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Quantum Decoherence in Neutrino Oscillations

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Quantum decoherence in neutrino oscillations was theorized almost 50 years ago, however there is still no clear theoretical understanding of this phenomenon, there is not even agreement on whether or not it could be observed at all.
Treating all particles, including the source and detector, consistently in QFT, we study a model where the decoherence emerges from the time evolution of the initial state. We started by studying some simplified cases, obtaining nonetheless interesting results: we have shown that some of the assumptions used in many works on decoherence (such as the covariance of the wavepackets) are inconsistent, since the time evolution would break the Lorentz invariance; moreover we have seen that, contrary to the usual intuition, the uncertainty on the detector momentum does not always play a relevant role in decoherence, at least as long as the detector particle is non-relativistic, since its contribution is suppressed by a factor proportional to p/M.
Finally, we also notice the emergence of a new quantum effect: the oscillations do not starts immediately but only only starts a very short time after the first neutrinos arrives; however, since the time window when this effect would be observable is extremely small, the precision required to measure such an effect is most likely well beyond the current technical capabilities

Working group

WG1

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