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Precision calculation of neutrino evolution in the early Universe

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In the primordial Universe, neutrino decoupling occurs only slightly before electron-positron annihilations. This leads notably to an increased neutrino energy density compared to the standard instantaneous decoupling approximation, parametrized by the effective number of neutrino species $N_{\rm eff}$. A precise calculation of neutrino evolution is needed to assess its consequences on BBN, structure formation or on the CMB, and requires to take into account multiple effects such as neutrino oscillations, which represents a genuine numerical challenge.

Recently, several improvements have been made towards such a precision calculation, leading to the new reference value $N_{\rm eff} = 3.0440$. We have managed to get a deeper understanding of the role of flavour oscillations, which has led to a new approximation of neutrino evolution, which exploits the large difference between the oscillation time scale and the kinetic evolution time scale. This novel approach can be generalized to study for instance the evolution of neutrino asymmetries in the early universe, allowing to perform a proper 3-neutrino calculation using the full collision term.

Reference to paper (DOI or arXiv)

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Your gender (free text)

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