5th International Conference on

PLASMA CHEMISTRY AND PLASMA PROCESSING

November 13-14, 2017 Paris, France

Keynote Forum

Day 1

Plasma Chemistry 2017






Edward J Kansa, J Biot Phyt 2017

Edward J Kansa
Convergent Solutions, USA

Overview of meshless radial basis functions of solve multi-dimensional problems

A radial distance, rab is the shortest path between a pair of points in a curved space, $\Re^n$; a radial basis function (RBF), $\varphi(r_{ab})$, is a univariate function of r_{ab}. The C∞ (infinite differentiability) RBFs are non-orthonormal wavelets that converge exponentially, and faster as the spatial dimensions increases making them the best tools for plasma simulations and multi-dimensional quantum mechanics. Since no mesh is involved, strictly hyperbolic PDEs can be very accurately modelled by allowing each interior point, xi in the interior, $\Omega\backslash\partial\Omega$ to move at a velocity, v_i, such that a complicated nonlinear PDE becomes an exact differential in a moving frame, v_i. Strict conservation of specie, mass, momentum components, and total energy are enforced by integrating the RBFs over space. The solution space can be enriched by including discontinuous RBFs; these are products of a Heaviside function in the normal propagation direction, and a RBF in $\Re^{(n-1)}$ in the tangential directions. RBFs are either very broad-banded or global; domain decomposition , pre-conditioners, regularization, global optimization are used to control ill-conditioning. Recent computer science developments in extended arithmetic precision permit the control of ill-conditioning to produce extremely accurate numerical results. In both accuracy and the minimization of execution time, the total number of discretization points can be minimized compared to finite element methods.

Biography

Edward J Kansa is the president of Convergent Solutions, LLC and principal investigator in computational sciences, LLC. He received his Ph D from Vanderbilt University; He has an experience of road background in solving multi-disciplinary problems in physics, and engineering with emphasis on analysis and computational modeling.

edwardjkansa@gmail.com

Notes:

Véronique Bommier, J Biot Phyt 2017

Véronique Bommier

LESIA, Paris Observatory, France

The anisotropic Debye Shielding as visible in sunspot photosphere

Recent measurements, that now allow 3D mapping of the solar magnetic field vector, as well as past astrophysics literature, coincide about the surprising feature that the vertical gradient of the magnetic field |dBz/dz|, which is found about 3 G/km, is not compensated for by the horizontal gradient |dBx/dx + dBy/dy|, which is found about 0.3 G/km only, in sunspot photosphere. The departure from zero of their combination to form divB is much larger than the estimated measurement uncertainties. A test of the observational result will be presented. I assign this feature to a plasma effect, the Debye shielding, but anisotropic as in plasma located at the surface of a star. The horizontal Froude number is found to be on the order of a few 1e-

2. The solar photosphere plasma is however dominated by neutral hydrogen atoms, whose density is on the order of 1e16 atoms per cubic centimetre, whereas the electron density is about 1e12 electrons per cubic centimetre only. Thus the magnetization remains small. I will present how the Debye shielding when anisotropic is able to explain how the gravity, which makes the velocities anisotropic by strong stratification, thus makes the shielding anisotropic, which results in an apparent magnetic flux non-conservation for the magnetic field created by the moving charges. Interesting experimental results in an also anisotropic plasma, also displaying measured non-zero divB, are available in the literature (Gekelman et al., 2012, ApJ, 753, 131 and Gekelman et al., 2016, Phys. Scr. 91, 054002).

Biography

Véronique Bommier, born in 1954, is "ancienne eleve" of the "Ecole Normale Superieure de Jeunes Filles". She was formed about quantum mechanics by Pr Cohen-Tannoudji at the "Ecole Normale Superieure". After her thesis about the magnetic field measurement by interpretation of the hanle effect observed in the He I D3 line of solar prominences, she participated to the preparation and development of the observations with the French-Italian THEMIS telescope. She was formed in radiactive transfer by Pr Egidio Landi Degl'Innocenti (Florence University), who developed also a Zeeman effect inversion code UNNOFIT, that V. Bommier generalized to the scan of active and quiet regions and unresolved magnetic structures. Thus, she is now an expert on all magnetic field measurements in all the various solar regions. She then applied to space data from the HINODE/SOT/SP and recently SDO/HMI satellites, the methods developed on THEMIS about active and quiet region magnetic field mapping.

