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The Ising Model on a Curved Manifold – The Affine Conjecture

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A formulation of lattice field theory (LFT) for curved manifolds uses the Regge's triangulated (simplicial) manifold for the Einstein Hilbert action that solves the equation of motion (EOM) for classical GR in the continuum. For the metric field, $g_{\mu\nu}(x)$, this is piece-wise constant finite element method (FEM) which applies equally to the classical field PDEs. But quantizing lattice fields on even a fixed Regge manifold is more difficult.

The analytical solution for the 2d Ising model demonstrated that a precise map between the ***quantum field geometry*** and the ***Regge manifold geometry*** is required. By using this map locally on tangent planes, the Riemann sphere ($\mathbb{S}^2$) lattice Ising model converged to the exact CFT solution. We conjecture that a similar Affine map exists more generally. A sequence of theoretical investigations and numerical tests are underway for non-integrable examples of increasing complexity: e.g. ϕ^4 theory and QED3 on $\mathbb{R} \times \mathbb{S}^2$, with the goal to establish a new LFT framework for gauge theories, complementary to the bootstrap and the fuzzy sphere.

Author: BROWER, Richard (Boston University)

Presenter: BROWER, Richard (Boston University)

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