GR 16: Quantenaspekte der Gravitation und vereinheiltichender Theorien 2

Zeit: Freitag 8:30–10:30 Raum: SFG 0140

GR 16.1 Fr 8:30 SFG 0140

Tensor Galileons and Gravity — •Peter Schupp[1], Fech Scen Khoo[1], Athanasios Chatzistavrakidis[2], and Diederik Roest[2] — [1]Jacobs University Bremen — [2]University of Groningen

When does an action functional lead to field equations which contain only second derivatives of the corresponding field? For a symmetric 2-tensor (i.e. a metric) the answer to this question are Lovelock invariants, including the Einstein-Hilbert action and the Gauss-Bonnet term. For scalar fields a similar role is played by Galileons. We extend these results to mixed-symmetry tensors, introducing an index free formulation based on Grassmannian variables. We find that (1,1)-tensor Galileons describe linearized Lovelock gravity in any dimension.

GR 16.2 Fr 8:50 SFG 0140

Towards apparent convergence in asymptotically safe quantum gravity — Tobias Denz[1], Jan M. Pawlowski[1,2], and •Manuel Reichert[1] — [1]Institut für Theoretische Physik, Universität Heidelberg, Philosophenweg 16, 69120 Heidelberg, Deutschland — [2]ExtreMe Matter Institute EMMI, GSI Helmholtzzentrum für Schwerionenforschung mbH, Planckstr. 1, 64291 Darmstadt, Deutschland

The asymptotic safety scenario in gravity is accessed within the systematic vertex expansion scheme for functional renormalisation group flows. In the present work this expansion scheme includes propagators, the graviton three-point function and, for the first time, the graviton four-point function. This provides us with a closed flow equation for the graviton propagtor: all vertices and propagators involved are deduced by their own flows. In terms of a covariant operator expansion the current approximation gives access to Λ, R, R^2 as well as $R^2_{\mu\nu}$ and higher derivative operators. We find a UV fixed point with three attractive and two repulsive directions, thus confirming previous studies on the relevance of the first three operators. In the infrared we find trajectories that correspond to classical general relativity and further show non-classical behaviour in some fluctuation couplings. We also find signatures for the apparent convergence of the systematic vertex expansion. This opens a promising path towards finally establishing asymptotically safe gravity in terms of apparent convergence.

GR 16.3 Fr 9:10 SFG 0140

Generalized Uncertainty Principle Modified Black Holes in Large Extra Dimensions — •Marco Knipfer[1,2], Maximiliano Isi[3], Sven Köppel[1,2], Roman Smit[1,2], Jonas Mureika[4], and Piero Nicolini[1,2] — [1]Frankfurt Institute for Advandced Studies (FIAS), Frankfurt am Main, Germany — [2]Institut für Theoretische Physik, Johann Wolfgang Goethe-Universität, Frankfurt am Main, Germany — [3]Physics Department, California Institute of Technology, Pasadena, CA 91125 — [4]Department of Physics, Loyola Marymount University, Los Angeles, CA

Thought Experiments show that General Relativity announces its own breakdown at the Planck Scale where a Theory of Quantum Gravity is needed. It is widely believed that Quantum Gravity will change some features of Black Holes like: 1) The singularity in the center of a Schwarzschild Black Hole, 2) the diverging (1/M) Hawking temperature and the evaporation endpoint. I will show modifications to the Schwarzschild Black Hole that impact mentioned features. The modifications are due to implementing the Quantum Gravity inspired Generalized Uncertainty Principle (GUP) in the Theory. An extension to Large Extra Dimensions (LXDs) needs a modified GUP as I will show.

GR 16.4 Fr 9:30 SFG 0140

Wave propagation on discrete quantum geometries and the spectral dimension — •Johannes Thürigen — Laboratoire de Physique Théorique, Bâtiment 210, Université Paris-Sud XI, F-91405 Orsay Cedex

In various approaches to a quantum theory of gravity, quantum states of space and histories of spacetime are based on discrete geometries. Wave propagation on such quantum geometries is governed by modified dispersion relations and a nontrivial spectral dimension of spacetime. Here I present a systematic analysis of the essential properties of quantum geometries which lead to characteristic modifications of wave propagation and the spectral dimension, in particular those leading to a flow of spacetime dimension to a value smaller than four.

GR 16.5 Fr 9:50 SFG 0140

Inter-universal entanglement in a cyclic multiverse model — Salvador Robles-Pérez[1,2], Adam Balcerzak[3,4], Mariusz P. Dabrowski[3,5,4], and •Manuel Krämer[3] — [1]Instituto de Física Fundamental, CSIC, Madrid, Spain — [2]Estación Ecológica de Biocosmología, Medellín, Spain — [3]Instytut Fizyki, Uniwersytet Szczeciński, Szczecin, Poland — [4]Copernicus Center for Interdisciplinary Studies, Kraków, Poland — [5]National Centre for Nuclear Research, Otwock, Poland

We study the model of a multiverse consisting of parallel cyclic universes that are classically disconnected, but quantum-mechanically entangled. This model is based on a quantum field theoretical formulation of the Wheeler–DeWitt equation, the so-called third quantization. We calculate the entropy of entanglement and find that it is large at the big-bang and big-crunch singularities as well as at the maxima of the expansion of the parallel universes. The latter hints towards a relation to earlier findings that quantum effects are strong at the turning point of the evolution of a universe.

GR 16.6 Fr 10:10 SFG 0140

Holographic Entanglement Entropy of Local Quenches in AdS_4/CFT_3: A Finite-Element Approach — •Alexander Jahn[1] and Tadashi Takayanagi[2] — [1]Dahlem Center for Complex Quantum Systems, Freie Universität Berlin, Germany — [2]Yukawa Institute for Theoretical Physics (YITP), Kyoto University, Japan

Understanding entanglement in three-dimensional conformal field theory (CFT_3) is a challenging task, as direct analytical calculations are often impossible to perform. Using the holographic entanglement entropy formula, the calculation of entanglement entropy turns into a problem of finding extremal 2-surfaces in 4-dimensional curved spacetime, which we tackle with a numerical finite-element approach. In particular, we compute the entanglement entropy between two half-spaces resulting from a local quench, triggered by a local operator insertion in the CFT_3. We find that when the conformal dimension of the local operator is small, the growth of entanglement entropy shortly after the quench corresponds to predictions from the first law of entanglement entropy. At large times the behavior of the system resembles the logarithmic time dependence familiar from the CFT_2 case. We hope that our work will motivate further analytical research on entanglement entropy in higher dimensions.