TurboTalk Script

Hello! My name is Sam Dunham and I thank you for taking time to watch this turbo talk about my poster for the 237th AAS meeting: General Relativistic Hydrodynamics with Dynamical Spacetimes in thornado.

The ultimate goal of this work is to simulate core-collapse supernovae, which are important to study for several reasons, some of which are highlighted in the poster.

The industry standard in the core-collapse supernova modeling community for solving the equations of radiation-hydrodynamics is the finite-volume method. We ask the question: “Is the discontinuous Galerkin method (aka, the DG method) preferable to the finite-volume method for this purpose?”

Details on the DG method, including its requirement of limiters, will be shown in the poster.

To help answer our question, we are developing the toolkit for high-order neutrino radiation-hydrodynamics, or thornado. thornado uses a DG method to solve the radiation-hydrodynamics equations in a general relativistic framework under the conformally-flat approximation. This is also explained more in the poster, which focuses on the coupling between the hydrodynamics and an external finite-element gravity solver, Poseidon.

We show results from a GR generalization of the Yahil self-similar collapse problem, where we compare our results to their Newtonian counterparts. We also present results from the adiabatic collapse of a realistic 15 solar mass progenitor, all the way to bounce. This benchmarks our code's coupling to Poseidon, our implementation of curvilinear coordinates, and our implementation of a nuclear, tabulated equation of state.

We also mention future work, including improving our limiters to allow continued evolution of the 15 solar mass progenitor, coupling to the radiation solver, incorporation of mesh refinement, and porting to GPUs.

To learn more about any of this, please checkout presentation 551.18! I hope to see you there! Thank you!