International School on Physics and Allied Disciplines (ISPAD-2021)

(Video Conference)

March 09-11, 2021

Organized by:
National Centre for Physics, Islamabad
The Abdus Salam International Centre for Theoretical Physics, Trieste

Book of Abstracts

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Plasma Physics: Theory and Applications

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Poster Session Plasma Physics: March 10, 2021 (16:55-18:00)

ABSTRACTS PLENARY TALKS

Frontiers of magnetic reconnection research

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Fast magnetic reconnection is considered to occur throughout our Universe and also in laboratory fusion plasmas. Recent advances in understanding its mechanisms and consequences, with an emphasis on laboratory experiments, will be highlighted in comparisons with space observations and numerical predictions. The motivating background, current status, and future prospects of the ongoing FLARE (Facility for Laboratory Reconnection Experiments;https://flare.pppl.gov) project at Princeton will be described and discussed.

Perspectives of quantum plasma and warm dense matter theory

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Presently we are witnessing dramatic progress in experiments with dense quantum plasmas where matter is being compressed to densities exceeding solid density. At the same time, accurate laser and x-ray based diagnostic tools have emerged that probe the properties of such warm dense matter [1]. To understand these experiments and predict new ones poses a challenge to theory and simulations. Promising tools include density functional theory and generalized quantum hydrodynamics [2,3], and quantum kinetic equations [4]. We will discuss some of the recent theory developments and present accurate results for the thermodynamic properties of the electrons [5], the electron dynamic structure factor [6] and for the plasmon dispersion in dense quantum plasmas [7].

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Advancements in Inertial Confinement Fusion (ICF) and future perspectives

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Inertial Confinement is an approach to Controlled Thermonuclear Fusion which relies on the implosion (compression and heating) of a small quantity of fuel (deuterium and tritium) by energetic laser beams. Currently the most advanced experiments are conducted at the National ignition Facility a MegaJoule laser system installed at the Lawrence Livermore National Laboratory in the US. This follows the so-called indirect-drive scheme, where the laser beams are focused inside a cavity (holhraum) and converted to soft X-rays which produced the implosion of the fuel placed inside the holhraum.

In contrast, in the direct-drive approach the laser beams produce the implosion directly. This is investigated in several facilities, first of all the laser Omega at the University of Rochester in the US. Several other big facilities (LMJ in France, SH III in China) and intermediate facilities (Gekko in Japan, PASL in Prague, Phelix in Germany, Orion in the UK, etc. etc.) allows studying the implosion process or the physics related to inertial fusion.

The lecture will provide the basic notions of inertial fusion for students and then proceed to briefly present the current status of ICF research and the novel approaches, in particular the so called “shock ignition”.

Twisted Light: Topological effects in plasma and optics

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Twisted light carries a finite amount of orbital angular momentum (OAM), and has received considerable attention in recent years. Topological effects associated with single and multiple states of OAM have been studied in plasmas and nonlinear optics. In this talk, we review our recent results, which include twisted plasmon and phonons. We describe donut wakes, fermionic plasmon states and plasma acceleration of helical beams.

The physical properties of light-springs, as opposed to single OAM laser pulses, will be defined. Self-phase modulation of twisted light and the formation of a supercontinuum in Kerr medium will be described. Finally, superfluidity of twisted light will also be considered.

Nonlinear Science: from Tsunami Waves to Optical Pulses and Plasmas

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The laws of Nature are intrinsically nonlinear. The dynamic response of matter to external stimuli is not proportional to its strength, as often thought, but may instead manifest a rich, multifaceted and often unpredictable qualitative behaviour. As a consequence, dynamics is governed by nonlinear mathematical laws. Nonlinearity is nowadays recognized as an inherent characteristic of dynamics, dominating evolution not only in science, but also e.g. in economy or mathematical biology [1].

