TT 15 Superconductivity - Properties, Electronic Structure, Order Parameter I

Zeit: Samstag 14:00–16:45 Raum: TU H2053

TT 15.1 Sa 14:00 TU H2053

Collision-limited Raman response in normal metals and superconductors — •Dirk Manske[1] and Dietrich Einzel[2] — [1]Max-Planck-Institut für Festkörperforschung, 70569 Stuttgart — [2]Walther-Meissner-Institut, 85748 Garching

We formulate a theory for describing the electronic Raman response in metals and superconductors with anisotropic scattering rates due to (a) elastic scattering of quasiparticles on impurities and (b) due to inelastic electron-electron scattering. Our approach is based on the Landau-Boltzmann equation for anisotropic metals at finite wavenumbers and takes into account (within RPA) the Coulomb repulsion as well as the relevant scattering processes. We employ our theory to the high-T_c cuprates for which the inelastic part of the scattering rates is taken from the solution of generalized Eliashberg equations based on a spin fluctuation-mediated Cooper-pairing. Numerical results for different scattering rates are presented.

TT 15.2 Sa 14:15 TU H2053

Electric fields above the surface of superconductors — P. Lipavský[1], •K. Morawetz[2,3], Jan Koláček[1], J.J. Mares[1], E.H. Brandt[4], and M. Schreiber[2] — [1]Institute of Physics, Academy of Sciences, Cukrovarnická 10, 16258 Praha 6, Czech Republic — [2]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [3]Max-Planck-Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany — [4]Max-Planck-Institute for Metal Research, D-70506 Stuttgart, Germany

The electrostatic potential above the Abrikosov vortex lattice, discussed earlier by Blatter *et al.* [Phys. Rev. Lett. **77**, 566 (1996)], is evaluated within the Ginzburg-Landau theory [1]. Unlike previous studies we include the surface dipole [2,3]. Close to the critical temperature, the surface dipole reduces the electrostatic potential to values below sensitivity of recent sensors. At low temperatures the surface dipole is less effective and the electrostatic potential remains observable as predicted earlier. Within the extension of the Landau-Ginzburg theory towards lower temperatures the electric fields above the superconducting surface are calculated for different experimental situations.

[1] P. Lipavský, K. Morawetz, J. Kolacek, J. J. Mares, E. H. Brandt, M. Schreiber, Pys. Rev. B in press, cond-mat/0409397
[2] P. Lipavský, K. Morawetz, J. Koláček, J. J. Mareš, E. H. Brandt, M. Schreiber, Phys. Rev. B 69 (2004) 024524-1-7
[3] P. Lipavský, K. Morawetz, J. Koláček, J. J. Mareš, E. H. Brandt, M. Schreiber, Phys. Rev. B 70 (2004) 104518-1-7

TT 15.3 Sa 14:30 TU H2053

Superconductivity related core level shift in HTSC — •Jörg Voigt[1,2], Raffaele Gilardi[1], Henrik Ronnow[1], Joel Mesot[1], Luc Patthey[1], Ming Shi[1], Oscar Tjernberg[3], and Thomas Claesson[3] — [1]Paul Scherrer Institut, 5232 Villigen-PSI, Schweiz — [2]Forschungszentrum Jülich, 52425 Jülich — [3]Royal Institute of Technology, Electrum 229, S-164 40 Kista, Sweden

We have studied the energy of the core levels in different families of cuprate superconductors as a function of temperature and doping. We confirm earlier results that showed a shift towards lower binding energy with increased hole doping. As a new result, we find a shift to lower binding energy on crossing the superconducting phase transition. We discuss, how the screening can be related to the electronic gap present in the superconducting state.

TT 15.4 Sa 14:45 TU H2053

Splitting of the CuO-band — •B. Müller[1], L. Dudy[1], H. Dwelk[1], A. Krapf[1], C. Janowitz[1], H. Höchst[2] und R. Manzke[1] — [1]Humboldt Universität zu Berlin, Institut für Physik, Newtonstr. 15, 12489 Berlin — [2]Synchrotron Radiation Center (SRC), Madison/Wisconsin (USA)

Polarization dependent ARPES measurements revealed a double-peak structure close to the Fermi surface in Bi2201 at a specific polarization of the incident light [1,2]. There are strong hints that this phenomenon displays charge-spin separation expected to occur in one-dimensional systems [2,3]. It is not yet clear, if this charge-spin separation stems from an actual one-dimensionality in the electronic structure of the CuO_2-plane or if it is a feature persisting also in two-dimensional systems. Now the same double-peak structure could be confirmed in Bi2212. In both materials this double-peak structure shows similar properties regarding dispersion of the peaks and dependence on temperature. The double-peak structure vanishes at a temperature which seems to coincide with T^*, the temperature of the closing of the pseudogap.

