GR 14: Didactical Aspects of Relativity

Time: Thursday 16:30–18:30 Location: H-HS IV

Invited Talk GR 14.1 Thu 16:30 H-HS IV

Teaching general relativity with sector models — •Ute Kraus and Corvin Zahn — Universität Hildesheim

In teaching general relativity, the use of models can help to build geometric insight. Geodesics and the curvature tensor are of particular interest. Sector models visualize the geometry of specific curved spacetimes; these models are based on the Regge calculus and represent two- or three-dimensional subspaces true-to-scale. Geodesics and curvature tensor components can be inferred from them. This talk presents several examples of sector models, including models for a Schwarzschild black hole, a neutron star, and a wormhole, and discusses the potential of this approach.

Invited Talk GR 14.2 Thu 17:15 H-HS IV

How Long Is Now? On the problem of accurate time measurements — •Thomas Filk — Institute of Physics, University of Freiburg, 79104 Freiburg, Germany

The eigentime in relativity depends on the world line of an object. If an object is extended or consists of several subunits (composite systems or bound states), one has to define a reference point (e.g. the center of mass) in order to assign a definite eigentime to the object. However, the eigentimes of the constituents may differ from this reference time, making an unambiguous assignment of an eigentime to the object as a whole questionable. If the object is a clock, which part defines the reading?

Even worse is the situation, when one has to assign a precise eigentime to a quantum object. Quantum objects do not follow well defined trajectories and, therefore, the assignment of an accurate eigentime is problematic. In addition, further quantum effects - superposition states of systems which serve as clocks, or the entanglement of such systems - make these assignments even more difficult.

The presentation will address and discuss some of these issues and their consequences also in the context of teaching relativity.

GR 14.3 Thu 18:00 H-HS IV

Experiment for time comparison in moving and resting clocks — •Jordan Petrow — University of Rostock, Faculty of Mathematics and Natural Sciences, Wismarschestrasse 45, 18057 Rostock, Germany

With the mission "Gravity Probe B" in 2011 was found that the Earth rotates space around itself. The rotation of space around the Earth means that space is also rotated around our Sun and basically around every matter rotating in space. This principle is effective even in the smallest dimensions.Therefore atomic clocks may not be moved during a time measurement.There is the danger that its atomic clock generator becomes spatially deformed so that the atomic clock would show false times. If atomic clocks would be unsuitable for time measurement in moving systems, experiments are required that allow a direct time comparison between moving and stationary systems: On the outer edge of a rotating disk a circular hollow light guide is attached. Inside this light guide, light pulses are sent along the path and their propagation time is evaluated for various boundary conditions at rest and when the disk rotates. In this way it will be possible to directly compare the propagation times of the light pulses in the rotating part with their projection on the resting plane outside the rotating disk. Present activities aim at constructing the experimentally device.

GR 14.4 Thu 18:15 H-HS IV

Circular Sagnac experiment confirms equivalence principle — •Jordan Petrow — University of Rostock, Faculty of Mathematics and Natural Sciences, Wismarsche Strasse 45, 18057 Rostock, Germany

In Albert Einstein's idea, the principle of relativity was derived from a moving train*paradigm. This hypothetical train is only a thought experiment,*while*practical measurements e.g.*on*light behaviour in this train are difficult. The*problems connected*with Einstein*s moving train can be*avoided by folding a rotationally symmetrical construction from this hypothetical train. The straight ahead movement of the train is replaced by a rotation. In this way, the novelty*we propose*is a circular Sagnac experiment as a device that is accessible for practical measurements. The*classical*Sagnac experiment was invented in 1913 and is currently used in many high technologies. The circular Sagnac experiment thus*may well rise*to a position to be honoured as the key experiment in physics. With it, many of the basic statements of modern physics can be verified. In particular, it demonstrates a fundamental relationship between space and matter. Previously more or less intuitive assumptions can be anchored in an experimentally determined set of formulas with the circular Sagnac device. Present activities aim at constructing the device to also experimentally confirm the equivalence principle.