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Multiferroic behavior at a spin state transition VIVIEN ZAPF, SHALINEE CHIKARA, JOHN SINGLETON, National High Magnetic Field Laboratory, Los Alamos National Lab (LANL), SHIZENG LIN, CRISTIAN BATISTA, Theory Division, LANL, BRIAN SCOTT, MPA-11, LANL, NATHAN SMYTHE, Chemistry Division C-IIAC, LANL — Traditionally, multiferroic behavior is studied in materials with coexisting long-range orders, such as ferromagnetism and ferroelectricity. Here we present multiferroic behavior at a spin-state transition (SST). SSTs, for example, the S = 1 to S = 2 transition in Mn^{3+} can become cooperative magneto-structural phase transitions due to structural coupling between ions. SSTs are accompanied by change in the orbital occupation and hence, strongly coupled to the lattice and charge degrees of freedom. They are a dominant functionality in metal-organic materials, persisting up to room temperature in some compounds. We demonstrate that a magnetic SST can induce ferroelectricity. We study a Mn-based metal-organic system in which a three-fold degenerate dynamic Jahn-Teller effect at high temperatures vanishes when the temperature is lowered, and the system drops into a lower spin state. Application of a magnetic field restores the high spin Jahn-Teller-active state and allows the Jahn Teller distortions to order cooperatively, creating a dielectric constant change and a net electric polarization. We use high magnetic fields at the NHMFL to study the magnetic and electric behavior of this system across a significant fraction of its T-H phase space, and compare to theoretical modeling.

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