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**Ultrafast relativistic response of Photo-excited Carriers in Graphene**[1] J. LEE, K.M. DANI, CINT, Los Alamos National Laboratory, R. SHARMA, Theoretical Division, Los Alamos National Laboratory, A.D. MOHITE, A.M. DATTELBAUM, H. HTOON, A.J. TAYLOR, R.P. PRASANKUMAR, CINT, Los Alamos National Laboratory, C.M. GALANDE, P.M. AJAYAN, Dept. of Mechanical Engineering and Materials Science, Rice University — Understanding the ultrafast non-equilibrium dynamics of photocarriers in graphene's unique relativistic band structure is important for the development of such high-speed, graphene-based photonic devices and also from a fundamental point of view. Here, we directly demonstrate the relativistic nature of a non-equilibrium gas of electrons and holes photogenerated in a graphene monolayer as early as 100 femtoseconds (fs) after photoexcitation. We photoexcited carriers in graphene and then measured the time-resolved, pump-induced change in reflection at various visible probe photon energies. We observe a nonlinear scaling in the Drude-like optical conductivity of the photocarriers with respect to their density, in striking contrast to the linear scaling expected from conventional materials with parabolic dispersion relations.

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