Molecular quantum spin liquid

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Quantum spin liquid proposed by P. W. Anderson in 1973 exhibits the absence of magnetic or valence bond solid order among entangled quantum spins even at zero temperature\(^1\). Although this third fundamental state for magnetism is a long-sought state of matter that has attracted much theoretical attention, the ground state and low-energy excitations of the S=1/2 antiferromagnetic triangular lattice are still far from full understanding and furthermore there are few candidates of real materials\(^2\). In a series of anion radical salts of a metal complex Pd(dmit)\(_2\) (dmit = 1,3-dithiol-2-thione-4,5-dithiolate)\(^3\), we found that β’-EtMe\(_3\)Sb[Pd(dmit)\(_2\)]\(_2\) with a quasi triangular lattice of [Pd(dmit)\(_2\)]\(_2\) dimers is a promising candidate for the quantum spin liquid\(^4\). Measurements of various properties including magnetic susceptibility, μSR, magnetic torque, \(^{13}\)C-NMR, specific heat, electrical/thermal transport, vibrational spectra, dielectric constant, and low-temperature crystal structure, have been performed\(^5\). First-principles DFT calculations followed by tight-binding fitting were also carried out\(^6\). The spin liquid in the Pd(dmit)\(_2\) salts exists as a "phase" and is situated between an antiferromagnetic phase and a charge order phase. The ground state of the Pd(dmit)\(_2\) salts is classified by the anisotropy of the triangular lattice that can be finely tuned by mixed cations with a minimum of disorder effect on the magnetic layer.