Contribution ID: **79** Type: **Talk**

Oscillation and decay of neutrinos in matter: an analytic treatment

Thursday, 4 August 2022 16:32 (22 minutes)

We present compact analytic expressions for neutrino propagation probabilities in matter, with invisible neutrino decay effects included. These will be directly relevant for long-baseline and reactor experiments.

The inclusion of decay leads to a non-Hermitian effective Hamiltonian, with the Hermitian component corresponding to oscillation, and the anti-Hermitian component representing the invisible decay effects. Due to a possible mismatch between the effective mass eigenstates and the decay eigenstates of neutrinos, these two components need not commute. Even for the special case where the decay and mass eigenstates in vacuum are the same, in the presence of matter, the two components will invariably become non-commuting. We overcome this by employing the techniques of inverse Baker-Campbell-Hausdorff (BCH) expansion, and the Cayley-Hamilton theorem applied in the 3-flavor framework. We also point out the conditions under which the One Mass Scale Dominance (OMSD) would be a good approximation.

The analytic results obtained provide physical understanding into possible effects of neutrino decay as it propagates through Earth matter. We show that certain non-intuitive feature like decay increasing the value of $P_{\mu\mu}$ at its first and second dip may be explained using our analytic approximations.

Attendance type

Virtual presentation

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Session Classification: WG1: Neutrino Oscillations

Track Classification: WG1: Neutrino Oscillation Physics