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When the Minkowski space-time foams

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I discuss the simplest solution of the covariant Schroedinger equation of quantum gravitational field derived using precanonical quantization, a quantization based on the De Donder-Weyl Hamiltonian theory which requires no space-time decomposition. This is a second-order PDE for a Clifford algebra valued wave function on the space of space-time and spin-connection variables which reproduces the Einstein field equations on average in the sense of the Ehrenfest theorem. The quantum-gravitational geometry is described by a probability amplitude of having some value of spin connection at one point and another value of spin connection at another point. A simple solution can be found when the expectation value of spin-connection equals zero, which corresponds to a quantum state associated with the Minkowski space-time in Cartesian coordinates. The solution shows that the scale when quantum fluctuations of space-time are noticeable can be several orders of magnitude above the Planck scale. We show that this scale actually depends on G, $\hbar$, c, and also on the scale $varkappa$ which is introduced in precanonical quantization and has been shown to be associated (surprisingly) to the scale of the mass gap in quantum gauge theories. This is the reason why, in precanonical quantization, the space-time seems to foam at much lower energies in precanonical quantum gravity than the estimations in LQG or string theory usually expect. Potentially, it opens an opportunity for experimental testing and falsifying some of the competing theories.

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