Spectral evidence for Dirac spinons in a kagome lattice antiferromagnet
(Oral)

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Abstract text: Emergent quasiparticles with a Dirac dispersion in condensed matter systems can be described by the Dirac equation for relativistic electrons, in analogy with Dirac particles in high-energy physics. For example, electrons with a Dirac dispersion have been intensively studied in electronic systems such as graphene and topological insulators. However, charge is not a prerequisite for Dirac fermions, and the emergence of Dirac fermions without a charge degree of freedom has been theoretically predicted to be realized in Dirac quantum spin liquids. These quasiparticles carry a spin of 1/2 but are charge-neutral and so are called spinons. In this talk, I will provide both thermodynamical and spectral evidences for the presence of Dirac spinons in an insulating kagome material $YCu_3(OH)_6Br_2[Br_{1-x}(OH)_x]$, where Cu^{2+} ions with spin S=1/2 form perfect kagome planes. No magnetic order is found down to 50 mK despite of the large superexchange energies. The specific heat shows a quadratic temperature dependence at zero field and a linear component appears under field. Moreover, the spin excitations are conical with a spin continuum inside, which is consistent with the convolution of two Dirac spinons. The predictions of a Dirac spin liquid model with a spinon velocity obtained from spectral measurements are in agreement with the low-temperature specific heat of the sample. Our results, thus, provide spectral evidence for a Dirac quantum spin liquid state emerging in this kagome lattice antiferromagnet. However, the locations of the conical spin excitations differ from those calculated by the nearest-neighbour Heisenberg model, suggesting the Dirac spinons have an unexpected origin.

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[3] Aini Xu, Qinxin Shen, Bo Liu et al., arXiv:2311.13089.