V.Bommier@obspm.fr

Notes:

Jas Pal Badyal, J Biot Phyt 2017

Jas Pal Badyal
Durham University, UK

Scalable plasma chemical deposition of functional nanocoating

The worldwide market for functional surfaces exceeds $100 billion per annum (US Department of Energy). A key driver is the added value that can be imparted to commercial products through the molecular engineering of their surface properties. For example, the cleanliness of optical lenses, the feel of fabrics, the resistance of biomedical devices to bacteria, the speed of computer hard disks, and even the wear of car brake pads is all governed by their surface properties. The fabrication of such surfaces requires the incorporation of specific functional groups; for which there exists no shortage of potential methods including: S elf-assembled monolayers (SAMs), Langmuir-Blodgett films, dip-coating, grafting, chemical vapour deposition, to name just a few. However, such techniques suffer from drawbacks including substrate-specificity cannot be easily adapted to different materials or geometries and environmental concerns associated with the utilization of solvents, strong acid / base media, or heat. A range of innovative plasma chemical approaches will be described for the tailoring of solid surfaces. Applications will include: Super-repellency, non-fouling, anti-fogging, thermoresponsive, rewritable bio arrays, opto-chiral, antibacterial, electrical barrier, water harvesting, capture and release, oil-water separation, and nano-actuation.

Biography

Jas Pal Badyal has completed his BA, MA and PhD degrees from Cambridge University; where he subsequently held King's College and Oppenheimer fellowships. He is the primary author and inventor of 175 peer reviewed journal publications and 41 patent families. He has been recipient of the Royal Society of Chemistry Harrison Prize; the British vacuum council Burch Prize; the International Association of Advanced Materials Medal; and in 2016 he was elected as a fellow of the Royal Society - UK and Commonwealth National Academy of Sciences. His research has led to three successful start-up companies: Surface Innovations Ltd; Dow Corning Plasma Ltd; and P2i Ltd.

j.p.badyal@durham.ac.uk

Notes:

5th International Conference on

PLASMA CHEMISTRY AND PLASMA PROCESSING

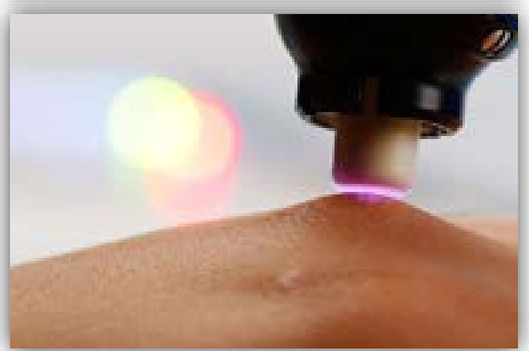
November 13-14, 2017 Paris, France

Keynote Forum

Day 2

Plasma Chemistry 2017






María Dolores Calzada, J Biot Phyt 2017

María Dolores Calzada

University of Cordoba - Rabanales Campus, Spain

High-quality graphene production from ethanol decomposition using a microwave plasma torch

Graphene is a perfect two-dimensional material with important electrical, mechanical and chemical properties that make this material suitable for a wide range of applications in different scientific and technological fields. Thus, it has been successfully used for manufacturing solar cells or as support for catalysts in the electrodes of fuel cells. Conventional methods as Chemical vapour deposition (CVD) and Liquid phase exfoliation (LPE) have both been applied for graphene production at industrial level. However, microwave plasmas have been reported as efficient, clean, eco-friendly and scalable technology for this purpose using alcohols as precursors. Microwave plasma torches have demonstrated the capability to dissociate the molecules introduced into the discharge, giving place to atoms and radicals. These species can recombine at the plasma exit forming different products to those used as precursors. In microwave plasma torches, the reactions in which the plasma species are involved depend on plasma parameters such as densities and temperatures, whose values can be modified acting on operational conditions used to create and maintain the plasma, thus offering an important degree of control over the final products. Besides, non-intrusive emission spectroscopy techniques can be used to identify the species and radicals formed into the plasma during the precursor decomposition. This fact contributes to understanding the key factors for graphene synthesis using plasma technology. A microwave plasma torch, so-called TIAGO (Torche à Injection Axiale sur Guide d'Ondes), has been used to obtain high-quality graphene 2-7 layers utilizing Ar and ethanol as carrier gas and carbon precursor, respectively. In this way, grapheme powder is directly formed in a single step without requiring any metal catalyst to induce the growing process. In addition, the device and procedure can be escalated at industrial level, adding a new technique for graphene production to those already available.

Notes:

Biography

María Dolores Calzada has completed her PhD degree in plasma physics from the University of Seville in 1994. She carried out postdoctoral in Group of Plasma Physics Department at University of Montreal, Canada. Since 1997, she joined the department of physics at University of Córdoba, Spain and she is full professor from 2012. Currently, she is Head of the laboratory in innovation in plasmas (LIPs) with research interests on the implementation of new spectroscopy methods for low-temperature plasmas and the application of these ones into hydrogen production, graphene synthesis, analytical chemistry, food conservation, and material treatment.

md.calzada@uco.es

V A Riaby, J Biot Phyt 2017

V A Riaby
University in Moscow, Russia

Elevating the precision of RF plasma probe diagnostics by elimination of bare probe protective shields' influence

