GR 9: Quantum Cosmology

Zeit: Donnerstag 8:30–9:50 Raum: VMP6 HS A

GR 9.1 Do 8:30 VMP6 HS A

Comparison of a quantum cosmology scenario with observations — •Susanne Schander[1,2], Aurélien Barrau[2], Boris Bolliet[2], Julien Grain[3], Linda Linsefors[2], and Jakub Mielczarek[2] — [1]TU Kaiserslautern, Germany — [2]LPSC Grenoble, France — [3]CNRS, Orsay, France

In the cosmological context, it is often argued that all physical events that happened before inflation are washed out by the latter, such that a priori quantum cosmology models are not testable. In this talk, based on arXiv:1508.06786 and arXiv:1510.08766, I am going to present cosmological results obtained by investigation of a quantum cosmology scenario within the loop approach that can be compared to observations, and refute in this way the above assertion. In particular, I will present the primordial power spectrum of scalar perturbations in loop quantum cosmology within the deformed algebra approach, and with a massive scalar field as the matter content of the Universe, which allows us to generate the angular power spectrum as it was measured very recently by cosmologists (PLANCK Collaboration 2015). The results will be compared to these observations, showing an incompatibility with the latter. This refutes the initial hypothesis that, in general, quantum cosmology models cannot be falsified.

GR 9.2 Do 8:50 VMP6 HS A

How does canonical quantum gravity affect inflationary perturbations? — David Brizuela[1], Claus Kiefer[2], and •Manuel Krämer[3] — [1]Fisika Teorikoa eta Zientziaren Historia Saila, UPV/EHU, 644 P.K., 48080 Bilbao, Spain — [2]Institut für Theoretische Physik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Germany — [3]Instytut Fizyki, Uniwersytet Szczeciński, ul. Wielkopolska 15, 70-451 Szczecin, Poland

We present detailed calculations for quantum-gravitational corrections to the power spectra of gauge-invariant scalar and tensor perturbations during inflation. We use canonical quantum gravity with the Wheeler–DeWitt equation as our formalism and perform a semiclassical Born–Oppenheimer type of approximation to obtain a Schrödinger equation with quantum-gravitational correction terms. As a first step, we carry out our calculation for a pure de Sitter universe and find that the correction terms lead to an enhancement of power on the largest scales. Furthermore, we present numerical methods to give an estimate for the modification of the corrections in the case of slow-roll inflation.

GR 9.3 Do 9:10 VMP6 HS A

A perfect bounce in quantum cosmology — •Steffen Gielen[1] and Neil Turok[2] — [1]Theoretical Physics, Blackett Laboratory, Imperial College London, London SW7 2AZ, United Kingdom — [2]Perimeter Institute for Theoretical Physics, Waterloo ON N2L 2Y5, Canada

We study the quantum cosmology of a universe with conformal matter comprising a perfect radiation fluid and a number of conformally coupled scalar fields. For FRW backgrounds, we are able to perform the path integral exactly; the evolution describes a "perfect bounce," in which the universe passes smoothly through the singularity. The Feynman path integral amplitude is precisely that of a relativistic oscillator, for which the scale factor of the universe is the time and the scalar fields are the spatial coordinates. We also study the quantum evolution of anisotropies (for a Bianchi I model) and of inhomogeneous perturbations, at linear and nonlinear order, viewed as a "scattering process" between incoming and outgoing asymptotic modes. We provide evidence for a semiclassical description in which all fields pass around the cosmological singularity along regular, complex classical paths.

GR 9.4 Do 9:30 VMP6 HS A

Cosmology of Born-Infeld type models — Alexander Kamenshchik[1,2], Claus Kiefer[3], and •Nick Kwidzinski[3] — [1]Dipartimento di Fisica e Astronomia, Università di Bologna and INFN, Bologna, Italy — [2]L.D. Landau Institute for Theoretical Physics of the Russian Academy of Sciences, Moscow, Russia — [3]Institut für Theoretische Physik, Universität zu Köln, Köln, Germany

We discuss the classical and quantum cosmology of a universe filled with a tachyon condensate and other Born-Infeld type fields. We analyse, in particular, the cases with a constant potential and with an inverse square potential. We apply the Wheeler-DeWitt equation of canonical quantum gravity to these models and show how it can be appropriately reformulated as a difference equation.