

CHAPTER 41

PHYSICS AND ASTROPHYSICS

Doctoral Theses

354. GEORGE (John P.)
Impact of Atmospheric Aerosols and Trace Gases on Radiative Forcings and Weather Forecasting in the Indian Region.
Supervisor : Dr. Man Mohan
Th 15714

Abstract

Studies in detail the distribution of aerosols in and around the Indian subcontinent using satellite observations, as study of the major atmospheric factors responsible for the observed aerosol distribution and relevant numerical experiments that address the aerosol radiative effects on weather forecast in the region. the numerical experiments also include an investigation on the comparative impact of uniformly mixed trace gases (CO_2 , CH_4 , N_2O and CFCs) in the radiative process and hence on numerical weather forecasting over the Indian region. Also an effort to routinely include the observations on aerosols in the operational Numerical Weather Prediction (NWP) system and thus improve the forecast quality over India.

Contents

1. Introduction. 2. Aerosol distribution and its variability over Indian region. 3. Aerosol distribution with respect to transport processes. 4. Aerosol and trace gases in NWP model : Impact over Indian region. Concluding remarks. Bibliography.

355. GUPTA (Pooja)
Study of Direct Photons at the CMS Experiment at Cern.
Supervisor : Prof. B. C. Choudhary and Prof. Raghuvir Singh
Th 15806

Abstract

Emphasizes the study of understanding photons from hard scattering in the CMS experiment at the LHC and study of

isolation to optimize the single to background (S/B) ratio and measurement of the direct photon plus jet cross-sections. Due to large abundance of photons at LHC energy, to make measurement of direct photon cross-sections over a large transverse momentum (P_T^y) range from the first set of data collected by the CMS detector. It also explored the direct photon + jet production at the CMS in the region of photon transverse momentum (P_T^y) from HLT P_T threshold of 80 GeV to a few hundred GeV and isolation conditions for the direct photon physics based on the tracker, the ECAL and the HCAL.

Contents

1. Introduction. 2. Physics of direct photon. 3. The CMS experiment at LHC. 4. Events generation, simulation and reconstruction. 5. Analysis. 6. Uncertainties. 7. Summary and conclusions. Bibliography.

356. MAHESHWARI (Priyanka Heda)
Development and Studies of Novel Carbon Materials for Energy Applications.
 Supervisors : Dr. R. B. Mathur and Prof. R. P. Tandon
 Th 15710

Abstract

Emphasizes on the development of two important carbon components of fuel cell, i.e. the porous conducting carbon paper used as a backing material for the electrode and the composite bipolar plate. the process of preparation and the characterization techniques used during the course of investigations has been discussed in detail. The effect of different reinforcing materials, their relative amount and the processing conditions on the properties of the carbon paper and composite plate and their performance in a unit PEM (Polymer electrolyte membrane) fuel cell is reported.

Contents

1. Introduction and scope of the work. 2. Experimental. 3. Characterization techniques. 4. Results on carbon fiber preform. 5. Results on porous conducting carbon paper. 6. Results on advanced composite bipolar plate. 7. Summary. Bibliography

357. MALIK (Amit)
Growth and Characterization of Infrared Detector Materials.
 Supervisors : Prof. K. Sreenivas and Dr. Ravinder Pal
 Th 15712

Abstract

Investigates process details on growth of p-HgCdTe material and device fabrication. HgCdTe being a low band gap material, is prone to surface related problems. Performance of a HgCdTe photodiode is generally limited by the surface leakage currents (dark currents). The dark current in a photodiode has contributions from both bulk and surface components. Bulk currents depend on the material quality (doping, composition, defect density, diffusion length, etc.) while surface leakage current depend on the passivation of HgCdTe and the related interface characteristics (fixed charge and interface-trap density). The quality of HgCdTe epitaxial layers minimizes the bulk component contribution to the dark current, and a reduction in the surface leakage current needs to be tackled at the device fabrication stage. The surface leakage currents normally limit the performance of photodiodes despite the use of high-quality HgCdTe-epitaxial layer.

