

## GR 7: Quantum Gravity and Quantum Cosmology I

Time: Monday 17:30–18:50

Location: SPA SR220

GR 7.1 Mon 17:30 SPA SR220

**Resolution of type IV singularities in quantum cosmology** — MARIAM BOUHMADE-LÓPEZ<sup>1</sup>, CLAUS KIEFER<sup>2</sup>, and •MANUEL KRÄMER<sup>2</sup> — <sup>1</sup>Department of Theoretical Physics, University of the Basque Country UPV/EHU, P.O. Box 644, 48080 Bilbao, Spain — <sup>2</sup>Institut für Theoretische Physik, Universität zu Köln, Zùlpicher Straße 77, 50937 Köln, Germany

We discuss the fate of classical type IV singularities in quantum cosmology. As a framework we use Wheeler-DeWitt quantization applied to a homogeneous and isotropic universe with a perfect fluid described by a generalized Chaplygin gas. Such a fluid can be dynamically realized by a scalar field. We treat the cases of a standard scalar field with positive kinetic energy and of a scalar field with negative energy (phantom field). We are able to solve the Wheeler-DeWitt equation for these models analytically for a special case and to draw conclusions for the general case. Adopting the criterion that singularities are avoided if the wave function vanishes in the region of the classical singularity, we find that type IV singularities are avoided only for particular solutions of the Wheeler-DeWitt equation. We compare this result with earlier results found for other types of singularities.

GR 7.2 Mon 17:50 SPA SR220

**On the relation between canonical and covariant Loop Quantum Gravity** — •ANTONIA ZIPPEL — Instytut Fizyki Teoretycznej, Uniwersytet Warszawski, Poland

Loop quantum gravity is a background independent and non-perturbative approach towards a quantum theory of gravity that divides into a canonical and covariant (or spin foam) model. Heuristically, spin foams can be understood as the Feynman graphs of Quan-

tum Gravity. Yet, summing over all ‘histories’ would lead to a projector on the physical Hilbert space of the canonical theory rather than to a true propagator due to the constraint nature of GR. Following this idea we construct a spin-foam operator acting on the kinematic Hilbert space and analyze its properties.

GR 7.3 Mon 18:10 SPA SR220

**Loop quantum gravity in higher dimensions and black hole entropy** — •NORBERT BODENDORFER — IFT UW, Warschau, Polen

A reformulation of higher-dimensional gravity theories is discussed which allows for the application of the loop quantum gravity program. To this end, a Hamiltonian formulation of the gravity theory has to be given on a Yang-Mills phase space such that the Yang-Mills gauge group is compact, the Poisson brackets are canonical, the variables are real and the theory is only subject to first class constraints. The computation of black hole entropy is discussed as an application.

GR 7.4 Mon 18:30 SPA SR220

**Lorentzian Regge Calculus and Spinfoam: an example with fixed Topology** — •DIMITRI MARINELLI<sup>1</sup> and GIORGIO IMMIRZI<sup>2</sup> —

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Regge Calculus is the classical starting point for a bunch of different models of Quantum Gravity. I will present two different solutions of this classical model of gravity for a fixed topology. Some interesting aspects and open problems related to the Lorentzian structure of the discrete system will be analyzed. Moreover, I will present the first steps towards the implementation of the Spinfoam Quantization based on these classical solutions of the Regge Calculus.