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Emergent Criticality and Ricci Flow in a 2D Frustrated Heisenberg Model

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In most systems that exhibit order at low temperatures, the order occurs in the elementary degrees of freedom such as spin or charge. Prominent examples are magnetic or superconducting states of matter. In contrast, emergent order describes the phenomenon where composite objects exhibit longer range correlations. Such emergent order has been suspected to occur in a range of correlated materials. One specific example are spin systems with competing interactions, where long-range discrete order in the relative orientation of spins may occur. Interestingly, this order parameter may induce other phase transitions as is the case for the nematic transition in the iron pnictides. In this talk, we introduce and discuss a system with emergent Z_6 symmetry, a two-dimensional frustrated Heisenberg antiferromagnet on the windmill lattice consisting of interpenetrating honeycomb and triangular lattices. The multiple spin stiffnesses can be captured in terms of a four-dimensional metric tensor, and the renormalization group flow of the stiffnesses is described by the Ricci flow of the metric tensor. The key result is a decoupling of an emergent collective degree of freedom given by the relative phase of spins on different sublattices. In particular, our results reveal a sequence of two Berezinskii-Kosterlitz-Thouless phase transitions that bracket a critical phase.