a few millimeters, was rarely done. Recently, interest in the development of systems on a chip, MEMS and their related micro system applications, has suggested the possibility of numerous applications for mini and micro plasma sources. Accordingly, this investigation is devoted to the development and the understanding of the behavior of very small microwave plasma sources. We have constructed microwave plasma systems based on microstripline technology that create and allow for the experimental investigation of millimeter size plasmas. Plasma are generated across a wide range of input parameters, including pressure variation from below 1 Torr to 1 atmosphere, input power at 2.45 GHz from one watt to 100 watts, and a variety of gas mixtures including argon, nitrogen and hydrogen. Microwave plasmas of various sizes (volumes) and aspect ratios are studied. Plasma density, size, shape, ignition, and emission spectra are measured to characterize the miniature plasma over the operating range. Companion modeling work based on the global model is used to further understand the operation of miniature microwave plasma sources. The experimental and modeling results are used to identify the experimental operating regime necessary to excite and maintain stable, high density, miniature microwave plasma sources. Data will be presented showing the discharge power density as a function of discharge pressure, input power and size. The power densities for discharges of dimensions in the range of 2 mm to 0.4 mm range from 100's to 1000's W/cm3and the plasma densities as indicated by the global model are in the range of 1013-1014cm-3. [C444]

"ECE and reflectometric imaging on tokamak plasmas"

Summary form only given. An exciting tool for the study and visualization of plasma turbulence is presently under development for the TEXTOR-94 tokamak. This system combines a high resolution electron cyclotron emission imaging (ECEI) diagnostic with an innovative microwave imaging reflectometer (MIR) diagnostic for the simultaneous localized measurement of electron temperature T. and electron density nefluctuations in the tokamak core. The ECEI diagnostic images second harmonic cyclotron radiation from the optically thick plasma onto a 1-D array, thereby forming an image of the Teprofile and fluctuations associated with the emission layer. The MIR diagnostic images radiation reflected from the plasma cutoff layer onto a similar 1-D array, thus forming an image of nefluctuations at the reflecting layer. Both diagnostics are capable of forming 2-D images of plasma turbulence by varying the frequency of the probing (for MIR) or received (for ECEI) signals. Adjustment of the reflectometer probing frequency permits the reflecting layer to be positioned coincident with the ECEI emission layer, thereby simultaneously sampling both Teand nefluctuations over an extended surface of the TEXTOR-94 plasma. Such data will permit the visualization of complicated 2-D and/or 3-D structures which is essential for

definitive comparisons to be made with the predictions of gyrokinetic computer simulations. In addition, the system will also be employed in the study of a number of MM phenomena such as plasma filament formation, magnetic islands and internal transport barriers. An overview of the simultaneous imaging diagnostic concept will be presented along with technical details and characterization measurements of the TEXTOR-94 diagnostic. The system is presently under fabrication, and will begin operation in August, 2002 when TEXTOR-94 resumes operation after the installation of a dynamic ergodic divertor. [C445]

"Particle flux and energy distributions in electron beam-produced ion-ion plasmas"

Summary form only given. Ion-ion plasmas are thought to prevent device damage and isotropic etch profiles resulting from localized surface charging in conventional electron-ion plasma processing. The advantage of ion-ion plasmas is derived from the ability to deliver anisotropic fluxes of both positive and negative ions to the substrate surface. We present the results of experiments aimed at forming electron beam-generated ion-ion plasmas. Temporally resolved ion flux and energy distributions are reported for pulsed plasmas produced in Ar/SF6mixtures. Positive and negative ions were extracted from the plasma by applying a low frequency, low voltage, square wave bias to an electrode located adjacent to the plasma. Supporting Langmuir probe and microwave absorption measurements are also reported to give a more complete description of the ion-ion character in these plasmas. The results are compared to those from electron-ion plasmas produced by the same high-energy electron beam in non-halogen gases. The appropriate gas phase kinetics are discussed as well as the experimental requirements needed to produce ion-ion plasmas. [C446]

"Density and temperature measurements of a torch plasma"

Summary form only given. A diagnostic method based on microwave absorption is being developed to measure the density and temperature of torch plasma. It uses an arrangement, which streams torch plasma through aligned holes on the bottom and top walls of a rectangular waveguide to act as a dielectric post. The dielectric post has a complex dielectric constant ε=ε'-jε" and can be represented by an equivalent two-port T-circuit with specified shunt and series impedances. Marcuvitz has analyzed this problem in the Waveguide Handbook. The analytical solution is the basis of the diagnostic technique. A 10 GHz microwave and a rectangular waveguide of dimensions 1 in. Ч 1/2 in. are used in the experiment. The holes on the waveguide top and bottom walls for torch plasma to stream through have a diameter of 1/2 in.. A network analyzer is used to measure the TT-10 mode transmission coefficient of this two-port network. Since the amplitude and phase of the transmission coefficient depend on the dielectric property of torch plasma, the measured results establish two independent relations for the two unknowns, the density and temperature, in the dielectric function of torch plasma. The experiment and results are presented. [C447]

"Design of the collective Thomson scattering diagnostics for Large Helical Device using a quasi-optical frequency tunable gyrotron as a radiation source"

Summary form only given. Development of the Collective Thomson Scattering (CTS) diagnostic system for LHD is presented. High frequency, tunable (87-97 GHz), medium power (100 kW) quasi-optical gyrotron will be used as a radiation source. We will show the detailed description of the system as well as initial calculations of the scattered microwave power from the LHD plasma. Using the quasi-optical gyrotron as a radiation source was inspired by the fact that this particular device has the ability of tuning of the operational frequency. Which is made it very attractive for using under the various scenarios for LHD plasmas. It is planned that the system utilize 'forward scattering schema' of the experimental set-up. The calculation of the expected scattered power shows that (in the chosen frequency range and chosen values of the scattered angle) the dominant part of it came from the so-called 'ion-feature'. This is a situation when the incident radiation is mainly scattered by the 'shielded ions' (by electron cloud). Other advantage for using gyrotron (not 10.6 μm CO2laser) as a power source is as follows. Since for the typical scattering experiments under consideration scattered wave number is k kisin(θB/2). Thus for coherent scattering to occur, it is possible to significantly increase the scattered angle θBas a wave length of the incident radiation increases from the short wavelength (CO2laser) through far-infra-red (FIR) wavelength to the millimeter wavelength of gyrotrons. [C448]

"Characterization of a plasma source excited by an annular waveguide resonator"

An experimental set-up for production of large volume discharge has been developed using the surface wave concept and is reported in this paper. A 1500W, 2.45GHz microwave power was obtained by a coherent association of two commercial water cooled magnetrons like those used in microwave ovens. An annular waveguide resonator with axial slots was built to operate as the electromagnetic launcher. The half wavelength slot antenna array extends axially on the inner side of the annular resonator sustaining the plasma in a quartz cylinder of 140 mm in diameter and 1200 mm in length. The microwave power is coupled into the discharge tube

by 10 resonant coupling slots which are positioned at regular intervals on the inner side of the annular waveguide. The measurements of the electron density and the electron temperature as function of argon pressure and the axial and the azimuthal positions were performed using a double Langmuir probe. The data acquisition and the calculation of plasma parameters are controlled by a personal computer. Preliminary results indicate an electron number density of the order of 1Ч1012cm-3and an electron temperature about 1 eV for a microwave power of 1500W and an argon pressure of 1 mbar. [C449]

"Initial operation of a plasma isotope separation system"

Summary form only given. A plasma-based isotope separation system has been installed at TheragenicsTMOak Ridge, TN facility and has recently been placed into operation. This facility is designed to separate stable isotopes of metallic elements utilizing the Plasma Separation Process' (PSP). In this process, electron cyclotron resonance heating using a microwave power source forms the plasma. Neutral particles of feed material to be separated are introduced by sputtering a feedstock plate and are ionized by the plasma electrons. Metal ions drift through a highly uniform magnetic field and are subject to ion cyclotron waves tuned to excite a specific isotope mass. The excited ions are separated from low energy off-resonant ions in a louver shaped collector structure. The facility utilizes a 2 T superconducting magnet with a 1 m bore and uniform field length of 5 m. This magnet is a pool-boiling type filled with 5500 L of liquid helium. The plasma chamber inside the bore of the magnet is maintained at high vacuum by two large diffusion pumps and is backfilled with low pressure argon gas to initialize the sputtering process. A 28 GHz CW gyrotron system capable of operating at up to 200 kW provides plasma ionization. Power is transmitted from the gyrotron to the vacuum chamber through a smooth-wall 63.5-mm waveguide and large-radius corrugated bends. A double disk cooled waveguide window is situated inside the vacuum to permit a high-field launch point. The plasma column formed inside the magnet is 0.4 m diameter and 6 m long. Typical plasma parameters maintained are 5Ч1017m-3electron density and [C450]

"Unbounded and bounded microwave plasmas generated by a monopole antenna structure"