The physical mechanisms involved in nonlinear systems are generic, i.e. they may be common among different contexts. Small excitations off equilibrium, in the presence of a restoring mechanism, are known to lead to propagating oscillations around the equilibrium state (waves). Beyond the small-wave-amplitude approximation, nonlinearity becomes dominant, leading to wave steepening and eventually to wave breakdown (surfer's wave). Fourier dispersion, on the other hand, leads to separation among different modes and wavepacket dissociation (a phenomenon analogous to chromatic dispersion in linear optics, the mechanism underlying the rainbow effect). When physical circumstances allow for a balance between these two mechanisms, propagating localized structures are formed, in the form of solitary waves (modelled by the mathematical paradigm of a soliton). Localized modes thus described may vary in form and bear various names in different branches of physics, i.e. solitary pulses, kink solitons, shocks, propagating fronts, blast waves, envelope waves, rogue (or freak) waves, oscillons, and so on [2-5].

This presentation aims to provide an overview of the qualitative aspects leading to the formation of nonlinear structures are in various physical contexts. Topics to be covered range from ocean dynamics to signal transmission in the DNA, and from laser-plasma interactions to pulse transmission along optical fibers. We will discuss the underlying mechanisms involved in the formation and propagation of these structures, and how these are manifested at different spatiotemporal scales in the real world. Particular focus will be paid to the unifying aspects linking the mathematical description of nonlinear phenomena across different disciplines.

Acknowledgment: Support from Abu Dhabi Department of Education and Knowledge (ADEK) in the form of an AARE-2018 (ADEK Award for Research Excellence 2018) grant is gratefully acknowledged.

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ABSTRACTS INVITED TALKS FROM ABROAD

Kinetic full wave analysis in inhomogeneous plasmas

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Full wave analysis including kinetic effects has been extensively studied in order to describe wave-plasma interactions in inhomogeneous plasmas. Time-dependent particle simulation can describe the wave-plasma interactions including nonlinear effects, but requires considerable computational resources. In the full wave analysis, boundary-value problem of Maxwell's equation is solved for given complex wave frequency. It has been applied to the the analysis of heating and current drive in magnetically-confined plasmas and eigenmode excitation in nonequilibrium plasmas. Most of previous kinetic analyses of wave propagation and absorption in an inhomogeneous plasma are based on the concept of wave number. Though the dielectric tensor in a homogeneous hot plasma has been usually expressed as a function of wave number, the wave number in an inhomogeneous plasma is not available a priori. Therefore, various approximations have been employed: assumption of cold-plasma wave number, replacement of wave number by spatial differential operator, or Fourier mode expansion in inhomogeneous plasmas. As an alternative approach independent of wave number, an integral form of dielectric tensor has been proposed. The plasma response to the wave electric field is expressed as an integral along an unperturbed particle orbit. The wave behavior is described by Maxwell's equation with the integral form of dielectric tensor

$$\nabla \times \nabla \times \boldsymbol{E}(\boldsymbol{r}) - \frac{\omega^2}{c^2} \int \mathrm{d}\boldsymbol{r}' \overleftrightarrow{\epsilon}(\boldsymbol{r}, \boldsymbol{r}') \cdot \boldsymbol{E}(\boldsymbol{r}') = \mathrm{i}\,\omega\mu_0 \boldsymbol{j}_{\mathrm{ext}}.$$

Three types of the integral forms have been derived: 1) in unmagnetized plasma, 2) in magnetized plasma along the field line, and 3) in magnetized plasma perpendicular to the field line. In case 1, the kernel function is a kind of Fourier inverse transform of the plasma dispersion function. Kinetic effects in laser-plasma interaction was analyzed. In case 2, similar kernel function has been derived in a weakly inhomogeneous magnetic field. Kinetic behavior of magnetic beach heating was analyzed. In case 3, the finite Larmor radius effects introduce kernel functions related to the Fourier inverse transform of the modified Bessel functions. The cyclotron resonance absorption by energetic particles and the behavior Bernstein wave have been analyzed. Recently the kinetic full wave analysis has been extended to the two-dimensional analyses to describe the O-X-B mode conversion of electron cyclotron waves in a small-size tokamak. Parameter dependence of the wave behavior are examined. More general formulation of the two-dimensional integral form of the dielectric tensor will be discussed.

