# Magnetic Phase Transitions and Multiferroicity in Quasi-two-dimensional Spin-1/2 Triangular Lattice Antiferromagnet $Ba_3CoNb_2O_9$

J. Hwang (FSU Physics, NHMFL); E. S. Choi (NHMFL); H. D. Zhou (NHMFL, Univ. of Tennessee);
P. Schlottmann (FSU Physics, NHMFL)

## Introduction

The magnetic and electric properties of $Ba_3CoNb_2O_9$ are investigated by the AC magnetic susceptibility and the magnetoelectric property measurements. The *H-T* phase diagram reveals multiferroicity and a series of phase transitions under magnetic fields.

## Experimental

The dielectric constant and the pyroelectric current measurement were done on polycrystalline samples with parallel capacitor geometry. The polarization was obtained by integration of the pyroelectric current with respect to time. All the measurements were conducted with the 18 T SCM2 magnet.

## Results and Discussion

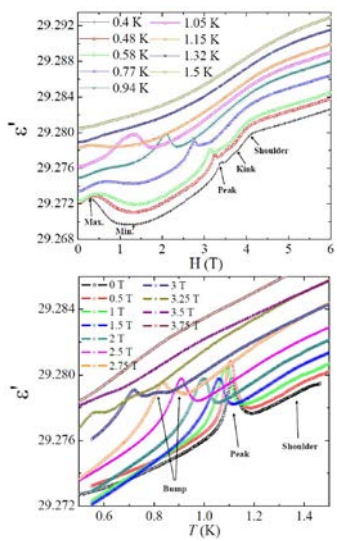


**Figure 1** The field and temperature dependence of the dielectric constant of $Ba_3CoNb_2O_9$.

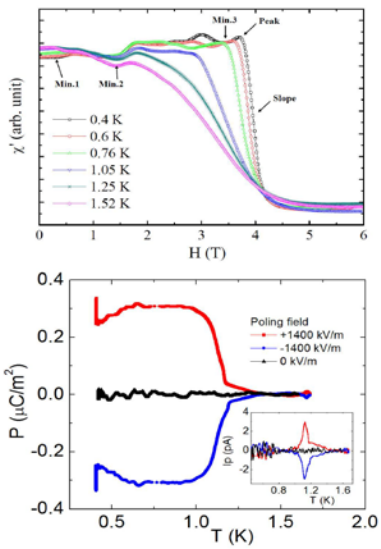


**Figure 2** The H-dependence of the AC susceptibility and the temperature dependence of polarization at H=0 T. The inset shows the pyroelectric current.

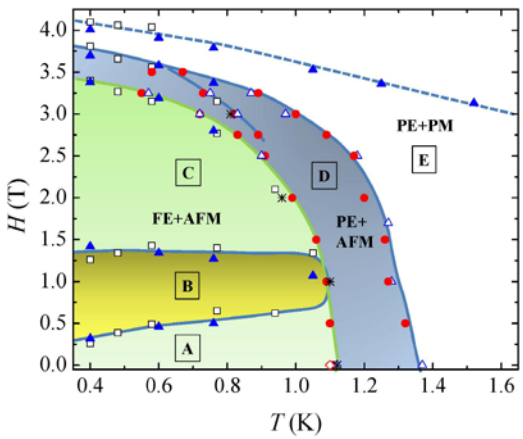


**Figure 3** *H-T* phase diagram for $Ba_3CoiNb_2O_9$ from different experimental techniques (▲,Δ: AC susceptibility; □, •: dielectric constant, *: polarization, ◊: specific heat).

The magnetoelectric properties of $Ba_3CoNb_2O_9$ show characteristic features of ferroelectric transitions as shown in **Figure 1** and **Figure 2** (lower panel). The AC susceptibility measurements confirmed the transitions have magnetic origins, which suggests multiferroicity is likely a generic feature in $Ba_3MNb_2O_9$ (*M*=Ni (S=1), Mn (S=5/2), Co (S=1/2)) [1]. Besides similarities among the compounds; 120 deg antiferromagnetic ordering at zero field, multiferroicity, successive magnetic transitions, the *H-T* phase diagram (see Figure 3) of $Ba_3CoNb_2O_9$ (S=1/2 at low temperatures [2]) is more complicated compared to the other compounds with higher spin numbers. It is probable that the difference is related to the higher degree of the quantum fluctuation and the single ion spin anisotropy in $Ba_3CoNb_2O_9$.

## Acknowledgements

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## References

[1] Hwang, J., *et al.*, Phys. Rev. Lett. **109**, 256401 (2012) and NHMFL Annual Report (2012).
[2] Shrita, Y., *et al.*, Phys. Rev. Lett. **108**, 057205 (2012).