Summary form only given. Methods of creating and controlling miniature microwave discharges that operate with low input power levels are being investigated. Various experimental structures to create these small sized and low input power microwave discharges are currently being constructed and measured. One variation creates the plasma discharge by the near fields of a short monopole antenna or electrode structure such that the discharge is attached or nearly attached to the antenna or electrode structure. The objective of this investigation is to explore the behavior of these discharges when they are operated at low microwave powers and with small physical dimensions. The experimental configuration utilized in this investigation is a single, microwave powered, monopole antenna or electrode extending into a discharge chamber. The microwave power supplied to the antenna structure is 2.45 GHz with a double stub tuner used for impedance matching to reduce the reflected power. The microwave discharge for a range of pressures and powers forms at the tip of the antenna with the size and properties of the discharge being dependent on the pressure and power. The discharge formed can be either unbounded where the plasma discharge surrounds the electrode tip, but the discharge is not large enough to touch the walls of the discharge chamber, or bounded where a discharge chamber enclosure confines the discharge. For the bounded discharges, three variations are considered including a spherical confinement, a cylindrical tube confinement and a flat disk shape confinement. The spherical confinement produces a plasma bounded in three directions, the cylindrical confinement produces a plasma bounded in two directions that is free to expand along the third direction, and the disk shaped confinement produces a plasma bounded in one direction and free to expand along the other two directions. The discharges are characterized using diagnostics to determine the discharge shape, size and power density via visual imaging and microwave power measurements, and the discharge charged particle densities and electron temperature via Langmuir probe measurements. Parameters varied in this study include the size and shape of the microwave antenna electrode, the discharge pressure (50 mTorr to- 50 Torr) in the chamber, the input microwave power (less than 1 Watt to 100 Watt) and the type of feed gas (Argon and Nitrogen). Discharge sizes studied range from several cubic centimeters down to just a few cubic millimeters. [C451]

"Atomic effects in the turbulent properties of microwave generated plasmas"

Summary form only given, as follows. Microwave plasmas are generated in helium, neon, argon, krypton, and xenon at various microwave powers and neutral gas pressures. A floating Langmuir double probe is employed to diagnose plasma electron density and temperature. Bias voltage and current characteristic curves are analyzed for the determination of electron temperature and density for all five gases. Turbulence analysis is carried out by using time resolved neutral line emission data from these gases at a sampling rate of 100 MHz. Fourier spectra of emission fluctuations allow determinations of the total turbulent energy and the characteristic turbulent fluctuation frequency, which is also evidenced by the periodic motion in the phase space trajectory. The computations for chaotic dimension are also carried out for all five species. Systematic trends in the turbulent

parameters show a dependence on atomic weight. These trends are consistent with observations of molecular influence on turbulent transport found in other plasmas and neutral gases and with current theoretical models. [C452]

"The uniform, steady-state atmospheric pressure DC plasma"

We have developed and diagnosed a steady-state DC plasma discharge apparatus that operates at atmospheric pressure. The device also works well with low frequency AC at 60 Hz. The new feature is a ceramic discharge electrode that prevents the diffuse discharge from contracting into an arc. The apparatus works well in air, but for large volume plasma generation of several liters, helium is used. The maximum DC power applied is 300 Watts. The apparatus has been used successfully in the destruction of microorganisms (1). Recent results from our plasma discharge in helium include separate measurements of the electron and the ion densities. These numbers differ, as the plasma contains negative ions as well as electrons. The most convincing electron density measurement is a microwave attenuation measurement of 10 exp 11 per cc. Conventional plasma resonance measurements do not work, as the high electron-gas atom collision rate suppresses the resonance effects. Although the attenuation is small-about one percent-the attenuation is readily observable by a chopping technique. As a byproduct of the density measurement, the lifetime of the free electrons before being converted into negative ions is observed to be tens of microseconds. A second plasma electron density measurement is made by measuring the electron drift current, which also yields 10 exp 11 per cc. Plasma ion density measurements have been made with a variety of single and double Langmuir probes, and yield densities on the order of 10 exp 12 per cc. [C453]

"Field enhanced microwave breakdown in gas for a plasma limiter"

Summary form only given, as follows. A new type of plasma limiter is being developed capable of turnon in less than 1 nsec. The approach taken is to initiate streamer breakdown via a micron radius needle tip. Studies were conducted on breakdown with a variety of gases at pressures from 103to 10-2torr. Gases tested included dry air, neon, argon, and krypton. Studies were also conducted on dc-voltage biasing the needle and its effect on breakdown. The experimental setup uses an S-band traveling wave resonant ring (TWRR) capable of power levels up to 100 MW when coupled to a 2.85 GHz, 4 MW, magnetron. High speed diagnostics with a response on the order of 1 ns record the microwave power, luminosity, and x-rays. A high speed CCD camera with an adjustable exposure time down to 10 nsec records a snapshot of the breakdown sequence. Preliminary results exhibit a reduction in expected gas breakdown levels by over two orders of magnitude. [C454]

"Time-averaged electron number density measurement of a one atmosphere uniform glow discharge plasma (OAUDGP) by absorption of microwave radiation"

Summary form only given. A simple and accurate technique for measuring the time-averaged electron number density of a plasma at atmospheric pressure is described. It is based on the angle-of-incidence dependent response of the plasma absorption to the incident microwave signal. The method is applied to determine the time-averaged electron number density of a One Atmosphere Uniform Glow Discharge Plasma (OAUDGP) generated in air on a dielectric-coated reflective substrate on which a series of parallel, plasma-generating electrodes are located. In the case of microwave propagation through this plasma, the refractive index of the propagation medium is complex, and the penetrating wave drops off exponentially from the boundary of incidence. The flux density drops by a factor of e-1after the wave has propagated a distance δ, known as the skin depth. The skin depth is inversely proportional to the square root of the electron number density. The author of reference has developed a steady-state, uniform glow discharge plasma at one atmosphere pressure that is generated in a thin surface layer in air and other gases. This OAUDGP layer is generated by applying an RF signal of 1-20 KHz on a dielectric flat panel covered with parallel strip electrodes. The electron number density of the plasma layer is periodic with the applied RF signal. If microwave radiation propagates through the plasma layer, the attenuation is proportional to the round-trip path length of the reflected wave. A 20 dB horn antenna, operating at 12 to 18 GHz, was used both at the transmitter and the receiver end. We compared the change in the intensity of the reflected signal with the plasma layer on and off. At normal incidence, our experimental results should agree with a relatively straightforward numerical calculation based on Appleton's equation. Finally, we hope to extend the experiment to stroboscopic electron number density measurement of the electron number density as a function of time. [C455]

"Electrodynamic models of resonator sensors in microwave diagnostics of semiconductors"

The paper is dedicated to electrodynamic models of resonator sensors, which are used in microwave diagnostics of semiconductors. Research results are compared using exact and approximate models. The field of use of the latter for description of resonator sensors of capacitive type is determined. [C456]

"ECH comes of age for magnetic fusion research"

Advances in gyrotron technology are resulting in new capabilities and scientific results on magnetic confinement devices for fusion research worldwide. Unit output power of 1 MW and higher, at frequencies greater than 100 GHz and quasi-cw operation have become possible. This has led to successful experiments on electron cyclotron heating, electron cyclotron current drive, non-inductive tokamak operation, tokamak energy transport, suppression of instabilities and advanced profile control leading to enhanced performance. The synthetic diamond gyrotron output window is being developed as the answer to the requirement for a low loss blocking window with excellent thermal and mechanical properties and the potential for cw operation at high power. Ancillary equipment for efficient microwave transmission over distances of hundreds of meters, polarization control, diagnostics and flexible launch geometry have all been developed and proven in regular service. There now is excellent convergence between the experimental measurements and theoretical understanding of the heating and current drive mechanisms. The reliability of high power gyrotron installations is at the level previously achieved by neutral beam systems. [C457]

"THz techniques in plasma diagnostics"

THz techniques have been widely employed In magnetic fusion plasma diagnostics, including far infrared Interferometry, polarimetry, and scattering to measure plasma electron density profiles, magnetic field strength profiles, and density fluctuations, respectively. The high magnetic field strength and high plasma densities anticipated for next generation fusion devices will further extend the applicability of THz techniques to the diagnostics of electron temperature profiles and fluctuations by electron cyclotron emission imaging, and electron density profiles and fluctuations by imaging reflectometry [C458]

"Realization of high efficiency in a plasma-assisted microwave source with two-dimensional electron motion"

Summary form only given. A plasma-assisted slow wave oscillator (pasotron) may be operated without an external magnetic field allowing for radial motion of the electrons. This phenomenon has been exploited to achieve an increase in interaction efficiency from 20% to 50% by injecting electrons into the weak RF field region near the axis and having them bunch as they move axially and radially toward the surface of the slow wave circuit where RF fields are strong and efficient energy extraction occurs. Both in-situ diagnostics and analysis confirmed that the enhanced interaction efficiency is due to the fact that RF forces dominate the beam dynamics. [C459]

