GR 4: Klassische Allgemeine Relativitätstheorie I

Zeit: Dienstag 14:00–16:20 Raum: A214

GR 4.1 Di 14:00 A214

Dedekind-like Configurations in Relativity — •Norman Gürlebeck[1] and David Petroff[2] — [1]Institute of Theoretical Physics, Prague, Czech Republic — [2]Theoretisch-Physikalisches Institut, Jena, Germany

Because a changing quadrupole moment leads to gravitational radiation in Einstein's theory of gravity, one might suppose that stationary but non-static and non-axisymmetric, isolated systems cannot exist. In Newtonian theory, the triaxial, homogeneous Dedekind ellipsoids are classical figures of equilibrium whose shape remains unchanged in an inertial frame due to internal motions. In this talk, I shall discuss the possibility of using Dedekind ellipsoids as a basis for finding non-axisymmetric figures of equilibrium in General Relativity.

GR 4.2 Di 14:20 A214

Rotierende Flüssigkeitsringe — •Stefan Horatschek und David Petroff — Theoretisch-Physikalisches Institut, Jena

Es wird ein analytisches Verfahren zur Behandlung von rotierenden Flüssigkeitsringen im Gleichgewicht präsentiert. Das Verfahren basiert auf einer Entwicklung um den Grenzfall dünner Ringe, bei dem der Querschnitt kreisförmig wird. Die Ergebnisse werden mit numerischen Lösungen verglichen.

GR 4.3 Di 14:40 A214

Are gravitational waves essentially linear? — •Nikodem Szpak — Albert-Einstein-Institut, Max-Planck-Institut für Gravitationsphysik, Golm

Einstein equations are obviously nonlinear while nonlinear wave equations, in general, have the property that also in the weak-field regime the propagating waves experience a nonlinear self-interaction and thus deviate from the linear approximation. We analyze how the special geometric structure of the Einstein equations determines the behavior of small amplitude gravitational waves and to what extent they behave as linear waves.

GR 4.4 Di 15:00 A214

Kosmologische Expansion und lokale Systeme — •Matteo Carrera[1] und Domenico Giulini[2] — [1]Physikalisches Institut, Albert-Ludwigs-Universität, Hermann-Herder-Str. 3, 79104 Freiburg — [2]Albert-Einstein-Institut, Am Mühlenberg 1, 14476 Golm

Die heutigen kosmologischen Messungen sind mit einem Bild eines sich beschleunigt expandierenden Universums verträglich. Im Vortrag wird die Frage untersucht, inwieweit die kosmologische Expansion auf kleinen Skalen (verglichen mit den kosmologischen) spürbar ist.

Es werden einige alte und neuere exakte Lösungen der Eintein'schen Gleichungen vorgestellt, die die idealisierte Situation von einer Inhomogeneität in einer kosmologischen Raumzeit modellieren. Dabei werden wir uns auf sphärisch symmetrische Raumzeiten spezialisieren und von deren besonders netten geometrischen Struktur gebrauch machen, die beispielsweise erlaubt, nützliche quasilokale Massendefinitionen einzuführen.

GR 4.5 Di 15:20 A214

Analytic solutions of the geodesic equation in higher dimensional static spherically symmetric space–times — Eva Hackmann[1], •Valeria Kagramanova[2], Jutta Kunz[2], and Claus Lämmerzahl[1] — [1]ZARM, Universität Bremen, Am Fallturm, D–28359 Bremen — [2]Institut für Physik, Universität Oldenburg, D–26111 Oldenburg

We present the complete analytical solutions of the geodesic equation of massive test particles in higher dimensional Schwarzschild, Schwarzschild–(anti)de Sitter, Reissner–Nordström and Reissner–Nordström–(anti-)de Sitter space–times. Using the Jacobi inversion problem restricted to the theta divisor the explicit solution is given in terms of Kleinian sigma functions. The derived orbits depend on the structure of the roots of the characteristic polynomials which depend on the particle's energy and angular momentum, on the mass and the charge of the gravitational source, and the cosmological constant. We discuss the general structure of the orbits and show that due to the specific dimension–independent form of the angular momentum and the cosmological force a rich variety of orbits can emerge only in four and five dimensions. We present explicit analytical solutions for orbits up to 11 dimensions. A particular feature of Reissner–Nordström space–times is that bound and escape orbits traverse through different universes.

GR 4.6 Di 15:40 A214

Geodesic equation in Kerr-de Sitter spacetimes — •Eva Hackmann and Claus Lämmerzahl — ZARM, Universität Bremen

Recently, a method for analytically solving the geodesic equation in Schwarzschild-de Sitter spacetime has been developed [Phys. Rev. Lett. 100, 171101 (2008), Phys. Rev. D 78, 024035 (2008)]. The solution ansatz utilizes the theory of hyperelliptic functions and is based on a limiting case of Jacobi's inversion problem in two complex dimensions. In its final form, the solution is given in terms of Kleinian sigma functions. We present our efforts for a generalisation of this method to the equation of motion in Kerr-de Sitter spacetimes.

GR 4.7 Di 16:00 A214

Motion of spinning particles — •Andreas Resch and Claus Lämmerzahl — ZARM, University Bremen, 28359 Bremen

In this talk the equations of motion of a rigid test body in General Relativity will be reviewed. We discuss the Mathisson-Papapetrou-Dixon equations for the pol-dipole particle and present the equations of motion both in PPN approximation and in Schwarzschild space–time. The equations in the latter case are integrated by a numeric solver. As expected, the solutions show deviations from the geodesic motion. The possible impact on the Flyby anomaly is discussed.