High power lasers for studying Proton stopping power in extreme state of matter

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The study of Ion Stopping Power close to the Brag peak in Warm Dense Matter is an open field of investigation where still many problems have to be solved. Theoretical models give different and controversy predictions in this regime and the experimental results are still rare in the field. In addition proton stopping power close to the Bragg peak require low energy (below 1 MeV) proton beams with a very thin targets (~ 1 um). Such extreme conditions together cannot be satisfied if using long pulse (~ ns) lasers such as the one in the large energy laser facilities because of the short lifetime of the heated target compared to the duration of the heater. The limited lifetime (~ hundreds of ps) of the Warm Dense Matter Target reduce drastically the free time of investigation forcing to reduce both the time of the probe and the time of measurement. High Power and ultra short (from ps down to fs) have opened the possibility to generate very short (few ps) proton beams with which is possible to probe the WDM that can also be generated with similar duration laser pulses.

Quantum kinetic theory of plasmas in the strong field regime

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Already in the simplest standard case of electrostatic non-relativistic approximations, the Wigner-formalism gives important extensions of classical kinetic theory, giving raise to new forms of wave-particle interaction. Extending the theory to cover spin dynamics and weakly relativistic effects such as spin-orbit interaction, the models become more intricate but also allow for still new phenomena. The spin degrees of freedom can be handled in (at least) two distinct ways. Either by a Q-transform, in which case the independent variables become extended with two spin variables (representing the position on the Bloch sphere), or by projecting the Wigner matrix on scalar and vector quantities. New physics appear in the strongly relativistic treatment. For example, in strongly magnetized environments (such as e.g. the vicinity of magnetars), relativistic Landau quantization make the electrons behave as a multi-species plasma. Finally, abandoning simplifying assumptions of the Dirac theory altogether, the electron and positron degrees of freedom will be coupled, and phenomena such as pair-production enters the picture. In this case, the Wigner theory will be represented by 16 scalar equations, the so called Dirac-Heisenberg-Wigner equations.

Common pitfalls and errors in nonlinear plasma wave modelling

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The nonlinear analysis of the characteristics of electrostatic and electromagnetic waves propagating in plasmas is recognized as a rich and apparently inexhaustible area of research in modern plasma science. Adopting a one-dimensional fluid plasma description, as the simplest (…) starting point, popular directions of research include: i) the *Korteweg-de Vries* theory (see e.g. in [1]) for small-amplitude weakly super-acoustic (or supersonic) solitons and for periodic nonlinear (cnoidal) waves, ii) the pseudopotential formalism (also known as the *Sagdeev theory*) [2] for large-amplitude solitary waves (pulses) and iii) the Newell-Kako multiple scales technique, known from nonlinear optics [3,4] to model modulated wavepackets and dark/bright envelope solitons and, more recently, via nonlinear Schrodinger type equations, to mention but a few of the analytical techniques developed in the field. Various multidimensional extensions of those theories (omitted here for brevity) have also been developed, though such extensions are non-integrable in general and the properties of their solution may thus differ dramatically.

Each of these methods may present certain shortcomings, in that its region of validity may be restricted by certain simplifying assumptions. Furthermore, the physical interpretation of certain apparently plausible algebraic results may be dubious or even doubtful in some cases (despite the apparent "elegance" of these results), often rendering certain models useless or unacceptable in a range of situations. Finally, certain "minor" algebraic errors may invalidate a model. Regretfully, the literature is full of such examples. This presentation is devoted to discussing a number of pitfalls, inaccuracies and errors that have appeared in the literature in the past. The (often overlooked) underlying physical conditions of certain models will be discussed, and the (often underestimated) effect of some typical "simplifying hypotheses" will be investigated. Methods to remedy a model by assessing its validity will be pointed out.

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Acknowledgment: Support from Abu Dhabi Department of Education and Knowledge (ADEK) in the form of an AARE-2018 (ADEK Award for Research Excellence 2018) grant is gratefully acknowledged.

