$YbZn_2GaO_5$: A Novel Triangular Lattice Quantum Spin Liquid Candidate

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The emergence of a quantum spin liquid (QSL), a state of matter that can result when electron spins are highly correlated but do not become ordered, has been the subject of considerable research in condensed matter physics. Spin liquid states have been proposed as potential hosts for high-temperature superconductivity and can exhibit topological properties with applications in quantum information science. However, the unambiguous experimental realization of QSL behavior in real materials remains challenging. In this study, we investigate the novel compound $YbZn_2GaO_5$, which hosts an ideal triangular lattice of effective spin-1/2 moments with no observable inherent chemical disorder [1]. Our thermodynamic and inelastic neutron scattering (INS) measurements, conducted on high-quality single crystal samples of $YbZn_2GaO_5$, exclude the possibility of long-range magnetic ordering down to 60 mK. These measurements reveal a quadratic power law for the heat capacity and demonstrate a continuum of magnetic excitations in parts of the Brillouin zone. Additionally, our recent ac-susceptibility measurements rule out the possibility of spin freezing in this compound at temperatures as low as 20 mK, providing additional evidence of the dynamic nature of the ground state. Our experimental results provide compelling evidence that $YbZn_2GaO_5$ is a U(1) Dirac QSL with gapless spinon excitations concentrated at specific points in the Brillouin zone. These experimental findings align with our theoretical calculations for a Dirac QSL on the triangular lattice.

[1] Xu, S., Bag, R., Sherman, N. E., Yadav, L., Kolesnikov, A. I., Podlesnyak, A. A., ... & Haravifard, S. (2023). Realization of U(1) Dirac Quantum Spin Liquid in $YbZn_2GaO_5$. arXiv preprint arXiv:2305.20040.