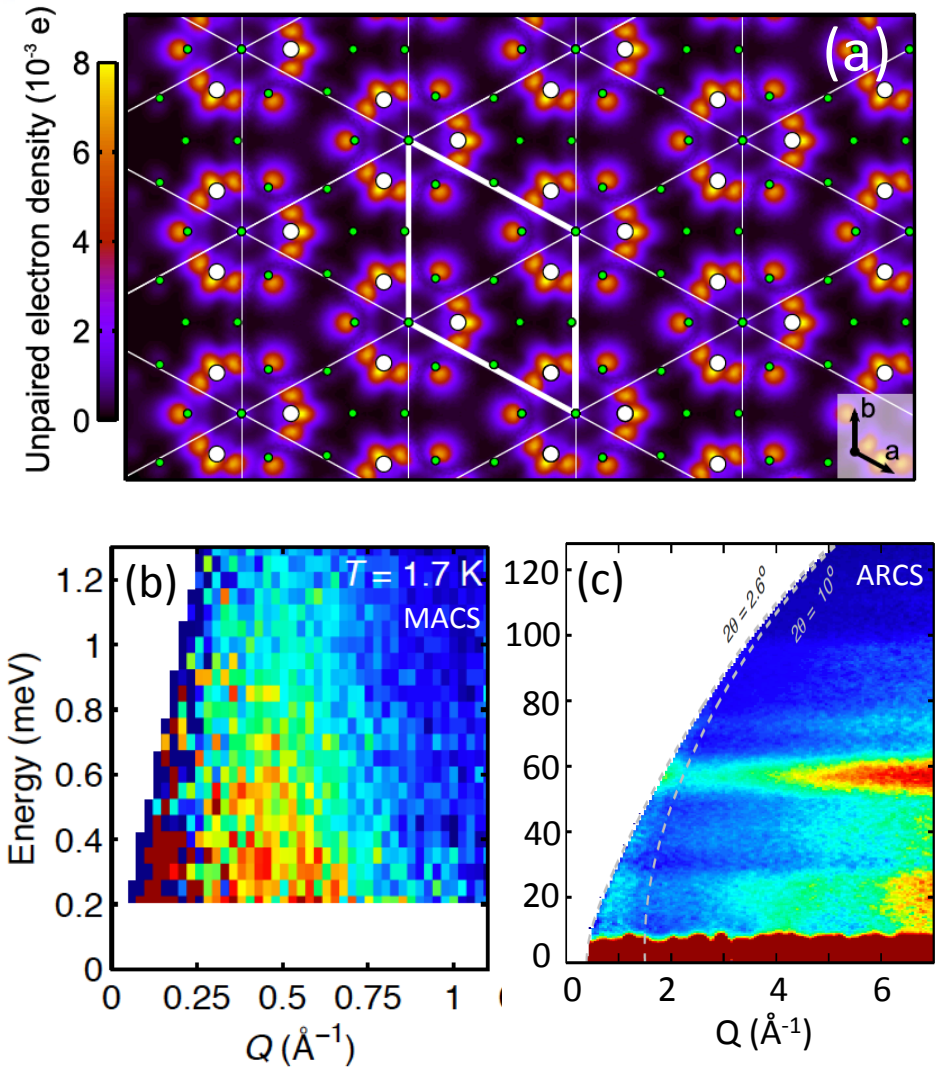
Molecular Quantum Magnetism in $LiZn_2Mo_3O_8$



Scientific Achievement

Evidence from neutron scattering for a quantum singlet dominated state of matter for a triangular lattice of triangular molecules discovered at IQM

Significance and Impact

Fluctuating in antiparallel pairs near the absolute zero temperature, the magnetic moments of electrons on neighboring Mo_3O_{13} molecules break with conventional magnetism to form a magnetic equivalent to liquid helium that does not freeze. Such a quantum state of magnetism has been proposed and sought for decades.

Research Details

- The molecular nature of $LiZn_2Mo_3O_8$ (a) is apparent from the non-dispersive lattice vibrations (c).
- High energy magnetic excitations do *not* take the form of sharp singlet-triplet modes (c)
- The extended electronic orbitals (a) strongly suppress magnetic scattering at high momentum, Q (b).
- The ridge of magnetic scattering at finite Q (b) indicates dynamic inter-molecular singlet formation
- Both near and next near neighbor singlets are in evidence from the detailed Q-dependence (b)
- The gapless spectrum (a) indicates resonating valence bonds or a random singlet state

M. Mourigal, W. T. Fuhrman, J. P. Sheckelton, A. Wartelle, J. A. Rodriguez-Rivera, D. L. Abernathy, T. M. McQueen, C. Broholm, Phys. Rev. Lett. **112**, 027202 (2014).

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