

Großes Physikalisches Kolloquium an der Universität zu Köln

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Quantum Gravity, Dark Energy, and the Origin of the Universe



Quantum gravity is described as a non-perturbatively renormalizable quantum field theory for the metric and a scalar field, with ultraviolet and infrared fixed points. The approximate scale invariance close to the ultraviolet fixed point is reflected in cosmology in the almost scale invariant spectrum of primordial cosmic fluctuations, as observed in the microwave background. The approach to the infrared fixed point in the asymptotic future is characterized by the dynamics of an almost massless scalar field responsible for dynamical dark energy. The cosmological solution can be extrapolated to the infinite past in physical time - the Universe has no beginning and no physical singularity. A simple model is compatible with all present cosmological observations. It could be tested by the observation of huge lumps in the cosmic neutrino background, the detection of early dark energy, or rather large primordial graviton fluctuations generated during inflation.

