Kerr Effect Measurements Through the Pseudogap of High-Tc Superconductors

Aharon Kapitulnik

Departments of Applied Physics and Physics, Stanford University, CA 94305, USA

One of the most challenging puzzles that has emerged within the phenomenology of the high-temperature superconductors is to understand the occurrence and role of the normal-state “pseudogap” phase in underdoped cuprates. This phase exhibits anomalous behavior of many properties including magnetic, transport, thermodynamic, and optical properties below a temperature, T^*, large compared to the superconducting (SC) transition temperature, T_c

Two major classes of theories have been introduced in an attempt to describe the pseudogap state: One in which the pseudogap temperature T^* represents a crossover into a state with preformed pairs with a d-wave gap symmetry, and another in which T^* marks a true transition into a phase with broken symmetry which ends at a quantum critical point, typically inside the superconducting dome. While at low-doping this phase may compete with superconductivity, it might provide fluctuations that are responsible for the enhanced transition temperature near its quantum critical point.

In this talk I will review Kerr effect measurements on several high-Tc systems, including $YBa_2Cu_3O_{6+x}$, $Pb_{0.55}Bi_{1.5}Sr_{1.6}La_{0.4}CuO_{6+x}$ and $La_{1.875}Ba_{0.125}CuO_4$. We will show data that strongly suggest a scenario in which onset of Kerr effect signal near T^* marks a true phase transition. While Kerr effect is sensitive to time-reversal symmetry breaking, we will argue that the measured magnetic signal tracks another electronic phase transition, most likely a weak structural and/or charge-order transition. We will supplement the Kerr effect measurements with other data that adds further evidence for such a scenario.