

Neutron Scattering Studies of Spin-1/2 Quantum Antiferromagnets with Strong Quantum Spin Fluctuations

Qing Huang

Department of Physics and Astronomy,
University of Tennessee

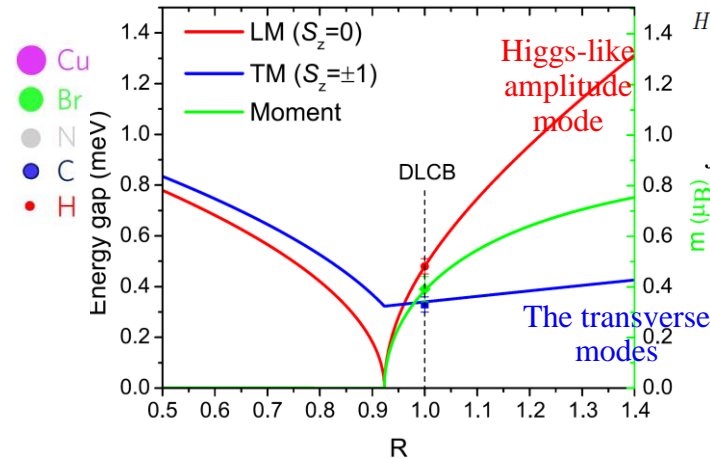
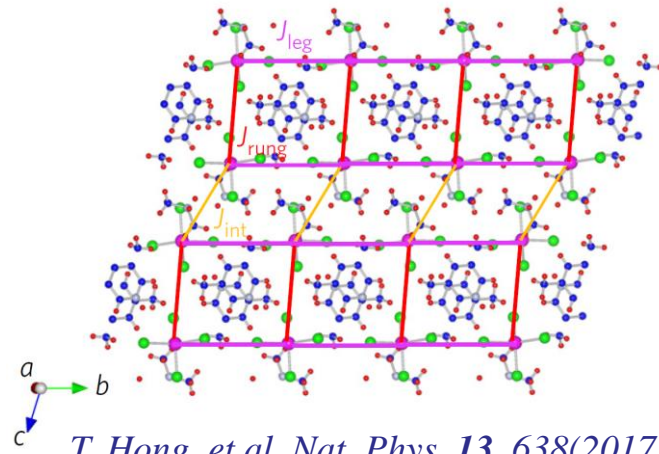
Mentor: Tao Hong

Neutron Scattering Division, Oak Ridge National
Laboratory

04-26-2018

Effect of Hydrostatic Pressure on DLCB

➤ DLCB: a 2D $S = 1/2$ antiferromagnet near the quantum critical point at ambient pressure



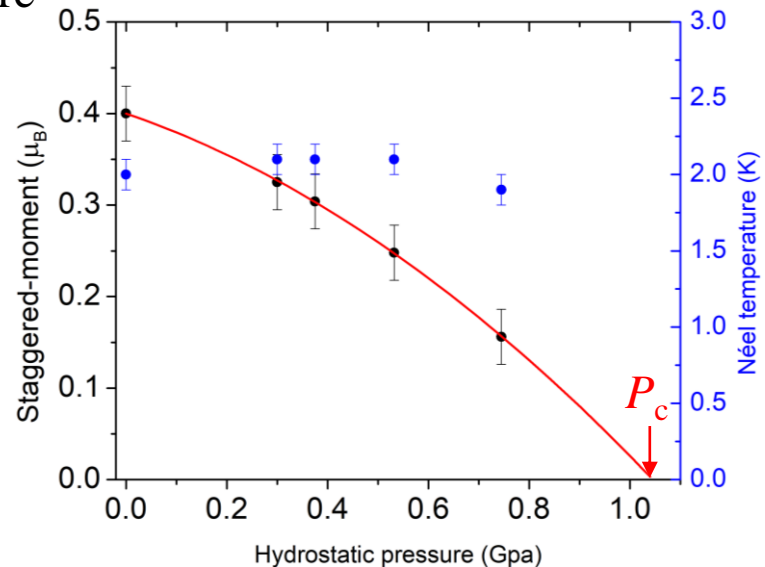
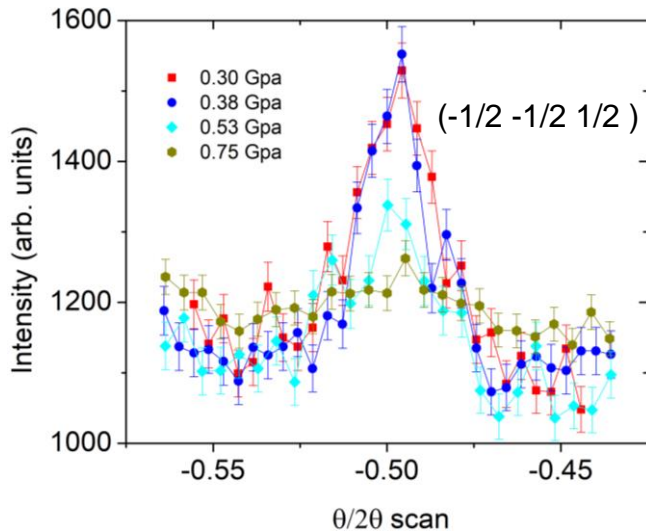
$$H = \sum_{\alpha, (i,j) \in \alpha\text{-link}} J_{\alpha} [S_i^z S_j^z + \lambda (S_i^x S_j^x + S_i^y S_j^y)]$$

