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A Hyperbolic Solver for Black Hole Initial Data in Numerical Relativity MARIA BABIUC, Marshall Univ — Numerical relativity is essential to the efforts of detecting gravitational waves emitted at the inspiral and merger of binary black holes. The first requirement for the generation of reliable gravitational wave templates is an accurate method of constructing initial data (ID). The standard approach is to solve the constraint equations for general relativity by formulating them as an elliptic system. A shortcoming of the ID constructed this way is an initial burst of spurious unphysical radiation (junk radiation). Recently, Racz and Winicour formulated the constraints as a hyperbolic problem, requiring boundary conditions only on a large sphere surrounding the system, where the physical behavior of the gravitational field is well understood. We investigate the applicability of this new approach, by developing a new 4th order numerical code that implements the fully nonlinear constraints equations on a two dimensional stereographic foliation, and evolves them radially inward using a Runge-Kutta integrator. The tensorial quantities are written as spin-weighted fields and the angular derivatives are replaced with "eth" operators. We present here results for the simulation of nonlinear perturbations to Schwarzschild ID in Kerr-Schild coordinates. The code shows stability and convergence at both large and small radii. Our long-term goal is to develop this new approach into a numerical scheme for generating ID for binary black holes and to analyze its performance in eliminating the junk radiation.

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