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Instabilities of collective neutrino oscillations induced by non-standard neutrino interactions

We study the effect of non-standard neutrino interactions (NSIs) on the growth of instabilities in neutrino energy spectra of a core-collapse supernova for different neutrino intensities and/or types of NSIs, notably including the exotic neutrino magnetic moment. Although it is usually attested that instabilities virtually smear out all potentially observable signatures, we show there are regimes in which they work as a magnifying glass, bringing tiny effects to the eye of the observer.

Summary

Our research is focused on the effects arising near neutrinospheres of core-collapse supernovae due to an interplay between collective effects in neutrino oscillations and the hypothesized non-standard neutrino interactions stemming from beyond-Standard-Model physics. We use numerical simulations (the so-called single-angle scheme) based on analytically derived effective Hamiltonians for collective oscillations, and then carry out a linear stability analysis revealing the spectrum and amplitudes of instabilities. It turns out that certain types of NSIs (notably the transition magnetic moment of Majorana neutrinos) does not trigger 'first-order' instabilities forbidden by certain 'selection rules', while perturbations introduced by other types of NSIs undergo an avalanche-like growth to quite observable values.

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