Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Nonlinear optical conductivity and subharmonic instabilities of graphene in a strong electromagnetic field ZHIYUAN SUN, DIMITRI BASOV, MICHAEL FOGLER, Department of Physics, University of California San Diego, 9500 Gilman Drive, La Jolla, California 92093 — We study theoretically the second-order nonlinear optical conductivity $\sigma^{(2)}$ of graphene as a function of frequency and momentum. We distinguish two regimes. At frequencies ω higher than the temperature-dependent electron-electron collision rate γ_{ee}^{-1}, the conductivity $\sigma^{(2)}$ can be derived from the semiclassical kinetic equation. The calculation requires taking into account the photon drag (Lorentz force) due to the ac magnetic field. In the low-frequency hydrodynamic regime $\omega \ll \gamma_{ee}^{-1}$, the nonlinear conductivity has a different form and the photon drag effect is suppressed. As a consequence of the nonlinearity, a strong enough photoexcitation can cause spontaneous generation of collective modes in a graphene strip: plasmons in the high-frequency regime and energy waves (demons) in the hydrodynamic one. The dominant instability occurs at frequency $\omega/2$.

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Date submitted: 20 Nov 2016

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