

CHAPTER 43

PHYSICS AND ASTROPHYSICS

Doctoral Theses

464. AJAY KUMAR
Effect of Nanomaterials on the Alignment and Memory Behavior of Ferroelectric Liquid Crystals.
Supervisors : Dr. Poonam Silotia and Dr. Ashok M. Biradar
Th 19059

Abstract

Deals with two main aspects i.e. alignment and memory behaviour of some ferroelectric liquid crystals (FLCs). The studies based on nanomaterials induced vertical alignment of some FLC mixtures have been presented and the effect of nanomaterials on the memory behavior of FLC materials have also been carried out.

Contents

1. Introduction of liquid crystals. 2. Experimental techniques. 3. Effect of polymeric nanoparticles on alignment, dielectric and electrooptical properties of ferroelectric liquid crystals. 4. Effect of cadmium telluride quantum dots on the alignment and dielectric anisotropy of ferroelectric liquid crystals. 5. Memory effect in a newly synthesized deformed helix ferroelectric liquid crystal. 6. Memory effect in cadmium telluride quantum dots doped deformed helix ferroelectric liquid crystals. Conclusion.

465. DUBEY (Abhinav)
Search for Standard Model Higgs Boson in $ZH \rightarrow \nu\nu b\bar{b}$ Channel in pp Collisions at $\sqrt{s} = 1.96$ TeV.
Supervisors : Prof. Brajesh C. Choudhary and Prof. Satyaki Bhattacharya
Th 19052

Abstract

A search for the standard model Higgs boson is performed in 5.2

fb^{-1} of pp collisions at $\sqrt{s} = 1.96$ TeV, collected with the DØ detector at the Fermilab Tevatron. The final state considered is a pair of b jets with large missing transverse energy, as expected from $\text{pp} \rightarrow \text{ZH} \rightarrow \text{vbb}$ production. Boosted decision trees are used to discriminate signal from background. Good agreement is observed between data and expected backgrounds, and, for a Higgs-boson mass of 115 GeV, a limit is set at 95% C. L. on the cross section multiplied by branching fraction of $(\text{pp} \rightarrow (\text{Z/W})\text{H}) \times (\text{H} \rightarrow \text{bb})$ that is a factor 4.57 expected and 3.73 observed larger than the value expected from the standard model.

Contents

1. Standard model. 2. The DØ detector. 3. Data and MonteCarlo samples. 4. Object identification. 5. Analysis. 6. Limit calculation. 7. Conclusion and bibliography.

466. GIRI (Varun)
Modeling Pre-Biotic Self-Organization : The Chemical Dynamics of Autocatalytic Networks.
 Supervisor : Prof. Sanjay Jain
Th 19063

Abstract

In this thesis a mechanism, based on autocatalytic set (ACSs) has been presented. A mathematical model describing the population dynamics of molecules in an artificial but prebiotically plausible chemistry in a well stirred chemical reactor. In the model large molecules can in principle be produced by successive ligations of pairs of smaller molecules. The smallest molecules in the chemistry compose the 'food set', whose concentrations are considered to be buffered. The chemistry contains a large number of spontaneous reactions of which a small subset could be catalyzed by molecules produced in the chemistry with varying catalytic strengths.

Contents

1. Introduction. 2. A model of pre-biotic chemistry. 3. Steady state properties of the spontaneous chemistry. 4. Catalyzed chemistries and autocatalytic sets. 5. Using ACSs to produce large molecules : The problem. 6. Nested ACSs : A structure to promote large molecules. 7. Hierarchy of nested ACSs : A possible route for the appearance of large molecules. 8. discussion and future outlook. Bibliography.

467. GOEL (Neeti)
Structural, Thermal, Optical & Dielectric Characterization of Solution Grown Pure and Doped Semi Organic Sodium Phthalate Single Crystals.
 Supervisor : Dr. Binay Kumar
Th 19104

Abstract

The study explore the growth, strucutral, optical, thermal and dielectric properties of pure and transition metal doped sodium hydrogen phthalate single crystals have been investigated to study the influence of transition metals on the physical properties and crystalline perfection of pure sodium phthalate crystals.

Contents

1. Introduction. 2. Literature survey and aim. 3. Experimental tools and techniques. 4. Results and discussion : Pure & Fe³⁺ doped sodium hydrogen phthalate single crystals. 5. Results and discussion : Pure & Zn²⁺ doped sodium hydrogen phthalate single crystals. 6. Results and discussion : PUre & Ni²⁺ dopped sodium hydrogen phthalate single crystals. 7. Results and discussion : Pure & Mn²⁺ doped sodium hydrogen phthalate single crystals. 8. Conclusions.

