Project titles/details (2017-18)

1. Sanjib Kumar Agarwalla
   Title: Addressing Leptonic CP-violation through Neutrino Oscillation

   Abstract: One of the major fundamental issues that needs to be addressed in neutrino oscillation experiments is to measure the value of CP Phase and to explore the possibility of CP-violation in the leptonic sector. The behaviour under the CP transformation is one of the fundamental properties of particles and a violation of the CP symmetry might be linked to the observed baryon asymmetry in the universe.

2. Dinesh Topwal
   I would like to offer two projects.
   (i) Role of local structure distortions in driving exotic properties of materials.
   (ii) Band structure mapping and spin orbit coupling of self-assembled systems.

3. ARIJIT SAHA
   Project Title: Weyl Semimetal and Weyl Superconductor

   Objective: Weyl Semimetal is a newly developed three dimensional Dirac systems whose low energy spectrum follows Weyl equation. The bulk of these materials consist of two Weyl nodes, while the surface follows a Fermi arc, unlike a circle in case of topological insulator. In these systems either inversion symmetry or time reversal symmetry is broken. In the project we would like to understand the bulk and surface topological properties of such materials.

4. Arun Nayak
   Project: Probing the CP nature of the Higgs boson at LHC

5. Debasish Chaudhuri
   I propose the following topics:
   (i) Stochastic entropy production in mesoscopic active systems,
   (ii) Role of activity in chromosomal morphology and segregation in bacteria,
   (iii) Dynamical phases in membrane bound active fluids.

6. D. Samal

   (i) Efficient selection and design/synthesis of Dirac electron (magnetic) based materials and related hybrids

   (ii) Exploration of electronic properties of selected quantum materials at unit-cell level/reduced dimension

7. P K Sahu

   (i) Characteristic study of Gaseous Electron Multiple detector.

   (ii) Signature of Quark Gluon Plasma produce at LHC energies.

8. T. Som
   Ion Implantation in materials using electron cyclotron resonance-based ion source

9. S. Sahoo
   Dilute Magnetic Semiconductor: Li doped ZnO thinfilms

The dilute magnetic semiconductor (DMS) has attracted much attention in recent decades due to its potential applications in spintronic devices. The key is to engage both the charge and spin degree of freedoms of the charge carriers in solid to obtain more efficient devices. Hexagonal ZnO has been extensively studied as it is predicted to be one of the most promising DMS materials. Room temperature ferromagnetism has been observed in doped ZnO systems and defects play a major role for this magnetic effect. Importantly, cation vacancies introduce local magnetic moments as well as holes in ZnO. It has been demonstrated that a threshold hole concentration is necessary to induce magnetism in ZnO. Hence, a stable ferromagnetism can be induced in ZnO by stabilizing cation vacancies and introducing holes at the same time. This can be achieved by doping with suitable elements. Lithium (Li) can be easily incorporated into ZnO, and it is known to result p-type nature in ZnO. In addition, Li doping can also induce ferromagnetism in ZnO. However, to control and engineer Li doping is a major challenge. Here, we will study the fundamental physical properties of Li doped ZnO.

Plan of work:

Followings are plans of the proposed project work;

1. Few nanometer thick ZnO thinfilms will be deposited on Si and quartz substrates using pulsed laser deposition (PLD) system.
2. Desire doses of Li ions will be implanted into ZnO thinfilms using low energy accelerator facility.
3. Low temperature Raman and photoluminescence studies of the ion implanted thin films will be carried out to understand the p-type nature of the Li-doped ZnO thin films. In particular, donors and acceptors bound excitons will be studied in details.
4. The magnetic measurements will be carried out to understand the room temperature magnetic properties.

10. Manimala Mitra: Next Page

Manimala Mitra :Projects-2018:

Topics: Neutrino Physics, Collider Physics

1. **Neutrinos and Beyond Standard Model Physics:**

The main focus of this project will be to understand the origin of neutrino masses. A plethora of outstanding oscillation experiments confirmed about electron volt neutrino masses and their mixings. However, the origin of the neutrino masses are yet unknown. A major part of this project will be a) to understand the different models behind neutrino mass generation b) to propose new experimental searches, that can pinpoint origin of neutrino mass. Additionally, the connection of the models with dark matter and Higgs phenomenology will also be explored. The project involves a combination of analytical calculation, as well as numerical simulation.

Reading essentials: Massive Neutrinos in Physics and Astrophysics- by Pal, Mohapatra, Dynamics of the Standard Model by Barry R. Holstein, Donoghue John F, and Eugene Golowich, hep-ph/0606054, and other reviews.

Prerequisite: Quantum Field Theory, basic knowledge of group theory and particle physics

2. **Boosted Object Searches at Colliders:**

The main goal of this project would be to understand the boosted object kinematics and decay properties at hadron and lepton colliders. Few of the objects, on which we will focus on are Higgs, top, boosted gauge bosons etc. The production processes for Standard Model and toy examples for effective field theory will be explored in detail. The project involves a combination of analytic calculation, theoretical understanding of the different kinematic features, as well as numerical simulation.

Reading essentials: Collider Physics – Barger & Philips, Dynamics of the Standard Model by Barry R. Holstein, Donoghue John F, and Eugene Golowich, hep-ph/0508097, other reviews.

Prerequisite: Quantum Field Theory, basic knowledge of group theory and particle physics, relativity