Dynamics of fluctuations in high temperature superconductors far from equilibrium conditions

Luca Perfetti

Laboratoire des Solides Irradiés, Ecole Polytechnique-CEA/DSM-CNRS UMR 7642,

F-91128 Palaiseau, France

E-mail: luca.perfetti@polytechnique.edu

Despite the extensive literature on high temperature superconductors, the critical dynamics of an incipient condensate has so far been studied just in equilibrium conditions. Here, I show that resolved THz measurements of $Bi_2Sr_2CaCu_2O_{8+\delta}$ discriminate the temperature regimes where superconductivity is coherent, fluctuating or vanishingly small. Above the transition temperature Tc the recovery to equilibrium conditions displays power law behaviour and scaling properties. The experimental evidence that some of the exponents weakly depend on doping level provide hints of universality in systems far from equilibrium. We find partial agreement between the scaling law of the optimal doped sample and the Time Dependent Ginzburg-Landau (TDGL) model. Inherent limits of TDGL call for non-equilibrium field theories treating fast degrees of freedom and fluctuations on equal footing. These results open a timely connection between superconducting condensates and Bose-Einstein condensates of ultra-cold atoms.