Experiment and simulation of kinetic instabilities in electron cyclotron resonance mirror plasma*

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We report observations of electromagnetic emissions at electron cyclotron harmonics in a mirror-confined electron cyclotron resonance (ECR) plasma [1]. The present research has achieved a new understanding of electron cyclotron instabilities by comparing measurements of emissions from a well-diagnosed laboratory plasma, with the predictions of analytical theory supported by Vlasov simulations. A notable success of this work is the revelation of the subtle effects that the presence of multi-component electron distribution functions involving a warm and ring-distributed [2] 200-400 eV mirror-confined population of electrons and a much colder 1 eV component have on the excitation of electron cyclotron instabilities, where the instability takes place at frequencies near the upper hybrid frequency of the cold component. The emissions may be used as a diagnostic of the electron composition of the plasma. This new understanding resulting from the research reported here is likely to have a significant impact on the many areas where electron cyclotron instabilities are of fundamental importance, including astrophysical plasmas [3] and near-Earth solar-terrestrial plasmas [4].

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* This project is funded in Russia by the RFBR under project No. 19-52-10007. In the UK the project is enabled by funding from the Royal Society, award IECnR2n181158 and the UK EPSRC under grants EP/R034737/1, EP/R004773/1, EP/M009386/1, EP/G04239X/1.

Introduction to Path Integral Monte Carlo simulations of degenerate electrons

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The path integral Monte Carlo (PIMC) method constitutes one of the most successful techniques in statistical physics as it in principle allows to obtain exact solutions for quantum many-body problems without any empirical input or simplifications. In this tutorial, we give a detailed introduction to the PIMC formalism and its practical implementation and application. Moreover, we look in detail at PIMC simulations of quantum degenerate electronic systems such as warm dense matter, which are afflicted with the notorious fermion sign problem.

Quantum hydrodynamics from time dependent density functional theory

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Methods for large-scale simulation of time-dependent features of quantum plasmas are crucial for fundamental and applied problems. This lecture will be focused on the derivation of quantum hydrodynamics from time dependent density functional theory. The microscopic theory of quantum hydrodynamics (MQHD) will be discussed [1-3]. Quantum hydrodynamic theory is presented as the orbital averaging of the MQHD equations. The introduced in this way many-electron Bohm potetnial is investigated using exact ab initio simulations. This lecture is for students of the scientific school ISPAD-2020. The presented derivations will help to understand some of the latest developments in the theory of dense plasmas.

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ABSTRACTS LOCAL INVITED TALKS AND POSTERS

Dielectric barrier discharge and its applications

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A plasma ozone generator is developed using the dielectric barrier discharge. It converts oxygen to ozone which is employed for different applications. The growth of bacteria on petri dishes is successively controlled. Bad smell and odor in rooms as well as the poultry sheds is eliminated successively with the ozone. Ozonized cold water is used for washing the laundry without detergent/ soap. It also removes the bad odor found in the hospital laundry. It is used for hygienic cleaning of water in swimming pools and any smell is removed. The ozonized water kills different

pests on the plants without using the pesticides. Hence, it helps in obtaining organic vegetables. In conclusion, it is an ecofriendly system that eliminates the use of pesticides as well as the detergents.

Plasmon Excitations in Metallic Nanowires

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A theoretical formulism is proposed for the excitation of plasmon modes due to a short electron pulse. For this purpose, a metallic quantum nanowire is considered containing quantum electrons with a fixed background of non-degenerate positive ions. Utilizing the electron quantum hydrodynamical equations, the dispersion relation for electrostatic plasmon modes is obtained, which not only accounts for quantum statistical and quantum diffraction effects but also for finite-size effects in the radial direction of nanowire. The use of Fourier transforms and steady state condition further leads to the plasmon wakefield excited by an electron beam propagating with a constant velocity V0 along the axial direction of nanowire. The stability conditions for wakefield are analyzed by using typical parameters of metals. It is found that excitation of plasmons in metals is strongly affected by the quantum parameters and can be useful for studying new sources of radiation in the extreme-ultraviolet range.

