GR 15: Quantum Gravity and Quantum Cosmology II

Time: Thursday 16:15–17:00 Location: KH 02.012

GR 15.1 Thu 16:15 KH 02.012

Lorentzian Cosmological path integrals in effective spin foams — •Sebastian Steinhaus and Alexander Jercher — Friedrich-Schiller Universität Jena, Theoretisch-Physikalisches Institut, Jena, Germany

Spin foam models, also called covariant loop quantum gravity, are a non-perturbative, Lorentzian path integral approach to quantum gravity. Its expressions are regularised by replacing the continuous manifold by a triangulation, where the sum over geometries is encoded in group-theoretic area and angle variables. However, making contact back with classical, continuum gravity is challenging. In this talk, I will address this question in cosmology from two directions. First, I will solve the discrete (transcendental) equations of motion of cosmological models in Regge calculus and showcase how to relate them to continuum cosmology. Second, I translate this into an oscillatory Lorentzian path integral with effective spin foams and evaluate it numerically, e.g. using acceleration operators. I will discuss under which conditions classical physics (in terms of expectation values of observables) can be recovered and give an outlook to non-classical transitions, e.g. bouncing cosmologies.

GR 15.2 Thu 16:30 KH 02.012

Einstein equations for Area Metric geometries from entanglement — •Aranya Bhattacharya[1,2], Lavish Chawla[1,3], Mario Flory[1], and Mateusz Kulig[1] — [1]Institute of Theoretical Physics, Jagiellonian University, Lojasiewicza 11, 30-348 Krakow, Poland — [2]School of Mathematics, University of Bristol, Fry Building Woodland Road, Bristol BS8 1UG, UK — [3]Theoretisch-Physikalisches Institut, Friedrich-Schiller-Universitat Jena, Max-Wien-Platz 1, D-07743 Jena, Germany

Area metrics provide a generalised notion of geometry, in which areas are fundamental but lengths may not be defined at all. They can be motivated from string theory, loop quantum gravity, and entropic gravity alike, which we will briefly touch upon during the talk. In this work, we use the holographic duality and the first law of entanglement as first principles, from which an equation constraining area metric fluctuations around a four dimensional Anti-de Sitter (AdS) background can be derived, thus extending the linearised Einsteins equations for these generalised geometries. In the framework of the AdS/CFT correspondence, these area metric fluctuations can be interpreted as encoding the energy-momentum tensor perturbations of a holographically dual three dimensional conformal field theory (CFT). For further implications of these results, see the talk by M. Flory.

GR 15.3 Thu 16:45 KH 02.012

A Relational Model of Gravitationally induced Decoherence for Photons — •Roman Kemper[1], Kristina Giesel[1], and Max Joseph Fahn[2] — [1]Friedrich-Alexander Universität Erlangen-Nürnberg, Germany — [2]Università di Bologna, Bologna Italy

This talk discusses the formulation of a decoherence model for Maxwell theory coupled to linearised gravity. The resulting dynamics are described by a master equation, which governs the evolution of the electromagnetic subsystem under the effective influence of the gravitational environment. The master equation is derived from the underlying action using the relational formalism to access the physical sector and the open quantum system framework to describe the effective influence of linearised gravity on Maxwell theory at the quantum level. Differences and similarities with existing models in the literature, including approaches based on scalar fields or alternative methods for accessing the physical sector, are discussed.