

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

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

Seminar Notice

Org. by

School of Physical Sciences

Title:	Mesoscopic entanglement with Bose-Einstein condensates
Speaker:	Sebastian Wuster, IISER Bhopal
Date:	December 10, 2019 (Tuesday)
Time:	16:00
Venue:	Physics Seminar Room (C-406), 3rd Floor, Centenary Building, IACS
Abstract:	It is an open fundamental question how the classical appearance of our environment arises from the underlying quantum many-body theory. Experiments explore this question through the creation of superposition states involving ever larger numbers of constituents. Atomic Bose-Einstein condensates (BECs) are a promising platform, due to their typically very well defined many-body state. We present proposals how entire clouds of cold atoms can be brought into mesoscopically entangled (or Schrodinger's cat) states in position space, implying that the cloud as a whole will be in a superposition of two different places at once. The first avenue presented involves highly excited Rydberg atoms. Due to their extreme interactions, these atoms are prone to the generation of entangled states. This entanglement can then be transferred to ultra-cold ground state atoms using the technique of Rydberg dressing, which can give rise to spatial cat states using dressed dipole-dipole interactions [1] or Rydberg phase imprinting [2]. However mesoscopically entangled states can also arise among cold ground state atoms alone, such as in binary collision of bright solitons. We show that these collisions exhibit intricate many-body quantum behavior, invalidating mean field theory [3,4]. After collision the two solitons find themselves in a superposition state of various constituent atom numbers, positions and velocities, in which all these quantities are entangled with those of the collision partner. As the solitons appear to traverse the quantum-classical boundary back and forth during their scattering process, they emerge as natural probe of mesoscopic quantum coherence and decoherence phenomena. [1] "Entangling distant atom clouds through Rydberg dressing", S. Möbius, M. Genkin, A. Eisfeld, S. Wüster and J. M. Rost, PRA 87, 051602(R) (2013). [2] "Phase-Imprinting of Bose-Einstein Condensates with Rydberg Impurities", R. Mukherjee, C. Ates, W. Li and S. Wüster, PRL 115, 040401 (2015). [3] "Condensate soliton collisions beyond mean-field theory" S. Choudhury, A. Sreedharan, R. Mukherjee, A. Streltsov and S. Wüster (2019), (in preparation). [4] "Solitons explore the quantum classical boundary" A. Sreedharan, S. Choudhury, R. Mukherjee, A. Streltsov and S. Wüster, http://arxiv.org/abs/1904.06552 (2019).

All are cordially invited to attend the seminar