

GRAVITY MEDIATED ENTANGLEMENT OF PHONONS IN BOSE-EINSTEIN CONDENSATES

SEMINAR

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Abstract

The eigenstates of two test-masses (where each test-mass is placed inside of a harmonic trap) separated by a distance, can get entangled where gravity acts as the mediator of entanglement and it has been argued in [arXiv:2511.07348 \[quant-ph\]](#) that this entanglement of masses cannot be generated without the underlying quantum nature of gravity. In this work, we consider two non-relativistic Bose-Einstein condensates (formed inside of harmonic trap potentials with identical trapping frequencies) separated by a distance. We take a linearized quantum gravity model and investigate the generation of entanglement while gravitons serve as the mediator of entanglement. The entanglement is generated between the phonon modes of the two condensates, and we observe that for very low separation distance, the entanglement generated is significantly higher than that observed for the quantum gravity induced entanglement of masses or QGEM protocol; however, the fall of entanglement is faster than the two-particle case for two separated Bose-Einstein condensates. We observe that when the number of particles in the condensate is increased, the degree of entanglement for a smaller separation distance becomes substantially higher compared to the case discussed in [Phys. Rev. D 105 \(2022\) 106028](#), which allows for a more robust experimental proposal using this quantum gravity induced entanglement of phonons or QGEP protocol.

Based on the work: Soham Sen, Sunandan Gangopadhyay, and Vlatko Vedral.
[arXiv:2604.20767 \[hep-th\]](#)

Everyone is invited to attend