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Strong-Field nonperturbative effects in solids¹

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We present recent results of nonperturbative high harmonic generation³ and below gap absorption⁴ in single crystal ZnO driven by mid-infrared pulses in a new regime where the field approaches the bandgap per lattice constant. In this limit, the field cannot be considered as producing a small perturbation to the crystal, instead the material properties are transiently yet nondestructively altered. Here we observe harmonics up to 25th order with a cutoff that scales linearly with applied field. The results are consistent with a simple model for tunnel ionization and radiation from nonlinear and attosecond acceleration of carriers in a band. In addition, we observe dramatic sub-band gap absorption of light nearly 10% below the gap, due to photon assisted tunneling. We discuss the relationship between these two effects.

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³S. Ghimire, A. D. DiChiara, E. Sistrunk, P. Agostini, L. F. DiMauro, and D. A. Reis. Observation of high-order harmonic generation in a bulk crystal. *Nat Phys*, 7(2):138-141, 2011.

⁴S. Ghimire, A. D. DiChiara, E. Sistrunk, P. Agostini, L. F. DiMauro, and D. A. Reis, Strong-field induced optical absorption in ZnO, CLEO/QELS 2011.