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Spontaneous spin-lattice coupling in the geometrically frustrated triangular lattice antiferromagnet CuFeO2[1]

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We use high-resolution synchrotron x-ray and neutron diffraction to study the geometrically frustrated triangular lattice antiferromagnet $CuFeO_2$. On cooling from room temperature, $CuFeO_2$ undergoes two antiferromagnetic phase transitions with incommensurate (IC) and commensurate magnetic order at T_{N1}=14 K and T_{N2}=11 K, respectively. The occurrence of these two magnetic transitions is accompanied by second- and first-order structural phase transitions from hexagonal to monoclinic symmetry. Application of a 6.9 T magnetic field lowers both transition temperatures by 1 K, and induces additional IC structural and magnetic modulations in the temperature region where magnetoelectric behavior has been observed.[§] These results show that a strong magneto-elastic coupling is intimately related to the multiferroic effect. It is believed that the IC magnetic structure is noncollinear because this would break the inversion symmetry, as required for the appearance of multiferroic behavior. Because the multiferroic phase appears only in a high magnetic field it is not possible to perform a full crystallographic study to demonstrate this noncollinearity, and an indirect method is being pursued that involves the measurement and characterization of the spin dynamics of this system using neutron scattering. This novel approach probes the link between multiferroelectricity and the appearance of noncollinear IC magnetic structures. [§]Ye et al, Phys. Rev. B 73, 220404 (R) (2006)

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