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Helicity coherence in binary neutron star mergers and nonlinear feedback

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In astrophysical environments such as core-collapse supernovae or binary neutron star mergers, the physical conditions are so extreme that neutrino propagation can have a significant role in the dynamics of the system, the nucleosynthesis, and modify the signals that might be detected from such events. Since the discovery of neutrino oscillations in 1998 and the assessment of the Mikheev-Smirnov-Wolfenstein (MSW) effect, steady progress had been made in understanding neutrino flavor conversions. Neutrino self-interactions have proven to complicate the problem, making the evolution equations intrinsically nonlinear, and have triggered a decade of theoretical investigations. A variety of flavor instabilities has been uncovered, depending on the physical conditions and the geometry of the environment considered. In anisotropic media, the most general mean-field equations include corrections to the relativistic limit, due to the nonzero neutrino mass. This contribution creates a coupling between neutrino and antineutrino referred as *helicity* or *spin coherence*.

In this talk, we summarize the progress made in neutrino flavor evolution, from solar neutrinos to binary neutron star mergers neutrinos, and we discuss the effects of helicity coherence on propagation in the context of these mergers [1].

[1] A. Chatelain and C. Volpe, "Helicity coherence in binary neutron star mergers and nonlinear feedback", Phys.Rev. D95 (2017) no.4, 043005, arXiv:1611.01862 [hep-ph].

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