"A review of dielectric properties of normal and malignant breast tissue"

This paper presents a review of the dielectric properties of normal and malignant breast tissues for radio through microwave frequencies, as well as a brief summary of the experiment methods and the mechanisms that explain the difference in the dielectric properties of normal and malignant breast tissue. This information provides a basis for the development of diagnostic techniques for breast cancer and also highlights the areas that are in need of more experiments [C460]

"IEEE Conference Record-Abstracts. 2002 IEEE International Conference on Plasma Science (Cat. No.02CH37340)"

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"34 GHz fundamental-mode peniotron for high device efficiency"

Summary form only given. The peniotron interaction has been proven capable of yielding electronic conversion efficiency as high as 75%. This inherently high efficiency is due to the nature of the interaction in which the electrons move forward in phase by 360° with each cyclotron orbit. Therefore, the electrons see the transverse component of the resonant wave as a "DC" electric field, experience ЕЧВ drift, and lose all or most of their transverse energy to the wave. However, while high conversion efficiency has been demonstrated, practical application of the peniotron requires that high power be efficiently extracted from the device while competing gyrotron modes are suppressed. This is the objective of the UCD harmonic peniotron. The UCD peniotron incorporates a four-vane slotted cavity with a vane radius of 1.82 mm and slot/vane radius ratio b/a of 1.45. The lowest order mode of this slotted circuit, the pi/2 mode, is a TE11-like mode with a large TE31component, which is necessary for the second-harmonic peniotron interaction. This mode is resonant (first axial mode) at approximately 34 GHz for the 31 mm cavity design length. The fundamental-mode interaction provides good separation from possible competing gyrotron modes with the nearest competition being the fourth harmonic

gyrotron. Simulation with a large-signal code however, indicates that the starting current of the fourth-harmonic gyrotron mode is above the peniotron operating current of 3.5 amps, further insuring stability. The cavity incorporates diffraction coupling through an output iris to achieve the desired loaded Q of 375 required for overcoupling of the device and maximum power output (approximately 125 kW). The iris output coupling also has the added benefit of heavily loading higher order axial modes, further enhancing stability. VVR-28 ports are coupled directly into the slots of the resonant cavity to allow for power measurement and other diagnostics. Large signal simulation of the device predicts an electronic conversion efficiency of 58% with a predicted device efficiency of 47%. The device is designed to be driven by a Northrop-Grumman Cusp electron gun. [C462]

"The 10 MW ECRH system for W7-X"

Electron Cyclotron Resonance Heating (ECRH) is the main heating method for the Wendelstein 7-X Stellarator (W7-X),which is the next step device in the stellarator line of IPP and is presently under construction. The experiment aims at demonstrating the inherent steady state capability of stellarators at reactor relevant plasma parameters and is therefore equipped with a superconducting coil system. A 10 MW ECRH power plant with CW-capability at 140 GHz is under construction to meet the scientific objectives. The microwave power is generated by 10 gyrotrons with 1 MW each. A prototype gyrotron is presently being developed in collaboration between European research-laboratories and industry and incorporates advanced features like single stage depressed collector, optimized quasi-optical mode converter and a CVD-diamond window. The first prototype was successfully tested and an output power of up to 1 MW, a pulse duration of up to 180 s (at reduced power) and an efficiency of up to 50% was achieved. Recent test results are reported. The gyrotrons are supplied by 10 modular solid state HV-supplies (65 kV, 50 A each) providing fast power control and high flexibility. The first power supply module is presently under test. The ten individual microwave beams are combined and transmitted to the main torus hall by an open quasi-optical transmission system with high transmission efficiency, which runs at normal pressure and consists of water cooled imaging mirrors. Cold tests of a full size, uncooled prototype line and the related RF-diagnostics are discussed. The microwave power is launched to the plasma through 10 diamond barrier windows and in-vessel quasi-optical plug-in launchers, which allow an independent steering of each beam. The polarization as well as the poloidal and toroidal launch angle of each microwave beam can be individually controlled to provide optimal conditions for different heating and current drive scenarios. The construction of the ECRH plant is well under way and the status is presented. [C463]

"Determination of the two-dimensional distribution of plasma parameters in an atmospheric microwave plasma"

Summary form only given. Using a 2.45 GHz microwave source, Ar-O2plasma was produced at atmospheric pressure in an azimuthally symmetric geometry. Optical emission spectroscopic method was used to measure the line-of-sight integrated emission spectrum at different microwave power and gas flow rate. A two-dimensional (r,z) distribution of the plasma density, electron temperature, and gas temperature was obtained by means of Abel inversion analysis. From the result, the effect of the ambient air on the atmospheric microwave plasma was investigated. [C464]

"Recent advances in the theory and experiments on plasma-assisted microwave source"

A plasma-assisted slow wave oscillator (Pasotron) may be operated without external magnetic field allowing for radial motion of the electrons. This phenomenon has been exploited to achieve an increase in the interaction efficiency from 20% to 50% by injecting electrons into the weak RF field region near the axis and having them bunched as they move axially and radially toward the surface of the slow wave circuit where RF fields are strong and efficient energy extraction occurs. The absence of a guide field, which gives the electrons the freedom to move not only axially but also transversely under the action of the RF fields, explains the high efficiency. This high efficiency is unattainable in conventional backward wave oscillators driven by linear electron beams in the presence of an externally applied guiding magnetic field. In our paper, recent theoretical and experimental studies of this device with two-dimensional electron motion will be described. Both in-situ diagnostics and theoretical analysis confirmed that RF forces dominate the beam dynamics. The innovation of simultaneously controlling the beam cross-section and optimizing the quality factor enables stable, high efficiency operation. These results greatly improve the prospects for developing advanced, plasma assisted, megawatt-class microwave sources. [C465]

"Electron density and electron temperature in pulsed atmospheric pressure air plasmas"

The use of atmospheric pressure air plasmas as reflectors for microwave radiation with frequencies up to 30 GHz requires electron densities of approximately 1013cm-3. It has been shown, that direct current microhollow cathode sustained (MCS) discharges meet this requirement. However, the power consumption of such air glow

discharges of 5 kW/cm3does not permit scaling to large volumes. Pulsing the discharge on a time scale, which is less than the characteristic time for glow-to-arc transition allows us to reduce the power density while keeping the average electron density at the required high value. So far the electron density in these pulsed discharges has been estimated using information on the plasma conductivity; data on the electron energy which is sharply shifted towards higher energies during the pulse have only been obtained through modeling. We have measured the electron density in a pulsed atmospheric air plasma by means of heterodyne interferometry. A measure for the electron energy, the electron temperature, was obtained by means of emission spectroscopy. 20% argon was added to atmospheric air, and the relative intensities of two argon lines, at 810.37 nm and 811.52 nm, were measured. Assuming a Maxwell-Boltzmann distribution of the electron energies allowed us to determine a value for the electron temperature. [C466]

"Electropuncture diagnostics results interpretation at mm-wave therapy conducting"

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"Electro-optic field-mapping as a diagnostic tool for microwave circuits and antenna arrays"

The effectiveness of an optical-fiber-mounted electro-optic probe as a scanning electric-field-mapping tool is demonstrated in diagnostic measurements on microwave and millimeter-wave circuits, antennas, and arrays. A combined electric-field and thermal-imaging capability is also discussed. [C468]

"Microwave probe based on resonance section of pair line"

Described in the paper is the influence of gorge non-linear effects on the operation of a plasma resonance microwave probe based on the resonance section of a pair line, both theoretically and experimentally. It is shown that such a probe (in non-linear mode) can be used for measurement of plasma density, as well as plasma temperature. Resonance probes, used for plasma diagnostics are very sensitive even to minor changes in media parameters. Shifting and expanding of the resonance curve is the main data source in such sensors. The probe should introduce minimal perturbations into the surrounding plasma, though these perturbations can also be used for diagnostics. Described in this paper is a plasma resonance microwave probe based on the resonance section of a pair line. Even at a comparatively low exciting signal, non-linear effects appear. The authors have developed a non-linear theory of resonance microwave probes based on the resonance section of a pair line, and compared theoretical calculations with experimental results. It is shown that the non-linear mode can be used successfully for measurement of plasma density, as well as plasma temperature. The plasma density and temperature data, obtained by means of the microwave sensor under consideration, agrees well with the measurement results obtained using traditional single and double probes. [C469]

"Snap of microwave plasmatron operation stability within pressure range in medium vacuum"

A snap of microwave plasmatron operation stability within the pressure range in medium vacuum was developed and tested on the basis of an optical diagnostics technique. The essence of the technique is simultaneous synchronous recording of the signal from the vacuum-gauge analog output and the signal from the photoelectric multiplying tube. Recording is carried out during plasmatron pumpout from the moment of gas cut-off to the moment of discharge starvation. We compared the data obtained during investigation of microwave discharge stability in different modes of plasma generation with the results of the snap of discharge glow properties. Such analysis proves the reliability and high informativity of the developed technique. [C470]

