CHAPTER 38

PHYSICS AND ASTROPHYSICS

Doctoral Theses

276. BATRA (Kriti)
Excitation and Ionization Studies of Atomic Systems Including Rydberg Atoms in External Electromagnetic Field.
Supervisor: Dr. Man Mohan
Th 14301

Abstract

Presents a general review of the theoretical and experimental work done. Different methods for solving the time-dependent Schrodinger equation have been discussed and a general review on the behaviour of atoms in laser fields with different regimes of intensity, frequency etc. have been presented. A brief idea on developments in the atom fields interaction is also given. Attemps to understand the bahaviour of atomic systems in external electromagnetic fields considering Rydberg atoms as prototypes. Investigates the selective exciation of alkali Rydberg atoms with frequency modulated fields and collisional and radiative excitations in microwave fields. Survey wide ranging phenomenon which have been opened for study by availability of very intense short pulse lasers and observes non-perturbative phenomenon in the high intensity regime. Results show stabilization to ionization at high field intensities and high frequencies. The results obtained strengthen the opinion on ionization suppression at high intensities and suggest alternate mechanisms of efficient population transfer. Suggests that study can also be extended to molecules in intense laser fields where effects like coherent control of dissociation, bond softening etc. can be observed and that methods used in the present work can also be applied to other atoms as well as molecules.

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Integration of Time Dependent Schrodinger Euqtion. 5. Conclusion.

277. GHUDE (Sachin Dinkar)
The Study of Greenhouse Gases Over Maitri, Antarctica.
Supervisors : Prof. M M Bajaj and Dr. S L Jain
Th 14303

Abstract

Deals with the measurement of surface air concentration of some of the major trace gases like carbon dioxide, methane, water vapour ozone and carbon monoxide at Antarctica. The data presented here were collected under the coldest, windiest, driest and awful environmental circumstances during an actual visit to Maitri, Antarctica (70^0 45' S, 11^0 45' E) for twenty months in a very well planned and well managed research programe of National Physical Laboratory, New Delhi. The measurements were made during twenty first, twenty second and twenty third Indian Scientific Expeditions to Antarctica conducted by Department of Ocean Development and National Centre for Antarctic and Ocean Research, Govt. of India. Few data records have also been used in the present study, which were collected during sixteenth Indian Scientific Expedition to Antarctica. The work is of immense practical importance to study the base line values of greenhouse gases in the atmosphere, its regional and global impact, chemistry and dynamics of the atmosphere and for the safety of our Earth's inhabitants. In-situ as well as passive remote sensing experimental techniques have been used for the measurements and data have been analyzed using the most advanced computer softwares.

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278. GUPTA (Ruby)
Study of Plasma Dynamics and Plasma Processing of Thin Film Materials.
Supervisor : Prof. M P Srivastava
Th 14305

Abstract

Reports the results of : (a) Study of plasma and current sheath dynamics using laser shadowgraphic technique and X-ray emission using diode X-ray spectrometer, from sequential dense plasma focus device, (b) thin film deposition of titanium and carbonitriding of stainless steel using dense plasma focus, and (c) deposition of nanosized grains of ferroelectric lead zirconate titanate on thin films using dense plasma focus.

Contents

279. JHA (Radha Krishna)
Experimental and Theoretical Studies on Entropy Enhancement Due to External Perturbing Factors.
Supervisor: Prof. M M Bajaj
Th 14308

Abstract

Gives a detailed and rigorous physical investigation of BIS (Breakdown of Integrated Systems) effect. Investigates the entropy enhancement in human body and in our environment due to external perturbing factors, such as addictive drugs, alcohol smoking, flesharian diets and other human activities. Mainly concentrates on neurological disorders specially in the light of new knowledge of neurotoxins and biotoxins entering into the human body through the dietary, respiratory and other routes. Also studies the impact of BIS entropy enhancers on the human nervous system. Using the Bessel functions of n^{th} order, the group theory, information entropy and BIS entropy production for explaining the BIS entropy rainfall. Four major types of BIS entropy enhancers (1) Cocaine, (2) Amphetamines, (3) Heroin and (4) Alchohol are dealt with. Also presents a new approach to the etiology proliferation and management of the Severe Acute Respiratory Syndrome caused by SARS coronavirus and critically examines hitherto unexplored issues related to

its origin and proliferation dynamics. The role of marine toxins in the etiology of Alzheimer's Disease and other body disorders are critically examined with special emphasis on BISIASIS & BISOSIS.