468. JAGJIT SINGH
Study of Atomic Processes Involving Aluminium Like Ions.
 Supervisor : Prof. Man Mohan
Th 19064

Abstract

This work has presented new atomic data in the form of energy levels, oscillator strength, transition probabilities, lifetime of Ti X and photoionization cross section of Ni XV using CIV3 and R-matrix method. The calculations have included all the correlation effects. Relativistic effects have been include in Breit-Pauli approximation.

Contents

1. Introduction. 2. Level energies, oscillator strength and transition probabilities in aluminium like titanium. 3. Lifetime calculations for fine-structure levels of aluminium like tatanium. 4. Photoionization of Ni XV using aluminium like Ni target. Conclusions.

469. JASMEET SINGH
Electron Molecule Scattering.
 Supervisor : Prof. K. L. Baluja
Th 19055

Abstract

The present study deals with the calculation of elastic [integrated and differential cross section (DCS)], momentum-transfer, excitation and ionization cross sections for electron impact on molecules having even number of electrons, using the R-matrix method. Also evaluated the scattering length of S_2 , O_2 and B_2 molecules. The calculations of differential cross sections and momentum-transfer cross section are also carried out for all the molecules considered here using the program POLYDCS.

Contents

1. Applications of electron-molecule scattering. 2. Theoretical background. 3. The ab initio R-matrix method. 4. Electron-impact study of PH radical : R-matrix method. 5. Electron-impact study of SO radical : R-matrix method. 6. Electron-impact study of NH radical : R-matrix method. 7. Electron-impact study of S_2 molecule : R-matrix method. 8. Electron-impact study of B_2 molecule : R-matrix method. 9. Electron-impact study of O_2 molecule : R-matrix method. 10. Effective collision frequency of electrons. Conclusions and bibliography.

470. KUSHWAHA (Satya Kumar)
Growth and Investigation for Crystalline Perfection vis-a-vis Physical Properties of Pure and Doped $LiNbO_3$, Benzophenone and ZTS NLO Single Crystals.
 Supervisors : Dr. Binay Kumar and Dr. G. Bhagavannarayana
Th 19058

Abstract

The work carried out in this is concern with growth and investigation of crystalline perfection vis-a-vis physical properties of device quality NLO single crystals. Lithium Niobate ($LiNbO_3$) termed as silicon of photonics is indispensable in advanced photonics and nonlinear optics and has been extensively studied.

Contents

1. Literature survey and theoretical aspects of nonlinear

optics, crystal growth and lattice imperfections. 2. Experimentation for the growth of single crystals. 3. Characterization techniques. 4. Czochralski growth, crystalline perfection and optical characterization of LiNbO_3 and Zn:LiNbO_3 NLO single crystals. 5. Crystalline perfection and optical properties of Czochralski-growth Fe:LiNbO_3 : A photorefractive NLO single crystal. 6. Enhancement in crystalline perfection and optical properties of benzophenone single crystals : A remarkable effect of liquid crystals. 7. A correlation of crystalline perfection with SHG efficiency of urea doped ZTS single crystals. 8. Effect of Cr^{3+} - doping on crystalline perfection and optical properties of ZTS : The NLO single crystals. References and summary.

471. MONIKA
Investigations on the Superconducting Behaviour of the Composites of ISO-Structural Diborides of Mg, Al and Nb.
 Supervisors : Prof. G. L. Bhalla and Dr. V. P. S. Awana
Th 19061

Abstract

This research work is to study the differences between superconducting behaviour of these iso-structural diborides namely MgB_2 , AlB_2 and NbB_2 . A detailed investigation employing techniques like X-ray diffraction (XRD) and scanning electron microscopy (SEM) is carried out for phase, structural and micro structural analysis. The resistivity and thermoelectric power measurements are carried out to confirm the existence of superconductivity and to analyse the reasons behind different superconducting behavior of diborides.

Contents

1. Introduction. 2. Experimental details : Synthesis and characterization techniques. 3. Synthesis and characterization of MgB_2 , AlB_2 and NbB_2 . 4. Absence of superconductivity in AlB_2 : Study of upression of superconductivity in $\text{Mg}_{1-x}\text{Al}_x\text{B}_2$ ($x=0.0-1.0$) system. 5. Study of superconducting behaviour of NbB_2 composites. 6. Study of superconducting behavior of $\text{MgB}_{2-x}\text{C}_x$: To improve the superconducting performance of MgB_2 . 7. Summary and conclusions.

