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Distorting an antiferromagnetic kagome lattice: Magnetism of single-crystalline clinoatacamite

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The spin-1/2 Heisenberg model on the antiferromagnetic kagome lattice is one of the fundamental models in frustrated quantum magnetism with a predicted quantum spin liquid (QSL) ground state, spinon excitations and a complex sequence of magnetization plateaus in applied magnetic fields [1-3]. From an experimental viewpoint, the mineral herbertsmithite with uniform couplings in the kagome layer stands out as candidate material featuring a QSL ground state [4]. Recent advances in quantum magnetism also explicitly cover deformed kagome lattices leading to many different motifs of non-uniform exchange couplings containing novel physics (see, for instance, Refs. [5,6]).

Here, we present a combined experimental and theoretical study on clinoatacamite, $Cu_2Cl(OH)_3$ [7], a mineral which is closely related to herbertsmithite. By means of density-functional theory we have derived the dominant magnetic exchange paths in this material forming non-uniform antiferromagnetic kagome layers of Cu sites with weak ferromagnetic coupling to the interlayer Cu site. Experimentally, we have investigated the zero-field magnetic phase diagram of clinoatacamite by means of thermodynamic measurement techniques as well as neutron diffraction using for the first time single-crystalline material. In agreement with earlier studies, we have found a transition of little entropic change at $T_N = 18.1$ K (with an order parameter developing below this temperature) [8]. Further, we have resolved for the first time a sequence of two close-lying transition anomalies at 6.2 and 6.4 K, which leads to a large entropy change in the material. We have refined the magnetic structure at 1.7 K based on single-crystal neutron diffraction data and present inelastic neutron scattering results revealing the low-energy spin excitations in the same temperature region.

[1] C. Broholm *et al.*, Science **367**, eaay0668 (2020).
[2] L. Balents, Nature **464**, 199 (2010).
[3] S. Nishimoto *et al.*, Nat. Commun. **4**, 2287 (2013).
[4] P. Khuntia *et al.*, Nat. Phys. **16**, 469 (2020).
[5] O. Janson *et al.*, Phys. Rev. Lett. **117**, 037206 (2016).
[6] K. Matan *et al.*, Nat. Phys. **6**, 865 (2010).
[7] J. D. Grice *et al.*, Can. Mineral. **34**, 73 (1996).
[8] X. G. Zheng *et al.*, Phys. Rev. Lett. **95**, 057201 (2005).

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