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280. MUKESH KUMAR

New Approach to Conservation Laws in Theoretical Mechanics.

Supervisor : Dr. S K Soni

Th 14311

Abstract

Studies conservation laws from a new perspective. Analyses the classical structure of the Helmholtz conditions to study conservation laws which are not just a way of mathematical representation of a system but are the very powerful restrictions on which system behaviour depends. The Helmholtz conditions are necessary and sufficient conditions for the existence of Lagrangian. For proof of the Helmholtz conditions, generalizes the canonical form of the Poisson bracket to a non-canonical form. This non-canonical Poisson bracket is expressed in terms of independent coordinates *x* and velocities *x* rather then conjugate momenta. The amioms satisfied by the Poisson bracket helps us to give a new proof of the Helmholtz conditions. To illustrate how the conservation laws of Lagrangian dynamical system may be studied classically by means of a formulation based on the Helmholtz conditions, we start from a conserved quantity ø given by Hojman, which was subsequently generalized by Gonzalez-Gascon and Lutzky. These conserved quantities holds for both Noether and non-Noether symmetry. A noether Symmetry is one under which leave the equations of motion and action integral invariant : a non-Noether symmetry does not leave action integral invariant. The explicit form of ø is determined from the knowledge of symmetry group generator E. For a Lagrangian system we can represent ø in the terms of integrating factor matrix *Wij*. Rest of the work is restricted to Noether symmetry. The constancy of ø is also proved

in the case of Noetherian symmetry by showing that the on shell time derivative of ø vanishes. Finally it finds the value of ø with the help of the Helmhotz conditions. The Constants so determined is actually found to vanish if the associated symmetries are Noether. Hence this constant of motion is trivial if the transformation studied is Noether. This study rely on Noether theorem for the calculation of conserved quantity. Summaries that approach for a classical mechanical system satisfying the Helmholtz conditions, is applicable to non-Noether symmetries only. In the case of Noether symmetry we have to rely on the classical Noether invariant from the constant of motion.

Contents

281. SAXENA (Aparna)
Pyroelectricity and Internal Bias Field Effects in Phosphoric Acid Doped Triglycine Sulphate (TGSP) Single Crystal.
Supervisor: Dr. K Sreenivas
Th 14309

Abstract

Focusses on the growth and characterisation of phosphoric acid doped TGS single crystals. Studies the structural, electrical, compositional, and mechanical properties. The presence of both zwitter ion and the glycinium ion in the phosphoric acid dopted TGS samples is concluded, and is atttributed to the very low incorporation of H_3PO_4 into the crystal lattice as evidenced from the comositional analysis. The effect of phosphoric acid doping in TGS on the transition temperature has been clarified and the changes in the electrical properties have been investigated in detail. The dielectric dispersion data in the frequency range (100 Hz to 100 kHz) has been analysed in the light of theoretical models, and the observed dispersion in the low frequency region is explained on the basis of Debye theory having a wide distribution of relaxation times. Studies on temperature dependence of dielectric onstant and loss show, that TGSP crystals exhibit a broad transition and the peak dielectric constant values are lowered and the transition temperature

shifts to lower values in comparison to undopted TGS. The cause for the shift in T_{Em} is explained. The Universal model is found inadequate to explain the observed dielectric dispersion, in comparison to the Debye model that agrees well when considered with a distribution of relaxation times. The presence of an interanl bias field and its influences on other electrical properties has been investigated. A method for the estimation of internal bias field is explained and pyroelectric materials figure of merit has been investigated as a function of the dopant concentration. For pyroelectric detertor applications a specific concentration of 0.2 to 0.25 moles of H_3PO_4 in the solution during crystal growth is found to be optimum for a high figure of merit for detectivity F_d = 428 $\mu C/m^2K$.