"Microwave diagnostics of cubic boron nitride"

Presented in this paper are the results of a study of cubic boron nitride (cBN) micropowder, synthesised at a controlled composition of reaction furnace charge. The possibilities of electron paramagnetic resonance (EPR) techniques are shown for the control of the stoichiometric composition and quality of the BN microcrystals. [C471]

"Dynamic characteristics of axially symmetric supersonic flow under microwave conditions"

Using supersonic dynamics and the Onsager potential transfer differential equation of irreversible process thermodynamics, the dynamic characteristics of the axially symmetric supersonic flow radiated by a microwave beam has been studied theoretically. The results of this research are relatively satisfied in comparison with experimental measurements. It is useful to study parameters of the plasma by ultrasonic methods for plasma diagnostic applications. [C472]

"High-power microwave generation by virtual cathode oscillator"

A new configuration of virtual cathode oscillator is proposed and tested experimentally. A resonant cavity is used to enhance the field feedback to the virtual cathode oscillation. The experiments were carried out on repetitive pulsed power generator "ETIGO-IV" (400 kV, 13 kA, 120 ns, 1 Hz). The diagnostic results have shown the peak microwave output power of 450 MW, giving peak-to-peak microwave power efficiency of 9%. [C473]

"A millimeter wave beam shaping phased antenna array"

A millimeter wave phased antenna array (PAA) serving as an electrically controlled "lens" is being developed for use in plasma imaging reflectometric diagnostics. To account for the rapid changes of the cutoff layer with plasma density variation, a true time delay (TTD) controlled phased antenna array (PAA) is being developed as an artificial lens with controllable focal length for launching the illumination beam of the microwave imaging reflectometry (NUR) system. Varactor diode loaded transmission lines, also called Nonlinear Delay Lines (NDL), are utilized in this electronic lens to control the time delays between each array element, and subsequently the wavefront of the probe beam. Proof of principle 1-D and 2-D PAAs have previously been demonstrated in beam steering systems. A 45 GHz monolithic NDL-based PAA is currently under development and will be installed on the National Spherical Torus Experiment (NSTX) in the near future. [C474]

"Automation of the pulsed diagnostics process for the linear induction accelerator LIA 0.4/6"

We considered solutions for soft hardware which automates the process of the pulsed microwave radiation characteristics and LIA parameter measurements. We include spectral diagnostic facilities for radiation based on reconfigurable narrow-band waveguide filter; specialized video input card obtained from the speed oscillograph (6 LOR-04 M); synchronization and guidance controller; suite and drivers for the interaction of the equipment with the PC for the control of the experimental installation operation and digital processing of the obtained signals. [C475]

"Microwave breakdown studies of He-N2 mixtures in a pillbox cavity from 760 to 3040 torr"

Microwave breakdown of various He-N2mixture combinations is investigated utilizing an S-band double window pillbox cavity. The objective is to determine the best combination of the two gases to maximize the mixture's ability to cool a dielectric surface while maintaining high breakdown thresholds. Helium is known to be an excellent source to dissipate heat from a dielectric, but it also has a low microwave breakdown threshold. Nitrogen does not transport heat as well, but has a much higher breakdown threshold. The studies focused on generating a series of E-field vs pressure curves for breakdown to help identify optimum He-N2mixture ratios. The S-band double window pillbox has a 333 cm3cavity with two ports to flow the gas mixture through. The pillbox is placed in a traveling wave resonant ring (TWRR) coupled to a 2.85 GHz, 4 MW, magnetron. This combination of double window pillbox and TWRR allows for testing power levels up to 40 MW. High speed diagnostics are used to measure the incident/reflected power and discharge luminosity. Coupled mass flow controllers maintain the gas mixture ratio and continuous gas flow through the cavity. Investigations can be conducted with single or multiple pulsed operations. Results ranged from a minimum of 5 MW for pure helium at 760 torr, to greater than 40 MW for pure nitrogen at 3040 torr. [C476]

"Investigation of nonequilibrium component of human microwave radiation"

Considered in this paper are the results of investigations, from three respondents, of microwave nonequilibrium radiation within the 53-78 GHz band. Nonequilibrium radiation is a perspective for diagnostics of a living organism's state. [C477]

"Terahertz imaging of wound healing"

An experimental system is being built to produce images in the little used frequency range of 0.1-3 THz of the electromagnetic system. A system is described, based on a femtosecond laser using optical rectification to generate and electro-optic sampling to detect the terahertz radiation. Different types of THz images are introduced, and the application of THz imaging to wound healing is discussed. Modifications to the initial design needed for in-vivo imaging are also discussed, with the final aim being the real-time imaging of a wound on a patient. [C478]

"Limited view thermoacoustic tomography"

Truncated conjugate gradient method was applied to study the limited view problem in thermoacoustic tomography, and the results were compared with those of modified backprojection method, which is the backprojection of the first order time derivative of acoustic signals. Our numerical simulations showed that there

is complete data for a stable and perfect reconstruction in a 2-D pi-view problem, where the least angle acquired by the detection curve is pi when viewed from the imaged region of interest. On the contrary, in a problem where the view is less than pi, data is incomplete, and artifacts and quantitative errors were obvious in the reconstructed images. It was pointed out that the result after one iteration in truncated conjugate gradient method is equivalent to that of modified backprojection, which can restore the high frequency information of imaged objects. The low frequency information can be recovered significantly in the next ten iterations of truncated conjugate gradient method. [C479]

"A beam-shaping phased antenna array based on true-time delay technologies"

The demand for phased antenna arrays (PAAs) has increased significantly during the past decade. For most applications, they are employed in radar and communication systems to transmit/receive a signal or trace a target. A common function of a PAA is to scan the main beam into the desired direction. Additionally, a PAA can also provide beam-shaping capability by appropriate arrangement of the feed signals, which is the focus of the current research. Such a beam shaping PAA system has been proposed to serve as an electronically controlled "lens" for use in plasma imaging reflectometric diagnostics. To account for the rapid changes of the cutoff layer with plasma density variation, a true time delay (TTD) controlled PAA is being developed as an artificial lens with controllable focal properties for launching the illumination beam of the microwave imaging reflectometry (MIR) system. [C480]

"Upgraded ultrashort pulse reflectometry system on SSPX"

A multichannel ultrashort pulse reflectometry (USPR) system has been upgraded to enhance the performance of simultaneously measuring electron density profiles and fluctuations on the sustained spheromak physics experiment device (SSPX). In addition to the use of a high power frequency multiplier in the transmitter subsystem, the optimization of filter bandwidths in the receiver subsystem results in significant improvement of the dynamic range and signal-to-noise ratios of the USPR signals, thereby dramatically reducing the number of "lost" signals. Details of the upgraded USPR system are described together with USPR profile and fluctuation data. [C481]

"2-D fluctuation imaging diagnostic for TEXTOR"

A system capable of simultaneous 2-D imaging of electron density and temperature turbulence on TEXTOR is presently under development. Concept design details are presented. The system combines both electron temperature and density diagnostic techniques into a single instrument capable of the simultaneous measurement of both fluctuations (both turbulent and coherent) on the TEXTOR tokamak. [C482]

"Electrophysical monitoring of stress state and its correction by influence of low-intensive MM-radiation"

In this paper it is shown that EHF therapy allows one to effectively activate the corresponding adaptive reactions of a human organism in conditions of deep stress by means of low intensity MM-wave radiation at Ka-band. Electropunctural monitoring allows one to indicate and control all stages of the process. [C483]

"Methods and equipment for electrophysical monitoring and MM-wave correction of human organism state"

We developed the methods and equipment for electropuncture express-diagnostics of functional state of a human organism by measuring of electrophysical skin parameters, as well as EHF-correction, using the influence of low intensity electromagnetic EHF-radiation. Discussed in this work is the possibility of a cybernetic approach to the control of biosystem functional status on the basis of a homeostasis model. [C484]

"Efficiency and compatibility of bio-resonance information-puncture therapy (BRIPT) and other effects at complex chronic ailment during rehabilitation period"

The paper states the experience of management of patients with plural chronic pathology using the curative-diagnostic complex "Ramed-Expert" in the conditions of a rehabilitation department. Efficiency of the complex application of K-band therapy with information-resonance therapy, exercise therapy, laser treatment and preliminary cleansing programs without negative reaction for organisms are shown. [C485]

"THz technology for label-free genetic diagnostics"

THz-wave based approaches for the label-free characterization of genetic material are presented. Time-resolved

