Constrained Models on Quasicrystals and Random Tilings

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Some of the most important phenomena in physics arise when correlations emerge from local constraints. I will outline results for a range of constrained models in the new setting of aperiodic tilings. On the Ammann Beenker tiling we prove the existence of Hamiltonian cycles (visiting each vertex precisely once), and thereby solve a range of problems including the three-colouring problem and the travelling salesperson problem. On the recently discovered 'Spectre' aperiodic monotiling we exactly solve the interacting quantum dimer model. In ongoing work we generalise these results to random graphs. Here we find that the classical problem admits a remarkable infinite-temperature confinement transition tunable by local graph structure. The quantum dimer model in periodic graphs coarse-grains to a compact U(1) gauge theory: we show that this mapping survives without periodicity. We construct the emergent particles (monomers, visons, and photons) and obtain their correlations using Kasteleyn theory.