Non-equilibrium Quasiparticle Spectrum of Highly Irradiated Semiconductors

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We present ab-initio calculations of the quasiparticle spectrum of highly irradiated semiconductors performed using an out-of-equilibrium generalization of the GW approximation based on the Keldysh Green's function approach. First, we derive a general expression for the self-energy (within the GW approximation) of a real material characterized by arbitrary electron occupation numbers. Then, we apply our formalism to the case of a semiconductor (GaAs) under intensive electromagnetic radiation. Our results indicate that the valence-conduction band gap is a sensitive function of the amount of electrons excited above the ground state. However, contrary to previous results, we find that it is not possible to induce a complete band gap closure by purely electronic means in the case of crystalline GaAs.