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Quantum Graphity: a model of emergent locality

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Quantum graphity is a background independent condensed matter model for emergent locality, spatial geometry and matter in quantum gravity. The states of the system are given by bosonic degrees of freedom on a dynamical graph on N vertices (that is, changing in time). At high energy, the graph is the complete graph on N vertices and the physics is invariant under the full symmetric group acting on the vertices and highly non-local. We find evidence that the model has a phase, in which the ground state breaks the permutation symmetry to translations and discrete rotations. In this phase the system is ordered, low-dimensional and local. Consideration of the free energy associated with the dominant terms in the dynamics shows that the ground state is thermodynamically stable under local perturbations. The model gives rise to an emergent U(1) gauge theory in the ground state by the string-net condensation mechanism of Levin and Wen. We will reformulate the model in graph-theoretic terms and compare its dynamics to some common graph processes.