

PMSc Review/Project topics (session 2020-21)

Ph.D. Vacancies Announced:-

- Prof. Bijay Agrawal (01 student)
- Prof. Abhik Basu (01 student)
- Prof. Arti Garg (01 student)
- Prof. Arunava Mukherjee (01 student)
- Prof. Kalpataru Pradhan (02 student)

Project/Review topics offered:-

- Project-1: Many-body localization;
Instructor: Prof. Arti Garg (CMT)
- Student will review analytical techniques like perturbative methods for strongly disordered and interacting systems, strong disorder renormalization group approach and/or some numerical techniques for studying dynamics in these systems.
- Project-2: Unconventional Superconductivity;
Instructor: Prof. Arti Garg (CMT)
Student will review some aspects of unconventional superconductivity in recently discovered magic angle twisted bilayer graphene and competition between charge density wave and superconductivity in context of high temperature superconductor.
- Project-3: 'Topological properties of magnetic skyrmions';
Instructor: Prof. Kalpataru Pradhan (CMT)
Topologically protected property of the skyrmions is the most important prerequisite to design magnetic skyrmion-based spintronics applications. In this project various mechanisms involved to generate skyrmions in magnetic systems will be reviewed.
- Project-4: Magnetic and magnet-transport properties of double perovskites; Instructor: Prof. Kalpataru Pradhan (CMT)
The magnetic and transport properties of double perovskites ($A_2BB'O_6$) are strongly controlled by the nature and the oxidation state of the transition metal ions (B and B'). It also depends upon the disorder of B and B' sites. We will review the antisite disorder dependence of the magnetic (and transport) properties of double perovskite oxides.
- Project-5: Universal scaling in statistical mechanics: critical points and broken symmetry phases; Instructor: Prof. Abhik Basu (CMT)

We intend to study and understand scaling and the universality classes near the critical points and in the broken symmetry phases. The different sub-topics to be covered are (in the following sequence): (i) Critical point scaling near second order phase transitions and mean-field theories; (ii) failure of the mean-field theories below the upper critical dimension (e.g., below $d = 4$ for the Ising model), (iii) Wilson renormalisation group (RG) methods for the Ising model/ ϕ^4 model, (iv) phases with broken continuous symmetries and soft (Goldstone) modes, (v) RG applications for scaling in the broken symmetry phases, e.g., membranes etc.

- Project-6: TBA (On LIGO) ;
Instructor: Prof. Arunava Mukherjee (Astro Nucl/GW)
- Project-7: Bayesian analysis of Equation of state of dense matter;
Instructor: Prof. Bijay K. Agrawal (Astro Nucl/GW)

–i Students will pick one review/project from the above list.

PMSc Theory Coordinator