CHAPTER 47

PHYSICS AND ASTROPHYSICS

Doctoral Theses

379. JASWANT KUMAR
Nature of Clustering of Large Scale Structures.
Supervisor : Dr. T. R. Seshadri
Th 16488

Abstract

Focusses on characterizing the distribution of points and galaxies using multifractal analysis. Emphases on calculating the Minkowski-Bouligand fractal dimension (D_q) of the distribution of points over different scale and hence finding the scale of homogeneity of the distribution. Effect, of finite size of the sample and clustering in the distribution, on the D_q has been studied in detial. The assumption that the large scale distribution of matter in the University is homogeneous has been verified with multifractal analysis of the data from Sloan Digital Sky Survey.

Contents

1. Introduction. 2. Statistical tools to analyze distribition analysis.3. Fractral dimensions of homogrneous and weakly clustered distribution. 4. Fractal dimension as a measure of homogeneity. 5. Testing homogeneity on large scales in the Sloan Digital Sky Survey. 6. Summary and future prospectus.

380. KULKARNI (Pavan S)
Study of Atmospheric Greenhouse Gases and Ozone Hole, over Antarctica.
Supervisors : Dr. Shahnawaz and Dr. S. L. Jain
Th 16492

Abstract

Deals with the baseline measurement of methance concentration surface air concentration of carbon monoxide along with total column ozone an direct solar UV-B irradiance

at the Indian Research Station, Maitri, Antractica (70^0 45' S, 11^0 45' E). The data presented here were collected by the author during his visit to Maitri, Antarctica during 23rd Indian Scientific Expedition of Antarctica (ISEA) in the year 2004, in a meticulously planned and well managed research program of National Physical Laboratory (NPL), New Delhi and National Center for Antarctic and Ocean Research (NCAOR), Government of India, Goa. Some of the supporting data has also been used from the database of earlier measurements done at Maitri by NPL and from the standard datasets like TOMS (Total Ozone Monitoring Spectrometer) an WDCGG (World Data Centre for Greenhouse Gases) which are available for the community on the web.

Contents

381. MAHAJAN (Sandeep)
Synthesis and Characterization of Barium Titanate based Ferroelectric Ceramics.
Supervisors : Prof. K. Sreenivas and Dr. Chandra Prakash
Th 16487

Abstract

Focuses on the development of $BaZr_xTi_{1-x}O_3$ ceramics with x=0.05 which is othorhombi at room temperature. due to partial substitution of Zirconium (with x=0.05) at the Ti sites in $BaTiO_3$, the lower ferroelectric phase transitions were expected to shifted to higher temperature and the three ferroelectric phases to be pinched near to the room temperature. Also keeping in view that the substitution rate and substitution site do play an important role, in the present study pure BZT compositions and doped compositions (with Bi, Nd and La) have been compared. The micro-structural properties have been studied using XRD and SEM, and the dielectric response over a wide range of temperature at different frequencies (100 Hx to 500 kHz) has been studied. Impedance spectroscopy measurements have been made over a wide frequency range (40 Hz-1 Mhz) in the high temperature range (473 K 873K) to undersatnd the individual contributions of grain and grain-boundaries on the dielectric

response, and the piezoelectric strain and ferroelectric properties have been measured.

Contents

1. Introduction. 2 Experiemtnal & characterization techniques. 3. Characterization of undoped $BaZr_xTi_{1-x}O_3$ ceramics. 4. Study of doping on $Bazr_{0.05}Ti_{0.95}O_3$ system. 5. Study of microwave sintered $Bazr_xTi_{1-x}O_3$ ceramics. Bibliography.

382. MALIK (Varun)
Study on Generation Mechanism and Characterstics of Atmospheric Gravity Waves in Troposphere and Lower Stratosphere.
Supervisor : Dr. S. K. Dhaka
Th 16489

Abstract

Relationship between evolution of convection in the lower and middle troposphere and induced gravity waves in the UTLS region is examined. Characteristic feature of updraft formation and gravity wave generation is separately shown. Histogram analysis has clearly shown the difference of vertical focing scale of the updrafts and gravity waves. Determinees forcing scale of gravity waves in the vertical direction using vertical wind profiles.

