

# Frustrated Magnetism and Spin Transitions via Lattice Magneto-Strain Measurements in Pulsed Magnetic Fields to 100 Tesla

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Strong geometrical frustration in magnets leads to exotic states, such as spin liquids, spin supersolids and complex magnetic textures.  $\text{SrCu}_2(\text{BO}_3)_2$ , a spin-1/2 Heisenberg antiferromagnet in the archetypical Shastry-Sutherland lattice, exhibits a rich spectrum of magnetization plateaus and stripe-like magnetic textures in applied fields. We reveal new magnetic textures via optical FBG magnetostriction and magnetocaloric measurements in fields up to 100.75 Tesla at 73.6 T and at 82 T which we attribute, using a controlled density matrix renormalization group approach, to a new 2/5 plateau, and to the long-predicted 1/2-saturation plateau<sup>[1]</sup>.  $\text{BiCu}_2\text{PO}_6$  is a frustrated two-leg spin ladder compound with a spin gap that can be closed with a magnetic field of approximately 20T. Magnetization, magnetostriction and specific heat vs magnetic fields to 65 T were used to obtain the anisotropic (H,T) phase diagram in single crystal samples for the first time. We propose that the anisotropy and complex phase diagram result from the interplay between strong geometrical frustration and spin orbit interaction<sup>[2]</sup>. Time permitting, I will also discuss briefly the case of  $\text{LaCoO}_3$ , where magnetic fields can be used to induce a series of spin transitions at  $H \lesssim 60$  T that have large effects in the lattice. <sup>[3]</sup>. Work at the NHMFL was supported by the National Science Foundation, the US Department of Energy, and the State of Florida.

<sup>[1]</sup> M. Jaime, et al. PNAS 109, 12407 (2012). <sup>[2]</sup> Y. Kohama et al., Phys. Rev. Lett. (2012) in the press. <sup>[3]</sup> M.M. Altarawneh et al., Phys. Rev. Lett. 109, 037201 (2012).