This work deals with probe diagnostics errors for radio-frequency (RF) plasma using Langmuir probes with bare protective shields that led to the proposal of a method of their correction. The parameters of xenon inductive plasma were measured by two differently located Langmuir probes having reference probes and bare protective shields. Accurate probe diagnostics with an advanced probe station VGPS-12 featuring precise registration of plasma electron energy distribution functions (EEDFs) and traditional plasma parameters, enabled effective quantitative evaluations of EEDF deviations from the Maxwell function. These deviations were considered as EEDF distortions that turned out to linearly depend on the length of the probe protective shield no. 1. Its EEDF distortions reached minimal level at the special point that was common for both probes where the shield length no. 1 became zero while the shield no. 2 remained rather long. In this point measurement differences for both probes were maximal. Their comparison identified the principled relationship between measurement errors and EEDF distortions, which enabled corrections of all measured plasma parameters. These actions have composed a method of RF plasma probe diagnostics without influence of bare probe protective shields. Its physical analysis showed that the nature of thus studied measurement errors was a short-circuited double-probe phenomenon in the bare protective shields caused by longitudinal variation of plasma space potential.

Biography

V A Riaby has completed his studies at Kalinin Suvorov Military College from 1949-1956 and graduated with golden medal. In 1962, he graduated from the Engine department of flying apparatus, Moscow Aviation Institute (MAI). He received scientific degree candidate of technical sciences and scientific rank of senior researcher in 1972 and 1981 respectively from the same MAI department. His research interests and professional activities are concentrated in the fields of electrical propulsion, plasma physics/diagnostics and plasma technology. Currently, he is working as leading scientist at the research institute of applied mechanics and electrodynamics of the moscow aviation institute.

riaby2001@yahoo.com

Notes:

Fortov V E, J Biot Phyt 2017

Fortov V E
Joint institute for high temperatures of RAS, Russia

Space experiment "plasma kristall–4" on the international space statin: first results

The new Russian-European "Plasma Kristall – 4" (PK-4) space laboratory is intended for investigation of fundamental properties of strongly coupled dusty (complex) plasma under microgtravity conditions. In dusty plasmas, the subsystem of μm-sized microparticles immersed in low-pressure weakly ionized gas-discharge plasmas becomes strongly coupled due to the high (103–104 e) electric charge on the microparticle surface. The microparticle subsystem of complex plasmas is available for the observation at the kinetic level, which makes complex plasmas appropriate for particle-resolved modeling of classical condensed matter phenomena. The PK-4 equipment was developed in close cooperation between scientists of the joint institute for high temperatures of RAS (JIHT RAS) and scientists of the Max-planck-institute fur extraterrestrische physik (MPE) in garching (Germany). The PK-4 space experiment is a continuation of previous Russian-German "Plasma Kristall – 3" (PK-3) and "Plasma Kristall – 3 Plus" space experiments. While the PK-3 setups were suitable mostly for investigations of dusty plasma crystals, the modern PK-4 setup is intended for investigations of hydrodynamic phenomena of highly nonideal dusty plasma liquid. The PK-4 setup was installed in the European laboratory module Columbus at the end of 2014 and commissioned at June 2015. The operation of the PK-4 laboratory is performing with the participation of the International Coordination Group (Facility Science Team). In contrast to the PK-3 setups, to generate plasma the PK-4 facility makes use of a classical dc discharge in a glass tube. The facility is equipped with two videocameras and illumination laser for the microparticle imaging, kaleidoscopic plasma glow observation sys-tem and mini spectrometer for plasma diagnostics and various micro particle manipulation devices (e.g., powerful manipulation laser). Scientific experiments are programmed in the form of scripts written with the help of specially developed C scripting language libraries. PK-4 is mainly operated from the ground (control center CADMOS in Toulouse, France) with the support of the space station crew. Data recorded during the experiments are later on delivered to the ground on the removable hard disk drives and distributed to participating scientists for the detailed analysis. The first experimental results from the PK-4 facility will be reported. Space experiment PK-4 is supported by the Russian State Corporation ROSCOSMOS and the European Space Agency.

Biography

Fortov V E is a well-known scientist in the field of plasma and space physics, extremely high pressures and temperatures, physics and chemistry of strong shock and detonation waves, pulsed energetics. He is academician of Russian Academy of Sciences, head of the division of energetics, machinery, mechanics and control systems of RAS and director of joint institute for high temperature of RAS. He performed experimental investigations on physical properties of hot dense matter at mega bar pressure range. He is one of the first who applied the intense shock and detonation waves for investigations of physical properties of plasmas under extreme pressure and temperature. Along with the Russian prizes and medals he was awarded L.P. Karpinsky international prize in physics and chemistry, 1997; international P. Bridgeman prize for achievements in high pressure physics and technology; 1999, international Max-Plank award for physics, 2002; international alfven prize of European Physical Society in plasma science; 2003; Americal Physical Society prize in shock compression science for pioneering research in high energy density physics, 2005; A.Einstein gold medal of UNESCO for achievements in science and international collaboration, 2005; order of merit of the Federal Republic of Germany (Bundesverdienstkreuz) for achievements in science and collaboration with german researchers, 2006; Honoured legion order, france, 2006; International glass memory award for achievements in shock wave science, 2009.

fortov@ficp.ac.ru