Contribution ID: **3** Type: **not specified**

Gravitationally induced decoherence: from theoretical models to signatures in neutrino oscillations

Wednesday, 18 December 2024 15:30 (30 minutes)

The formalism of Open Quantum Systems with linearised gravity as environment serves as a tool to predict the effective evolution of quantised matter systems under the influence of gravity. It is of use to analyse features of specific quantum gravity candidate theories and to search for signs of quantum gravity effects for instance in neutrino oscillations.

In the talk, a model consisting of a scalar matter field and linearised gravity as environment is considered. In order to formulate dynamics and to deal with the gauge freedom present in the environment, the entire system is formulated in terms of relational observables that allow a physical interpretation of temporal and spatial coordinates.
The resulting master equation, which is the effective time evolution equation for the quantised scalar field under the influence of gravity, exhibits UV-divergent terms. To extract the physics of a single scalar particle, the equation is projected onto the one-particle subspace and the individual terms are interpreted as Feynman diagrams. This yields the possibility to perform a QFT renormalisation and the resulting master equation is cast into a completely positive Lindblad form using specific approximations. In the end, the one-particle master equation is applied to study gravitationally induced decoherence in neutrino oscillations.

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