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Spin waves and phonons in a paraelectric antiferromagnet EuTiO_3 ¹ HUIBO CAO, JIAWANG HONG, OLIVIER DELAIRE, STEVEN HAHN, GEORG EHLERS, SONGXUE CHI, VASILE GARLEA, JAIME FERNANDEZ-BACA, BRYAN CHAKOUMAKOS, JIAQIANG YAN, BRIAN SALES, Oak Ridge National Laboratory — Perovskite titanates ATiO_3 (A=Ba,Pb,Sr,Ca,Cd,or Eu) are widely studied for their interesting instabilities and broad applications. A ferroelectric (FE) transition occurs in Ba, Pb, and Cd titanates, but not in SrTiO_3 (STO) or EuTiO_3 (ETO). In the case of STO, fluctuations yield a quantum paraelectric state, but whether ETO is quantum paraelectric remains an open question. Despite a number of similarities with well-studied STO, ETO is also unique owing to the magnetic Eu ions. By applying a tuning parameter, such as bi-axial tension, ETO can be turned into a FE ferromagnet, the ideal multiferroic. [J. H. Lee, et al., Nature 466, 954 (2010)] Studies of spin-spin and spin-lattice couplings in ETO are of great interest not only from a fundamental standpoint, but also for technological applications. We successfully grew a large, high-quality isotopically-enriched ETO crystal for neutron scattering. The crystal and magnetic structures were characterized with single crystal diffraction at HB-3A at HFIR at ORNL. The spin waves and phonons were measured in the temperature range of 1.5-400 K with CNCS at SNS and HB-3 at HFIR at ORNL. In this presentation, we will discuss structural instabilities, spin-spin interactions, and spin-phonon couplings in ETO.

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