

Parabolic-hyperbolic formulation of the black holes initial data – numerical studies

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The parabolic-hyperbolic form of the constraints [1–3] is integrated numerically [4]. The applied numerical stencil is 4th order accurate (in the spatial directions) while 'time'-integration is made by using the method of lines with a 4th order accurate Runge-Kutta scheme. The proper implementation of the applied numerical method is verified first by monitoring the relative and absolute errors determined by comparing numerical and analytically known solutions of the constraints involving boosted and spinning vacuum black hole configurations. The main part of the investigations is centered on construction of initial data for distorted black holes which, in certain cases, have non-negligible gravitational wave content. The applied new method allows to construct initial data for highly boosted and spinning black holes, essentially for the full physical allowed ranges of these parameters. In addition, the use of the evolutionary form of the constraints is free from applying any sort of boundary conditions in the strong field regime.

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