



Contribution ID: 1245

Type: **Neutrinos**

Neutrino Decoherence in Simple Open Quantum Systems

Wednesday 26 May 2021 16:45 (15 minutes)

Neutrinos lose coherence as they propagate, which leads to the fading away of oscillations. In this work, we model neutrino decoherence induced in open quantum systems from their interaction with the environment. We first present two different models in the quantum mechanical framework, in which the environment is modeled as forced harmonic oscillators with white noise interactions, or two-level systems with stochastic phase kicks. We then look at the decoherence process in the quantum field theoretic framework induced by elastic scatterings with environmental particles. The exponential decay is obtained as a common feature for all models, which shows the universality of the decoherence processes. We also discuss connections to the GKSL master equation approach and give a clear physical meaning of the Lindblad operators.

Summary

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Session Classification: Neutrino III