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Theory of Fast Flavor Conversion for Supernova neutrinos

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We all know that in the dense anisotropic interior of the star, neutrino- neutrino forward-scattering can lead to fast collective neutrino oscillations, which has striking consequences on flavor dependent neutrino emission and can be crucial for the evolution of a supernova and its neutrino signal. Although the triggering and initial growth of fast oscillations are understood, owing to its complicated nonlinear evolution, the final impact is not yet known. Interestingly, stellar explosion and the neutrino signal are sensitive to the processed flavor-dependent fluxes, but the required neutrino theory prediction is still lacking. In my talk I will address this crucial theoretical and phenomenological obstacle and present a theory of fast flavor conversions that will explain how, when and to what extent do the flavor differences change. Finally, I will give a method and a simple formula for computing the final fluxes that can be a crucial input for supernova theory and neutrino phenomenology. This work solves a critical problem revealing the final state of fast conversions that has eluded the community for almost two decades with two fundamentally new physical insights, viz., coarse-grained evolution and transverse relaxation.

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