Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

**Non-diffusive thermal conductivity in semiconductors at room temperature** ALEXEI MAZNEV, JEREMY JOHNSON, JEFFREY ELIASON, KEITH NELSON, AUSTIN MINNICH, KIMBERLEE COLLINS, GANG CHEN, Massachusetts Institute of Technology, JOHN CUFFE, TIMOTHY KEHOE, CLIVIA SOTOMAYOR TORRES, Catalan Institute of Nanotechnology — The "textbook" value of phonon mean free path (MFP) in silicon at room temperature is ~40 nm. However, a large contribution to thermal conductivity comes from low-frequency phonons with much longer MFPs. We find that heat transport in semiconductors such as Si and GaAs significantly deviates from the Fourier law at distances much longer than previously thought, $\geq$1 $\mu$m at room temperature and above. We use the laser-induced transient thermal grating technique in which absorption of crossed laser pulses in a sample sets up a sinusoidal temperature profile monitored via diffraction of a probe laser beam. By changing the period of the thermal grating we vary the thermal transport distance within the range ~1-10 $\mu$m. In measurements performed on thin free-standing Si membranes and on bulk GaAs the thermal grating decay time deviates from the expected quadratic dependence on the grating period, thus providing model-independent evidence of non-diffusive transport. The simplicity of the experimental configuration permits analytical treatment of non-equilibrium phonon transport with the Boltzmann transport equation. Our analysis shows that at small grating periods the effective thermal conductivity is reduced due to diminishing contributions of "ballistic" low-frequency phonons with long MFPs.

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Date submitted: 11 Nov 2011 Electronic form version 1.4