Based on the fitting of excitation spectra:
 $J_{\text{leg}}=0.60(4)$ meV, $J_{\text{rung}}=0.64(9)$ meV,
 $J_{\text{int}}=0.19(2)$ meV and $\lambda=0.93(2)$

With the bond operator calculations:
 J_{rung} is fixed
 $J_{\text{leg}}^* = R \times J_{\text{leg}}$
 $J_{\text{int}}^* = R \times J_{\text{int}}$

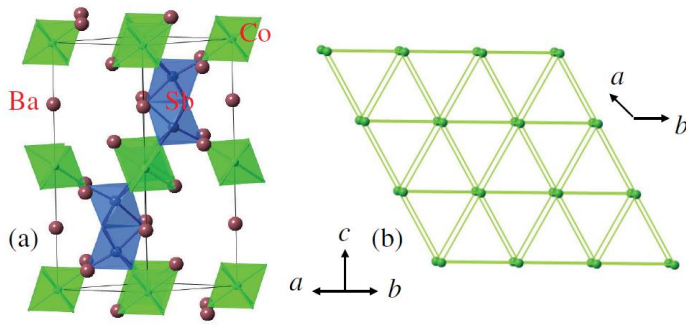
Quantum Critical Point (QCP) is located at $R_c=0.93$ ($R=1$ for DLCB)
 So DLCB is close to QCP

➤ Tune the ground state by hydrostatic pressure

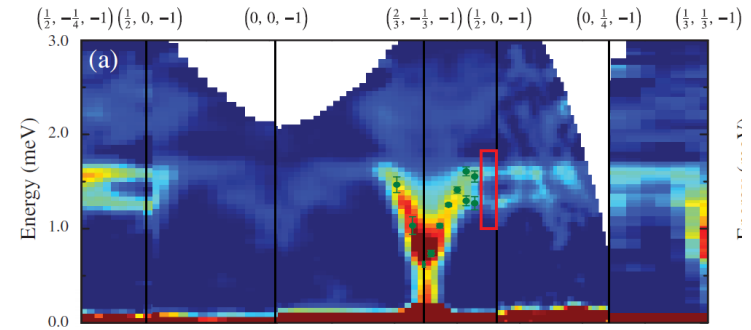


Effect of Chemical Pressure on $\text{Ba}_3\text{CoSb}_2\text{O}_9$

- $\text{Ba}_3\text{CoSb}_2\text{O}_9$: a 2D effective $S = 1/2$ triangular-lattice antiferromagnet

