

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

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

Seminar Notice

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School of Physical Sciences

Title:	Open quantum field theory of two (many-body) entangled atoms in De Sitter Space
Speaker:	Sayantan Choudhury, Max Planck Institute for Gravitational Physics (Albert Einstein Institute), Potsdam, Germany
Date:	May 31, 2019 (Friday)
Time:	11:30 a.m.
Venue:	Physics Seminar Room (C-406), 3rd Floor, Centenary Building, IACS
Abstract:	In this paper, our prime objective is to connect the curvature of our observable De Sitter Universe with the spectroscopic study of entanglement of two atoms in an open quantum system (OQS). The OQS considered in our work is made up of two atoms which are represented by Pauli spin tensor operators projected along any arbitrary direction. They mimic the role of a pair of freely falling Unruh De-Witt detectors, which are allowed to non-adiabatically interact with a conformally coupled massless probe scalar field in the De Sitter background. The effective dynamics of the atomic detectors are actually an outcome of their non-adiabatic interaction, which is commonly known as the Resonant Casimir Polder Interaction (RCPI) with the thermal bath. We find from our analysis that the RCPI of two stable entangled atoms in the quantum vacuum states in OQS depends on the De Sitter space-time curvature relevant to the temperature of the thermal bath felt by the static observer. We also find that, in OQS, RCPI produces a new significant contribution appearing in the effective Hamiltonian of the total system and thermal bath under consideration. This will finally give rise to Lamb Spectroscopic Shift, as appearing in the context of atomic and molecular physics. This analysis actually plays a pivotal role to make the bridge between the geometry of our observed Universe to the entanglement in OQS through Lamb Shift atomic spectroscopy. In two atomic OQS, Lamb Shift spectra are characterised by a L^{-2} decreasing inverse square power law behaviour when inter atomic Euclidean distance (L) is much larger than a characteristic length scale (k) associated with the system, which quantifies the breakdown of a local inertial

description within OQS. On the other hand, the RCPI of this two atomic OQS immersed in a thermal bath in the background of Minkowski flat Universe is completely characterised by a temperature independent $L^{\wedge\{1\}}$ decreasing inverse power law. This mimics exactly the same situation where the characteristic length scale k is sufficiently large compared to the interatomic Euclidean distance between the two atoms. Thus, we are strongly aiming to connect the curvature of the background space-time of our Universe to open quantum Lamb Shift spectroscopy by measuring the quantum properties of a two entangled OQS in the atomic experiment. Additionally, we also solve the time evolution of the reduced density matrix of the system in presence of effective Hamiltonian and Lindbladian to explicitly know about the large-time equilibrium behaviour of the OQS under consideration, which will help us to know about the temperature dependence of the environment (thermal bath) of OQS.

All are cordially invited to attend the seminar