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Molecular Quantum Magnetism in $LiZn_2Mo_3O_8$[1]

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Considerable theoretical and experimental efforts are devoted to understanding frustrated two-dimensional antiferromagnets, searching for quantum spin-liquid states hosting deconfined fractional spin excitations. To make quantitative comparisons with theory, the sensitivity to defects and site mixing inherent to magnetic transition metal oxides is a significant challenge. Spin degrees of freedom delocalized on stable organic molecules or inorganic clusters offer an interesting alternative. The layered insulating material $LiZn_2Mo_3O_8$ is such a compound. It comprises spin-1/2 Mo_3O_{13} molecules organized on the triangular lattice [1]. Its thermo-magnetic properties suggest it hosts collective magnetic phenomena with hints of a possible valence-bond condensation and absence of long-range spin order. Inelastic neutron scattering from powder specimen of $LiZn_2Mo_3O_8$ reveal the presence of gapless collective magnetic excitations at low-energy that are surprisingly broad in momentum space and involve at most a third of the spins. The corresponding structure factor is consistent with the presence of valence-bonds involving nearest-neighbor and next-nearest-neighbor spins [2]. No magnetic signal is apparent at higher energies, suggesting that the remaining spins contribute as a broad continuum rather than as a well defined resonance. $LiZn_2Mo_3O_8$ thus offers an example of molecular based spin-liquid material with collective excitations consistent with a disordered or dynamic ground-state.

[1] J. P. Sheckelton, J. R. Neilson, D. G. Soltan, and T. M. McQueen, Nature Mater. **11**, 493496 (2012).
[2] M. Mourigal, W. T. Fuhrman, J. P. Sheckelton, A. Wartelle, J. A. Rodriguez-Rivera, D. L. Abernathy, T. M. McQueen, and C. L. Broholm, arXiv:1309.1165

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