GR 11: Quantum Cosmology and Quantum Gravity II

Zeit: Donnerstag 11:00–12:45 Raum: HS 5

GR 11.1 Do 11:00 HS 5

Quantum Cosmological Perturbations with Back Reactions — •Susanne Schander and Thomas Thiemann — Institute for Quantum Gravity, Friedrich-Alexander-Universität Erlangen-Nürnberg

We investigate linear quantum cosmological perturbation theory in scenarios of the very early Universe while including back reactions from a homogeneous background.

GR 11.2 Do 11:15 HS 5

Hamiltonian diagonalization in hybrid quantum cosmology — •Beatriz Elizaga Navascués[1], Guillermo A. Mena Marugán[2], and Thomas Thiemann[1] — [1]Institute for Quantum Gravity, Friedrich-Alexander University Erlangen-Nürnberg, Staudstraße 7, 91058 Erlangen, Germany — [2]Instituto de Estructura de la Materia, IEM-CSIC, Serrano 121, 28006 Madrid, Spain

In this work, we explore the possibility of selecting a natural vacuum state for scalar and tensor gauge-invariant cosmological perturbations in the context of hybrid quantum cosmology. For that, we make use of a canonical formulation of the entire cosmological system (background geometry and perturbations) in which the gauge-invariant degrees of freedom are identified as canonical variables. Introducing background-dependent linear canonical transformations that respect the spatial symmetries of the background on the gauge-invariant perturbations, and completing these transformations in the entire system, we are able to characterize a generic collection of annihilation and creation-like variables that obey the dynamics dictated by a respective collection of Hamiltonians. We then impose that such Hamiltonians display no self-interaction terms, and thus in a Fock representation with normal ordering they act diagonally on the basis of n-particle states. This leads to a very precise characterization of the allowed annihilation and creationlike variables, which we argue can be further restricted to a unique choice under some physical considerations. Finally, we discuss the relation of our selected vacuum and the standard adiabatic vacua in the context of quantum field theory in curved spacetimes.

GR 11.3 Do 11:30 HS 5

Massive vector bosons in Hamiltonian formulation — •Maria Schlungbaum, Thoralf Chrobok, and Horst-Heino von Borzeszkowski — Institut für Theoretische Physik, Technische Universität Berlin

In the Standard Model of particle physics the vector bosons assume the function of "force carrier particles", i.e. they convey the interaction between massive particles. Their dynamics can be described either by the Proca or Stückelberg Lagrangian density, which both take the form of a singular system. Therefore constraints arise when passing to Hamiltonian formulation. This talk takes a closer look on these constraints and the differences, which may occur due to the gauge invariance of the Stückelberg theory.

GR 11.4 Do 11:45 HS 5

Non-Locality in the Cosmic Microwave Background — •Dipanshu Gupta — Goethe Universität, Frankfurt am Main

We want to explore signatures of Quantum Gravity in cosmology in the UV spectrum. We do so by studying the non-local effects one expects in a fundamental theory of gravity and derive its consequences. We study Non-Commutative Geometry (NCG) and Generalised Uncertainty Principle (GUP) in this context. In principle, we would like to put a bound on the non-commutative parameter in both these theories using Cosmic Microwave Background (CMB) data from the Planck satellite.

GR 11.5 Do 12:00 HS 5

Localized gravitons as essence of dark energy: Implications for accelerated cosmic expansion — •Deiana Drakova[1] and Gerold Doyen[2] — [1]Sofia University, Sofia, Bulgaria — [2]LMU Munich, Germany

A theory of Emerging Quantum Mechanics (EQM) has been developed [1] contributing to the understanding of the measurement problem by assigning a quantum dynamical process to collapse within Schrödinger's theory.
EQM treats cosmological problems in a quantum field theory in high dimensional spacetime (11D) including matter and the gravitational field. Gravity is quantized in the weak interaction limit. The EQM Lagrangian contains terms up to fourth order in the gravitational field. Second and fourth order terms are associated with repulsive dark energy and third order terms with attractive dark matter effects. Gravonon-gravonon repulsion, i.e. dark energy in EQM, modifies the structure of the gravitational field and leads to accelerated expansion of the universe.
Quantum diffusion of the matter particles in three dimensional space is suggested as the mechanism of the expansion of the universe. The rate of expansion is given by the frequency of the soft gravitational modes. The deceleration parameter for the expansion of the universe suggested in EQM is in the range between -0.6 and -0.8, an observed value of -0.54 has been reported.
[1] G. Doyen and D. Drakova, Foundations of Physics **45**, 959 (2015).

GR 11.6 Do 12:15 HS 5

Reconciling reality, space and time: A graviton driven quantum mechanism of cosmic expansion and CMB radiation — •Gerold Doyen[1] and Deiana Drakova[2] — [1]LMU Munich, Germany — [2]Sofia University, Sofia, Bulgaria

The theory of emerging quantum mechanics (EQM) is a quantum field theory in flat 11 dimensional spacetime, quantizing gravity in the weak interaction limit. In EQM the quantum fields materialize (i.e., they become real) if they entangle with the gravonons, i.e. localized gravitons, thereby forming beables. If not entangled with gravonons, the quantum field is in a limbo state as e.g. exemplified by the state inbetween source and screen in the double slit experiment. Quantum diffusion proceeds via repeated limbo - beable transitions. This leads to the impression that particles having been measured at a certain separation in space suddenly disappear and reappear at a different separation, For any cosmological experiment this is consistent with the interpretation that space has expanded. The rate of cosmic expansion is then equal to the rate of beable - limbo transitions. This rate is calculated from first principles and equals the experimentally determined Hubble parameter. Explicit calculations on the generation of the cosmic microwave radiation (CMB) require to consider the beabling process of the electromagnetic quantum field. The beabling condition is fulfilled for light-atom-lattices. Temperature emerges in EQM by escape of the particle out of the warp resonance (beable). Without fitting any free model parameter the CMB radiation temperature as 2.2 K which is to be compared to the experimental value of 2.7 K.

GR 11.7 Do 12:30 HS 5

Riding on a Dark Bubble : Emergent de Sitter cosmology from decaying AdS — •Souvik Banerjee, Ulf Danielsson, Giuseppe Dibitetto, Suvendu Giri, and Marjorie Schillo — Uppsala University, Uppsala, Sweden

Recent developments in string compactications demonstrate obstructions to the simplest constructions of low energy cosmologies with positive vacuum energy. The existence of obstacles to creating scale-separated de Sitter solutions indicates a UV/IR puzzle for embedding cosmological vacua in a unitary theory of quantum gravity. Motivated by this puzzle, we propose an embedding of positive energy Friedmann-Lemaitre-Robertson-Walker (FLRW) cosmology within string theory. Our proposal involves confining four dimensional gravity on a brane which mediates the decay from a non-supersymmetric five dimensional Anti deSitter false vacuum to a true vacuum. In this way, it is natural for a four dimensional observer to experience an effective positive cosmological constant coupled to matter and radiation, avoiding the need for scale separation or a fundamental de Sitter vacuum.