GR 1: Classical GR

Zeit: Montag 16:00–17:30 Raum: HS 4

Hauptvortrag GR 1.1 Mo 16:00 HS 4

Probing the spacetime curvature using geometric optics — •Mikolaj Korzynski, Julius Serbenta, and Michele Grasso — Center for Theoretical Physics, Polish Academy of Sciences, Warsaw

In general relativity light propagation is affected by gravity, leading to the well-known effects of light bending, Shapiro delays and gravitational redshift. On top of that the results of observation of light by an observer are also affected by the special relativistic phenomena like the aberration or time dilation. All these effects influence the measurements of shape, parallax, redshift and position drift (proper motion) of distant objects. We show that all results of those measurements can be understood as functions of the curvature along the line of sight. This opens up the possibility to probe the spacetime curvature directly using optical observations. Applications of the results include cosmology and numerical relativity.

GR 1.2 Mo 16:45 HS 4

Geodetic Concepts in the Framework of General Relativity — •Dennis Philipp — ZARM, Universität Bremen

The description and determination of the Earth's gravity field is one of the central objectives of geodesy. Fundamental geodetic concepts and notions are usually defined within Newtonian gravity and must be reconsidered in General Relativity (GR) to have a theoretical framework that can keep up with ever increasing experimental accuracy. Moreover, in GR the rate of a clock, as compared to some reference, depends on the clock's state of motion and its position in the gravitational field. This is the starting point of chronometric geodesy, an entirely new field that is based on comparing state of the art (optical) atomic clocks.

In my talk, I will introduce the relativistic description of the Earth's geoid, its so-called normal gravity field, and a relativistic height definition. In the (post-)Newtonian limit, well-known results are recovered. To estimate the magnitude of relativistic "corrections", the differences to the respective Newtonian notions are calculated to first order.

GR 1.3 Mo 17:00 HS 4

The extended gravitational clock compass — •Gerald Neumann[1], Guillermo Rubilar[1], and Dirk Puetzfeld[2] — [1]Departamento de Física, Universidad de Concepción, Casilla 160-C, Concepción, Chile — [2]University of Bremen, Center of Applied Space Technology and Microgravity (ZARM), 28359 Bremen, Germany

By extending the framework of the gravitational clock compass [1], we show how a suitably prepared set of clocks can be used to extract information about the gravitational field in the context of General Relativity. Conceptual differences between the extended and the standard clock compass are highlighted. Particular attention is paid to the influence of kinematical quantities on the measurement process and the setup of the compass. We also discuss the precision with which quantities as the acceleration and the angular velocity of the frame, as well as the components of the curvature of the spacetime, can be determined.

[1] D. Puetzfeld, Y.N. Obukhov and C. Laemmerzahl, Gravitational clock compass in general relativity, PRD 98 024032 (2018).

15 min. break