GR 5: Foundational Problems and General Formalism

Zeit: Dienstag 14:00–15:15 Raum: HS 5

GR 5.1 Di 14:00 HS 5

Deviation of structured test bodies — •Dirk Puetzfeld — ZARM, Universitaet Bremen

Within the theory of General Relativity, the relative motion of test bodies is described by means of the geodesic deviation (Jacobi) equation. This equation only holds under certain assumptions and can be used only for the description of structureless neutral test bodies. Here we present a generalized deviation equation in a Riemann-Cartan background, also allowing for spacetimes endowed with torsion. This equation describes the dynamics of the connecting vector which links events on two general (adjacent) world lines. Thereby it provides the foundation for a unified description of structured test bodies in a large class of geometries.

GR 5.2 Di 14:15 HS 5

Gravitational closure of weakly birefringent spacetimes to second order — •Florian Wolz — Leibniz Universität, Hannover, Deutschland — Friedrich-Alexander-Universität, Erlangen, Deutschland

Within the constructive gravity program it was shown that any predictive and quantizable matter field theory poses strong conditions on the underlying geometry. This allows to determine the geometry's Lagrangian completely by solving a system of linear homogeneous partial differential equations called the gravitational closure equations.

In most practical situations it suffices to perturbatively solve these equations. In this talk I will present the results for the gravitational closure to second order field equations of the geometry of birefringent electrodynamics. This is necessary to calculate the generation of gravitational waves in a binary system.

GR 5.3 Di 14:30 HS 5

Refined cosmology from refined electrodynamics — •Maximilian Düll — Zentrum für Astronomie der Universität Heidelberg

The Constructive Gravity program provides new insights into the interaction of matter and gravity. Its central statement is that the gravitational action is derived from a matter action as the solution to a set of linear partial differential equations, the gravitational closure equations. Requiring common canonical evolution of initial data for both matter and background geometry, the task of finding viable gravity theories is reduced to solving a set of linear partial differential equations.

Once gravitational field equations have been obtained, one often wishes to solve them under symmetry assumptions. We will show how to include such a symmetry reduction into the Constructive Gravity program. This allows us to solve a simplified version of the closure equations to directly obtain the appropriately symmetry-reduced gravitational field equations.

Using Maxwell electrodynamics as matter input, we showed that such a symmetry-reduction at the level of the gravitational closure equations works. We can directly derive the Friedmann equations without having to know the full Einstein equations. Refining the matter input by implementing general linear electrodynamics, we can follow the same steps towards refined Friedmann equations. When performing this symmetry reduction, we find new techniques how to handle the gravitational closure equations and obtain solutions to them.

GR 5.4 Di 14:45 HS 5

Der Sagnac-Effekt widerspricht Einsteins Relativität — •Albrecht Giese — Taxusweg 15, 22605 Hamburg

Die Verträglichkeit des Sagnac-Effekts mit der Speziellen Relativitätstheorie wurde schon häufig untersucht; üblicherweise mit dem Ergebnis, dass beides verträglich ist. Dabei beschränkten sich die Untersuchungen jedoch stets auf Situationen, bei denen ein Konflikt nicht sichtbar ist.

Wir werden den Fall des in der Navigation gebräuchlichen Sagnac-Kreisels vorstellen, bei welchem der Beobachter an einer Drehung des Systems teilnimmt. Für diesen Beobachter ist die Lichtgeschwindigkeit im Lichtleiter nicht c, sondern um die Drehgeschwindigkeit des Systems verändert; sonst hätte der Kreisel keine Funktion. Bei einer angenommenen beliebigen Ausdehnung des Kreisels nähert sich nun die gekrümmte Lichtbahn einer Geraden, ohne dass sich die Diskrepanz Sagnac vs. Einstein verringert. Damit erlischt der Einwand der Nichtanwendbarkeit der Speziellen Relativitätstheorie im drehenden System. Folgerung: Die Festlegung Einsteins für ein konstantes c in jedem Bewegungssystem ist tatsächlich nicht haltbar.

Ursache für diesen logischen Konflikt ist eine zu kühne Annahme in Einsteins Arbeit von 1905, welche in einem Zirkelschluss endet. Bei seinem Ansatz der Uhrensync. postulierte Einstein die Konstanz von c im bewegten System, um sie dann wiederum als Ergebnis zu erhalten.

Auch die Diskussion um einen Äther bekommt hierbei neue Nahrung.

Weitere Info unter: www.ag-physics.org/Sagnac

GR 5.5 Di 15:00 HS 5

Parametrodynamics — •Alexander Wierzba — Ludwig-Maximilians-Universität München

Parameters appearing in physical theories are usually considered to be constants whose values have to be determined by experiment. In this talk, however, we present a method to instead predict the values of parameters appearing in a large class of local field theories. In order to do this, we first promote the previously constant parameters to dynamical objects in their own right - analogous to what Einstein did with the previously flat spacetime metric in Maxwell theory in order to obtain his general theory of relativity. In a second step, we then derive a multi-parameter family of actions for these parameters as the unique dynamics that enjoys a consistent co-evolution with the already dynamical matter fields of the initially stipulated matter theory.

We illustrate this mechanism for a refined version of Proca electrodynamics with an anisotropic mass. As crucial technical prerequisite to these studies, we furthermore develop a comprehensive scheme to calculate the principal polynomial for initially non-involutive systems of partial differential equations.