4CS19-2019-000030

Abstract for an Invited Paper
for the 4CS19 Meeting of
the American Physical Society

Discovery of Bose-Einstein Condensation in a Strongly Spin-Orbit Coupled Quantum Magnet[1]

GAVIN HESTER[2], Colorado State University

A canonical example of Bose-Einstein condensation (BEC) is the that of the ultracold gas, however, an often-overlooked example of BEC is that which occurs in quantum magnets. BEC occurs in quantum magnets when two spins are closely separated and entangle to form a singlet state. The system is then tuned to a BEC state by applying a magnetic field, the strength of which is determined by the single-triplet energy gap. This type of BEC has only been observed in 3d transition metal compounds, which typically have exchange interactions on the order of 1-10 meV. This leads to a large single-triplet gap and thus, large critical fields to enter the BEC. In this work we have discovered a BEC in a rare-earth magnet (Yb2Si2O7), which naturally exhibits lower energy exchange interactions (<1 meV). This has allowed us to bring previously inaccessible techniques to bear on the entire phase diagram. We have performed specific heat and ultrasound velocity measurements to map out the edges of the phase diagram, showing smaller critical fields then ever previously observed. For the first time ever we have directly probed the singlet-triplet excitations throughout the entire BEC phase diagram with inelastic neutron scattering. The discovery of this system allows for a new testing ground of BEC physics that is accessible to almost all conventional condensed matter probes.

[1]This research was supported by the National Science Foundation Agreement No. DMR-1611217.
[2]Harry Lustig Award Session