GR 17 Relativitätstheorie im Experiment

Zeit: Mittwoch 10:15–12:30 Raum: TU BH262

Hauptvortrag GR 17.1 Mi 10:15 TU BH262

Is the velocity of light really constant? – The experimental status of Lorentz invariance — •Claus Lämmerzahl — ZARM, University of Bremen, Am Fallturm, 28359 Bremen

Lorentz invariance is one of the pillars of modern physics. It is not only a frame for all other physical theories, for the standard model as well as for Einstein's General Relativity, but also reached the level of a daily life application (navigation, time standard, geodesy, Earth sciences, climate research). Being of such an importance, the experimental basis has to be as strong as possible. In this talk, after a short introduction to basic notions of relativity and the identification of meaningful measurable quantities, we review the present status of laboratory tests of Lorentz invariance. This includes the tests of properties of light propagation which are covered by the famous Michelson–Morley, Kenedy–Thorndike, and Ives–Stilwell experiments, as well as tests of properties of matter which explore the maximum velocity of massive particles or probe the isotropy of quantum particles as has been done in Hughes–Drever experiments. Furthermore, the available test theories, kinematical as well as dynamical test theories, for describing and comparing various experiments of Lorentz invariance are outlined. Finally, we mention hypothetical violations of Lorentz invariance which follow from various approaches towards a theory of quantum gravity and discuss possible consequences and the experimental search for corresponding effects.

Hauptvortrag GR 17.2 Mi 11:00 TU BH262

Was Einstein right? — •Clifford M. Will — McDonnell Center for the Space Sciences, Department of Physics, Washington University, St. Louis, USA

We review the experimental evidence for Einstein's general relativity. Tests of the Einstein Equivalence Principle support the postulates of curved spacetime, while solar-system experiments strongly confirm weak-field general relativity. The Binary Pulsar provides tests of gravitational-wave damping and of strong-field general relativity. We describe ongoing and future experiments, such as the Stanford Gyroscope Experiment, a satellite test of the Equivalence principle, and tests of gravity at short distance to look for extra spatial dimensions. Recently, operational laser interferometric gravitational-wave observatories, and a future space interferometer, may provide new tests via the properties of gravitational waves. We also discuss how general relativity is important in daily life.

Hauptvortrag GR 17.3 Mi 11:45 TU BH262

The first double pulsar - A unique laboratory to test general relativity — •Michael Kramer — Jodrell Bank Observatory, University of Manchester, Jodrell Bank, Macclesfield, SK11 9DL, UK

The first ever double pulsar, discovered by our team last year, consists of two pulsars, one with period of only 22 ms and the other with a period of 2.8 sec. This binary system with an orbital period of only 2.4 hr provides a truly unique laboratory for relativistic gravitational physics. The observations of both pulsars, orbiting each other with orbital speeds exceeding 1 Million km/hr, already allow us to perform the most stringent tests of general relativity in the strong field limit, exceeding the precision tests done with the Hulse-Taylor binary pulsar. In the future, it promises to even allow us the detection of effects of second Post-Newtonian order, and probably the direct measurement of a neutron star's moment of inertia. In this contribution I report on the discovery of this exciting system and its applications in tests of theories of gravity. I will present the latest results such as the detection of gravitational wave damping and will also demonstrate the double pulsar's use as a superb tool to study relativistic plasma physics under extreme conditions.