Institute for Research in Fundamental Sciences

Condensed Matter Lecture

QED_3 THEORY OF PSEUDOGAP HIGH TEMPERATURE SUPERCONDUCTORS

Speaker: Dr. Kamran Kaveh,
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Monday & Wednesday
9 & 11 Mordad 1391
Time: 14:00-15:30

Beginning form a d-wave superconducting state (dSC) with nodal quasi-particles in low- temperatures, we construct a Dirac theory for the quasi-particles which is coupled to a singular gauge-field through a Franz-Tesanovic transformation. Unlike similar approaches to the modeling of phase fluctuating d-wave superconductors in the pseudogap regime, the gauge transformation introduces two bosonic fields to represent the phase fluctuations of the superconducting order parameter. The three phases of d-wave superconductor, pseudogap and anti-ferromagnetic phases are distinguished by the gauge field losing or acquiring mass and/or the originally massless Dirac quasi-particles gaining mass. We show that the effective theory for the pseudogap phase where both fermionic fields and bosonic gauge fields are massless is effectively represented by quantum electrodynamics (QED) in 2+1 dimensions and the well-known mechanism of dynamical mass generation in QED_3 translates to creation of an anti-ferromagnetic (AF) order parameter for such theory. At the end we discuss the phase diagram of the underdoped regime in low- temperatures and possibilities of a quantum critical point at zero temperature for direct AF-dSC transition or coexistence of the AF and dSC in low-dopings.

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