Contents

282. SHARMA (Seema)
Investigations on Water Degradation of Sr^{2+}, Al^{3+} and Zn^{2+} Substituted $YBa_2Cu_3O_{7-\delta}$.
Supervisor : Prof. G L Bhalla
Th 14304

Abstract

Studies the water degradation of the single cation substituted $YBa_2Cu_3O_{7-\delta}$ superconductors, viz, Sr^{2+}at Ba^{2+} and Al^{3+} at Cu(1) site; Zn^{2+} at Cu(2) site in $YBa_2Cu_3O_{7-\delta}$. The single cation substituted $YBa_2Cu_3O_{7-\delta}$ has been subjected to 16h deionized water treatment. In the present studies the single cation substituted $YBa_2Cu_3O_{7-\delta}$ samples have been treated with water for 16h. The Al^{3+} subsitituted samples have been water treated for 8h also. Subsequently the degradation effect on the sample was studied by using temperature dependent resistivity measurements, X-ray diffraction studies, oxygen content determination and the morphological studies using scanning electron microscope (SEM). The experimental data is likely to provide information to change in the critical transition temperature, oxygen content, structure tranformation in $YBa_2Cu_3O_{7-\delta}$formation of the impurity products/phases, changes in the morphology of the samples consequent to single cation

substitution in $YBa_2Cu_3O_{7-\delta}$ and on their water treatment. Systematic analysis of such a data for untreated and water treated samples and their comparative studies is expected to throw light on the cause of degradation in $YBa_2Cu_3O_{7-\delta}$ superconductor.

Contents

283. SINGHAL (Nisha)
Molecular Dynamics of Diatomic and Polyatomic Molecules in Presence of Polarised Laser Field.
Supervisor: Dr. Man Mohan
Th 14306

Abstract

Attempts to understand the dynamics of diatomic and polyatomic molecules in presence of external electromagnetic fields of different polarisation nature. Collisionless and collisional study of various transitions of molecules has also been presented. Several non-perturbative techniques have been used to study the molecular dynamics. Studied and analysed various semi classical phenomena to understand molecular dynamics of diatomic and polyatomic molecules in the presence of polarised laser beans. Discussed the effect of polarisationon the rotational transition of HF in its ground electronic and lowest vibrational level in a complete dynamical treatment that will include resonant and non resonant excitations of molecule. These studies of the dynamics of transitions evolved from various J states are essential to many spectroscopic investigations. The dynamics of rotational excitation of HF molecule in presence of electromagnetic radiation having linear and circular polarisation is also studied. The formalism is non perturbative in nature and applicable to multiphoton processes involving arbitrary high field strengths, provides a simple picture for the intensity and time dependent multiphoton phenomena. This method can be extended to study different types of problems, in atomic and molecular physics, in which number of photons are exchanged during collision.

Contents

1. Introduction. 2. Polarisation Effect on Rotational Transitions of Diatomic Molecule. 3. Mode-Selective Dynamics of Polyatomic Molecule. 4. Role of Ellipticity in Rovibrational Dynamics of Diatomic Molecule. Bibliography.

284. SOBINDER SINGH

In-Depth Studies on the Experimental and Theoretical Aspects of Entropy Amplification in Biomedical and Terrestrial Systems.

Supervisor: Prof. Madan Mohan Bajaj

Th 14302

Abstract

Provides in-depth studies of BIS consequences in two different types of systems : (a) Biomedical and (b) Terrestrial. Examines the role of complex BIS loads in traumatology using Poisson relations. Explains different types of BIS impedances. A human body is an integral system, it can exist and function on its own in the presence of proper atmosphere and gravitation. Human organs are differential systems, which cannot function independently. They can function properly only as a part of an integrated structure. Depending on the basic chemical, physical and neural manifestations, observed three distinct types of BIS impedances : Resistive, Inductive, Capacitative. These ruin the human body and destroy the neural networks. Phase difference between real and imaginary components arises due to phase difference between these three components. Studied the relationship between trauma probability and BIS impedance. Discusses the economics of aquaculture and enumerate the countries practicing aquaculture. Global aquaculture of fisheries is examines and also discusses the industrialization or killing of Shrimp in India, shrip Export in India, effect of viral diseases, configuration spaces and associated loop spaces in human beings originating due to BIS intake of shrimp, crab squillete, four types of viruses, and multiple viral infection. Presents the studies on the entropy amplification by the killing of fisheries. All major regions in the Atlantic, Mediterranean, and Pacific, have declining catches and exhibit, non-sustainability. Depending of fish, increase of population, war on fisheries has intensified. After World War II fisheries adapted military detection technologies such as radar, sonar and loran to peaceful efforts of food gathering. But from the fished perspective it might have seemed that war was

