GR 9: Numerische Relativitätstheorie I

Zeit: Donnerstag 11:45–12:25 Raum: A214

GR 9.1 Do 11:45 A214

Using curvature invariants for wave extraction in numerical relativity — •Oliver Elbracht[1] and Andrea Nerozzi[2] — [1]Institut für Theoretische Physik und Astrophysik, Julius-Maximilians-Universität, Am Hubland, 97074 Würzburg, Germany — [2]Institut für Angewandte Mathematik, Friedrich-Schiller-Universität, Ernst-Abbe-Platz 2, 07743 Jena, Germany

We present a new expression for the Weyl scalar Ψ_4 that can be used in numerical relativity to extract the space-time gravitational wave content. The formula relies upon the identification of transverse tetrads, namely the ones in which $\Psi_1 = \Psi_3 = 0$. It is well known that tetrads with this property always exist in a general Petrov type I space-time. A sub-class of these tetrads naturally converges to the Kinnersley tetrad in the limit of Petrov type D space-time. However, the transverse condition fixes only four of the six parameters coming from the Lorentz group of transformations applied to tetrads. Here we fix the tetrad completely, in particular by giving the expression for the spin-boost transformation that was still unclear. The value of Ψ_4 in this optimal tetrad is given as a simple function of the two curvature invariants I and J.

GR 9.2 Do 12:05 A214

Zoom whirl orbits of black holes — •Roman Gold — TPI, FSU Jena, Germany

For several years research on the binary black hole problem has focused on quasi-circular (minimally eccentric) orbits because of the circularizing effect of gravitational radiation in a binary system.

Allowing significant eccentricity reveals an interesting region of the parameter space of the GR two-body problem: zoom whirl orbits. These orbits are loosely defined as the behaviour of two bodies that approach each other on very eccentric trajectories, move (or "whirl") around each other several times very closely in a nearly circular orbit and then eventually merge or separate. These events produce some of the most intense gravitational wave signals in black hole binaries and therefore may provide an upper bound on the radiated energy for two equal mass Schwarzschild black holes.

I show results from numerical studies of the Einstein equation in vacuum for these zoom whirl orbits including the orbital dynamics, the extracted waves and the radiated energy.