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Collective Effect in Supernova Neutrinos

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Due to neutrino-neutrino forward scattering, the neutrino flavor conversion inside a supernova is still an open question. This type of interaction leads to a non-linear evolution of neutrino states and is strongly dependent on their angular distribution. Thus, the peculiarities of the supernovae's innermost environment impose a number of complexities on an accurate calculation of the neutrino evolution towards the outside of the star. Unquestionably, a comprehensive understanding of the neutrino flavor conversion mechanisms is essential to extract astrophysical information from future detections of supernovae neutrinos. Therefore, in this talk, we present some preliminary results for this problem, in which we have adopted a numerical solution approach. First, we discuss an isotropic neutrino gas and its connection to simpler systems, such as a pendulum. Then, we show the results of modeling the supernova neutrino emission as a sphere (Bulb-Model), which has connections with the isotropic scenario when considering a single-angle emission approximation. Finally, we explain the limitations of this model and the next steps toward a more detailed calculation. It is worth emphasizing that the numerical implementation of the code is public (open-source), and is already available for users interested in studies of neutrino collective effects.

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