Incommensurate and multiple-q magnetic misfit order in the frustrated quantum spin ladder material antlerite, $Cu_3SO_4(OH)_4$

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In frustrated magnetic systems, the competition amongst interactions can introduce extremely high degeneracy and prevent the system from readily selecting a unique ground state. In such cases, the magnetic order is often exquisitely sensitive to the balance among the interactions, allowing tuning among novel magnetically ordered phases. We present antlerite, $Cu_3SO_4(OH)_4$, as a potential platform for tuning frustration. Contrary to previous reports, the low-temperature magnetic state of its three-leg zigzag ladders is a quasi-one-dimensional analogue of the magnetic state recently proposed to exhibit spinon-magnon mixing in botallackite [1]. In addition to this low-temperature phase of coupled ferromagnetic and antiferromagnetic spin chains, in zero field antlerite hosts an incommensurate helical+cycloidal state, an idle-spin state, and a multiple-q phase which is the magnetic analog of misfit crystal structures [2]. The antiferromagnetic order on the central leg is reentrant. Density functional theory calculations indicate that antlerite's magnetic ground state is exquisitely sensitive to fine details of the atomic positions [3], with each chain independently on the cusp of a quantum phase transition, indicating an excellent potential for tunability, and making antlerite a particularly promising platform for pursuing exotic magnetic order.

References:

1

H. Zhang, *et al.*, Phys. Rev. Lett. **125**, 037204 (2020).

2

A. A. Kulbakov *et al.*, arXiv:2207.05606.

3

A. A. Kulbakov *et al.*, Phys. Rev. B **106**, L020405 (2022).