Ultrafast pump-probe reflectance study of multiferroic \( \text{Eu}_{0.75}\text{Y}_{0.25}\text{MnO}_3 \)

DIYAR TALBAYEV, ANTOINETTE J. TAYLOR, Los Alamos National Laboratory, RICHARD D. AVERITT, Boston University, CHENGLIN ZHANG, SANG-WOOK CHEONG, Rutgers University — Dynamical studies of multiferroic materials help unravel the fundamental interactions between various degrees of freedom and answer technological questions such as achievable switching speeds in multiferroic-based memory elements. We report the results of the ultrafast pump-probe reflectance study of multiferroic \( \text{Eu}_{0.75}\text{Y}_{0.25}\text{MnO}_3 \). The material undergoes antiferromagnetic ordering and, upon further cooling, ferroelectric ordering that strongly couples to the material’s magnetic state. We measured the relaxation time of the pump-probe reflectance in this compound using 800-nm pump and probe pulses. The temperature dependence of the relaxation time follows that of the low-energy spectral weight that includes phonons and electro-active magnons [1]. This suggests a strong coupling between electronic (1.55 eV) and low-energy electro-active excitations in \( \text{Eu}_{0.75}\text{Y}_{0.25}\text{MnO}_3 \) that can be tuned by magnetic field. The relaxation time increases upon the application of magnetic field along the crystal’s \( c \)-axis in the ferroelectric phase, but exhibits no change in the paraelectric phase. Our results indicate the importance of multiple energy scales (electronic, lattice, and magnetic) for the multiferroicity of \( \text{Eu}_{0.75}\text{Y}_{0.25}\text{MnO}_3 \). 1. R. Valdes Aguilar et al, Phys. Rev. B 76, 060404(R) (2007)