Contents

1. Introduction and review of photodetectors. 2. Growth of HgCdTe and photodiode fabrication technology. 3. Energy band variation in $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ - CdTe and $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ - $\text{Hg}_{1-y}\text{Cd}_y\text{Te}$ Heterojunctions. 4. Surface recombination velocity and excess carrier lifetime in Boron doped HgCdTe. 5. Passivation of HgCdTe and effect of annealing on interface. 6. An overall summary of the work. Appendix. Bibliography.

358. PRANAV KUMAR
Observational and Theoretical Aspects of Early Universe Cosmology.
 Supervisor : Dr. Daksh Lohiya
 Th 15711

Abstract

Describes an effort to rid the SBB of some of its problems. Explores the difficulties encountered in the standard model and views cosmology and its observations from a different theoretical standpoint, and that comes with a minimal promise of at least providing a self consistent formalism. Deals with

nucleosynthesis constraints. Revisits an alternative mechanism for Astrophysical production of deuterium : the “Spallation Process”. Establishes that deuterium can indeed be produced to its observed levels by such astrophysical processes. This relieves SBBN of the stranglehold of baryonic mass constraints and opens the possibility of closing dynamic mass estimates by baryons alone.

Contents

1. Introduction. 2. The standard model : A review. 3. PIB and deuterium formation. 4. Nucleosynthesis in linear coasting cosmology. 5. Electron screening and thermonuclear reactions rates. 6. Summary and discussion. Bibliography.

359. SAMAL (Areejit)
Study of the Structure and Dynamics of Complex Biological Networks.
 Supervisors : Prof. Sanjay Jain and Prof. Shobhit Mahajan
 Th 15786

Abstract

Studies the large scale structure and system level dynamics of three organisms, Escherichia coli, Saccharomyces cerevisiae and Staphylococcus aureus biological networks using tools from graph theory, computational biology and dynamical systems. It further studies the dynamics of the large scale genetic network controlling E. coli metabolism.

Contents

1. Introduction. 2. Low degree metabolites enhance modularity and explain essential reactions in metabolic networks. 3. The regulatory network of E. coli metabolism exhibits both homeostasis and flexibility of response. 4. Design features of the genetic network controlling E. coli metabolism. 5. Discussion and future outlook. 6. Bibliography.

360. SHARMA (Raksha)
Structural and Magnetic Behaviour of Conducting Polymer/ Iron Oxide Nanocomposites.
 Supervisor : Prof. S. Annapoorni
 Th 15713

Abstract

Investigates on the nanoparticles of iron oxide and the nanocomposites of iron oxide-polypyrrole and iron oxide-polyaniline (PANI) prepared by POC method. The effect of iron irradiation on the magnetic properties of the composite sheet have been investigated. The ability of the PANI and PANI/Iron oxide free standing sheets, to sense acidic vapors has been demonstrated.

Contents

1. General introduction. 2. Experimental techniques. 3. Synthesis, characterization and magnetic properties of iron oxide nanoparticles. 4. Synthesis, characterization and magnetic properties of iron oxide/polypyrrole nanocomposites. 5. Synthesis, characterization and magnetic properties of iron oxide/polyaniline nanocomposites. 6. Self standing sheets of iron oxide/polyaniline nanocomposites. 7. Summary and conclusions. Appendix. Bibliography.

361. YADAV (Harish Kumar)

Growth and Characterization of Multifunctional Zinc Oxide (ZnO) Nanoparticles and Thin Films.

Supervisor : Dr. Vinay Gupta
Th15715

Abstract

Focuses on the study of multifunctional properties of ZnO thin films and nanoparticles. The emanation of new properties in ZnO thin film with dopant substitution has been studied. The main emphasis is on to the photoconductivity studies on ZnO thin films for enhanced photoresponse. The basic studies on the size dependent properties of ZnO nanoparticles especially acoustic phonon confinement have been investigated. ZnO thin films deposited from nanoparticle colloidal solution by electrophoretic deposition technique were studied for UV photon detector applications.

Contents

1. Introduction. 2. Growth and characterization of ZnO thin film. 3. Multifunctional properties of ZnO thin films. 4. ZnO thin film ultraviolet (UV) photon detector. 5. Growth and characterization of ZnO nanoparticles. 6. ZnO nanoparticulate thin films for UV photon detection . 7. Scope and suggestions for future work. Symbol index. Bibliography.