Lighting up superconductivity

E. Demler
Institute for Theoretical Physics, ETH Zurich, Switzerland
e-mail: demlere@phys.ethz.ch

This talk will review new insights into high temperature superconductors revealed by novel optical probes with an emphasis on the theoretical models necessary for interpreting experimental results. We will start by discussing recent experiments in the pseudogap phase of the YBCO cuprates that have been interpreted as the light induced Meissner effect. We will approach this phenomenon from the perspective of nonlinear dynamics of the sine-Gordon model triggered by the strong terahertz pump pulse. This interpretation suggests that these experiments reveal strong superconducting correlations in the pseudogap state but do not require photoinduced superconductivity. I will argue that other experimentally observed features of the photoexcited transient state in YBCO can be explained from the perspective of a Floquet material. I will present a general theoretical framework for understanding Floquet materials, in which the pump-induced oscillations of a collective mode lead to the parametric generation of excitation pairs. This can result in features such as photo-induced edges in reflectivity, enhancement of reflectivity, and even light amplification.