SpECTRE – A new Discontinuous Galerkin Code for Solving General Relativistic Partial Differential Equations

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The observation of gravitational waves with ground-based detectors of increasing sensitivity, as well as future space-based detectors, will increase the number of gravitational wave events and the accuracy with which event are observed. This requires associated high-precision modeling of the gravitational wave sources, most notably compact object binaries consisting of black holes, neutron stars, or exotic compact objects. Gravitational waves from these systems need to be computed with sufficient precision for the various analyses, as well as all physical processes that lead to electromagnetic and particle emission.

This talk reports on the status of a new code to accomplish these tasks, being developed by the Simulating Extreme Spacetimes (SXS) collaboration. This code, named SpECTRE, is based on Discontinuous Galerkin methods with task-based parallelism. In particular, we will present the elliptic solver of SpECTRE, which combines hp-adaptive mesh refinement, multi-grid preconditioners with Schwarz smoothers, and supports curvilinear and compactified domains. We discuss applications to solving the constraint equations of General Relativity for black hole spacetimes, and tests toward solving binary Neutron star initial data for equations of state with phase transitions.