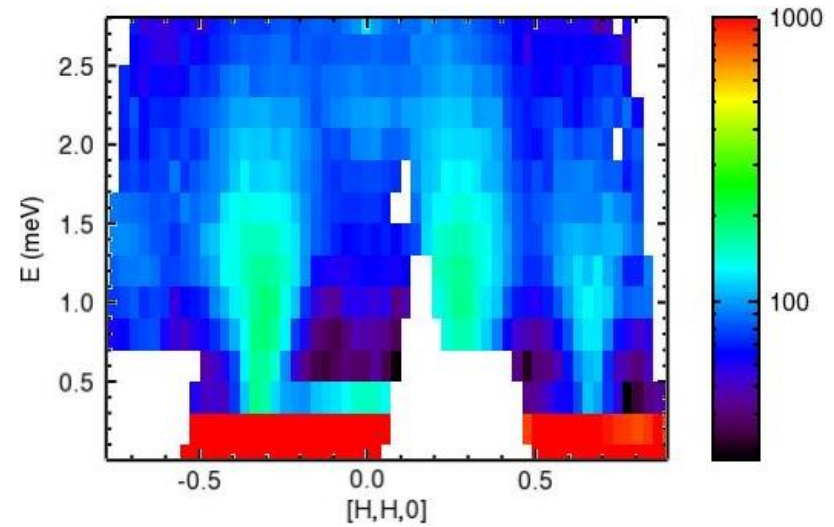
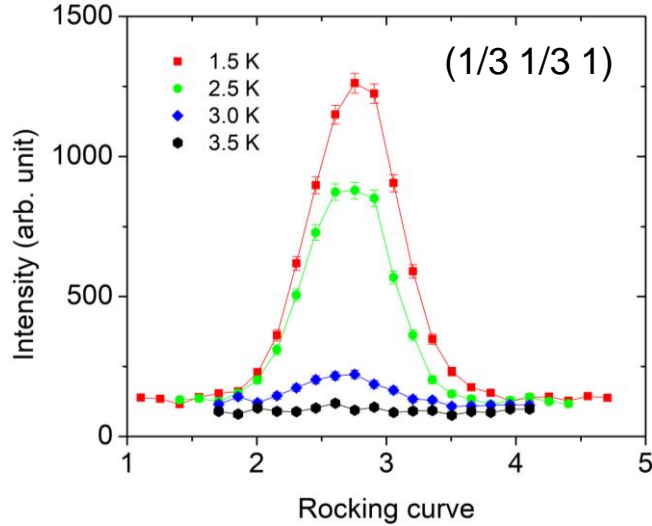


H. D. Zhou, et al. PRL 109, 267206(2012)



J. Ma, et al. PRL 116, 087201(2016)

- Tune the ground state by chemical pressure in $\text{Ba}_{2.8}\text{Sr}_{0.2}\text{CoSb}_2\text{O}_9$

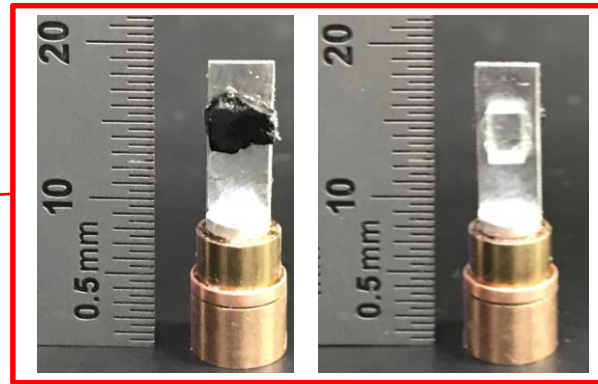
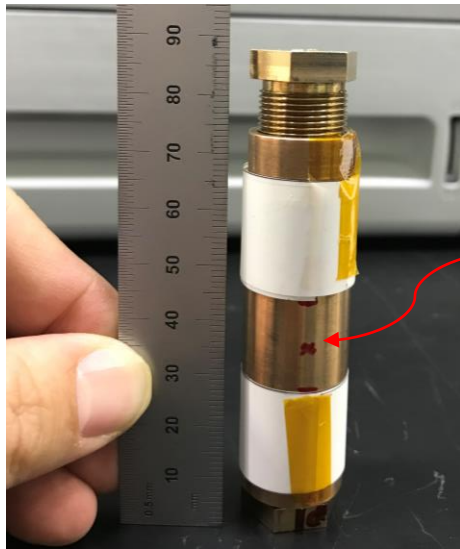


Future plan

➤ $\text{Ba}_{2.8}\text{Sr}_{0.2}\text{CoSb}_2\text{O}_9$

(i) Solve the magnetic structure at zero field and conduct elastic neutron scattering measurements at finite fields

(ii) To study the effects of site disorder on spin dynamics, analyze inelastic neutron scattering data at zero field and make further measurements at finite fields



➤ DLCB

(i) Determine the critical pressure P_c where the long-range magnetic ordering disappears.

(ii) Study effect of hydrostatic pressure on spin dynamics with inelastic neutron scattering.