Ranjan Chaudhury

Honorary Fellow (Superannuated Professor)
CMPMS
ranjan@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Suraka Bhattacharjee; Study of Generalized Spin and Charge Stiffness Constants of Doped Quantum Antiferromagnets on Low Dimensional Lattices Based on t-J-Like Models; Thesis submitted
2. Koushik Mandal; Investigation of the Properties of Correlated Fermionic Systems in Low-dimension; Under progress

Teaching

1. 4th semester (2020); Physics of Materials; IPhD; 7 students; with Prof. P. Mahadevan
2. 2nd semester (2020); Advanced Condensed Mattter Physics I; PMSC-PhD; 10 students; with Prof. P. Mahadevan
3. 4th semester (2021); Superconductivity and Magnetism; IPhD; 4 students; with Prof. K. Mandal
4. 2nd semester (2021); Advanced Condensed Matter Physics; PMSC-PhD; 5 students; with Prof. K. Mandal

Publications

a) In journals

1. Suraka Bhattacharjee and **Ranjan Chaudhury**, *Study of effective coupling between charge degrees of freedom in low dimensional hole-doped quantum antiferromagnets*, Canadian Journal of Physics, 99, No. 3, 2021
2. Koushik Mandal and **Ranjan Chaudhury**, *Interplay of pairing correlation and Coulomb correlation in Boson exchange superconductors*, The European Physical Journal B, 94, 46, 2021

Administrative duties

Discharged duties as a member of VASP (EVLP) at SNBNCBS

Membership of Learned Societies

(i) Continued to be an active Member of American Chemical Society (Physics Division), USA

(ii) Continued to be an active Member of Physics Division of ATINER (Athens, Greece)

Outreach program organized / participated

(a) Taught 2 courses viz.

(i) Basic Condensed Matter Physics and

(ii) Advanced Condensed Mater Physics to the Master's (M.Sc) students at RKMVERI (Belur) as Visiting Professor there.

(b) Supervised 6 Master's Projects and 1 Bachelor (B.Sc.) projects at Belur as Visiting Professor at RKMVERI.

Areas of Research

Theoretical Condensed Matter Physics Involving Strongly Correlated Electronic Systems and Superconductivity

(i) The generalized charge stiffness constant was calculated for strongly correlated hole doped quantum antiferromagnets in low dimensional systems in the form of t-J- like models. It was shown explicitly that this charge stiffness constant truly represents the effective static interaction between the mobile charge carriers. Furthermore, it was found that this effective interaction can indeed turn attractive in a narrow regime of q-space in the optimally doped to overdoped regime in 2D, signalling a genuine possibility of an electronic mechanism for superconducting pairing in some of the Cuprates. This work was carried out in collaboration with Suraka Bhattacharjee (SRF, CMPMS).

(ii) Interplay of pairing correlation and Coulomb correlation was theoretically investigated for a boson exchange superconductor under two different situations. In the first case, Coulomb correlation was introduced only in the Bardeen-Cooper-Schrieffer (BCS) ground state, keeping the parental normal phase uncorrelated. In the second case, the BCS pairing was considered from a Coulomb correlated normal phase itself. Detailed calculations were performed for the first case during this period under consideration. The calculations based on full variational approach involving Gutzwiller projected BCS state lead to superconducting gap function's dependences on both boson mediated attractive coupling constant and repulsive Coulomb coupling constant with interesting consequences. The theoretical results find good application to the experimental results from NbSe_2, a phonon exchange based superconductor. This work was carried out in collaboration with Koushik Mandal (SRF, CMPMS).

Plan of Future Work Including Project

(a) Theoretical investigation of the microscopic mechanism for superconductivity in both conventional and non-conventional systems to be continued alongwith interplay of itinerant magnetism and charge ordering with superconductivity in these systems.

(b) Several interdisciplinary projects at the interface of Physics with other branches of Science to be pursued.

Any other Relevant Information including social impact of research

(a) My research in the domain of Condensed Matter Physics, in particular the understanding of the mechanism for high temperature superconductivity in various classes of material systems, is expected to contribute to a possible technological revolution based on dissipationless electrical transport at room temperature.

(b) Some of my projects in the regime of interdisciplinary sciences are expected to lead to better environmental conditions and possible cure from many diseases.