THz spectroscopic analysis of genetic sequences (polynucleotides) demonstrate a clearly distinct complex refractive index in the THz frequency range as a function of the hybridization state (hybridized/denatured) of the analysed DNA sequences. By monitoring THz signals one can thus infer the binding state of oligo- and polynucleotides, enabling the label-free determination of the genetic composition of polynucleotides. A broadband experimental proof-of-principle in a free-space configuration, as well as a first demonstration of a high-sensitivity integrated approach reaching femtomol detection levels and single base mutation detection capabilities, are presented. [C486]

"Using of advanced methods for express-diagnostics and control of medical process dynamics"

This paper proposes a new approach for express-diagnostics and control of medical process dynamics at different pathological and functional changes in human organisms. Clinical tests were conducted in order to fix the change of complex admittance parameters in bio-active points (BAP) during therapeutic procedures using mm-wave electromagnetic radiation. [C487]

"Emittance measurement of space charge dominated electron beam confined by a longitudinal magnetic field"

Summary form only given, as follows. In microwave devices, the quality of electron beam is of considerable importance. For an axisymmetric beam in a uniform focusing channel, the emittance of the beam is related with the transverse electron temperature and the beam radius. While, the transverse electron temperature can be uniquely defined as a function of the electron density profile. Therefore, measuring the radial distribution of the electron density allows us a determination of the transverse electron temperature and thus the beam emittance. We present a method of measuring the beam emittance using a multi-layer Faraday cup. The experiment is done by directly measuring the beam current that flows into each layer of the Faraday cup, and these currents are then converted to the radial profile of the current density. The transverse temperature and emittance of the beam are calculated by fitting the current profile obtained from the measurement and that from the calculation. This method enables us to measure the emittance of a space charge dominated electron beam confined by a longitudinal magnetic field. The measurement is straightforward and it is possible to avoid the electron deflection and plasma generation due to the electron hitting the slits in a slit-slit method. The proposed method has been used to measure the emittance of a matched beam in a uniform compressing channel. The details of the method and experimental results are presented [C488]

"Electron removal rate modification in optically pumped plasmas"

Summary form only given, as follows. The electron production rate and electron density in optically pumped argon and nitrogen plasmas seeded with carbon monoxide, and with the addition of small amounts of oxygen or nitric oxide have been measured. A Thomson discharge probe and microwave attenuation were used to measure the electron production rate and electron density, respectively. Nonequilibrium ionization in these plasmas is produced by an associative ionization mechanism in collisions of highly vibrationally excited carbon monoxide molecules. Carbon monoxide is excited by optical pumping using a carbon monoxide laser. High vibrational states (up to v=40) of CO are subsequently populated by vibration-vibration energy transfer. It is shown that adding small amounts of oxygen or nitric oxide (50-100 mTorr) to the baseline gas mixtures at P=100 Torr results in an increase of the electron density by up to a factor of 20-40. This occurs while the electron production rate slightly decreases or remains nearly constant. It is also shown that the electron-ion recombination rates inferred from these measurements decrease by 2 to 3 orders of magnitude compared to the case with no oxygen or nitric oxide added. The overall electron-ion removal rates in the presence of equal amounts of oxygen or nitric oxide additives are nearly equal, which shows that the effect of electron attachment to oxygen at these conditions is negligible. These results suggest a novel method of electron density control in cold laser-sustained steady-state plasmas and afford a means of sustaining stable, high-pressure, nonequilibrium plasmas at high electron densities with a low plasma power budget [C489]

"Measurement of excitation temperature on a microwave induced atmospheric plasma"

Summary form only given, as follows. Utilizing a 500 W, 2.45 GHz microwave system, an argon-assisted plasma was produced at atmospheric pressure. Stable generation of the plasma required optimized conditions such as appropriate quartz tube dimension, gas flow rate etc. Optical emission spectroscopy used for spectral line identification revealed the existence of oxygen radicals as well as argon ions and neutrals inside the plasma. Measurement of the excitation temperature was performed by using a Boltzmann plot. The result shows that it is a function of argon gas flow rate. It was also found that the plasma showed behavior as a recombining plasma due to cooling by the incoming cold argon gas [C490]

"Gas breakdown in the sub-nanosecond regime with voltages below 15 kV"

Summary form only given, as follows. Gaseous breakdown in the sub-nanosecond regime is of interest for fast pulsed power switching, short pulse electromagnetics, and for plasma limiters to protect devices from high power microwave radiation. Previous investigations of sub-nanosecond breakdown were mainly limited to high pressure gases or liquids, with applied voltages in excess of 100 kV. We investigate the possibilities to achieve sub-nanosecond breakdown at applied voltages below 7.5 kV in point-plane geometries. The setup consists of a pulser (risetime between 400 ps to 1 ns), 50-Ohm transmission line, axial needle-plane gap with outer coaxial conductor, and a 50-Ohm load line. The needle consists of tungsten and has a radius of curvature below 0.5 mm. The constant system impedance of 50 Ohm (except in the vicinity of the gap) and a special transmission-line-type current sensors enables current and voltage measurements with a dynamic range covering several orders of magnitude, with temporal resolutions down to 80 ps. For pulse amplitudes of 1.7 kV (which are doubled at the open gap before breakdown) delay times between start of the pulse and start of a measurable current flow (amplitude > several milliamperes) have a minimum of about 8 ns, at a pressure of 50 torr in argon. Voltages of 7.5 kV produce breakdowns with a delay of about 1 ns. With negative pulses applied to the tip, at an amplitude of 7.5 kV, breakdown is always observed during the rising part of the pulse, with breakdown delay times below 800 ps, at pressures between 1 and 100 torr. At lower pressure, a longer delay time (8 ns at 50 mtorr) is observed. We expect the breakdown mechanism to be dominated by electron field emission, but still influenced by gaseous amplification [C491]

"Properties of plasma in shielded dual-spiral antenna ICP system"

Summary form only given, as follows. The plasma properties have been investigated in an experimental system utilizing an external dual-spiral antenna coupled to the plasma through a dielectric window and a structured electrostatic shield. The Langmuir probe (LP), microwave interferometer (MWI) and self-excited electron resonance spectroscopy (SEERS) technique were used to study properties of produced plasma. The ICP RF power used in this study was in range up to 5 kW (13.56 MHz) and argon pressures from 2 to 15 Pa. At these conditions high density plasma (above 1012 cm-3and electron temperature of 2 eV) has been produced due to strong inductive coupling of antenna to plasma. Spatial properties of plasma parameters (ne(i), Te, Vp and Vf) vs. ICP power and argon pressure and using electrostatic shield at different electrical condition were measured and compared to RF field simulations. The hysteresis of L to H-mode conversion was observed. Potential application of dual-spiral antenna for ionized PVD and feasibility of monitoring an ionized PVD process by SEERS technique were investigated. The extended application of SEERS technique was proven for ICP including Cu in discharge chemistry. The effect and efficiency of an inductive coupling using various electrostatic shield internal structures were simulated and verified by experiment. The results of computer simulation of antenna parameters were in good correlation with experimental results and used as predictive tool for new antenna designs [C492]

"Plasma conditions in a moly-oxide electrodeless bulb discharge"

Summary form only given, as follows. Due to the hazardous material designation of spent fluorescent lamps on board naval vessels, the Naval Research Laboratory has been investigating alternative lighting concepts which are free of mercury. Previous work (ICOPS '00) on an electrodeless moly-oxide discharge for lighting applications investigated the plasma and emission properties of a cylindrical tube containing a flowing mixture of argon and oxygen and an axial Mo wire. We have upgraded the configuration to a quartz bulb filled with ~1 Torr Ar, excited by an external RF coil at 13 MHz, and introduced the metal as a MoO3powder. Plasma conditions are investigated using microwave interferometry for the electron density (1013-10 14cm-3); near IR emission line spectroscopy for the electron temperature (1.1-1.4 eV); and absolute spectroscopy for the visible luminous flux (~3000 lumens). Analysis with a Boltzmann code given the above conditions and a simple atomic model for Mo provides an estimate of its density (1012-1013cm). Compositional effects and approaches to improving the output will be discussed [C493]

"Microwave driven torches for high temperature chemistry and production of atomic species"

Summary form only given, as follows. Several microwave driven plasma torches are being developed at PSI for a variety of applications. The plasma in the torches is confined by a vortex flow, thereby eliminating the need for confining dielectric tubes. This allows the use of very high power discharges with very reactive gases such as oxygen and fluorine. Temperatures from less than 1000 °C to over 4000 °C can be achieved, resulting in the efficient dissociation of a number of useful gases. Gases tested to date include air, oxygen, nitrogen, SF6, steam as well as others. Torches operating with 30 kW @ 915 MHz and 5 kW @ 2450 MHz are described. Measurements of the operating parameters, including the enthalpy and gas species content, are presented and compared to results of simulations [C494]

"Rubidium filtered Thomson scattering measurement in an atmospheric pressure argon arc"

