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Dirac-like spinons and emergent symmetry in s=1/2 kagome antiferromagnets

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Kagome antiferromagnets have garnered significant attention in condensed matter physics owing to their potential to host a diverse range of quantum spin liquids (QSLs) and fractional magnetization plateaus. In particular, the S=1/2 kagome antiferromagnet has been regarded as a holy grail for realizing QSLs, with candidates ranging from gapped Z2 to U(1) Dirac QSLs. Theoretical studies further predict that kagome lattices exhibit fractional magnetization plateaus, which involve both entangled and unentangled spin states. These intriguing phenomena highlight the need for experimental validations to elucidate the underlying quantum phases.

In this presentation, I will share our group's recent work on the ground-state and field-induced phases in s=1/2 kagome antiferromagnets. In the first part, I will present thermodynamic and spectroscopic signatures of disordered Dirac spinons in $YCu_3(OH)_{6+x}Br_{3-x}$ (x˜0.5), which forms a nearly perfect kagome lattice with an exchange interaction of J˜60 K.

In the second part, I will highlight our observation of the sought-after 1/9, 1/3, and 5/9 plateaus under magnetic fields up to 140 T. Notably, the nature of the m=1/9 plateau remains a topic of debate, with possibilities including a topological Z3 spin liquid or a valence bond crystal. Remarkably, the angular dependence of our thermodynamic and NMR data reveals the emergence of C3-symmetric, gapless excitations and a field-induced Lifshitz transition of the spinon Fermi surface. These findings suggest that the 1/9 plateau phase originates from a topological reorganization between Dirac-like and other gapless spinon bands.

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