Ranjan Chaudhury

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Dr. Ranjan Chaudhury received his PhD (Science) from TIFR , Mumbai (Bombay University) in 1988 ; he was a Post-doctoral & collaborating Visiting Scientist at ICTP (Trieste, Italy) , McMaster University (Hamilton, Canada), University of Minnesota (Minneapolis, USA) , LEPES-CNRS (Grenoble, France) & BLTP-JINR (Dubna, Russia); Full Faculty at S.N. Bose Centre since 1994; his Awards/Honours include : NSTS scholarship by NCERT (1976); Biography selected and published in Marquis Who's Who in the World , New Jersey, USA (1999 & 2011) and in Marquis Who's Who in Asia , New Jersey, USA (2007) ; Awarded International Scientist of the Year 2007 by IBC , Cambridge, Great Britain (2007) ; Visiting Professor at AUST (Abuja, Nigeria) under NMI (Washington DC, USA) during 2009-2010; Member of Physics Division of American Chemical Society since 2010; Fellow of Minnesota Supercomputer Institute (Minneapolis, USA) since 1992; Member of Rayonnement du CNRS since 1995.

Supervision of Research / Students

Ph.D. Students

1. Subhajit Sarkar; Topological Excitations and Spin Dynamics in Magnetic Systems in Low Dimensions; Completed.
2. Soumi Roy Chowdhury; Studies on Superconducting Pairing Mechanism in Low Dimensional Materials; Ongoing.
3. Suraka Bhattacharjee; Study of generalized spin and charge stiffness constants of doped quantum antiferromagnets on low dimensional lattices based on t-J model; Ongoing.
4. Koushik Mandal; Superconducting Pairing in Strongly Correlated Systems (tentative); Ongoing.

Teaching activities at the Centre

1. 4th semester; Magnetism & Superconductivity; IPhD, Elective, PHY 409; 4; K. Mandal
2. 2nd semester; Advanced Condensed Matter Physics Magnetism & Superconductivity with normal state excitations; PMSC-PhD, PHY 601; 5; K. Mandal

Publications in Journals

1. Suraka Bhattacharjee and **Ranjan Chaudhury;** *Calculation of generalized spin stiffness constant of strongly correlated doped quantum antiferromagnet on two-dimensional lattice and its application to effective exchange constant for semi-itinerant systems;* Physica B; 2016; **500;** 133-141.
2. Subhajit Sarkar, **Ranjan Chaudhury** and Samir K. Paul; *Semi-phenomenological analysis of neutron scattering results for quasi-two dimensional quantum anti-ferromagnet;* Journal of Magnetism and Magnetic Materials; 2017; **421;** 207-215.
3. Timothy Chibueze and **Ranjan Chaudhury;** *Synthesis of conventional phenomenological theory of superconductivity with Marginal Fermi Liquid model;* Journal of Ovonic Research; 2016; **12**(3); 121-127.

Other Publications

1. Ranjan Chaudhury; Microscopic understanding of high temperature superconductivity and its possible role towards enhancement of critical temperature; Journal of Material Science and Engineering (special issue as Proceedings of CMP 2016); 2016; 5; 85.

Independent publications of students

1. Suraka Bhattacharjee; Investigation of the magnetic behavior of doped quantum antiferromagnets on low-dimensional lattices; Journal of Material Science and Engineering (special issue as Proceedings of CMP 2016); 2016; **5**; 75.

Lectures Delivered

1. Microscopic understanding of high temperature superconductivity and its possible role towards enhancement of critical temperature; CMP 2016 (OMICS Conference) held in Chicago (USA); October; 2016; sent a shortened version of my scheduled invited talk to the organizers due to late arrival of Visa for going to US.

Membership of Committees

Internal Committee

Chairman of Space Reallocation Committee (Visitors' and Students' sitting arrangement) (SNBNCBS)

Awards / Recognitions

1. Selected as an Active Member of Physics Unit of Athens Institute For Education And Research (Athens, Greece) in May 2016.