Contents

1. Introduction. 2. Theoretical formulation of atmospheric motions. 3. Experimental technique and methods of analysis. 4. Characteristics of atmospheric gravity waves over Indian region. 5. Gravity waves characteristics over Indonesian region.6. Summary, conclusion. Bibliography.

383. SEN (Vikram)
Electrical, Magnetic and Thermal Properties of Colossal Magneto-Resistive Manganite Perovskites.
Supervisors : Dr. S. K. Agarwal and Prof. G. L. Bhalla
Th 16486

Abstract

Substitutional effects have been studied on various physical properties like electrical resistivity, magneto-transport,

thermoelectric power (TEP), thermal conductivity and specific heat of the polycystalline manganite perovskites. The sustitution of different ions at the rare-earth and manganes sites have been carried out. Rare-earth site substitution mainly influences the carrier density (valence of Mn ion) and the lattice distrotion (Mn-O-Mn bond angle and bond length). On the contracy, Mn-site substitution affects the mechanism between Mn^{3+}/Mn^{4+}directly, which could provide some insight about the unusual properties of the manganites. The present work mainly involves the syntheisis and characterization of bulk polycrystalline $Pr_{2/3}Ba_{1/3}MnO_3$ (PBMO) and $La_{2/3}Ba_{1/3}MnO_3$ (LBMO) systems with Sb^{5+} doping at Mn-site X-ray diffraction (XRD) has been carried out to check the phase purity and evaluation of the lattice parameters of various samples. Scanning electron microscopy (SEM) technique has been employed to study the grain morphology of the samples.

Contents

384. MUNJAL (Hema)
Electron Scattering with Tri-Atomic and Tetra-Atomic Molecules using R-Matrix Method.
Supervisor : Prof. K. L. Baluja
Th 16490

Abstract

Presents the R-matrix calculations of elastic differential, integral, momentum transfer and electronic excitation cross sections for the scattering of electrons from the tri-atomic and tetra-atomic molecules, at their respective equilibrium geometries. The molecules studied are : C_3,NH_3,PH_3,NO_2 and SiF_2. The molecule C_3 belongs to D_h point group, NH_3 and PH_3 belong to C_{3v} point group; and the radical NO_2 and the closed-shell SiF_2 are represented by C_{2v} point group.Configuration interaction (CI) wave functions are used to represent all the target states studied here. In each case, core electrons are frozen in doubly occupied molecular orbitals while remaining electrons are free to occupy available valence and virtual orbitals.

Contents

1. The importance of electron-driven processes. 2. Theoretical methods for the study of electron molecule scattering. 3. Symmetry and group theory. 4. Electron scattering with C_3. 5. Electron scattering with NH_3. 6. Electron scattering with PH_3. 7. Electron scattering with NO_2. 8. Electron scattering with SiF_2. Bibliography.

385. RANJIT KUMAR
Study of Exact Solutions of Certain Types of Nonlinear Diffusion-Reaction Equations and their Applications.
Supervisors : Dr. R. S. Kaushal and Dr. Awadhesh Prasad
Th 16485

Abstract

Considers some specific forms of reaction kinetics which arise in different contexts. Also many phenomena in nature are described by the interaction of convection and diffusion. In some cases it has also been found that the diffusion coefficient itself becomes density-dependent and in this case one obtains NL D-R eqation with NL convective flux term. Another aspects of the present study is the one when two species are involved int he diffusion process. As a result, the modeling of such phenomena has been done through couples NL D-R equations. Important aspect of study is to show the relevance of the obtained exact solutions to the level of actual applications of the results, particularly in the field of biological ecological and social sciences.

