

Optical responses of photoexcited materials: from parametric amplification to photoinduced superconductivity

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Optical drives at terahertz and mid-infrared frequencies in quantum materials are commonly used to explore the nonlinear dynamics of interacting many-body systems. Recent experiments demonstrated several surprising optical properties of transient states induced by driving, including the appearance of photo-induced edges in the reflectivity, enhancement of reflectivity, and even light amplification. I will show that many of these unusual properties can be understood from the general perspective of reflectivity from Floquet materials, in which pump-induced oscillations of a collective mode lead to parametric generation of excitation pairs. This analysis predicts a universal phase diagram of drive induced features in reflectivity, which evidence a competition between driving and dissipation. I will argue that this mechanism explains several recent experimental observations, including photoinduced superconductivity in the pseudogap phase of high T_c cuprates.