suddenly declared on them. Showing that the entropy amplification is associated with the Minamata disease, consumption of high of alpha-radioactivity, damages due to P C B and pesticides, poisoning due to Hg & Pb. Conclude that stopping the murder of aquatic creatures can reduce the complex BIS load.

Contents

285. THAKUR (Anil Kumar)
Electroclinic Liquid Crystal.
Supervisors: Prof. G K Chadha and Dr. A M Biradar
Th 14310

Abstract

Attempts to study electro-optical and dielectric properties of two commercially available room temperature electroclinic liquid crystals. The main objective is to understand the dielectric properties of electroclinic liquid crystals during Sm-c*-Sm-A phase transition and a clear demarcation line has been drawn between FLC and ELC. The electro-optical properties have also been investigated in transition region. Gives a brief review of the whole field of liquid crystals with special emphasis on ELCs and its microscopic properties has been presented. Includes experimental techniques, used for the preparation and characterization of ELC samples, The different stages in the preparation of an ELC sample are presented in detail. Studies dielectric relaxation near the transition temperature of Sm-C*-Sm- A phase in two types of electrocline liquid crystal. Analyses the dielectric permittivity behaviour of electroclinic liquid crystals near the transition temperature of Sm-C* - Sm-A phase. The behaviour of bias field on dielectric permittivity is also studied. It has been concluded that due to high dielectric strength near the phase transition region, the sharp phase transition could not be observed. The detection of soft mode neat T_c in Sm-C* phase is difficult even at high bias field by dielectric method in electroclinic liquid crystals. Shows

the dielectric and electro-optical behaviour of electroclinic liquid crystals in Sm-A and Sm-C* phase. A possibility of obtaining grey level image storage has been explored by using optically addressed spatial light modulator made up of deformed helix ferroelectric liquid crystals. Observes that OASLM made up of deformed helix ferroelectric liquid crystal has wider operational efficiency and show grey level image storage.

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286. UPADHYAY (Shiva) nee SHIVA PANDEY
Studies of the Complexities Generated by LSFAO of α–, β– and γ– Types.
Supervisor: Prof. M M Bajaj
Th 14307

Abstract

Deals with the impact of LSFAO of α–, β– and γ– types on astronomy, geological and biomedical science. LSFAOs enhance allergies, neural disorders, natural disasters. Their elimination provides excellent opportunities to alter the darkest horizons of human future. Co-existence, non-violence and truth are the three strong pillar of the research activity. Provides a clear and unbiased view to explain the role of BIS inputs in enhancing the neuronic entropy by studying the different regions of brain and their role in the onset of depression. This enhanced neuronic entropy leads to depression. Thus, the growth of mind is the result of BIS and anti-BIS processes. In this part we have tried to understand mind in terms of neuronal strings of brain. Proper neuronal connections dictate the mental condition of phenomena of living beings: We regard that the thought processes are the consequences of different neural connections. Courser neural connections are affected by the food we take, air we breath and atmosphere we live in. Addiction due to alcohol, tobacco, products hallucinating drugs leave the impact on the neural

strings. Slowly it cripples the human brain and uproots the existence of living beings. Collected data from different states of India. Analysed the behavioural peculiarities, neural aberrations and mental disorders, which lead to degression. Concludes that in order to save our body and ecosystem from the cruel clutches of incurable diseases and different natural calamities such as earthquakes, tsunamis and other natural disorders, we must stop killing of living creatures and must not consume toxic and extremely harmful substances, which are inherently present in meat and products of barbaric salaughter.

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