2025 North American Einstein Toolkit Workshop



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Neutrino Radiation Hydrodynamics with Flash-X+thornado

Thursday 12 June 2025 16:30 (1 hour)

Neutrino-matter coupling via weak interactions is one of the most important physical mechanisms in the evolution of core-collapse supernovae (CCSN). The numerical modeling of these systems is an inherently multiphysics, multi-method and multi-scale problem. In this talk, we will give an introduction to neutrino radiation hydrodynamics and then describe the union of three codes to simulate CCSN: Flash-X+thornado+WeakLib, which evolve the fluid and gravity and provide the computational infrastructure (Flash-X), a code that evolves neutrino radiation hydrodynamics in a spectral two-moment model using the discontinuous Galerkin method (thornado), and a library that provides the equation of state and weak interaction opacity tables (WeakLib). We will describe the two-moment spectral neutrino transport in thornado, the mapping of fluid data in different representations (finite volume and discontinuous Galerkin), as well as our performance portability strategy using OpenMP/OpenACC offloading to harness heterogeneous exascale machines such as Frontier at the OLCF. We will also present the Oak Ridge Leadership Computing Facility at Oak Ridge National Laboratory and the computing opportunities for researchers through programs like DOE INCITE.

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