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Quantum geometry of space-time from precanonical quantization of GR

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I review the approach of *precanonical quantization* based on the structures of the De Donder-Weyl Hamiltonian formulation of field theories. The approach requires no splitting to space and time and it leads to a new understanding of quantum fields as a *hypercomplex* generalization of quantum theory rather than an infinite-dimensional one. A relationship with the standard QFT in the *functional Schroedinger representation*, which emerges from precanonical quantization as a singular limiting case, is explained using the example of scalar field theory in flat and curved space-time. We apply the framework to the Palatini formulation of GR in vielbein and spin-connection variables and derive the precanonical analogue of the Schroedinger equation for quantum gravity, which is a PDE on the total space of the bundle of spin-connection coefficients over space-time. We discuss the Hilbert space in this formulation, the quantum gravitational avoidance of curvature singularities and the emergence of the Einstein equations in the classical limit. Using a simplified cosmological model we also show that the approach leads to a very specific prediction of the Levy-type of statistics of quantum fluctuations of spin-connection that may point to a fractal nature of quantum space-time.

Summary

The talk belongs to the section of Quantum Gravity and it also has certain elements relevant for Gravity theory, Beyond Einstein's Gravity and General Relativity and Cosmology.

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