THz wave-matter interactions in connection to a novel robotic THz spectroscopic imaging system*

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Electromagnetic (EM) radiation is a widely used non-destructive testing (NDT) tool. THz waves are EM in nature with frequency falling between the microwave and infrared regions. THz technology is rapidly progressing in recent decades due to ability of THz waves for non-destructive and non-invasive inspection of dielectric materials and semiconductors. It also has certain advantages over infrared (IR), ultraviolet (UV) and X-rays based technologies. In this work, we have proposed a new THz time domain spectroscopy (TDS) and imaging system for application in archaeology and art conservation. The limitations of present robotic THz TDS systems are described and a new design is proposed. Theoretical investigations of wave-matter interaction analysis are also proposed by full wave analysis to have a better understanding of propagating THz waves in matter. The concepts of prototype THz TDS system are described and theoretical modelling framework is given.

*This project is supported by Kyoto University of Advanced Science, Kyoto Japan through Interdisciplinary Research Activity Support Program 2020

Comparative analysis between mathematical formulations for electromagnetic resistive drift instability in fusion plasma

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The equivalence between the two-fluid plasma mathematical model and the extended MHD mathematical model for resistive drift Alfven mode is analyzed by deriving local dispersion

relations in a nonuniform magnetized plasma. Our results validate that the two-fluid approach is comparable to the extended MHD for treating the electromagnetic drift mode. Using the two-fluid mathematical model, it is shown that the electromagnetic or electrostatic character of the mode can be controlled through plasma beta. Then, the finite Larmor radius effects which suppress growth rates are examined. It is found that the two-fluid effect is more prominent as compared to that in extended MHD mathematical model due to an additional term associated with ion polarization drift. We further investigate the dependence of the growth rate on parallel and perpendicular wave number as well as on the plasma resistivity. The results should be useful to interpret the electromagnetic fluctuations in nonuniform fusion plasma, where resistivity plays a key element in the calculation of dissipative drift instabilities

Interaction dynamics of multisolitons in cylindrically confined pair ion Plasma

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A theoretical investigation is carried out for understanding the nonlinear properties of solitary waves in an unmagnetized Pair-ion-electron plasma in nonplanar geometry. By making use of reductive perturbation technique nonlinear nonplanar cylindrical Kadomstev-Petviashvilli equation is derived in pair-ion plasmas to study the propagation and interaction of two solitons. Using a novel Gauge transformation it is possible to analytically find the exact solution of CKP equation it turns out that solutions are showing different character from planar KP . A completely different analytical exact solution is obtained using Hirota method. We observe the deviation from line soliton to horse shoe like solitons in nonplanar case ,and also found that propagation of one and two solitons is affected by plasma parameters. The present study may have relevance to understand the formation of two solitons in laboratory produced pair plasmas.

Interaction of electron acoustic waves in the presence of superthermal electrons in terrestrial magnetosphere

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We have investigated the propagation and interaction of nonlinear electron acoustic waves (EAWs) in a plasma comprising hot (superthermal) and cold electrons and immobile ions. We have derived the Korteweg-de Vries equation for EAWs in the small amplitude limit. Employing the Hirota's Direct method, we have investigated the multisoliton solutions for electron acoustic solitary waves (EASWs). It has been found that the system under consideration admits only rarefactive electrostatic solitary structures. As the observable data are available in terms of electric field rather than electric potential, therefore, we have discussed our results in terms of bipolar electric field structures. The numerical analysis has revealed that the ratio of hot to cold electrons and superthermality of hot electrons play a crucial role in changing the amplitude of EASWs. The interaction of the two solitons and its dependence on the choice of propagation vectors, superthermality, and density ratio have also been elaborated. The results of the present study may be beneficial to comprehend the interaction between two EASWs in astrophysical and laboratory plasmas.

Grad B effects on Gravitational/Rayleigh Taylor Plasma instability for space plasmas

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Effects of gradient in magnetic field on the Gravitational/Rayleigh-Taylor (RT) instability are investigated in space plasma with inhomogeneity in density. Fluid hydrodynamical model is used to formulate the dispersion relation for the Ralyeigh-Taylor instability which becomes modified with the inclusion of the gradient in ambient magnetic field. Graphically it is shown that the direction of the gradient in magnetic field can control the instability. It is shown that the gradient in magnetic field produces density gradient which modifies the linear growth rate of RT instability. It is also noted that the grad B antiparallel to constant gravitational acceleration g makes stabilization in instability. The work should be useful in studies of laser produced-plasma, Earth's magnetospheric plasma.

