GR 15: Fundamental Problems and General Formalism

Time: Thursday 11:10–12:50 Location: H 2013

GR 15.1 Thu 11:10 H 2013

On a unified framework for test body equations of motion in gravity — •Dirk Puetzfeld — ZARM, U Bremen, Germany

We present a unified covariant multipolar framework for the description of test bodies in gravity. The framework covers a very large class of gravitational theories, and one can use it as a theoretical basis for systematic tests of gravity by means of extended deformable test bodies. The classes of theories covered range from simple generalizations of General Relativity, e.g. encompassing additional scalar fields, to theories with additional geometrical structures, which are needed for the description of microstructured matter. Furthermore, we discuss the impact of nonstandard couplings between matter and gravity on the resulting test body equations of motion.

GR 15.2 Thu 11:30 H 2013

The Radar experiment in Finsler and Lorentzian spacetime geometry — •Christian Pfeifer — Institut für theoretische Physik, Leibniz Universität Hannover, Deutschland

The radar experiment intertwines an observers measurement of spatial lengths and distances and observers spatial equal time surfaces with the geometry of spacetime. Thus for any change of the geometry of spacetime, motivated for example from quantum gravity, explanations for dark matter and dark energy or an effective description of quantum field theory on curved spacetime, it has to be discussed how this change influences the observers measurement of spatial lengths. I will describe the radar experiment on a general Finsler spacetime geometry before I compare the experiment on two example geometries: a flat fourth order polynomial Finsler spacetime geometry and Minkowski spacetime geometry. The result for the forth order Finsler spacetime geometry will be the explicit spatial length measure of observers which deviates from the usual euclidean one and the change of the spatial equal time surfaces for observers moving relatively to each other. In a next step the radar experiment can be used to model observers on Finsler spacetime geometries such that the speed of light is a constant independent of the state of motion of the observer, as it is the case in Minkowski spacetime geometry.

GR 15.3 Thu 11:50 H 2013

Parametrized Non-Linear Electrodynamics — •Rico Berner, Horst-Heino von Borzeszkowski, and Thoralf Chrobok — Institute for Theoretical Physics, Technical University Berlin, Berlin

Based on the parametrization method introduced by Kuchař we derive the canonical Hamiltonian description out of the Lagrangian formulation for non-linear electrodynamics. We consider the Legendre transformation and the constraints that arise. In this framework, we introduce an extension of Dirac's approach and give an alternative view of the quantization procedure concerning the Born-Infeld electrodynamics. Further, we present the application of the extended approach to various theories of non-linear electrodynamics.

GR 15.4 Thu 12:10 H 2013

The Definition of Density in General Relativity — •Ernst Fischer — Stolberg, Germany

According to general relativity the geometry of space depends on the distribution of matter or energy fields. The relation between the local geometrical parameters and the volume enclosed in given limits varies with curvature and thus with the distribution of matter. As a consequence properties like mass or energy density, defined in Euclidean tangent space, cannot be integrated to give conserved integral data like total mass or energy. To obtain integral conservation, a correction term must be added to account for the curvature of space. This correction term is the equivalent of potential energy in Newtonian gravitation. With this correction the formation of singularities by gravitational collapse does no longer occur and the so called dark energy finds its natural explanation as potential energy of matter itself.

GR 15.5 Thu 12:30 H 2013

Fluid dynamics on Finsler spacetimes — •Manuel Hohmann — Institut für Physik, Universität Tartu, Estland

I discuss the description of fluid dynamics in the language of Finsler spacetime geometry. Such a description is an important ingredient for gravity theories based on Finsler geometry. The description I present here is based on the kinetic theory of fluids on the tangent bundle of spacetime. In my talk I introduce the basic geometric concepts and provide illustrative examples, in particular for fluids with cosmological symmetry.