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Novel magnetic textures in $SrCu_2(BO_3)_2$ from magnetostriction up to 97.4 tesla[1]

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Quantum magnets are model systems wherein strongly frustrated spin interactions generate a variety of exotic magnetic phases of current interest, including quantum spin ices, spin liquids, spin supersolids and complex magnetic superstructures. $SrCu_2(BO_3)_2$, the only classic realization of the spin-1/2 Heisenberg antiferromagnet in the Shastry-Sutherland (orthogonal spin dimer) lattice is known to exhibit numerous magnetization plateaus due formation of stripe-like magnetic textures in high fields. However, the fine structure of these plateaus remains controversial on both experimental and theoretical fronts due to the existing limits for achievable magnetic fields in the laboratory, the sensitivity of current magnetization techniques, and the uncontrolled nature of available theoretical approaches for highly frustrated magnetic lattices. This talk will describe how we probe magnetic textures in $SrCu_2(BO_3)_2$ via a recently-developed *magnetostriction* technique based on optical fiber Bragg gratings [1]. We achieve microstrain (nm-resolution) sensitivity in ultrahigh pulsed fields to 97.4 T using the NHMFL 100 tesla multi-pulse magnet system [2]. The magnetostriction data reveal fine structure corresponding to all magnetization plateaus, and a significant lattice response to the long-predicted 1/2-saturation plateau at 82 T, as well as a new feature at 73.6 T that we attribute to a never before observed structure corresponding to 2/5 of magnetization saturation [3]. These data are complemented by simultaneous magnetocaloric-effect measurements, and are supported by numerical results obtained using a controlled density matrix renormalization group method.

[1] Daou R. et al., *Rev. Sci. Instrum.* **81**, 033909 (2010).
[2] Sims J.R., et al. IEEE Trans. Appl. Supercond. 18, 587-591 (2008).
[3] M. Jaime et al., submitted. In collaboration with R. Daou, S.A. Crooker, F. Weickert, A. Uchida, A. Feiguin, C.D. Batista, H. Dabkowska, and B. Gaulin.

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