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Giant optical nonlinearity of graphene in a strong magnetic field[1]

XIANGHAN YAO, ALEXEY BELYANIN, Texas A&M University — We demonstrate theoretically that graphene placed in a strong magnetic field possesses by far the highest third-order optical nonlinearity among all known materials. The giant nonlinearity originates from unique electronic properties and selection rules near the Dirac points, which gives rise to resonantly enhanced nonlinear response. We present rigorous and intuitive quantum-mechanical density-matrix formalism for calculating linear and nonlinear optical properties of graphene, valid for arbitrarily strong magnetic and optical field [1]. The calculated magnitude of the third-order nonlinearity is of the order of 0.01 esu for the field of several Tesla in the mid/far-infrared spectral range. Due to this giant nonlinearity, even one monolayer of graphene gives rise to appreciable nonlinear frequency conversion efficiency for incident mid/far-infrared radiation.

[1] X. Yao and A. Belyanin, Giant optical nonlinearity of graphene in a strong magnetic field, Phys. Rev. Lett. submitted; arXiv: 1110.4869.

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