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Lepton Flavour Asymmetries: from the early Universe to BBN

Thursday 29 May 2025 15:00 (20 minutes)

In this talk I discuss the constraints imposed by BBN and CMB observations on primordial lepton flavour asymmetries with vanishing total lepton number. I show that solving the momentum averaged quantum kinetic equations describing neutrino oscillations and interactions is an accurate approximation to the full momentum-dependent system, and the results reveal a rich flavour structure in stark contradiction to the assumption of simple flavour equilibration. In particular, the appearance of non-adiabatic MSW transitions lead to especially strong or weak washouts—a phenomenon for which I will present the first analytical understanding in the standard case with three active neutrinos. We further encounter (i) a particular direction in flavour space, in which the flavour equilibration is efficient and primordial asymmetries are essentially unconstrained and (ii) a minimal washout factor yielding a conservative estimate for the allowed primordial asymmetries in a generic flavour direction. I discuss the implications of the resulting BBN and CMB constraints on models of first-order QCD phase transition facilitated by large lepton asymmetries as well as baryogenesis from large and compensated asymmetries.

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