Some features of the Hamiltonian Analysis of Asymptotic Safe Quantum Gravity

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After a brief introduction to the basic ideas underlying Asymptotic Safety, we analize a RG improved Einstein-Hilbert Lagrangian in which the cosmological constant and the gravitational constant are non geometrical fields, functions of the Space-Time and determined by the Renormalization Group. The main goal of this Hamiltonian analysis is to probe the vacuum of Asymptotic Safety. This Hamiltonian theory exibits non trivial Dirac's constraints which, despite Einstein General Relativity, are second class due to the breaking of diff invariance by $G(x)$ and $\Lambda(x)$. To throw light on this complicated scenario, the parent Brans-Dicke theory is analyzed. Contrary to general belief, it shows first class momentum constraints and second class Hamiltonian constraint. In general it is believed that Brans-Dicke theory is equivalent to Einstein General Relativity by passing from the Jordan Frame to the Einstein Frame. We prove this transformation is not canonical and generates two inequivalent Hamiltonian theories and then two inequivalent quantum theories. Minisuprespace models are analyzed in this framework. They have the advantage to avoid some of the technicalities encountered above. They inherit from Asymptotic Safety quantum mechanical behaviour which cause the appearance of features impossible to emerge from the analogous classical models.

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