GR 6: Relativistische Astrophysik

Zeit: Dienstag 14:00–16:00 Raum: SFG 0140

GR 6.1 Di 14:00 SFG 0140

The gravitomagnetic clock effect — •Eva Hackmann and Claus Lämmerzahl — ZARM, Universität Bremen

In General Relativity the rotation of a gravitating object causes purely relativistic effects on the motion of orbiting test particles, which are often referred to as frame dragging or gravitomagnetic effects. Here we will discuss a frame dragging effect on clocks first introduced by Cohen and Mashoon (Phys. Lett. A 181, 353 (1993)) as the difference in proper time as measured by two clocks, one on a prograde and one on a retrograde equatorial circular orbit, after a revolution of 2π. A generalisation of this effect to arbitrary geodesic motion of the two clocks allows to consider much more general settings. In particular, we will discuss this effect for two pulsars orbiting Sagittarius A*, the supermassive black hole in the center of our galaxy.

GR 6.2 Di 14:20 SFG 0140

Analytic model for relativistic dust accretion onto a Kerr-Newman black hole — •Kris Schroven, Eva Hackmann, and Claus Lämmerzahl — Zarm, Universität Bremen, Bremen, Germany

We will discuss analytically a stationary axis symmetric accretion fl ow of dust-like particles on a Kerr-Newman black hole. Even though the particles are treated to be non interacting, we will expect them to form, if charged, a plasma. Streamlines are expressed by the equations of motion of charged test particles in Kerr-Newman space time. The corresponding density field, created by charged and uncharged particles, is calculated numerically. This model provides a good way to present the in influence of the specific angular momentum and the specific charge of the black hole and test particles on the course of the accretion flow and density field. Furthermore the influence on the location of the outer and inner edge of the formed accretion disc can be discussed within this model.

GR 6.3 Di 14:40 SFG 0140

Gravitational waves and rotational properties of hypermassive neutron stars from binary mergers — •Matthias Hanauske[1,2], Luciano Rezzolla[1,2], and Horst Stöcker[1,2,3] — [1]Institut für Theoretische Physik, Max-von-Laue-Straße 1, Frankfurt, Germany — [2]Frankfurt Institute for Advanced Studies, Ruth-Moufang-Straße 1, Frankfurt, Germany — [3]GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

One hundred years after Albert Einstein developed the field equations of general relativity and predicted the existence of gravitational waves (GWs), these curious spacetime-ripples have been observed from a pair of merging black holes by the LIGO detectors. As GWs emitted from merging neutron star binaries are on the verge of their first detection, it is important to understand the main characteristics of the underlying merging system in order to predict the expected GW signal. Based on a large number of numerical-relativity simulations of merging neutron star binaries, the emitted GW and the interior structure of the generated hypermassive neutron stars (HMNS) have been analyzed in detail. This talk will focus on the internal and rotational HMNS properties and their connection with the emitted GW signal. Especially, the appearance of the hadron-quark phase transition in the interior region of the HMNS and its conjunction with the spectral properties of the emitted GW will be addressed. arXiv:1611.07152

GR 6.4 Di 15:00 SFG 0140

Simulating generic binary neutron star mergers — •Tim Dietrich[1], Sebastiano Bernuzzi[2], Bernd Bruegmann[3], Maximiliano Ujeviv[4], and Wolfgang Tichy[5] — [1]Max Planck Institute for Gravitational Physics, Albert Einstein Institute, D-14476 Golm, Germany — [2]DiFeST, University of Parma, and INFN Parma I-43124 Parma, Italy — [3]Theoretical Physics Institute, University of Jena, 07743 Jena, Germany — [4]Centro de Ciencias Naturais e Humanas, Universidade Federal do ABC, 09210-170, Santo Andre, Sao Paulo, Brazil — [5]Department of Physics, Florida Atlantic University, Boca Raton, FL 33431 US

Binary neutron star mergers are associated with a variety of observable phenomena in the gravitational and electromagnetic spectra. We investigate binary neutron stars in the last milliseconds before and after their merger with full 3D numerical simulations. We explain how we access previously unaccessible regions of the binary neutron star parameter space, e.g. spinning and high mass ratio setups, and we discuss first simulations with generic setups. We also show that recent upgrades allow us to improve the accuracy of the simulation and decrease the phase error of the obtained gravitational waveforms. With this updates our waveforms can be used for validating and improving semi-analytical waveform models.

GR 6.5 Di 15:20 SFG 0140

Carter constant and Killing tensors for fluids — •Vojtěch Witzany — ZARM, Universität Bremen, Germany

One of the surprises of the "golden age of general relativity" was the fact that the space-time of an isolated spinning black hole, the Kerr space-time, has an unexpected non-explicit symmetry which manifests itself in the existence of a Killing(-Yano) tensor and the integrability of a number of equations for test fields. In this talk we report on the generalization of the concept of a Killing tensor and the corresponding integral of motion, the Carter constant, to perfect-fluid flows in the Kerr space-time.

One notable result is the fact that every Killing tensor in a metric conformally related to the Kerr metric can be understood as a fluid-Killing tensor in a barotropic flow. We construct explicitly a class of such fluid-Killing tensors and demonstrate their applicability in the case of a family of stiff-fluid solutions.

GR 6.6 Di 15:40 SFG 0140

White Dwarfs in Scalar-Tensor-Theory — •Kevin Eickhoff, Burkhard Kleihaus, and Jutta Kunz — Institut für Physik, Universität Oldenburg, D- 26111 Oldenburg, Germany,

Scalar-Tensor Theory (STT) can give rise to new branches of compact objects, which exhibit spontaneous scalarization, as first observed for neutron stars. In scalarized objects the mass-radius relation can strongly deviate from the one found in General Relativity. Here we investigate whether scalarization can also occur in white dwarfs. We employ a STT with function $A(\varphi) = e^{\frac{\beta}{2}\varphi^2}$, and vary the coupling constant β for the scalar field φ. We discuss the dependence of the mass-radius relation and the presence of scalarization on the strength of the coupling β.