GR 13: Classical GR

Zeit: Donnerstag 16:30–19:35 Raum: NW-Bau - HS3

Hauptvortrag GR 13.1 Do 16:30 NW-Bau - HS3

Theoretical aspects of relativistic geodesy — •Dennis Philipp — ZARM, Universität Bremen

General Relativity is at present the best available theory of gravity, as its predictions have been verified by all previously conducted experiments and observations. The technological capabilities for gravitational measurements on Earth and in its vicinity recently improved dramatically. Therefore, relativistic effects become increasingly important in modern relativistic geodesy. Although at present usually the first order post-Newtonian approximation of GR is sufficient, this may not be correct for specific applications and for future and contemporary high-precision geodetic measurements. We review results for high-precision relativistic orbit modeling, the analytic description of the (gravitational) redshift between satellites and Earth-bound clocks, relativistic leveling, and the definition of the relativistic geoid. In addition, we outline how methods and concepts from relativistic geodesy can be applied to astrophysics of compact objects and vice versa.

GR 13.2 Do 17:15 NW-Bau - HS3

Building a Hamiltonian for spinning bodies in curved spacetime — •Vojtěch Witzany — ZARM, Universität Bremen, Am Fallturm 2, 28359 Bremen, Germany

The motion of bodies smaller than the curvature scale of the background space-time can be effectively described by a multipolar formalism. Several Hamiltonians for this mode of motion were proposed, but they lack generality and theoretical foundation. In this talk, I show how to construct a set of fundamental Poisson brackets and a Hamiltonian for the multipolar body from its governing field theory.

GR 13.3 Do 17:35 NW-Bau - HS3

The gravitational clock compass — •Dirk Puetzfeld — ZARM, Uni Bremen

We show how a suitably prepared set of clocks can be used to extract all components of the gravitational field in the context of General Relativity. Conceptual differences between the clock compass and the standard gravitational compass, which is based on the measurement of the mutual accelerations between the constituents of a swarm of test bodies, are highlighted. Particular attention is paid to the construction of the underlying reference frame.

GR 13.4 Do 17:55 NW-Bau - HS3

Static Orbits in Rotating Spacetimes — •Lucas Gardai Collodel, Burkhard Kleihaus, and Jutta Kunz — Institut für Physik, Universität Oldenburg, Postfach 2503 D-26111 Oldenburg, Germany

We show that under certain conditions an axisymmetric rotating spacetime contains a ring of points in the equatorial plane, where a particle at rest with respect to an asymptotic static observer remains at rest in a static orbit. We illustrate the emergence of such orbits for boson stars. Further examples are wormholes, hairy black holes and Kerr-Newman solutions.

GR 13.5 Do 18:15 NW-Bau - HS3

Wormholes Immersed in Rotating Matter — Christian Hoffmann[1], Theodora Ioannidou[2], Sarah Kahlen[1], •Burkhard Kleihaus[1], and Jutta Kunz[1] — [1]Institut für Physik, Universität Oldenburg, Germany — [2]Aristotle University of Thessaloniki, Thessaloniki, Greece

We demonstrate that rotating matter sets the throat of an Ellis wormhole into rotation, allowing for wormholes which possess full reflection symmetry with respect to the two asymptotically flat spacetime regions. We analyse the properties of this new type of rotating wormholes and show that the wormhole geometry can change from a single throat to a double throat configuration. We further discuss the ergoregions and the lightring structure of these wormholes.

GR 13.6 Do 18:35 NW-Bau - HS3

Cosmological constant is a conserved charge — •Kamal Hajian — Institute for Research in Fundamental Sciences (IPM), Tehran, Iran

Cosmological constant can be considered as the on-shell value of a top form in gravitational theories. The top form is the field strength of a gauge field, and the theory enjoys a gauge symmetry. After reviewing a short history of cosmological constant, we will show that cosmological constant in this context is the charge of global part of the gauge symmetry, and is conserved irrespective of the dynamics of the metric and other fields. In addition, we will introduce its conjugate chemical potential, and prove the generalized first law of thermodynamics which includes variation of cosmological constant as a conserved charge. At the end, we will discuss how our new term in the first law is related to the volume-pressure term. This talk is based on the paper arXiv:1710.07904 in collaboration with Dmitry Chernyavsky.

GR 13.7 Do 18:55 NW-Bau - HS3

Einstein and the Ether — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

The development of the theory of relativity is closely connected to the development of the view of the ether. At the time when several variants of the theory of relativity were being discussed (around 1900), the corresponding understanding of the phenomenon ether played a crucial role.

Special relativity can be treated comparatively well with or without reference to an ether. The situation is, however, more complicated in the case of general relativity. In contrast to Einstein, his colleagues Ernst Mach and Hendrik Lorentz, who were very familiar with Einstein's view, tended to regard the ether as an unavoidable assumption in this context.

We will present both sides of the argument and discuss the possible conclusions in the light of our present knowledge of physics.

More info: Ludwik Kostro, Einstein and the Ether, Apeiron 2000.

GR 13.8 Do 19:15 NW-Bau - HS3

Gedanken zu $\mathbf{E = m \cdot c^2}$ — •Helmut Hille — Fritz-Haber-Straße 34, 74081 Heilbronn

Ich halte Einsteins berühmte Gleichung für seine größte Leistung, insofern sie den Materiebegriff erweitert hat, ob sie nun quantitativ zutreffend ist oder nicht. Sie war eine kühne Vorausschau auf Atom- und Wasserstoffbomben und hätte eigentlich als Warnung dienen können, die Büchse der Pandora nicht zu öffnen. Ich frage hier nach dem Ursprung dieser mächtigen Energie und sehe sie als einen weiteren Beweis dafür an, dass unser Kosmos aus einem gemeinsamen Ereignis hervorgegangen ist, das wir in Deutschland etwas mythisch verklärt Urknall nennen.