Summary form only given, as follows. High temperature, atmospheric pressure plasmas represent a significant challenge for diagnostics. The temperature is too high for physical probes, the plasmas are filamentary with dimensions too small to be resolved by microwave techniques, and the plasma luminosity and Rayleigh scattering background limit optical diagnostics. We report the measurement of electron temperature and number density in an atmospheric arc discharge by Thomson scattering collected through an optically thick Rb filter. A backward scattering geometry is used because of the configuration of the arc plasma device, demonstrating the utility of this approach for single-ended diagnostics. The illumination laser is a narrow linewidth, frequency-tunable, pulsed, Ti:sapphire laser that is tuned to the 780 mn absorption line of Rb vapor. The Rb vapor is optically thick at the laser wavelength, so the light that is Rayleigh scattered from the neutral species in the plasma and background scattering from the plasma containment vessel are filtered out. The Thomson scattering is frequency-broadened by the thermal motion and the ion acoustic coherent motion of the electrons. The linewidth of the Thomson scattering is much greater than the absorption linewidth of the rubidium, so it passes through the Rb filter and into a spectrometer. The detector is time-gated synchronously with the laser to suppress the plasma luminosity. The frequency spectrum of the Thomson scattered light is fitted to a theoretical model in order to determine the electron temperature and number density [C495]

"Repetitive pulsed-power generator "ETIGO-IV""

Summary form only given, as follows. A repetitive pulsed-power generator, "ETIGO-IV", has been developed for applications in pulsed particle beam acceleration and high-power microwave generation. It is capable of delivering, to a matched load, an output pulse of 400 kV in peak voltage, 13 kA in peak current, and 120 ns in pulsed length, at the repetition rate of 1 Hz. It consists of a high-voltage supply unit, a pulse-forming unit, and a central control unit. The diagnostic results of its operation and the initial experiments on electron beam generation will be reported [C496]

"Conceptual study of an ultra-short bunch length monitor"

A bunch length monitor for very short charge bunches based on microwave spectroscopy has been conceptually studied. It consists of a coaxial cavity coupled to the beam pipe through four symmetrical apertures. This signal excited by the bunch can be collected by a small antenna connected to a coaxial line transporting the signal to the measurement device. By frequency domain analysis of the measured signal it is possible to obtain the bunch length. The analytical frequency response relating the primary field radiated by the bunch in the beam pipe and the measurable electromagnetic field has been determined [C497]

"Beam of neutral or charged atoms as a source of stimulated microwave radiation"

High-frequency electromagnetic dynamics of charged or neutral atom beams which are widely used at present is analyzed. One of perspective mechanisms of radiation bound with high-frequency intratomic electronic transitions is considered. As it is shown a flux of fast nonexcited atoms, due to anomalous Doppler's transitions on slow waves in a gas or plasma, can be unstable and be a source of stimulated high-frequency radiation. As a whole process has a complex nature since photon radiation is accompanied by excitation of atoms with following emission of more high-frequency photons. The possible parameters of such physical systems are estimated [C498]

"Longitudinal measurements and simulations of stretched bunches in the NSLS VUV ring"

Certain longitudinal instabilities in the stretched bunches of the National Synchrotron Light Source Vacuum Ultra-Violet ring are described and simulated using a code for the integration of the Vlasov-Fokker-Planck equation (these proceedings). Results for the microwave instability driven by a broadband impedance, an instability driven by high-Q RF modes, and response functions in stretched bunches, are compared with measurements from the ring [C499]

"The microwave electron linac in the treatment of cancer"

Immediately after the discovery of X-rays at the end of the nineteenth century the enormous medical value of ionizing radiation was clear. Radiation has certain unique properties for cancer treatment not duplicated by any other modality. In the modern clinical setting more than half of all cancer patients are treated with radiation and this percentage is increasing with the availability of new techniques. X-rays dominate with electrons used in 5 to 10 percent of the cases and other kinds of radiation playing a peripheral role. An extraordinary effort went into the search for the optimum radiation treatment machine during the twentieth century. Microwave electron linacs producing bremsstralung beams of 4 to 6 megavolts and versions producing bremsstralung beams from 4 to 25

MV, with ancillary electron beams from 4 to 20 MeV, have emerged as the overwhelming treatment system of choice. Today these machines are computer controlled and can provide advanced dose shaping capabilities with the use of dynamic Multi-Leaf Collimators, MLC's in conjunction with specialized dose planning systems. WHO statistics indicate a doubling of cancer incidence and mortality by the year 2020 and an increasing need for such equipment. Commercially available medical linacs are impressively robust and extraordinarily cost effective and are used extensively in both developed and developing countries [C500]

"Status of X-band pulsed magnicon project"

A frequency-doubling magnicon amplifier at 11.4 GHz has been designed and built as the prototype of an alternative microwave source for the Next Linear Collider project, and to test high power active RF pulse compressors, RF accelerating structures, etc. The tube is designed to produce ~60 MW at 60% efficiency and 59 dB gain, using a 470 W, 220 A, 2 mm-diameter beam. The results of beam envelope measurements and the first observations of RF performance are presented [C501]

"The impact of e-diagnostics-one year later"

Initially, the industry viewed e-diagnostics as a way to collect, trend, and extract potential failure points from equipment, as well as to provide the ability for a remote service engineer to gain access to equipment for trouble shooting. As e-diagnostics progressed, the industry needed to implement an e-diagnostics enabling solution that not only collected and analyzed data, but also delivered true added value support with the goal of making tools more productive. KLA-Tencor's iSupport e-Diagnostics program was the first in the industry to design a solution integrating a value-added support program with e-diagnostics technology. During the first year of iSupport connectivity to worldwide customer sites, the program focused on assisting users with "Reactive" and "Escalation" support calls. This paper addresses the background, success cases, and value experienced by many iSupport customers throughout this first year of operation. Additionally, this paper addresses the iSupport road map, where predictive failure monitoring holds much promise [C502]

"Relativistic L-band magnetron and nonrelativistic oven magnetron experiments"

Summary form only given, as follows. Investigation is underway of the effects of space charge densities and impedances of the relativistic L-band magnetron and nonrelativistic oven magnetron. A Maxwell Physics International L-band magnetron is being driven by the MELBA accelerator. Parameters attained include: voltage=-400 kV, current=1-10 kA, and pulselengths=0.1-0.5 microseconds. Time frequency analysis of the heterodyned microwave signals finds generation at two frequencies 1.04 GHz and 0.95 GHz in the relativistic magnetron. Measured microwave power has been generated of at least 150 MW out of one cavity (with 2 output cavities). Microwave power versus beam current and beam pulselength will be presented. Stark broadening of H lines is being explored as an electric field diagnostic. Commercial kilowatt oven magnetrons operating in S-band (2.45 GHz) are also being investigated. Oven magnetron efficiency and time-resolved frequency spectra are studied under varying parameters [C503]

"True time phased antenna array systems based on nonlinear delay line technology"

The design, construction and performance of proof-of-principle true time delay phased antenna arrays (PAAs) based on both hybrid and monolithic nonlinear delay line technology are presented. A 2-D, 4\Ч4 hybrid PAA exhibited approximately \±9\° beam scanning in both the E-plane and H-plane at 5 GHz center frequency in agreement with theoretical predictions. A monolithic NDL-based PAA intended for operation at 6-18 GHz is currently under development and test. A longer term electronically controlled "lens" application for plasma reflectometric diagnostics requires a 1\Ч8 array operating at 88 GHz. [C504]

"Millimeter wave imaging technologies"

Imaging technologies using millimeter (MM) waves offer unique measurement means in many application areas. We discuss here MM-wave focal plane imaging technologies whose resolution is limited by diffraction and also MM-wave scanning near-field microscopy whose resolution is much smaller than operating wavelength. Results of our research on both of these imaging technologies are presented. [C505]

"Atomic UV emission temperature profiles in an air microwave plasma torch"

Summary form only given, as follows. An atmospheric pressure microwave plasma torch has been shown to be a sensitive and accurate atomic excitation medium for stack exhaust compliance monitoring of trace metals air pollution. High electron excitation energies are needed for minimizing the detection limits of some important metal pollutants such as mercury and arsenic. A study has been made of the effects of power and airflow on the

electronic excitation temperature, Texc, of a 0.9-1.5 kW, 2.45 GHz plasma torch. The plasma is sustained in a 28 mm internal diameter fused quartz tube which penetrates through the wide walls of a tapered and shorted WR-284 (72Ч17 mm cross-section) waveguide. Abel inversion of radial profile chord averaged Fe I emission lines in the 370 to 377 nm range have been used to obtain localized Texcprofiles inside the waveguide excitation region. Microwave power has little effect on temperature, but increased airflow from 14 lpm to 28 lpm constricts the plasma and increases temperature by about 13 %. Temperature profiles are relatively flat with a maximum central Texcobserved of 6550 K +/- 350 K at 28 lpm. The axially peaked temperature profiles and almost no microwave reflection (< 1%) are consistent with skin depth of order 10 mm and an electron density of ~ 1013cm-3 [C506]