Fellow / Member of Professional Body

1. Continued as the Member of Physical Chemistry Division of American Chemical Society (USA).

Collaborations including publications (Sl. No. of paper/s listed in 'Publications in Journals' jointly published with collaborators)

International

1. With T. Chibueze (Univ. of Nigeria, Nigeria (Sl. No.3).
2. With M.P. Das (ANU, Canberra, Australia); manuscript under preparation.

Member of Editorial Board

1. Continued as the Editor-in-Chief of Journal of Opinion in Condensed matter Physics (Singapore) till December 2016.

Significant research output / development during last one year

General research areas and problems worked on

1. Theoretical and microscopic investigation of superconductivity with anisotropic nature in multi-layered systems with inclusion of various intra-layer, inter-layer and inter-band processes, relevant to cuprates and Fe-pnictides.
2. Detailed theoretical investigation of generalized spin stiffness constant for doped quantum antiferromagnet with strong electronic correlations on low dimensional lattices.
3. Extension and application of our calculational results and analysis for spin dynamics of quasi-two dimensional XY-anisotropic antiferromagnetic models to both small and large spin layered materials.

Interesting results obtained

1. The consequences of intra-layer s-wave pairing combined with the coherent inter-layer pair hopping processes were examined within mean field approximation. The two distinct order parameters viz. In-plane superconducting gap and out-of-plane superconducting gap were properly identified and expressions for the quasi-particle operators were explicitly determined. The results obtained are shown to be very different from those obtained from a similar approach of H. Suhl et al carried out in another context much earlier. The formulation for taking care of inter-band mixing and its effect on the phases of the two kinds of superconducting gap functions were also initiated.
2. The magnetic correlation in doped quantum Heisenberg antiferromagnetic system on one-dimensional lattice is investigated theoretically on the basis of the single band strongly correlated t-J model. The presence of a maximum in the plot of our theoretically obtained generalized spin stiffness constant as a function of doping concentration, occurring at a finite doping, suggests the emergence of a tendency to form a new magnetic ordering of itinerant nature in the system in the low doping regime and its disappearance as the doping is increased further. This prediction of ours is quite novel and awaits direct verification by independent experiments in future. Besides, the comparison between our theoretical results for spin stiffness constant and those for the effective exchange constant extracted from the available experimental results obtained so far from the chains of $YBa_2Cu_3O_{6+x}$ at low temperature show very similar behaviour as a function of doping concentration. This firmly establishes the role of spin stiffness constant as effective exchange constant for strongly correlated semi-itinerant systems in one-dimension. Our results also receive good support from those based on other theoretical approaches appropriate to 1D.
3. Our conjecture involving the limitations of the conventional Berezinskii-Kosterlitz-Thouless (BKT) scenario with semi-classical treatments for quasi-two dimensional XY-anisotropic antiferromagnets involving topological excitations, relating to the magnitude of spin, found further support from the inelastic neutron scattering experiments performed on high spin XXZ systems like $MnPS_3$ (with S = 5/2) . In this material, the conventional theoretical treatment was found to be adequate and no quantum approach was required for quantitative agreement with the experimental results. This is in sharp contrast to our earlier investigation involving La_2CuO_4 (with S = ½).

Proposed research activities for the coming year

1. Completion of the ongoing calculation for full quantum magnetic dynamical structure function in the case of quantum BKT scenario. This would help resolve the disagreement between theory and experiments for low spin systems of both ferromagnetic and antiferromagnetic in nature.
2. Completion of the ongoing charge stiffness calculations for strongly correlated doped quantum antiferromagnet on low-dimensional lattices.
3. Understanding the microscopics of superconducting pairing in the pesudo-gap region of the cuprates.
4. Extension of my quantum modelling developed earlier, to explore various other processes involving DNA.

Any other matter

The manuscript draft for my proposed book on condensed matter physics is nearing completion and I hope to submit it soon.