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Neutrino flavor conversions in the remnants of binary neutron star mergers

Neutrino-neutrino interactions dominate the flavor evolution in core-collapse supernovae and binary neutron star mergers. Remarkably, neutrino self-interactions lead to intriguing "fast"flavor conversions that can develop on the nanosecond timescale in the core of core-collapse supernovae and compact binary mergers. Due to the nature of neutrino self-interactions, non-linear solutions to the flavor are realizable in such astrophysical environments posing great challenges for modern large-scale simulations. Inevitably, since neutrinos are copiously produced in the merger of two neutron stars, fast neutrino conversions are predicted to be ubiquitous in these environments with potentially major implications on the nucleosynthesis of the elements heavier than iron. If the imprint of neutrino flavor conversions on the binary environment is significant, the related kilonova electromagnetic emission could be strongly affected.

We present the first multi-dimensional numerical modeling of the neutrino flavor evolution above the merger remnant disk. Although neutrino fast conversions are predicted to be ubiquitous in neutron star merger remnants, our findings suggest that the flavor unstable regions in the disk of the remnant do not lead to substantial neutrino mixing. This work opens the question on the role of neutrino self-interactions in the outflows of neutron star merger remnants and constitutes a major step forward in the numerical modeling of neutrino collective oscillations in dense media.

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