"Autonomous PHM with blade-tip-sensors: algorithms and seeded fault experience"

Blade tip sensors embedded into the engine case have been used for decades to measure blade tip clearance and blade vibration. Many sensing technologies have been used; capacitive, inductive, optical, microwave, infra-red, eddy-current, pressure and acoustic. These sensors generate data streams far greater than have been historically used in engine diagnostic units. Data streams of about 10,000 samples per second per sensor are about the minimum achievable, with some sensor front-ends delivering data streams of greater than 1Megasamples per second per sensor. In a PHM application, this data cannot be stored for later human analysis, but must be analyzed and discarded. This paper outlines autonomous algorithms for the real-time analysis of this data stream for PHM purposes. The application of these algorithms to several seeded fault tests is described. The need for a series of additional seeded fault tests is highlighted, for the purpose of maturing these algorithms prior to introduction into service [C507]

"PPPS-2001 Pulsed Power Plasma Science 2001. 28th IEEE International Conference on Plasma Science and 13th IEEE International Pulsed Power Conference. Digest of Papers (Cat. No.01CH37251)"

First Page of the Article [C508]

"Plasma diagnostics for technological complex optimisation"

Wide use in modem instrument making of RF and microwave plasma technological complexes (PTC) and dynamics of tariffs on the primary electric power put questions of power resources saving and increase of the efficiency. Marked circumstances compel us to formulate questions of PTC diagnostics again [C509]

"Quasi-optical band-rejection filters"

Band-rejection filters are used in microwave engineering to provide one or several suppressed frequency bands in the given wavelength range. For the mm and submm wavelength ranges this problem arises in the hot plasma diagnostics at experimental fusion machines. Here, it is necessary to receive a plasma cyclotron radiation signal in a wide frequency range, ensuring that no high-power radiation of microwave heating made by gyrotrons in a narrow band inside this range enters the receiver. Because of the wide application of quasi-optical equipment in plasma diagnostics, the problem of developing quasi-optical band rejection filters is timely [C510]

"Microwave diagnostic of ozone layer at the polar latitude"

The ground-based microwave remote sounding of the upper atmosphere has been effective in investigations of atmospheric ozone and other small gas constituents performing at altitudes above 20 km (Connor et al, 1986 and 1987). The method of microwave sounding is based on observations of resonant lines of molecules with rotary spectra at millimeter and submillimeter wave bands. The microwave measurements depend less on weather conditions and atmospheric aerosol components in comparison to optical and infrared ones. The millimeter-wave spectral devices can register round the clock variations of stratospheric ozone with high temporal resolution. For physical understanding of problems in polar ozone, it is necessary to continue accumulation of the data about the behaviour of ozone at different high-altitude levels. It is necessary to note, that in altitude range from 20 up to 80 km, ozone and the associated family of small gas constituents are the least investigated. The microwave radiometry is capable of ensuring a long measuring series of O3at the necessary altitude intervals. In this paper, results are given for ground microwave observations of stratospheric ozone in polar latitudes [C511]

"Detection of the near field of thermal emission and its application for media temperature diagnostics"

Theoretical and experimental research of possibility to detect of near-field (quasi-static) component of thermal radio emission of lossy media has been carried out and prospects of application of near-field radiometric

measurements for temperature profile retrieval are shown. [C512]

"Super-high-frequency study of biologically active compounds"

The results of a study on melanin pigments are presented. Advantages of super-high-frequency (SHF) diagnostics in combination with optical spectroscopy and some chemical methods are shown for analysis of the melanins. It is found that origin and structure determine a wide spectrum of melanin parameters. Possible applications for protection against radiation and gene-toxic effects are discussed. [C513]

"An attempt of time domain microwave computed tomography for biomedical use"

So-called time-domain measurement techniques were employed for visualizing the complex permittivity distribution inside a human body. A microwave pulse with a bandwidth from 0.8 GHz to 4.2 GHz is radiated from a transmitting antenna toward the object immersed in a saline solution that is called a bolus. The transmitted signal is detected by a receiving antenna that is placed on the opposite side of the transmitting antenna. The signal transmitted on the straight path between those two antennas is measured by leaving only the signal that corresponds to the transmission time between those two antennas. This procedure is repeated to obtain a complete set of projection data of the target while the antenna pair is moved on and around the translation- and rotation-axes just like the first generation X-ray CT. The transmission time between two antennas is estimated from complex permittivity of a bolus and biological phantoms. It was demonstrated that time-domain microwave computed tomography (TD-MCT) is feasible by measuring only the transmitted signal on a straight-transmission-path between two antennas by means of a time-domain measurement technique. [C514]

"Rubidium filtered Thomson scattering measurement in an atmospheric pressure argon arc"

High temperature, atmospheric pressure plasmas represent a significant challenge for diagnostics. The temperature is too high for physical probes, the plasmas are filamentary with dimensions too small to be resolved by microwave techniques, and the plasma luminosity and Rayleigh scattering background limit optical diagnostics. We report here the measurement of electron temperature and number density in an atmospheric arc discharge by Thomson scattering collected through an optically thick Rb filter. A narrow linewidth, frequency-tunable pulsed Ti:Sapphire laser was employed. The Thomson scattering is frequency broadened by the thermal motion and the ion acoustic coherent motion of the electrons. The linewidth of the Thomson scattering is much greater than the absorption linewidth of the Rb, so it passes through the Rb filter and into a spectrometer. The detector is time-gated synchronized with the laser to suppress the plasma luminosity. The frequency spectrum of the Thomson scattered light is fitted to a theoretical model in order to determine the electron temperature and number density. [C515]

"Quantitative image reconstruction in simultaneous 123 I/ 99m Tc myocardial SPECT"

In the 123I/99mTc myocardial SPECT study the image reconstructed with the counts of primary photons emitted from the low photopeak energy (99mTc) radionuclide is distorted by Compton scattered photons originating in the high photopeak energy (123I) radionuclide. To correct the scattered photons included in the low energy photopeak window in the simultaneous data acquisition, we proposed a method with a neural network at the IEEE MIC in 1999. This method uses a layered neural network (input units: 10, hidden units: 20 and output units: 2). El Fakhri et al. (2001) also proposed a method at the IEEE MIC in 1999 which was like our approach, and they obtained good results. The major differences between their method and ours are (1) the energy range for data acquisition, (2) the width of the narrow energy window, and (3) the method for calculating the number of primary photons. This paper investigates the performance of their method and ours in consideration of the above three points. Performance was evaluated with Monte Carlo simulation data and experiment data. In the simulation we used the MCAT phantom and accuracy was evaluated by the mean squared error in the reconstructed images. The results indicated that the accuracy of our method was slightly superior to El Fakhri's method. In the experiment we fixed the energy range to 120-180 keV and changed the width of the narrow energy window to 2.2, 4.4 and 6.7 keV. The results showed that a window width of 2.2 keV was too narrow for as an energy window. In conclusion, it was confirmed that our method was slightly superior to El Fakhri's method and both methods were fairly effective in separating 99mTc and 123I accurately [C516]

"Experimental investigation of mini-microwave plasma sources"

Summary form only given. In the past, the challenge in microwave plasma research was to develop techniques that provide high ion and free radical densities uniformly, over large and ever increasing process areas. Scale-up was usually an important issue when considering industrial applications. Thus, the creation of very small microwave plasmas-on the order of a few millimeters-was rarely investigated. However, the recent interest in development of systems on a chip, MEMs and their related micro system applications, has suggested the

possibility of numerous applications for mini and micro plasma sources. Accordingly, this investigation is devoted to the development and the understanding of the behavior of very small microwave plasmas. We have constructed a microwave plasma system that creates and allows for the experimental investigation of millimeter size plasmas. Plasmas are generated across a wide range of input parameters, including pressure variation from one millitorr to one atmosphere, input power from one Watt to one hundred Watts, microwave frequency from 2.45 to 15 Gigahertz, and a variety of gas mixtures (e.g. hydrogen, methane, argon, nitrogen). The system construction allows for quick reconfiguration of the microwave reactor, such that different probe shapes and sizes can be used to effect plasma formation, size, and stability. Plasma density, size, shape, ignition, and emission spectra are monitored during each experiment to characterize the mini plasmas over the input parameter space. The experimental results will identify the experimental operating regime necessary to excite and maintain stable, high density, millimeter scale microwave plasma sources for micro system applications and will also identify the important figures of performance, such as electron temperature vs. power, absorbed power densities (Watts per cubic centimeter), plasma densities per Watt, etc [C517]

"Production of sheet electron beams with crossed-field secondary emission diodes"

