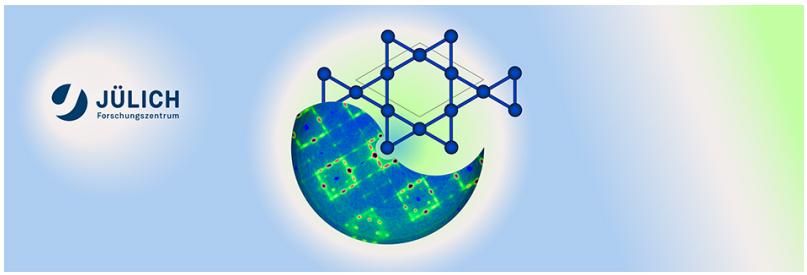

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Magnetism of a frustrated triangular lattice antiferromagnet

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The study of geometrically frustrated systems with antiferromagnetically (AFM) ordered spins has recently gained considerable attention for their exotic quantum magnetic properties. In order to explore effects related to quantum magnetism we investigate the triangular AFM $Na_2BaMn(PO_4)_2$, a compound with S=5/2.

By performing single crystal neutron diffraction and theoretical modeling, for magnetic fields applied in the basal plane and along the c-axis of the trigonal symmetry. At zero field the system undergoes two successive magnetic transitions at about 1.25 K (AFM2) and 1.1 K (AFM1), respectively. The out-of-plane incommensurate component k of the propagation vector (1/3, 1/3, k) exhibits a significant change in the two phases and potentially indicates non-negligible interlayer couplings. Depending on the field direction, Na2BaMn(PO4)2 undergoes several magnetic field induced transitions, which are accompanied by changes in the propagation vector, before reaching the spin polarized state. Combining neutron diffraction, low-temperature specific heat and magnetization we construct the temperature-magnetic field phase diagrams for the two field directions. The performed ab initio calculations and Monte Carlo simulations are crucial for the interpretation of the ground state, phase diagrams, and 3D structure. They show that the frustration mechanism involves out-of-plane couplings, and perfectly describe the constructed phase diagram.

This combined experimental and theoretical study reveals that $Na_2BaMn(PO_4)_2$ is a 2D-system with a weak 3D coupling acting only as a “witness” for what is happening in two dimensions. The separation between the two zero-field transitions (AFM1 and AFM2) depends on XXZ nature of the anisotropy and on the 3D coupling. Finally, we compare our results with the Co (with S=1/2) and Ni (with S=1) counterparts and we discuss their similarities and differences.

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