GR 4: Klassische Allgemeine Relativitätstheorie 1

Zeit: Dienstag 8:30–10:30 Raum: SFG 0140

Hauptvortrag GR 4.1 Di 8:30 SFG 0140

Observations of binary black hole coalescence events by LIGO — •Badri Krishnan — Max-Planck-Institute for Gravitational Physics, Callinstr. 38, 30167 Hannover

The advanced LIGO detectors have observed two binary black hole coalescence events with high significance: GW150914 on September 14, 2016 and GW 151226 on December 16, 2016. These detections enable us, for the first time, to probe the properties of black holes in full nonlinear general relativity. In this talk I will summarize these events and other results from the first observational run of the Advanced LIGO detectors. In particular, I will discuss the significance of the events, some properties of the binary black holes observed, implications for fundamental Physics and future prospects.

GR 4.2 Di 9:10 SFG 0140

Recent analytic results for spin effects of black hole binaries — •Jan Steinhoff — Albert Einstein Institute Potsdam

Black holes binaries are the most prominent source for current gravitational wave observatories. Spin effect are expected to be important in particular for long waveforms, as demonstrated by the event GW151226. This talk discusses recent analytic results for spin effects of black hole binaries. The leading order spin effects in the post-Newtonian approximation can be summed to all orders in spin, leading to a connection between spin effects in comparable mass binaries and test body motion in Kerr spacetime. Furthermore, spin effects were computed to fourth order in the post-Newtonian approximation. We give an outlook how these recent results can improve models for spin effects in the strong-field regime. For these investigations it turns out to be useful to understand the choice of a center of the black holes as a gauge symmetry in a point-particle action.

GR 4.3 Di 9:30 SFG 0140

The gravitational compass: Mapping of the gravitational field in General Relativity — •Dirk Puetzfeld — ZARM, Uni Bremen

In General Relativity, the comparison of clocks, as well as the measurement of the mutual accelerations between the constituents of a swarm of test bodies, is of direct operational significance. We show how a suitably prepared set of clocks and test bodies can be used to extract all components of the gravitational field. In particular, we comment on the role of the underlying reference frame in the determination of suitable clock and test body setups.

GR 4.4 Di 9:50 SFG 0140

The relativistic geoid — •Dennis Philipp, Dirk Puetzfeld, Eva Hackmann, Volker Perlick, and Claus Lämmerzahl — ZARM, University of Bremen, Germany

We construct a relativistic geoid based on a time-independent redshift potential, which foliates the spacetime into isochronometric surfaces. This relativistic potential coincides with the acceleration potential for isometric congruences. Known Newtonian and post-Newtonian results are recovered in the respective limits. Being fully relativistic, this notion of a geoid can also be applied to neutron stars.

By definition, this relativistic geoid can be determined by a congruence of Killing observers equipped with standard clocks by comparing their frequencies. The redshift potential gives the correct result also for frequency comparison through optical fiber links as long as the fiber is at rest w.r.t. the congruence.

We give explicit expressions for the relativistic geoid in the Kerr spacetime and the Weyl class of spacetimes. To investigate the influence of higher order mass multipole moments we compare the results for the Schwarzschild case to those obtained for the Erez-Rosen and q-metric spacetimes.

GR 4.5 Di 10:10 SFG 0140

Friedmann-like initial data for an inhomogeneous universe with black holes — •Michael Fennen[1] and Domenico Giulini[1,2] — [1]ZARM, Universität Bremen — [2]ITP, Universität Hannover

The very successful standard model of cosmology is based upon the cosmological principle stating that the Universe is homogeneous and isotropic. This is only true on the largest scales so that we are aiming for a model that takes the inhomogeneous structure on smaller scales into account. For this reason we consider the initial data of a closed vacuum space-time filled with black holes at the moment of maximal expansion. Since we do not expect that every configuration of black holes leads to a Friedmann-like time evolution, we present a new simple criterion for these black hole configurations such that the initial data is similar to a spherical Friedmann dust universe in some sense.