Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Collective coupling of $\sim 10^{16}$ Fe_8 single-molecule magnets to a resonant cavity[1] ANDREW EDDINS, JONATHAN FRIEDMAN, Department of Physics, Amherst College, CHRISTOPHER BEEDLE, DAVID HENDRICKSON, Department of Chemistry and Biochemistry, UCSD — When a spin resonantly couples to the electromagnetic mode of a cavity, spin and photon states hybridize producing entangled states and a "vacuum Rabi splitting" between the states. The magnetic-dipole transition between the coupled states results in a splitting <100 s^{-1}, practically unmeasurable. The well-known model of Tavis and Cummings [1] predicts that for N spins coupled to the cavity, the vacuum Rabi splitting is enhanced by $\sqrt{N}$. We performed a reflection spectroscopy experiment at 1.75 K on a single crystal of the Fe_8 single-molecule magnet (SMM) in a cylindrical cavity with a bare frequency of 147.6 GHz. An applied magnetic field brings the SMMs to resonance with this mode, resulting in an observed splitting of $\sim 3.4 \times 10^9$ s^{-1}. This value corresponds to $N \sim 2 \times 10^{16}$ Fe_8 SMMs collectively coupled to the cavity. From the dimensions of the crystal, we estimate a total of $N \sim 6 \times 10^{16}$ SMMs in the sample, suggesting that a substantial fraction of the crystal's molecules are simultaneously coupled to the cavity. As temperature is increased, N decreases, reducing the observed splitting. [1] Phys. Rev., **170**, 379 (1968).

[1]Support: NSF grant no. DMR-0449516

Jonathan Friedman
Department of Physics, Amherst College

Date submitted: 20 Nov 2009 Electronic form version 1.4