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Occurrence of spin electron acoustic soliton in a beam interacting spin polarized plasma

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Degenerate plasmas have received increasing attention in the last decade due to their importance in various areas of physics such as semiconductors, metals, microelectronics, carbon nanotubes and in the astrophysical environments. In this article the formation and the properties of spin electron acoustic (SEA) soliton are examined in the beam interacting spin polarized plasma. For this purpose, we employ separate spin evolution-quantum hydrodynamic (SSE-QHD) model along with Maxwell equations to study the propagation of second harmonic waves in a semiconductor plasma. The reductive perturbation theory is used to reduce the basic set of quantum fluid equations to Korteweg-de Vries (KdV) equation. It is found that when the ratio of beam density to background density is n_{0b}/n_{0e}=0.001, only rarefactive type of spin dependent solitons occur. However, for n_{0b}/n_{0e}>0.01, the system admits both the compressive and rarefactive solitons. Further, the effect of beam parameters and spin polarization on the phase velocities and soliton profile has been discussed. Application of the model to semiconductor is pointed out.

Beltrami States in electron-depleted multi-ion dusty plasmas

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In magnetized electron-depleted multi-ion dusty plasmas, a possibility of self-organization is determined. Making use of the equation of motion of the plasma's mobile species, i.e., positive ions and two types of negative ions with Ampere's law, we obtain a quadruple Beltrami field. This higher order Beltrami field is characterized by four scale parameters. We have investigated the generation of self-organized structures. The typical length of these structures is attributed to the skin depth λp of positive ions. The influence of Beltrami parameters and scale parameters on the structure formation has also been investigated. It is found that there is a possibility of the formation of large scale structures of the order of system size and the formation of small scale structures of the order of skin depth simultaneously in the electron depleted multi-ion dusty plasmas, which are very useful to explain the dynamo theory. This study should be useful to describe the relaxed structures in space plasmas such as the D-region of Earth's mesosphere and F-ring of Saturn and in laboratory work where the dust particles are present as impurities.

Compressive and rarefactive ion acoustic cnoidal waves in nonthermal plasmas

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The ion acoustic cnoidal waves have been studied in a plasma having cold ions and Cairns distributed electrons. Using reductive perturbation method, the Korteweg-de Vries (KdV) and modified Korteweg-de Vries (mKdV) equations have been derived, and their cnoidal wave solutions have been obtained. It has been pointed that the KdV equation fails at plasma critical composition, and thus the higher order nonlinearity leads to the derivation of mKdV equation. The co-existence of compressive and rarefactive cnoidal waves is pointed out in the critical case. So far, this aspect has not been tackled at all in the nonthermal plasma literature on cnoidal waves. It is the degree of nonthermality of electrons that is responsible for the rarefactive solutions. The present plasma model accounts for the cnoidal wave structures (Jovanovic and Shukla Phys. Rev. Lett. 84, 4373 2000) in the magnetosphere observed via FAST and POLAR spacecrafts.

2D drift solitary structures in inhomogeneous magnetized O-H ion plasmas with generalized (r,q) distributed electrons

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The effect of generalized (r,q) distributed electrons on the linear and nonlinear coupling of drift and ion acoustic waves in a nonuniform plasma containing Hydrogen and Oxygen ions is investigated. In the linear regime, it is observed that increasing the percentage of flat-topped (i.e. $r>0$) electrons enhances the frequency of the coupled drift-ion acoustic waves whereas the increasing values of the spectral index q mitigates it. In the nonlinear regime, one and two dimensional KdV-like and KP-like equations are derived and their solutions are plotted for different ratios of ion number densities and for different values of double spectral indices r and q of the generalized distribution of electrons. It is found that only rarefactive structures exist for two dimensional solitons, however, both rarefactive and compressive structures are observed for the one dimensional case. Spatial scales for the formation of rarefactive and compressive solitary structures are also discussed with reference to the changing electron distribution functions.

