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Quantum phase transitions on percolating lattices

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When a quantum many-particle system exists on a randomly diluted lattice, its intrinsic thermal and quantum fluctuations coexist with geometric fluctuations due to percolation. In this talk, we explore how the interplay of these fluctuations influences the phase transition at the percolation threshold. While it is well known that thermal fluctuations generically destroy long-range order on the critical percolation cluster, the effects of quantum fluctuations are more subtle. In diluted quantum magnets with and without dissipation, this leads to novel universality classes for the zero-temperature percolation quantum phase transition. Observables involving dynamical correlations display nonclassical scaling behavior that can nonetheless be determined exactly in two dimensions. Moreover, by exploring a relation between quantum Hamiltonians and classical nonequilibrium processes, we demonstrate that exotic percolation transitions can also occur in epidemic spreading and diffusion-limited chemical reactions.