

Ecole Doctorale Carnot-Pasteur

Proposition de sujet de thèse

Intitulé français du sujet de thèse proposé :

Trous noirs binaires avec vecteur de Killing hélicoïdale

Intitulé en anglais :

Binary black holes with a helical Killing vector

Unité de recherche :

IMB

Nom, prénom et courriel du directeur (et co-encadrant) de thèse :

KLEIN, Christian, christian.klein @u-bourgogne.fr

Domaine scientifique principal de la thèse :

Mathématiques

Domaine scientifique secondaire de la thèse :

Physique

Description du projet scientifique

Coalescing binary black holes are generally seen as the strongest sources of gravitational radiation, and the first experimental discovery of these waves is related to such a binary system. The quasistationary phase of a binary system where the change of radius due to the emitted radiation is small during one revolution can be approximated by a spacetime with a helical Killing vector. In a projection formalism, the vacuum Einstein equations can be written in this case as the Einstein equations for 3-dimensional gravity with a sigma model as the energy-momentum tensor. The equations are singular at the horizons, at the light cylinder, and null infinity.

The thesis will focus on the efficient numerical integration of these equations. The idea is to use multi-domain spectral methods for spherical and bispherical coordinates with a Newton iteration to solve the equations. At some outer boundary the solution will be matched either to an asymptotically flat spacetime (this represents the case of a helical Killing vector only in the vicinity of the black holes) or to a solution of the linearized Einstein equations for a helical Killing vector having an oscillatory singularity at null infinity. A parameter study is to be performed for the distance of the black holes and their angular velocity to identify the innermost stable orbit of the model.

Connaissances et compétences requises :