GR 15: Quantenaspekte der Gravitation und vereinheitlichender Theorien 1

Zeit: Donnerstag 16:30–18:30 Raum: SFG 0140

Hauptvortrag GR 15.1 Do 16:30 SFG 0140

The Nambu-Goto string as an effective field theory and its semi-classical limit — •Jochen Zahn — Institut für Theoretische Physik, Universität Leipzig

The Nambu-Goto string, being purely geometrical and exhibiting diffeomorphism invariance, can be seen as a toy model for (quantum) gravity. I present an effective field theory approach to its quantization, based on perturbation theory around non-trivial classical solutions. It employs the BRST formalism (to deal with diffeomorphism invariance) and renormalization methods developed for QFT on curved space-times. It can be seen as the string theory analog of perturbative quantum gravity. Using rotating classical solutions as the starting point of perturbation theory, one can compute semi-classical corrections to the energy.

Several deviations from standard quantum strings are found. For example, the theory is consistent, as an effective field theory, for any dimension of the target space. Furthermore, the semi-classical limit of standard quantum strings does not coincide with that of our perturbative approach. The origin of these deviations will be briefly discussed.

The talk is partly based on joint work with D. Bahns and K. Rejzner.

GR 15.2 Do 17:10 SFG 0140

Quantum properties of theories with anisotropic scaling — •Christian F. Steinwachs[1], Andrei O. Barvinsky[2,3], Diego Blas[4], Mario Herrero-Valea[5], Dmitry V. Nesterov[2], Guillem Perez-Nadal[6], and Sergey M. Sibiryakov[4,5,7] — [1]Physikalisches Institut, Albert-Ludwigs Universität Freiburg, Hermann-Herder-Str. 3, 79104 Freiburg, Germany — [2]Theory Department, Lebedev Physics Institute, Leninskii Pr. 53, Moscow 119991, Russia — [3]Department of Physics, Tomsk State University, Lenin Ave. 3 6, Tomsk 634050, Russia — [4]CERN Theory Division, CH-1211 Geneva 23, Switzerland — [5]Institut de Théorie des Phénomènes Physiques, EPFL, CH-1015 Lausanne, Switzerland — [6]Departamento de Física, Universidad de Buenos Aires, Ciudad Universitaria, pabellón 1 (1428) Buenos Aires, Argentina — [7]Institute for Nuclear Research of the Russian Academy of Sciences

We discuss the quantum properties of theories with an anisotropic scaling of space and time. Such theories break fundamental Lorentz invariance in the UV. New techniques have to be applied to analyze general renormalization properties and to perform explicit calculations – among them a non-local gauge fixing procedure. We present a method how calculations of quantum divergences in a non-covariant theory can be related to the well known heat kernel technique for covariant theories and discuss the application of this technique to the model of Hořava-Lifshitz gravity.

GR 15.3 Do 17:30 SFG 0140

Hawking radiation: Comparison of pure-state and thermal description — •Yi-Fan Wang and Claus Kiefer — Institut für Theoretische Physik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln

We present the power spectral densities for a quantum field in the background of a Schwarzschild black hole and compare the cases of the field being in a pure state and in the usual thermal state. In the low-energy regime the densities strongly differ, while at high energies they practically coincide. We define a distance measure between the resulting two density operators and evaluate it assuming an UV cutoff and discrete field energy levels. We find that the distance is exponentially small with respect to the number of the levels as well as the ratio of the cutoff and the Hawking temperature. We finally discuss the operational meaning of a vanishing distance.

GR 15.4 Do 17:50 SFG 0140

Singularity avoidance in Kantowski-Sachs quantum cosmology — •Nick Kwidzinski — Institute for Theoretical Physics, University of Cologne, 50937 Cologne, Germany

We study the classical and quantum cosmology of Kantowski-Sachs universes. Special attention will be given to the singularities that occur in these models and their resolution in the corresponding quantum models. Quantization is performed within the minisuperspace approximation of quantum geometrodynamics.

GR 15.5 Do 18:10 SFG 0140

Planck-scale-modified dispersion relations in homogeneous and isotropic spacetimes — •Christian Pfeifer — ITP Uni Hannover, Hanover Deutschland

Last year I presented how one can understand dispersion relations covariantly as level sets of a Hamilton function on the point particle phase space of spacetime. In this talk I will demonstrate how one obtains the most general homogeneous and isotropic dispersion relation and how this allows us to study a specific Planck-Scale deformation of Friedman-Lemaître-Robertson-Walker (FLRW) geometry. This deformation has the property that it is locally identical to the κ-Poincaré dispersion relation studied extensively in quantum gravity phenomenology. Studying the motion of particles subject to such Hamiltonian we derive the redshift and lateshift as observable consequences of the Planck-scale deformed FLRW universe.

This talk is based on the article: https://arxiv.org/abs/1612.01390