Contents

1. Introduction. 2. Survey of methods for obtaining exact solutions of nonlinear PDEs. 3. Real and complex nonlinear D-R equations. 4. Applications of auxiliary equation method. 5. Application of homogeneous balance (HB) method. 6. Applicational aspect and summary. Bibliography.

386. RANJU RANJAN
Thermoluminescence and Photoluminescence of Some Micro- and Nanostructured TLD Phosphors.
Supervisors : Dr. P. D. Sahare and Dr. S. Somorendro Singh
Th 16483

Abstract

Studies photoluminescence and thermoluminescence of some of the wide-band gap materials, popularly known as 'TLD phosphors' for the applications in radiation dosimetry of high-energy radiations such as γ-rays and energetic swift-heavy ion beams. Photoluminesence is mainly used as a tool (technique) to idnetify activator impurity ions in their desired ionic forms to tailor the porperties of the 'TLD phophors' in question for their desired 'good' characteristics. Some of the phosphors have also been studied in their 'nanocrystalline' forms for their specific applications.

Contents

387. SETHI (Geetanjali)
Topics in Early Universe Cosmology.
Supervisors : Dr. Daksh Lohiya and Prof. Amitabha Mukherjee
Th 16491

Abstract

Explores the possibility that the difficulties encountered by the standard model could be serious enough to warrant a fresh look at the background model itself. Also explores viability of a cosmology in which scale factor of the FRW metric evolves linearly in time : $a(t) \propto t$. Such a scaling defines a "linear coasting cosmology". Describes two important results for a linear coasting model : Nucleosynthesis and the Hubble test.

Contents

388. SHANDILYA (Swati)
Studies on Electrical and Optical Properties of c-Axis Oriented $LiNbO_3$ Thin Films.
Supervisor : Dr. Vinay Gupta
Th 16482

Abstract

Focuses on the growth and optimization of c-axis oriented $LinbO_3$ thin film by reproducible growtn techniques including rf sputtering and pulsed laser deposition. Effect of post deposition annealing on the structural, electrial and optical properties of amorphous $LinbO_3$ film deposited using rf sputtering technique has been investigated in detail. It is found that the growth of c- axis orented $LinbO_3$ thin film demands the presence of nucleating layer having epitaxial or lattice compatibility, therfore $LinbO_3$ film have been deposited on either (001) Sapphire crystal of (002) ZnO buffer layer. The presence of stress in the $LinbO_3$ thin film has been investigated as a function of processing conditions (Sputtering pressure and gas composition) and correlated witht he Raman phonon modes. Using the optimized deposition parameters, stree free, defects free and stochiometric $LinbO_3$ thin film with preserred c- axis orientation has been obtained.

Contents

389. SHALINI

Study of the Structure and Evolution of Complex Metabolic Networks.

Supervisors : Prof. Sanjay Jain and Prof. Amitabha Mukherjee

Th 16484

Abstract

Attempts to study the metabolic networks of some organisms and to deduce certain system level characteristics. In particular it attempts to decompose the large scale networks into their functional subnetworks and to study the relationship between the parts and the whole. It also attempts to characterize the evolution of the metabolic networks by a comparative study of metabolic networks of different organisms at the system level. Discusses the nature of the metabolic network and its role within the cell and relationship with other cellular networks.

Contents

390. UNNIKRISHNAN (Sanil)
Theoretical Study of Dark Energy Parameters in Cosmology.
Supervisor : Dr. T. R. Seshadri
Th 16481

Abstract

Presents a theoretical study of dark energy and its obervational consequences. A detailed discussion of various observational evidences supporting the paradigm of late-time accelerated expansion of the Universe is presented. This is followed by a detailed descriptions of various theoretical approaches involved to explain this late-time accelerated expansion of the Universe. These includes cosmological constant model and various scalar field models of dark energy such as quintessence, tachyon, phantom, k-essence etc. In addition, the possibility of the origin of this late-time cosmic acceleration arising from a modified gravity theory is also discussed. Also presents a detailed investigation of the nature of perturbationin dark energy.

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