Bouncing and Emergent Cosmologies from Hamiltonian Analysis of Asymptotically Safe Quantum Gravity

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Abstract

Recent results based on renormalization group approaches to Quantum Gravity suggest that the Newton's and Cosmological constants should be treated as a dynamical variables whose evolution depend on the characteristic energy scale of the system. An open question is how to embed this modified Einstein's theory in the Dirac's theory of constrained systems. In this talk, the Hamiltonian formalism for a renormalization-group scale dependent Newton's and Cosmological constants is discussed paying particular attention to Dirac's constraint analysis. It is shown that the algebra of the Dirac's constraints is closed under certain conditions. Brans-Dicke theory is also studied as a Dirac's Constrained Dynamical System and it is confronted and contrasted with modified Einstein Theory of General Relativity via Asymptically Safe Quantum Gravity. Applications to the physics of the Early Universe is explicitly discussed assuming the framework of Asymptotic Safety. In particular, it is shown that in the Minisuperspace case with FLRW metric, RG improved Friedmann equations exibit Bouncing and Emergent Universes solutions. While, in the classical case, Emergent universe solutions hold for closed topologies (K=+1), in the sub-Planckian regime they hold also for flat (K=0) and open (K=-1) topologies.

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