TT 5 Superconductivity - Mechanisms, Phase Diagram, Competing Order

Zeit: Freitag 18:00–19:00 Raum: TU H104

TT 5.1 Fr 18:00 TU H104

Interplay between competing and coexisting ground states in electron doped cuprates — •Yoshiharu Krockenberger[1,2], Andreas Winkler[3], Bettina Welter[3], Dirk Manske[2], Michio Naito[4], and Lambert Alff[5] — [1]NTT Basic Research Laboratories, NTT Corporation, 3-1 Wakamiya, Morinosato, Atsugi-shi, Kanagawa 243-0198, Japan — [2]Max Planck Institute for Solid State Research, Heisenbergstr. 1, 70569 Stuttgart, Germany — [3]Walther-Meissner-Institute, Bayerische Akademie der Wissenschaften, 85748 Garching, Germany — [4]Department of Applied Physics, Tokyo University of Agriculture and Technology (TUAT), 2-24-16 Naka-cho, Koganei, Tokyo 184-8588, Japan — [5]Vienna University of Technology, ISAS, Applied Electronic Materials, Gusshausstr. 27-29/366, A-1040 Wien, Austria

The ground state of superconductors is characterized by the long-range order of condensed Cooper pairs: this is the only order present in conventional superconductors. The high-T_c superconductors, in contrast, exhibit more complex phase behaviour, which might indicate the presence of other competing ground states. Here we report the existence of a second order parameter hidden within the superconducting phase of the underdoped (electron-doped) high-T_c superconductor $Pr_{2-x}Ce_xCuO_{4+y}$. The existence of a pseudogap when superconductivity is suppressed excludes precursor superconductivity as its origin. This supports the picture that the physics of high-T_c is determined by the interplay between competing and coexisting ground states.

TT 5.2 Fr 18:15 TU H104

Inhomogeneous charge and spin order in electron-doped high-T_c cuprate superconductors — •H.-H. Klauss[1], D. Baabe[1], H. Luetkens[2], D. Mienert[1], P. Adelmann[3], Y. Krockenberger[4], L. Alff[4], M. Naito[5], and F.J. Litterst[1] — [1]IMNF, TU Braunschweig, Germany — [2]PSI, Villigen, Schweiz — [3]IFP, FZ Karlsruhe, Germany — [4]WMI, TU München, Germany — [5]NTT, Atsugi, Japan

We investigated the relevance of inhomgeneous charge and spin order in the electron-doped high-T_c superconductors $(Nd,Pr)_{2-y}Ce_yCuO_4$ with $0.05 \leq y \leq 0.125$ by means of muon spin relaxation (μ^+SR). In this doping range the samples show long- range antiferromagnetic order below $T \approx 100$ K. In all samples we found inhomogeneous local field distributions, which are consistent with an electronic phase separation on a nanometer length scale. This suggests, in addition to similar results in hole-doped cuprates, that this phenomenon is of general relevance for the physics of cuprate superconductors. We also studied the magnetic and superconducting properties of a 20 nm Ag/300 nm $La_{1.9}Ce_{0.1}CuO_4$ (LCCO) heterostructure by means of low-energy μ^+SR. For temperatures below $T = 90$ K, the stoichiometrically homogeneous LCCO film exhibits a magnetic layer at the interface to the Ag capping. Energy-dependent low-energy μ^+SR reveals that the thickness of this magnetic layer continuously increases from 0 nm to 50 nm with decreasing temperature and that it persists below the superconducting transition at $T_c = 28$ K. In an applied magnetic field, the LCCO film shows Meissner screening with a magnetic penetration depth of the order of 350 nm proving the coexistence of bulk superconductivity and magnetism in the same sample.

TT 5.3 Fr 18:30 TU H104

Excitation spectrum of d-wave Fermi surface deformation — •Hiroyuki Yamase — Max-Planck-Institute for Solid State Research, Heisenbergstrasse 1, D-70569, Stuttgart, Germany

The d-wave Fermi surface deformation (dFSD) is one of possible orders competing with the d-wave singlet pairing, and is generated by forward scattering processes of electrons. We report dynamical properties of the dFSD and calculate its correlation functions within the random phase approximation. In the normal state, the excitation spectrum shows a low energy peak, which smoothly connects to critical fluctuations of the dFSD at lower temperature. The competition with the d-wave pairing, however, blocks the critical fluctuations. The whole spectral weight is transferred to high energy where a pronounced peak appears in the d-wave pairing state. This peak is an overdamped collective mode of the dFSD and can grow to become a resonance mode at moderate finite wavevectors.

TT 5.4 Fr 18:45 TU H104

Photobleaching in $R Ba_2Cu_3O_{7-\delta}$ in a simultaneous Raman and transport experiment — •S. Bahrs[1], A. R. Goñi[2], J. Guimpel[3], B. Maiorov[4], A. Fainstein[3], G. Nieva[3], and C. Thomsen[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstrasse 36, 10623 Berlin, Germany — [2]ICREA Research Professor, Institut de Ciència de Materials de Barcelona, Campus de la UAB, 08193 Bellaterra, Spain — [3]Centro Atómico Bariloche, Comisión Nacional de Energía Atómica, 8400 San Carlos de Bariloche, Río Negro, Argentina — [4]Superconductivity Technology Center, MS K763, Los Alamos National Laboratory, Los Alamos, NM 87545, USA

Persistent photoinduced change of physical properties in the $R Ba_2Cu_3O_{7-\delta}$ high temperature superconductor family has for some time been investigated with various, complemental experimental methods. Illumination induced effects are observed in electrical transport as well as in Raman spectra, and more recently, in reflectance anisotropy spectroscopy. While a connection to oxygen deficiencies in the chain plane of the material is obvious in all experiments, the precise mechanism of photobleaching is still uncertain, nor it is clear if all methods probe aspects of the same physical property of the material.

In this study we focus on the explicit connection between electrical transport and optical phenomena by performing a simultaneous experiment. Both the change of resistivity and Raman features in thin films of $GdBa_2Cu_3O_{7-\delta}$ under illumination have been recorded. We present a comparison of the time dependencies and discuss the results in the framework of the oxygen-vacancy picture of photobleaching.