Department of Theoretical Physics

THE QUANTUM SPACETIME SEMINAR SERIES

Open quantum theory of two entangled atoms in De Sitter Space

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In this talk, we explore the features of quantum entanglement of two atoms in background De Sitter space-time. Our set up is an Open Quantum System (OQS), where the two atoms, each having two energy levels and represented by Pauli operators projected along any arbitrary direction. The system mimics 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 which has the role of background thermal bath. The effective dynamics of this combined system takes into account of the non-adiabatic interaction, which is commonly known as the Resonant Casimir Polder Interaction (RCPI) with the thermal bath. Our analysis reveals 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 find that the Lamb Shift is characterised by a decreasing inverse square power law behaviour, L^{-2}, when inter atomic Euclidean distance, L, is much larger than a characteristic length scale, k, which is the inverse of the curvature of De Sitter space. If the background space-time would have been Minkowskian this shift decreases as, L^{-1}, and is independent of temperature. Additionally, after tracing over bath modes we solve the time evolution of the reduced system in presence of a dissipator or Lindbladian operator to know the early and late time behaviour of the OQS, which will help us to quantify the equilibrium temperature of the thermal bath. Finally, we quantify various quantum information theoretic measures and the issue of quantum non-locality through Bell's inequality violation to study the role of quantum entanglement and long-range correlations in De Sitter space.

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