

Numerical relativity codes that do not make assumptions on spatial symmetries most commonly adopt Cartesian coordinates. While these coordinates have many attractive features, spherical coordinates are much better suited to take advantage of approximate symmetries in a number of astrophysical objects, including single stars, black holes, and accretion disks. SphericalNR is a suite of thorns that enables the use of spherical coordinates in the Einstein Toolkit infrastructure, originally designed for Cartesian coordinates. This is done by providing appropriate MPI-parallelized parity boundary conditions at the internal boundaries of spherical coordinates. The evolution equations are written as a reference-metric version of the Baumgarte-Shapiro-Shibata-Nakamura formulation together with a proper rescaling of tensorial quantities. I will present numerical simulations for a disturbed Kerr black hole, the extracted the gravitational wave signal, and demonstrate that the noise in these signals is orders of magnitude smaller when computed on spherical grids rather than Cartesian grids. We have recently extended SphericalNR to include fCCZ4, a spacetime evolution formalism that provides constraint damping. We have adapted GRHydro, a general relativistic magnetohydrodynamics (GRMHD) code in the Einstein Toolkit, to use the reference metric formalism applied to the Valencia formulation of GRMHD, thus enabling the evolution of matter spacetimes in spherical coordinates with the Einstein Toolkit. I will present first results including gravitational collapse of neutron stars as well as stable evolution of equilibrium models for rotating neutron stars. We are currently working on extending the reference metric approach to include the evolution of magnetic fields as well and I will report on these developments.