Nuclear Physics in Astrophysics XI



Contribution ID: 74

Type: Contributed talk

Collective neutrino oscillations and the heavy-element nucleosynthesis in supernova

Thursday 19 September 2024 12:40 (15 minutes)

In high energy astrophysical processes involving compact objects, such as core-collapse supernovae or binary neutron star mergers, neutrinos are likely to play an important role in the synthesis of nuclides. Neutrinos in these environments can experience collective flavor oscillations driven by neutrino-neutrino coherent forward scattering. Recently, there has been interest in exploring potential beyond-the-mean-field effects in the collective oscillations of neutrinos. Here, we seek to explore possible implications of these effects for the heavy-element nucleosynthesis yields in supernova environments with different astrophysical conditions and neutrino inputs. We find that collective oscillations can impact the operation of the vp-process and r-process nucleosynthesis in supernovae. The potential impact is particularly strong in high-entropy, proton-rich conditions, where we find that neutrino interactions can nudge an initial ν p process neutron rich, resulting in a unique combination of proton-rich low-mass nuclei as well as neutron-rich high-mass nuclei. We describe this neutrino-induced neutron capture process as the " ν i process". In addition, nontrivial quantum correlations among neutrinos, if present, could lead to distinctly different nucleosynthesis results compared to the corresponding mean-field treatments, by virtue of modifying the evolution of the relevant one-body observables.

Primary author: WANG, Xilu (Institute of High Energy Physics, Chinese Academy of Sciences)

Co-authors: BALANTEKIN, Baha (University of Wisconsin-Madison); CERVIA, Michael (The George Washington University; University of Maryland, College Park); PATWARDHAN, Amol (University of Minnesota); SUR-MAN, Rebecca (University of Notre Dame)

Presenter: WANG, Xilu (Institute of High Energy Physics, Chinese Academy of Sciences)

Session Classification: Plenary Session