Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Multiple regimes of carrier cooling in photoexcited graphene probed by time-resolved terahertz spectroscopy A.J. FRENZEL, MIT / Harvard University, N.M. GABOR, MIT, P.K. HERRING, MIT / Harvard University, W. FANG, J. KONG, P. JARILLO-HERRERO, N. GEDIK, MIT — Energy relaxation and cooling of photoexcited charge carriers in graphene has recently attracted significant attention due to possible hot carrier effects, large quantum efficiencies, and photovoltaic applications. However, the details of these processes remain poorly understood, with many conflicting interpretations reported. Here we use time-resolved terahertz spectroscopy to explore multiple relaxation and cooling regimes in graphene in order to elucidate the fundamental physical processes which occur upon photoexcitation of charge carriers. We observe a novel negative terahertz photoconductivity that results from the unique linear dispersion and allows us to measure the electron temperature with ultrafast time resolution. Additionally, we present measurements of the relaxation dynamics over a wide range of excitation fluence. By varying the pump photon energy, we demonstrate that cooling dynamics of photoexcited carriers depend on the amount of energy deposited in the graphene system by the pump pulse, not the number of absorbed photons. The data suggest that fundamentally different regimes are encountered for different excitation fluences. These results may provide a unifying framework for reconciling various measurements of energy relaxation and cooling in graphene.

Alex Frenzel
MIT / Harvard University

Date submitted: 17 Dec 2012 Electronic form version 1.4