[1] R. Manzke, R. Müller, C. Janowitz, C. Ast, H. Höchst, Phys. Rev. B **63** (2001) R 100504 [2] C. Janowitz, R. Müller, L. Dudy, A. Krapf, R. Manzke, C. Ast, H. Höchst, Europhys. Lett. **60** (2002) 615 [3] K. Byczuk, C. Janowitz, R. Manzke, J. Spalek, W. Wojcik, Europhys. Lett. **67** (2004) 1011

TT 15.5 Sa 15:00 TU H2053

Determination of the hole density of $(Bi,Pb)_2(Sr,La)_2CuO_{6+\delta}$ superconductors — •L. Lasogga[1], R. Mitdank[1], A. Krapf[1], H. Dwelk[1], S. Rogaschewski[1], C. Janowitz[1], R. Manzke[1], K. Scheurell[2], and I. Murwani[2] — [1]Humboldt University Berlin, Department of Physics, Newtonstrasse 15, 12489 Berlin — [2]Humboldt University Berlin, Department of Chemistry, Brook-Taylor-Strasse 2, 12489 Berlin

The hole concentration of the CuO_2 planes of $Bi_{2-y}Pb_ySr_{2-x}La_xCuO_{6+\delta}$ cuprates has been investigated in great detail by two techniques, x-ray absorption spectroscopy (XAS) at the $Cu-L_3$ edge and iodometric titration. The XAS measurements were performed at the BESSY II beamline PM3. Our investigations include both ceramics and single crystals containing no lead (y = 0) and larger amounts of lead (y = 0,16 ... 0,45). For each case we studied series of variable content of lanthanum (x = 0,0 ... 0,8). Finally we compare ceramics and single crystals, discuss the dependence between hole density, critical temperature and content of lead and lanthanum. Moreover we show the dependence of the x-ray absorption from the angle of incidence.

Pause

TT 15.6 Sa 15:30 TU H2053

STM structure analysis of Pb-doped Bi-2212 depending on the Pb-content — •Hendrik Glowatzki, Alica Krapf, Christoph Janowitz, and Recardo Manzke — Institut f. Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin

Scanning Tunneling Microscopy (STM) was used to analyse the surface modification of double layered bismuth single crystals (BSCCO) due to partial substitution of Bi by Pb resulting in $Bi_{2-x}Pb_xSr_2CaCu_2O_{8+\delta}$. A typical structure found on Pb-free BSCCO is the well known (4.7x1) superstructure modulation, which can be clearly seen along the ab-(001) plane. The increasing substitution of Bi by Pb was reported to lead to a weakening of the modulation structure, thus increasing the modulated wavelength and finally disappearing at $x = 0,5$ [1]. Depending on the Pb-content x we were able to verify the increasing wavelength, but not a complete disappearance of the modulation. We found the modulation structure not covering the whole surface but building an arrangement of domains at $x \geq 0.3$. Our observations show an alternation of domains, parts of which seem to be flat while others reveal the modulated structure. The structural features will be discussed in terms of the crystal composition.

[1] Lei Shi *et al.*, J. Phys.: Condens. Matter **13**, 5195 (2001)

TT 15.7 Sa 15:45 TU H2053

Scanning tunneling spectroscopy on (100) plane of $NdBa_2Cu_3O_{7-\delta}$ — •Pintu Das[1], Michael R. Koblischka[1], Thomas Wolf[2], Uwe Hartmann[1], and Iduru Shigeta[3] — [1]Institute of Experimental physics, University of Saarbruecken, P.O.Box-151150, D-66041 Saarbruecken, Germany — [2]Forschungszentrum Karlsruhe GmbH, Institute of Solid State Physics, D-76021, Karlsruhe Germany — [3]Department of General Education, Kumamoto National College of Technology, Kumamoto 861-1102, Japan

We report the results of STS experiments performed on the (100) plane of $NdBa_2Cu_3O_{7-\delta}$ (NdBCO) single crystals ($T_c = 95.5$ K) at 4.2 K. From the dI/dV curves, which represents the local density of states (LDOS), we find a V-shaped curve with a very high conductance at the zero bias in the gap region which is typical in case of d-wave symmetry of the order parameter. In a region of 200 Å, we also observed other curves with very

low coherence peaks or even with no peak structure, which is possible if the oxygen content is inhomogeneously distributed across the surface. A third type of curve, which is not frequently observed, has a peak at the zero bias conductance (ZBCP). We consider that the ZBCP is due to the Andreev reflection at the impurity potential (geometrically rough surface) and can be explained with the theory of roughness effect on the density of states of d-wave superconductor [1]. We can explain the data considering the symmetry order parameter to be $d_{x^2-y^2}$ wave, but at this moment we can not confirm if there is a mixing of any other component.

[1] Tanuma et al., Phys. Rev. B57, 7997 (1998).

