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Nonequilibrium QFT approach to leptogenesis

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The observed baryon asymmetry of the Universe can be elegantly explained in the leptogenesis scenario, where a net lepton asymmetry produced by the decay of heavy right-handed neutrinos is then transfered to the baryon number through the Standard Model sphalerons.

Being an intrinsicly quantum effect the generation of such an asymmetry in the hot early Universe can be described systematically only using nonequilibrium quantum field theory tools. Starting from first principles one derives a quantum Boltzmann equation which is free of the double counting problem and which incorporates consistently the medium corrections to the masses and decay widths.

Medium corrections are particularly large for the CP-violating parameters. The total decay widths are affected to a lesser extent. Moreover thermal corrections to the heavy neutrino mass play an important role in the case of quasi-degenerate and mildly-degenerate mass spectrum, and can even lead to an avoided level crossing. Therefore a resonant enhancement of the CP-violating parameter can be present at high temperature but absent in the vacuum case.

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