Abstract Submitted
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Laser-driven parametric instability and generation of entangled photon-plasmon states in graphene and topological insulators[1] ALEXEY BELYANIN, YONGRUI WANG, Texas AM University, IVAN OLADYSHKIN, MIKHAIL TOKMAN, Institute of Applied Physics, Russian Academy of Sciences — Massless Dirac electrons in graphene and on the surface of topological insulators such as Bi_2Se_3 demonstrate strong nonlinear optical response and support tightly confined surface plasmon modes. Although both systems constitute an isotropic medium for low-energy in-plane electron excitations, their second-order nonlinear susceptibility becomes non-zero when its spatial dispersion is taken into account. In this case the anisotropy is induced by in-plane wave vectors of obliquely incident or in-plane propagating electromagnetic waves. In this work we show that a strong (0.1-1 MW/cm^2) near-infrared or mid-infrared laser beam obliquely incident on graphene can experience a parametric instability with respect to decay into lower-frequency (idler) photons and THz surface plasmons. The parametric gain leads to efficient generation of THz plasmons. Furthermore, the parametric decay process gives rise to quantum entanglement of idler photon and surface plasmon states. This enables diagnostics and control of surface plasmons by detecting idler photons. A similar parametric process can be implemented in topological insulator thin films.

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