Summary form only given. Crossed-Field Secondary Emission (CFSE) diodes, which are based on a mechanism of self-sustained secondary electron emission, generate normally tubular electron beams with the current of up to several hundreds of Amperes for diode voltages of less than 40 kV (Saveliev et al., 1999). Linear current density of the output electron beam is in the range of 1-20 A/cm. A number of applications such as planar microwave devices (Agafonov et al., 1997) and large area plasma processing systems (Fernsler et al., 1999) do however require sheet electron beams rather than cylindrical beams. This work is concerned with a development of a CFSE planar diode that is capable of producing sheet electron beams. Several diode designs having cathode widths of 45-60 mm have been tested and characteristics of output electron beams were investigated. For diode voltages in the 25-40 kV range, the electron beams were generated with total currents of 15-40 A and linear current densities of 2-8A/cm depending on the diode voltage, magnetic field strength and the diode design. Due to the specific nature of the electron flow production in this CFSE diodes, two closely spaced electron sheets of ~1 mm thickness separated by 1-2 mm are produced. One of these can be easily suppressed, if desired, by the incorporation of a downstream reflecting electrode. A significant problem encountered in this research was the non-uniformity of the linear current density distribution j(x) along the diode width where the main contributory factor was found to be due to cathode edge effects. The influence of these edge effects has been reduced by an appropriate design of the cathode electrodes and, to date, a ±25% uniformity of the j(x) distribution has been achieved. Considerations relating to the further refinement of the electron beam characteristics and extension of-the beam width will be discussed [C518]

"Study and diagnostics of the effect of emissive current variations in segmented electrode Hall thruster"

Summary form only given, as given. Segmented electrodes, which are placed along the Hall thruster channel, were shown to affect thruster operation in several ways, whether the electrodes produce low emission current or high emission current. Measured by plume divergence, and the current utilization efficiency the performance of Hall thruster operation, even with only one power supply, can approach or surpass that of non segmented operation over a range of parameter regimes. In particular, the low gas flow rate can exhibit low plume divergence with low emissive electrodes. An increase of the emissive current from the electrode placed at the exit of the thruster channel can affect the axial electron current across the radial magnetic field. In addition, interior probe measurements indicated relatively strong changes in spatial distribution of plasma parameters in the whole thruster channel with the emission current. Interestingly, that these changes can be observed with floating and biased emissive electrode placed at the channel exit [C519]

"Self-consistent modeling of low pressure microwave discharges including non-collisional heating processes"

Summary form only given. Low pressure microwave plasma sources used for materials processing generally operate as overdense plasmas with the plasma density greater than the critical density. These sources can be operated with a static magnetic field that provides for ECR heating or without a static magnetic field via ohmic, resonance and other non-ohmic and stochastic heating mechanisms. Even when ECR strength magnetic fields are present these other heating mechanisms that occur in unmagnetized plasmas can be important and may even dominate. This paper examines via a two-dimensional, self-consistent microwave field and plasma model the heating of low pressure, overdense, magnetized and unmagnetized plasma discharges. Low-pressure (collision frequency ≪ excitation frequency) microwave plasma simulations that model the spatial variation of the microwave heating fields and plasma discharge are difficult to use in the local regions where the plasma frequency is near the excitation frequency. In these regions resonance effects occur and the microwave electric

field can become large. Because of the localized nature of the resonance (high microwave field strength) region, stochastic (non-collisional) heating can occur as the electrons are accelerated/heated in this region and/or transverse through this resonance region via their initial momentum. This paper explores the self-consistent modeling of microwave discharges including resonance effects and stochastic heating effects. Further the models are constructed to closely match an experimental system that has been extensively characterized. This experimental system is a 2.45 GHz resonant cavity plasma source that has been studied while running argon discharges at pressures of 4-60 mTorr using Langmuir probes to determine the plasma density and electron temperature and using microwave field probes and optical diagnostic techniques to measure the microwave field strength [C520]

"Progress in the pasotron theory and experiments"

Summary form only given, as follows. Plasma-assisted slow wave oscillators (pasotron) are unique high-power microwave sources, which can operate without (or at small) guiding magnetic fields. Beam transport is provided by plasma, which compensates for the defocusing space charge forces of the electron beam. Plasma assisted microwave devices have the potential to advance the technological and scientific base of microwave tubes. A joint University of Maryland/Hughes Research Lab. program is focused on the basic physics processes in pasotrons. An analysis of coherent Cherenkov radiation in the absence of guiding magnetic field, and mode interaction in backward-wave oscillators with strong end reflections were completed. Studies of operation with weak magnetic field demonstrated that the weak magnetic field required for protecting the slow-wave structure from electron bombardment depends on the microwave power. In situ diagnostics were developed to characterize a 1.2 GHz, 30% efficient helix pasotron operating at 40 kV and 30-100 A. The axial beam current distribution, beam focusing, as well as gas and plasma density measurements were performed. The most important results will be presented, as well as current efforts aimed at improving the characteristics, reducing size, and increasing the overall efficiency of pasotrons [C521]

"The use of mm-wave-dielectrometry for the cardio-vascular diseases early diagnostic, therapy and preventive maintenance"

Altered activity of the sympathetic nervous system is known to contribute to hypertension via neurohormonal stimulation of adrenergic receptors (ARs), which are members of the guanidine nucleotide superfamily and are divided into some major types. ARs are characterized according to their functional response to their stimulation or inhibition by various substances.Our investigation is devoted to the assessment of molecular mechanisms of transmembrane signal transduction into a cell by means of modeling of these processes under the condition of non-destructive control using the method of dielectrometry combined with traditional technology. The researches of dielectric characteristics in this millimeter wavelength allow to receive unique information about the water component of biosystems. The physical basis is the large difference between a dielectric permeability of biopolymers and bound water and a dielectric permeability of free water, because there is an area of free water dispersion in this range. This method is based on the analysis of conversions of the biopolymer-water matrix owing to conformational conversions of cell macromolecules at the binding of agonists, antagonists and modulators with membrane receptors [C522]

"mm-wave dielectrometry methods for prediction, prevention, diagnostics and individual treatment at acute cardiac infarction and cardiomyopathy"

The aim of this work is the elaboration of methodology for prediction, prevention, diagnostics and individual treatment of cardiovascular pathology relevant to the molecular-cellular mechanism disturbances of membrane receptors functioning in the adenylate cyclase system (ACS) and cytoskeleton complex. The authors use dielectrometry data in the region of free water dispersion in acute cardiac infarction (ACI) and cardiomyopathy. Dielectrometry at extremely high frequencies (EHF-dielectrometry) along with biochemical technology enables the authors to conduct cellular level screening when acting upon various control complexes of a cell with biologically active agents in real time, under conditions which avoid object destruction. For the analysis the authors use the modification of cell water environment conditions, resulting from component conformational transformations on the specific binding of biologically active substances. The integration of modern biochemical and radiophysical methods has allowed the development of a new methodological approach to the analysis of cell regulating systems using nondestructive monitoring conditions and operating in real time [C523]

"A 2-stage Gauss-Newton reconstruction technique for improved object detection in microwave imaging"

We have developed a 2-stage Gauss-Newton iterative reconstruction technique to improve the general image quality with our microwave tomographic imaging system. It has been applied to simulation, phantom and in vivo

breast imaging experiments with quantifiable improvement in the recovered property distributions over those achieved with our original, Levenberg-Marquardt approach. The latter method incorporates spatial filtering at the end of each iteration as a means of stabilizing the reconstruction process. However, the stabilization resulted in blurring of fine structures within the imaging region, particularly in the case of small high contrast objects. The new technique utilizes the original approach as the first stage in a 2-step strategy, allowing the algorithm to identify a distribution in the neighborhood of the ideal solution without converging to an unwanted local minimum. This intermediate result is subsequently employed as an initial estimate for the second stage process-a Tikhonov-based reconstruction with a weighted Euclidean distance penalty term to constrain the final result to be within the vicinity of the intermediate solution while allowing full impact of the electric field minimization without the detrimental effects of the spatial smoothing of the first step. While this approach has enhanced the recovery of features internal to the breast during microwave examinations, it has also improved our capability to recover small, high-contrast objects. This paper illustrates quantifiable improvements in the recovery of small objects in a laboratory setting [C524]

"Microwave holography for antenna and radome diagnostics"

Microwave holography is currently being used in antenna and radome manufacturing and in antenna and radome diagnostics and repair. The subject of this paper is the examination of the resolution of the holographically reconstructed field at the antenna (or antenna-radome combination) surface and the interpretation of these fields with respect to diagnosing antenna and radome behavior. Measured data is presented to demonstrate achievable resolution and interpretation aspects of microwave holography [C525]

"Microwave imaging for breast tumor: 2D forward and inverse methods"

Microwave breast imaging techniques have been proposed over the past few years because of their potentially high specificity for breast cancer diagnosis due to the high contrast. in electrical properties between normal and malignant human breast tissues. We develop fast forward and inverse scattering algorithms to unravel multiple scattering effects. These algorithms are applied to form high resolution images to simulate an experimental prototype of MWI breast imaging system. Our methods are based on the fast Fourier transform, extended Born approximation, conjugate- and biconjugate-gradient, and contrast source inversion methods [C526]

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