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Developing Discontinuous Galerkin Methods for Solving Multiphysics Problems in General Relativity LAWRENCE KIDDER, SCOTT FIELD, SAUL TEUKOLSKY, Cornell University, FRANCOIS FOUCART, Lawrence Berkeley National Laboratory, SXS COLLABORATION — Multi-messenger observations of the merger of black hole-neutron star and neutron star-neutron star binaries, and of supernova explosions will probe fundamental physics inaccessible to terrestrial experiments. Modeling these systems requires a relativistic treatment of hydrodynamics, including magnetic fields, as well as neutrino transport and nuclear reactions. The accuracy, efficiency, and robustness of current codes that treat all of these problems is not sufficient to keep up with the observational needs. We are building a new numerical code that uses the Discontinuous Galerkin method with a task-based parallelization strategy, a promising combination that will allow multiphysics applications to be treated both accurately and efficiently on petascale and exascale machines. The code will scale to more than 100,000 cores for efficient exploration of the parameter space of potential sources and allowed physics, and the high-fidelity predictions needed to realize the promise of multi-messenger astronomy. I will discuss the current status of the development of this new code.

Lawrence Kidder
Cornell University

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