GR 6: Klassische Allgemeine Relativitästheorie I

Zeit: Dienstag 18:15–19:30 Raum: HS 6

GR 6.1 Di 18:15 HS 6

Skyrmion-Wormholes — •Burkhard Kleihaus — Universität Oldenburg, Oldenburg, Germany

Skyrmions are solitons stabilized by a topological charge. When minimally coupled to gravity, self-gravitating Skyrmions emerge from the flat space Skyrmion. They exist up to a critical value of the gravitational coupling parameter. Also Skrymion black holes arise, when an event horizon is imposed.

In this talk I will consider gravitating Skyrmions in the context of another kind of solutions of Einstein gravity, namely wormholes. Here the wormhole connects two asymptotically flat universes and is supported by a scalar phantom field. The coupled Einstein and field equations for the metric, the phantom field and the Skyrme field are solved numerically. The properties of the Skyrmion-wormholes are discussed, especially the domain of existence. It will be shown that Skyrmion-wormholes possess an instability mode, and hence are unstable.

GR 6.2 Di 18:30 HS 6

Gravitating vortons as ring solitons in general relativity — Jutta Kunz, •Eugen Radu, and Bintoro Subagyo — Institut für Physik, Universität Oldenburg, Postfach 2503, D-26111 Oldenburg, Germany

The vortons are spinning vortex loops stabilized by the centrifugal force and were proposed more than 20 years ago in the context of the local U(1)xU(1) theory of superconducting cosmic strings of Witten. We present an explicit construction of gravitating vortons in four dimensional general relativity, as solutions of an elliptic boundary value problem. We also discuss their properties and determine their domain of existence. Similar to Q-balls, we shown that the vortons exist only in a limited frequency range. The coupling to gravity gives rise to a spiral-like frequency dependence of the mass and charge of the vortons.

GR 6.3 Di 18:45 HS 6

Local spacetime effects on gyroscope systems — •Christian Pfeifer and Mattias Wohlfarth — Universitaet Hamburg, II Institut fuer theoretische Physik, Hamburg, Deutschland

Guided by the question what exactly is meant when people talk about a rotating spacetime I investigate the transport of initially aligned gyroscopes along different paths, between some initial and final point in spacetime. It turns out that the gyroscopes loose their alignment due to the curvature of spacetime and their relative motion. Sets of aligned gyroscopes can be used to synchronize spatial frames of observers, hence their desynchronization gives rise to a relative rotation of observers. As application we use our findings for a class of observers in Kerr spacetime and suggest a local experiment how these observers are able to determine if their spacetime is described rather by a rotating Kerr or non-rotating Schwarzschild metric.

GR 6.4 Di 19:00 HS 6

Eine direkte Herleitung der Schwarzschildlösung aus der Newtonschen Mechanik mit Hilfe einer linearen Regression — •Hans-Otto Carmesin — Gymnasium Athenaeum, 21680 Stade, Harsefelder Straße 40 — Studienseminar Stade, Bahnhodstraße 5, 21682 Stade

Das Problem: Die Schwarzschildlösung hat viele Anwendungen, aber die übliche Herleitung erfordert die Einstein-Gleichung und deren Lösung. Das ist mathematisch aufwändig und verstellt so den Blick auf den physikalischen Gehalt.

Eine Lösung: Hier wird die Schwarzschildlösung mit Hilfe geometrischer Grundüberlegungen aus der Newtonschen Gravitationstheorie mit Hilfe einer linearen Regression aufgestellt. Die lineare Regression ersetzt eine ähnliche Näherung in niedrigster Ordnung bei der Einführung der Einstein-Gleichung.

Aus der hier entwickelten Schwarzschildlösung kann die Einstein-Gleichung hergeleitet werden. Damit liegt ein einfacher Zugang zur allgemeinen Relativitätstheorie vor.

Es wird über Erfahrungen mit verschiedenen Lerngruppen berichtet.

GR 6.5 Di 19:15 HS 6

GRT - well proven and also incomplete? — •Jürgen Brandes — Karlsbad, Germany

There are two contradictory formulas about the total energy of a particle resting in the gravitational field [1]. From the formulas of radial free fall one gets: $E = mc^2\sqrt{(1-2GM/c^2r)}$. This is at least qualitatively correct since removing the particle from the gravitational field needs energy. Doing this the total energy of the particle becomes $E = mc^2$ and therefore, within the gravitational field it has to be lower. On the other side, there is the equivalence principle. A particle resting in its local inertial system (i.e. the freely falling particle) has a total energy equal to its rest mass: $E = mc^2$. Both of the formula contradict each other. Certainly, they belong to different reference systems with one of them being accelerated, in fact. But: At time point $t = 0$ the free falling particle is also a resting one since its velocity $v = 0$. Only its acceleration $b \neq 0$. Special theory of relativity is applicable and therefore the free falling particle at $t = 0$ as well as an always resting particle at the same position possess identical total energy $E = mc^2$.

This contradiction proves Lorentz interpretation [1] and being so simple proves a 'hardnosed' classical theory of general relativity, too.

[1] J. Brandes, J. Czerniawski: *Spezielle und Allgemeine Relativitätstheorie für Physiker und Philosophen - Einstein- und Lorentz-Interpretation, Paradoxien, Raum und Zeit, Experimente*, 4. Aufl. 2010