472. RAWAT (Sangeeta)
Ion Track Based Electronic Devices.
 Supervisor : Dr. Amita Chandra
Th 19065

Abstract

An attempt has been made to use the properties of the (TEMpos) structures in fabricating magnetic field sensor which has been designed by inserting magnetic nanoparticles inside the ion tracks. The SiO₂/Si substrate has been irradiated with high energy swift heavy ions that create latent tracks in it. This is followed by etching via chemical process to get the etched ion tracks. The irradiated sample has been studied with different analyzing softwares like SRIM/TRIM.

Contents

1. Introduction. 2. Experimental techniques. 3. Surface morphology of empty and filled etched ion tracks in dielectric layer. 4. Ferrofluid in ion tracks : Earth magnetic field sensor. 5. Transition metal oxide nanoparticles in ion tracks. 6. Ion-selective device. 7. Summary.

473. SAHA (Pratishruti)
Addressing Some Issues Beyond the Standard Model at Hadron Colliders.
 Supervisors : Prof. Debajyoti Choudhury and Prof. Amitabha Mukherjee
Th 19051

Abstract

Attempts to produce the new particles predicted by various models in the laboratory, and second, try to identify deviations from Standard Model predictions in the production/decay/scattering rates of Standard Model particles which may be occasioned by new interactions or by new particles appearing in a propagator.

Contents

1. Introduction. 2. Search for heavy resonances. 3. Width effects in Dijet resonances. 4. Top forward-backward asymmetry and new physics. 5. New physics in the top sector : A model independent study. 6. Anomalous top coupling - Clues in the higgs sector. 7. Recent developments. Appendixes and bibliography.

474. SAINI (Arun)
Beam Dynamics Studies and the Design, Fabrication and Testing of Superconducting Radiofrequency Cavity for High Intensity Proton Accelerator.
 Supervisor : Dr. Kirti Ranjan
Th 19056

Abstract

The emphasis of this is on the design of superconducting radio frequency (SCRF) cavities for intermediate and high energy sections of the Project-X linac and on the design of beam transport line (lattice) for CW linac. The use of an elliptical cavity for particle acceleration has resulted as a consequence of a series of trade-off between different cavity parameters, ranging from RF to mechanics, and takes into account the constraints imposed due to cavity design technique and fabrication experience. The fundamental aspects of cavity design comprise of choice of operating frequency, number of cells in mutli-cell cavity, operating range of cavity etc.

Contents

1. Motivation and framework : Proposed porject-X facility at fermilab. 2. Fundamentals of radio frequency cavity & beam dynamics.

475. TARUN KUMAR
Study of Quantum Optical Effects in Micro-Mirrors and Bose-Einstein Condensates.
 Supervisor : Prof. Man Mohan and Dr. Aranya B. Bhattacharjee
Th 19062

Abstract

The work carried out in this explores the dynamics of optomechanical systems and Bose Einstein Condensates inside an optomechanical system i.e. inside micromirrors. As well as the effect of radiation pressure inside the micromirrors and are of potential application in transmission spectroscopy of ultracold atoms, entanglement among ultracold atoms, quantum information and processing.

Contents

1. Introduction. Superfluidity of periodically trapped ultracoded

atoms in optical lattices. 3. Entangling two Bose Einstein condensates in double cavity system. 4. Dynamics of movable micromirrors : Cooling and parametric normal mode splitting. Conclusions.

476. TRIPATHI (Neeti)
Structural, Optical and Electrical Properties of Metal-Oxide Semiconductors and Ion-Induced Modifications.
 Supervisor : Dr. Shyama Rath
Th 19057

Abstract

The present thesis focuses on the fabrication and characterization of two metal-oxide semiconductors namely indium oxide (In_2O_3) and zinc oxide (ZnO). In_2O_3 is studied with a understanding the ion irradiation induced modification in properties relevant for the optoelectronic and plasmonic devices. Chemical synthesis of ZnO films and nanostructures offer the advantage of low temperatures processing, ease of fabrication and wide compatibility.

Contents

1. Introduction. 2. Experimental techniques. 3. Indium oxide thin films deposited by electron-beam evaporation and pulsed laser deposition methods. 4. Effect of swift heavy ions (SHI) on indium oxide thin films fabricated by electron-beam evaporation method. 5. Effect of swift heavy ions (SHI) and low energy ion on indium oxide thin films deposited by pulsed laser deposition method. 6. Structural and optical investigation on ZnO films and nanostructure fabricated by chemical methods. 7. Summary and further scope.

