GR 4: Mathematical Aspects of Classical and Quantum Gravity (with MP)

Zeit: Dienstag 8:30–10:30 Raum: VMP6 HS A

Hauptvortrag GR 4.1 Di 8:30 VMP6 HS A

The Black Hole Stability Problem — •Gustav Holzegel — Imperial College, London

A fundamental open problem in general relativity is to establish the non-linear stability of the Kerr-family of black holes. I will review recent progress in this field including a discussion of a proof of the linear stability of the Schwarzschild solution under gravitational perturbations, which I obtained in collaboration with Dafermos and Rodnianski.

Hauptvortrag GR 4.2 Di 9:00 VMP6 HS A

Towards Quantum Gravity via Quantum Field Theory: Problems and perspectives — •Klaus Fredenhagen — II. Institut fuer Theoretische Physik, Universität Hamburg

General Relativity is a classical field theory; the standard methods for constructing a corresponding quantum field theory, however, meet severe difficulties, in particular perturbative non-renormalizability and the problem of background independence.

Nevertheless, modern approaches to quantum field theory have significantly lowered these obstacles. On the side of non-renormalizability, this is the concept of effective theories, together with indications for better non-perturbative features of the renormalization group flow. On the side of background independence the main progress comes from an improved understanding of quantum field theories on generic curved spacetimes. Combining these informations, a promising approach to quantum gravity is an expansion around a classical solution which then is a quantum field theory on a given background, augmented by an identity which expresses independence against infinitesimal shifts of the background.

The arising theory is expected to describe small corrections to classical general relativity. Inflationary cosmology is expected to arise as a lowest order approximation.

Hauptvortrag GR 4.3 Di 9:30 VMP6 HS A

Asymptotically Safe Quantum Gravity — •Frank Saueressig — Radboud University, Nijmegen, The Netherlands

Weinberg's Asymptotic Safety scenario, building on a non-trivial fixed point of the gravitational renormalization group flow, provides an elegant mechanism to construct a quantum theory of gravity within the framework of quantum field theory. The most important tools for investigating this scenario are functional methods which allow constructing renormalization group flows of a theory without resorting to the expansion in a small parameter or specifying the fundamental action a priori. This talk will give a concise introduction to the gravitational Asymptotic Safety program before reviewing its current status and future perspectives.

Hauptvortrag GR 4.4 Di 10:00 VMP6 HS A

Loop quantum gravity: a canonical review — •Christian Fleischhack — Institut für Mathematik, Universität Paderborn, 33095 Paderborn

Over the past 25 years, loop quantum gravity has become a relevant attempt to explain the mystery of quantum gravity. However, despite several remarkable achievements, not all the initial dreams have turned into reality; e.g., the dynamics of the theory has remained a rather open territory.

In our review on the current status of loop quantum gravity, we will focus on its canonical part. After presenting the well-understood kinematical basis, we will address dynamical issues as well as an implementation of symmetries that allows to partially relate loop quantum gravity to loop quantum cosmology.