Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Supercollisions and Electron-Lattice Cooling in Graphene JUSTIN SONG, School of Engineering and Applied Sciences, Harvard and Department of Physics, MIT, MICHAEL REIZER, None, LEONID LEVITOV, Department of Physics, MIT — Hot carrier proliferation is dependent on slow cooling between electron and lattice systems. In graphene, these cooling rates can be slow due to a small Fermi surface size and the momentum-conserving character of electron-phonon scattering. This in concert with the small ratio between the sound velocity, s, and the Fermi velocity, v_F, such that $s/v_F = 1/100$ produces a phase space constrained by the Fermi wavevector, k_F. In each of these first order scattering events, the energy exchanged between electronic and lattice systems is of the order $T_{\rm BG} = s\hbar k_F$ which at typical doping densities can be many times smaller than k_BT; non-thermal phonons are the dominant contributors to scattering dramatically suppressing cooling power. This constraint can be lifted by considering "supercollisions" that utilize the full thermal distribution of phonons. While the frequency of supercollisions may be lower than the first order process, energy transfer for supercollisions is now on the order of k_BT which is many times larger than the first order process. We we will show that this large exchange of energy allows supercollisions to give a dramatic boost to the cooling rate dominating over the first order process.

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Date submitted: 27 Nov 2011

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