477. TRIPATHI (Rahul)
Magneto-Transport and Electrical Studies of Ca, Sr and Ba Substituted LaMnO_3 and its Silver Composites.
 Supervisors : Prof. G. L. Bhalla and Dr. Hari Kishan
Th 19053

Abstract

The attempts has been made to get sharp T^{MI} /higher TCR at elevated temperature, i.e, at/above room temperature, with enhanced low field MR (LFMR). Explores a composition which has both high TCR and LFMR at/close room temperature (300 K).

The study has been carried out on bulk polycrystalline perovskite manganites samples which show significant TCR and MR. A systematic investigation has been carried out employing variety of techniques, such as X-ray diffraction (XRD) studies, scanning electron microscopy (SEM), magnetization (saturation magnetization and Curie temperature) studies, resistivity versus temperature measurements and magnetoresistance measurements.

Contents

1. Introduction. 2. Characterization techniques. 3. Magneto-transport and electrical studies of $\text{La}_{2/3}\text{Ca}_{1/3}\text{MnO}_3$: Ag_x composites. 4. Magneto-transport and electrical studies of silver added $\text{La}_{0.7}\text{Ba}_{0.3}\text{MnO}_3$ compound. 5. Effect of sintering temperature and oxygen annealing on pure $\text{La}_{2/3}\text{Ca}_{1/3}\text{MnO}_3$. 6. Magneto-transport & electrical studies of $\text{La}_{0.7}\text{Ca}_{0.3-x}\text{Ba}_x\text{MnO}_3$: Ag_x compositions. 7. Electrical & magneto-transport studies of $\text{La}_{0.70}\text{Ca}_{0.3-x}\text{Sr}_x\text{MnO}_3$ and its silver composites. 8. Summary and conclusions.

478. VAJPAYEE (Arpita)
Studies on the Doping of Inorganic and Organic Materials in MgB_2 Superconductor.
 Supervisors : Prof. G. L. Bhalla and Dr. V. P. S. Awana
Th 19054

Abstract

The present work is to study the doping effect of carbon inclusive dopants on phase formation, lattice parameters and superconducting properties (T_c , J_c , H_{c2} and H_{irr}) of MgB_2 . The MgB_2 has been doped with carbon using inorganic and organic compounds as source of carbon. Experimental research has been conducted. The commercially available inorganic carbon containing nano-particles, viz, nano-diamond (nD), nano-silicon carbide (n-Sic) and carbon nano tube (CNT) have been used as dopants and the superconducting properties of the doped MgB_2 samples have been studied. The organic compounds namely poly vinyl acetate (PVA) and adipic acid have been used as dopants, which produce the fresh carbon and then the superconducting properties of thus carbon doped MgB_2 have been studied.

Contents

1. Literature review of Magnesium-diboride (MgB_2) superconductor.
2. Experimental details : Synthesis and characterizations. 3.

Synthesis and physical property characterization of undoped MgB_2 superconductor. 4. Effect of inorganic nano-particles doping on the superconducting properties of built MgB_2 . 5. Effect of doping of MgB_2 superconductor with carbon using organic compounds. Summary.

479. VIJAYARANGAMUTHU K.
Optical Studies on Low-Dimensional Semiconductors.
Supervisor : Dr. Shyama Rath
Th 19060

Abstract

This work has investigated nanostructure formation in two group IV oxides, namely germanium oxide (GeO_2) and tin oxide (SnO_2) using optical spectroscopic techniques. The advantage of Ge nanocrystals over the Si nanocrystal (IV group material and widely studied) is that confinement can occur even at relatively larger nanocrystals. Ge oxide films are also useful for planar waveguide structures, optical fibres, and infra red optics. SnO_2 has a high excitation binding energy (130meV) value, which gives advantage of having UV emission at room temperature.

Contents

1. Introduction and material properties. 2. Material fabrication and characterization techniques. 3. Raman and photoluminescence spectroscopic studies of Ge nanocrystals embedded in a Ge oxide matrix. 4. Spectroscopic ellipsometry study of Ge oxide films modified by thermal annealing and swift heavy ion irradiation. 5. Raman spectroscopic studies of tin oxide nanoparticles. 6. UV-visible and photoluminescence spectroscopic studies of tin oxide nanoparticles. 7. Optical sensing based on surface-enhanced Raman scattering. 8. Conclusion and future scope.