Shastry-Sutherland Compound ErB_4 – a Potential Spin Supersolid Candidate

M. Islam [1,2], A. Steppke [1], D. J. Gawryluk [1], R. Sibille [1], E. Ressouche [3], M. Medarde [1], P. F. S. Rosa [4], M. Janoschek [1,2]

1 PSI Center for Neutron and Muon Sciences CNM, 5232 Villigen PSI, Switzerland, 2 Physik-Institut, Universität Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland, 3 Université Grenoble Alpes, CEA, IRIG, MEM, MDN, 38000 Grenoble, France, 4 Los Alamos National Laboratory, Los Alamos, New Mexico 87545, USA

manishaislam@psi.ch

A spin supersolid is a magnetic quantum state that combines the properties of a rigid, crystalline spin solid and of a spin superfluid, which flows without friction and is analogous to the frictionless mass transport in conventional superfluids as observed in helium. It exhibits a solid-like magnetic order, like spins in a specific pattern on a lattice, but also allows a spin current to flow frictionlessly, breaking the lattice's translational symmetry. Quantum magnets that crystallize with magnetic ions sitting on a Shastry-Sutherland lattice (SSL) have been identified as candidates to host these exotic states [1-4]. Here we study the rare-earth tetraboride family, RB4, which crystallises into a tetragonal structure *P4/mbm)*, forming a network of squares and triangles within the *ab* plane that map onto the SSL [1, 2]. This structure gives rise to strong magnetic frustration, in which long-range magnetic order tends to be suppressed, resulting in a large degeneracy of the magnetic ground state. ErB_4 has been identified as an ideal candidate to investigate the interplay of magnetic frustration and anisotropy due to the Ising-like character of its magnetism and, in turn, for the search of these exotic spin phases [1, 5]. Using heat capacity, magnetocaloric, and single crystal neutron diffraction measurements, we have identified the existence of two previously unobserved phases allowing the construction of the phase diagram in Figure 1. Interestingly, these phases are located between the collinear antiferromagnetic (CAFM) and half-plateau (HP) orders and the HP and field-polarised (FP) regions, which is precisely where theory predicts the spin supersolid and superfluid phases to exist [1].

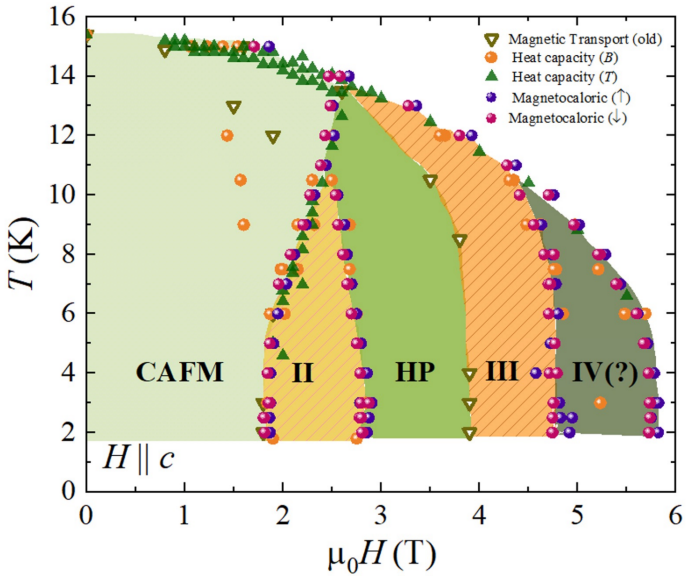


Figure 1. *Phase diagram of ErB_4 constructed with heat capacity measurements with both varying field and temperature, magnetocaloric measurements with field ramped up and down and transport measurements taken from [1].*

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