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Towards a quantum treatment of leptogenesis

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Leptogenesis is an attractive mechanism for explaining the baryon asymmetry of the universe, and provides interesting links between cosmology and neutrino physics. In addition, within the scenario of resonant leptogenesis, models with implications for LHC and future colliders have been proposed. However, the predictions depend on a correct calculation of the generated asymmetry in terms of the fundamental masses and couplings. Typically, classical Boltzmann equations with vacuum matrix elements are used. Since the lepton asymmetry results from a quantum interference process that is out of equilibrium, it is desirable to study the mechanism within a purely quantum field theoretical description. We present a calculation of the resonant enhancement based on a first principle approach. We identify the correct behaviour when the mass difference of the right-handed neutrinos is of the order of their width, and show that the generated asymmetry is smaller compared to the Boltzmann approach.

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