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Fluctuating magnetic droplets immersed in a sea of quantum spin liquid

The search of quantum spin liquid (QSL), an exotic magnetic state with strongly-fluctuating and highly-entangled spins down to zero temperature, is a main theme in current condensed matter physics. However, there is no smoking-gun evidence for deconfined spinons in any QSL candidate so far. The disorders and competing exchange interactions may prevent the formation of an ideal QSL state on frustrated spin lattices. Here we report comprehensive and systematic measurements of the magnetic susceptibility, ultralow-temperature specific heat, muon spin relaxation (μSR), nuclear magnetic resonance (NMR), and thermal conductivity for NaYbSe2 single crystals, in which Yb3+ ions with effective spin-1/2 form a perfect triangular lattice. All these complementary techniques find no evidence of long-range magnetic order down to their respective base temperatures. Instead, specific heat, μSR and NMR measurements suggest the coexistence of quasi-static and dynamic spins in NaYbSe2. The scattering from these quasi-static spins may cause the absence of magnetic thermal conductivity. Thus, we propose a scenario of fluctuating ferrimagnetic droplets immersed in a sea of QSL. This may be quite common on the way pursuing an ideal QSL, and provides a brand-new platform to study how a QSL state survives impurities and coexists with other magnetically ordered states.

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