INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

2A&B, Raja S.C. Mullick Road, Jadavpur, Kolkata-700032, India

Seminar Notice

Org. by

Theoretical Physics Department

Title:	**Study of many-body quantum dynamics using Rydberg atoms**
Speaker:	**Rick Mukherjee, Rice University**
Date:	**April 12, 2018 (Thursday)**
Time:	**2:00 PM**
Venue:	**Theoretical Physics Seminar Room (C406),3rd Floor, Centenary Building, IACS**
Abstract:	Understanding emergent behaviour of many-body quantum systems is an important area of ongoing research relevant for condensed matter physics as well as quantum information. Ultra-cold quantum systems with long range interactions provide a unique platform to investigate such manybody phenomena. In this context, Rydberg atoms are fascinating as they can potentially create entangled states and exotic phases of matter. However, most of these applications were driven by alkali Rydberg atoms. Proposals to study many-body phenomena using alkaline-earth atoms mainly involve the ground state. In the first part of the talk, I would discuss the potential of exploring many-body physics unique to Rydberg alkaline-earth atoms in optical lattices [1]. As a specific example, we study charge transfer dynamics of an ion immersed in a Rydberg-dressed atomic lattice gas [2]. The character of the charge exchange crucially depends on the coupling between the electronic dynamics and the vibrational motion of the atoms and ion. We formulate a criterion for distinguishing coherent and incoherent regimes. For the second part of my talk, I would like to discuss certain tools useful to study many-body dynamics in ultra-cold systems in general. For example, the use of Ramsey spectroscopy to characterise and understand the far-from-equilibrium many-body dynamics of an initially uncorrelated quantum system where the correlations evolve due to Rydberg interactions [3]. Yet another way to study correlations in many-body interacting systems is by direct visualisation. I will present a method to geometrically visualise spin correlations and exemplify its broad usefulness by considering specific spin models in ultra-cold matter. This one-to-one map between the spin correlations and our three-dimensional geometrical object is analogous to the map between the single spin and the Bloch vector [4]. [1] R. Mukherjee, J. Millen, R. Nath, M.P.A. Jones and T. Pohl J. Phys. B 44 18 (2011) [2] R. Mukherjee, I. Lesanovsky and T. Pohl (in preparation) [3] R. Mukherjee, T.C. Killian, and K.R.A. Hazzard Phys. Rev. A 94, 053422 (2016) [4] R. Mukherjee, A.E. Mirasola, J. Hollingsworth, I.G. White, K.R.A. Hazzard arXiv:1612.06459v2

All are cordially invited to attend the seminar