TT 15.8 Sa 16:00 TU H2053

Two length scales in the crystalline electronic state of underdoped cuprate superconductors — •Jürgen Röhler — Universität zu Köln, D-50937 Köln, Germany

Spatial- and energy-resolved differential tunneling measurements from STM have shown evidence for a crystalline electronic structure in the pseudogap regime of lightly doped cuprate superconductors [1]. The conductance exhibits *minima* at the perimeter atoms of a four Cu_2O-unit-cell square "checkerboard". The internal electronic structure of the $4a \times 4a$ squares consists of 3×3 conductance *maxima*, incommensurate with the atomic lattice. We suggest to relate this electronic crystal structure with a "supersolid" of paired self-protecting singlets (PSPS) [2]. Hole pairs underlying not only a non-double-occupancy constraint for the copper sites, but also for the oxygen cages, extend over $4a$ (4 oxygen cages), and may cause a $4a \times 4a$ modulation of the electronic structure. Maxima in the local density of states, however, are expected to occur with a periodicty of $3a$ (4 copper sites). The interference between the $4a$ and $3a$ length scales yields a possible explanation for the atomic-scale electronic structure variations observed within the checkerboard.

[1] T. Hanaguri *et al.*, Nature **430**, 1001 (2004), cond-mat/0409102.
[2] J. Röhler, J. Supercond. **17**, 159 (2004), cond-mat/0307310.

TT 15.9 Sa 16:15 TU H2053

Unkonventionelle Supraleitung und starke Fluktuationen in $Na_{0.3}CoO_2{\cdot}1.3H_20$ — •Niels Oeschler[1], R.A. Fisher[1], N.E. Phillips[1], J.E. Gordon[2], M.L. Foo[3] und R.J. Cava[3] — [1]LNBL and Department of Chemistry, University of California, Berkeley, CA, USA — [2]Physics Department, Amherst College, Amherst, MA, USA — [3]Department of Chemistry, Princeton University, Princeton, NJ, USA

Seit Entdeckung der Hoch-Temperatur-Supraleiter 1986 sind viele Gruppen auf der Suche nach neuen Supraleitern, in denen die Kupferatome durch andere Übergangsmetalle ersetzt sind. Erst 2003 wurde die erste supraleitende Kobaltoxid-Verbindung $Na_{0.3}CoO_2{\cdot}1.3H_20$ mit $T_c = 4.5$K gefunden. In diesem System ordnen sich die Co-Atome nicht quadratisch in der Kobaltoxid-Schicht wie die Cu-Atome in den Kupraten, sondern trigonal an. Dies führt zu einer Frustration der Co-Spins, die vermutlich entscheidend für die Supraleitung ist. Daher spekuliert man auf nicht-phononische Supraleitung, die über magnetische Fluktuationen vermittelt wird. Wir berichten über Messungen der spezifischen Wärme an $Na_{0.3}CoO_2{\cdot}1.3H_20$ im Bereich $0.8K \leq T \leq 12K$ und $B \leq 9$T. Die spezifische Wärme (C) von $Na_{0.3}CoO_2{\cdot}1.3H_20$ unterscheidet sich in der supraleitenden Phase deutlich von der eines konventionellen Supraleiters. Bei tiefen Temperaturen folgt die spezifische Wärme einem T^2-Verhalten ($C \propto T^2$). Dies deutet auf Knoten der supraleitenden Energielücke auf der Fermi-Fläche hin. Weitere Hinweise auf unkonventionelle Supraleitung werden durch die Magnetfeldabhängigkeit des Sommerfeld-Koeffizienten erhalten. Starke Fluktuationen zeigen sich trotz relativ niedrigem T_c in einer feldunabhängigen Onset-Temperatur T_c^{onset}.

TT 15.10 Sa 16:30 TU H2053

Cooperative effect of phonons and electronic correlations for superconductivity in cobaltates — •A. Foussats[1], A. Greco[1], M. Bejas[1], and A. Muramatsu[2] — [1]Facultad de Ciencias Exactas, Ingeniería y Agrimensura and Instituto de Física Rosario (UNR-CONICET). Av. Pellegrini 250-2000 Rosario, Argentina — [2]Institut für Theoretische Physik III, Universität Stuttgart, 70550 Stuttgart, Germany

We propose that unconventional superconductivity in hydrated sodium cobaltate Na_xCoO_2 results from an interplay of electronic correlations and electron-phonon interactions [1]. On the basis of the $t-V$ model plus phonons we found evidences for a) unconventional superconductivity, b) realistic values of T_c and c) the dome shape existing near $x \sim 0.35$. This picture is obtained for V close to the critical Coulomb repulsion V_c which separates the uniform Fermi liquid from $\sqrt{3} \times \sqrt{3}$ CDW ordered phase.

[1] A. Foussats, A. Greco, M. Bejas, A. Muramatsu, cond-mat/0410290