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Solving Einstein's Equations Using Discontinuous Galerkin Methods EAMONN O'SHEA, Cornell University, SXS COLLABORATION — The success of LIGO in discovering gravitational waves from binary black hole (BBH) mergers has been aided by several large catalogs of waveforms produced from simulations of BBH mergers through inspiral, merger and ringdown. One such catalog was produced using the SpEC code, which solves the Generalized Harmonic form of Einstein's equations using spectral collocation methods. With the advent of multi-messenger astrophysics, we require codes that can accurately calculate the gravitational wave signals from merger events involving neutron stars, which are beyond the capabilities of spectral methods. Discontinuous Galerkin (DG) methods have emerged as a robust method which demonstrate spectral convergence for smooth solutions, and can also capture shocks present in hydrodynamical systems. SpECTRE is a code which implements DG methods using task based parallelism, shown by Kidder et al.[1] to effectively scale to massive supercomputers when solving various hydrodynamics problems.We show how the Generalized Harmonic form of Einstein's equations can be implemented within SpECTRE. With the specific example of a 3D Kerr-Schild black hole, we show that we achieve exponential convergence and also a stable evolution over long times.

[1]Kidder et al., arXiv:1609.00098

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