Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Phonon Bottleneck in the Single-Molecule Magnet Fe_8 Induced by Pulsed Millimeter-Wave Radiation M. BAL, JONATHAN FRIEDMAN, Department of Physics, Amherst College, Amherst, MA 01002, WEI CHEN, Physics Department, Stony Brook University, Stony Brook, NY 11794, MARK TUOMINEN, Physics Department, University of Massachusetts, Amherst, MA 01003, EVAN RUMBERGER, DAVID HENDRICKSON, Department of Chemistry and Biochemistry, University of California at San Diego, La Jolla, CA 92093 — We report measurements of the magnetization dynamics of the Fe_8 single-molecule magnet on timescales as short as ∼10 ns using millimeter-wave radiation to drive transitions between the ground ($m = 10$) and first excited ($m = 9$) states. We find that during the radiation pulse the magnetization decreases linearly, while afterwards it decays exponentially back to its initial value with a long time constant of ∼10 μs. We interpret these results as evidence of a phonon bottleneck in which a non-equilibrium number of phonons resonant with the 10- to-9 transition builds up in the crystal, leading to an population increase in the m = 9 state. The time for these phonons to decay (either by escaping the crystal or through scattering) is interpreted to be the measured ∼10 μs. We observe that the phonon bottleneck is established in less than ∼15 ns, which suggests that the spin-phonon relaxation time T_1 is (rather unexpectedly) shorter than this value.

Department of Physics, Amherst College, Amherst, MA, 01002; 2. Physics Department, University of Massachu

Date submitted: 20 Nov 2006 Electronic form version 1.4