Oblique interaction of electrostatic nonlinear structures in relativistically degenerate dense magnetoplasmas

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In this work, we have investigated the interaction of obliquely propagating ion acoustic solitary waves in a magnetoplasma with relativistically degenerate electrons. Using the quantum hydrodynamics (QHD) model and by employing the extended PLK technique, we have derived a set of KdV equations for two solitons. We have observed that the system under consideration allows the formation of only compressive solitons and their velocities remain in the sub-acoustic limit. Furthermore, phase shifts of solitons as a result of their interaction have been calculated. The phase shifts have been observed to be dependent on the obliqueness and the physical parameters of plasma. It has also been noticed that phase shifts remain negative for the whole range of parameters generally found in white dwarf stars. We have observed that the phase shifts enhance with the enhancement in number density, however, the converse happens when the magnetic field is enhanced. It has also been observed that the phase shift is slightly greater for the solitons that are less oblique as compared to their more oblique counterparts.

Contributions
Radiation-Matter Interaction

Abstracts not available

Posters

Posters of Plasma Physics -Theory and Applications as well as Radiation-Matter Interaction can be found in the archives of the ISPAD 2021 at the NCP page; http://www.ncp.edu.pk/index.php

Collected and compiled by: Theoretical Physics Department, National Centre for Physics, Islamabad (S. A. Khan)

International School on Physics & Allied Disciplines (Webinar)

March 09 – 11, 2021
Islamabad, Pakistan

Directors:
Hafeez R. Hoorani (NCP, Pakistan), Joseph Niemela (ICTP, Italy)

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The National Centre for Physics (NCP), Islamabad, Pakistan and The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy are jointly organizing the International School on Physics & Allied Disciplines (ISPAD) in Islamabad, Pakistan from March 09 - 11, 2021. Due to pandemic of COVID-19, the ISPAD-2021 will be held virtually.

Introduction

The idea of holding the ISPAD at NCP is to provide a platform for the local and the foreign participants to exchange scientific knowledge and to generate enthusiasm for science and innovation. Around 250 young Pakistani M.Phil./Ph.D. students, researchers, university faculty and many foreign invited speakers and participants will take part in the deliberations of ISPAD-2021.

Format

Each year, the topics (technical activities) of School are chosen keeping in view the present and future research interests of NCP, universities and national R&D institutions. Due to pandemic of COVID-19, the presentations / lectures will be delivered online.

Topics and Coordinators

A. **Plasma Physics: Theory and Applications (PP)**

Basic Plasma Physics, Coherent Nonlinear Phenomena, Quantum Plasmas, Computational Plasma Physics, Experimental Techniques, Fusion Plasma Physics

Coordinators: Mohsin Siddiq (NCP), Waqas Masood (CIIT), Shabbir Ahmed Khan (NCP)

B. **Radiation – Matter Interaction (RMI)**

Computer Simulation of Radiation Interactions, Radiation Induced effects in Solids, High Harmonics Generation (HHG), Ion Implantation, Medical Radioisotopes Production with Ion Beams, Radiation Protection & Safety. Advanced Materials Analysis using Ion-Beam, Lasers (LIBS, laser based mass spectroscopy etc), Gamma-rays, X-rays, Neutron and Synchrotron Radiation Techniques etc.

Coordinators: M. Aslam Baig (NCP), Turab Ali (NCP), Muhammad Shahid (PNRA)

Participation

Fresh graduate & post graduate students, post-doctoral researchers, faculty and research scientists who have also published research work in recognized international journals during the last three years are encouraged to participate (oral or poster presentation)

How to apply

The Online Registration Form can be accessed at: http://www.ncp.edu.pk/ispad-2021.php. The Application Form should be submitted by **February 28, 2021 by foreign and local participants**. Selection will be made by the Technical Committee of ISPAD-2021. There is **no registration fee** for participation in the ISPAD-2021.

Application Deadline

Feb 28, 2021
For Foreign and Local Participants

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