TT 31 Correlated Electrons - Low-dimensional Materials I

Zeit: Dienstag 14:00–16:00 Raum: TU H2053

TT 31.1 Di 14:00 TU H2053

Scaling Behavior of the Longitudinal and Transverse Transport in Quasi One-Dimensional Organic Conductors — •Martin Dressel[1], Konstantin Petukhov[1], Belal Salameh[1], Pedro Zornoza[1], and Thierry Giamarchi[2] — [1]1. Physikalisches Institut, Universität Stuttgart, Germany — [2]DPMC, University of Geneva, Switzerland

The organic conductors $(TMTSF)_2PF_6$ and $(TMTSF)_2ClO_4$ are model systems to study the Luttinger-liquid behavior in one dimension. We have investigated the dc and microwave transport properties along the a, b', and c^* directions. In the normal state of $(TMTSF)_2PF_6$ below $T = 70$ K, the dc resistivity follows a power-law with ρ_a and $\rho_{b'}$ proportional to T^2 while $\rho_{c^*} \propto T$. Above $T = 100$ K the exponents extracted from the data for the a and c^* axes are consistent with what is to be expected for a system of coupled one-dimensional chains (Luttinger liquid) and a dimensional crossover at a temperature of about 100 K. The b' axis shows anomalous exponents that could be attributed to a large crossover between these two regimes. The organic superconductor $(TMTSF)_2ClO_4$ is more a two-dimensional metal with an anisotropy $\rho_a/\rho_{b'}$ of approximately 2 at all temperatures. Such a low anisotropy is unexpected in view of the transfer integrals. Slight indications to one-dimensionality are found in the temperature dependent transport only above 200 K. Even along the least conducting c^* direction no region with semiconducting behavior is revealed up to room temperatu

TT 31.2 Di 14:15 TU H2053

Numerical study of the two-chain Hubbard model: possible relevance with triplet superconductivity in Bechgaard salts — •Satoshi Nishimoto[1], Yukinori Ohta[2], Tomonori Shirakawa[2], and Youji Yamaguchi[2] — [1]Institut für Theoretische Physik, Universität Göttingen, Germany — [2]Department of Physics, Chiba University, Japan

The properties of quasi-one-dimensional Bechgaard salts $(TMTSF)_2X$ have been extensively studied in recent years. This system exhibits a rich phase diagram and the superconducting phase is in proximity to the insulating phase. This is similar to the quasi-two-dimensional organic conductor $(BEDT\text{-}TTF)_2X$ and the high-T_c superconductor, in which the d-wave singlet pairing is realized. However, most of recent experiments show strong evidences of triplet pairing in $(TMTSF)_2X$, and the mechanism of pairing and symmetry of superconducting order parameter are still an open issue. Motivated by such a situation, we study the ground-state properties of a two-chan Hubbard model with zigzag bonds where we include the intra- and inter-site Coulomb repulsions as well as anisotropic hopping parameters. We use the density-matrix renormalization group and exact diagonalization methods to calculate the spin, charge, and pairing correlations of the model. We thereby find enhancement of triplet pairing correlations for some sets of parameter values, which may have some relevance with triplet superconductivity in $(TMTSF)_2X$.

TT 31.3 Di 14:30 TU H2053

Comparative resistivity studies under hydrostatic pressure on different variants of the organic superconductor $\kappa-(ET)_2Cu[N(CN)_2]Br$ — •Christian Strack[1], Cemil Akinci[1], Bernd Wolf[1], Michael Lang[1], John Schlueter[2], Jochen Wosnitza[3], and Dieter Schweitzer[4] — [1]Physikalisches Institut, J.W. Goethe-Universität Frankfurt, FOR 412 — [2]Materials Science Division, Argonne NL, Illinois, USA — [3]Institut für Festkörperphysik, TU Dresden — [4]3. Physikalisches Institut, Universität Stuttgart

Resistivity measurements on four samples of $\kappa-(ET)_2Cu[N(CN)_2]Br$, synthesized by following two different preparation routes, yield strongly sample-dependent ρ(T) profiles. By comparing the interlayer resistivities and their response to hydrostatic pressure we infer: (i) a significant part of the inelastic-scattering contribution, causing the anomalous ρ(T) maximum around 90K, is extrinsic in nature, (ii) the abrupt change in the slope of ρ (T) around $T^* \approx 40K$ is sample independent and most likely marks a second-order phase transition, (iii) the origin of the $\rho(T) \propto AT^2$ dependence at low temperatures, with a strongly sample dependent coefficient A and range of validity, is different from coherent Fermi-liquid excitations.

TT 31.4 Di 14:45 TU H2053

Spin-Charge Separation in TTF-TCNQ — •Holger Benthien[1], Florian Gebhard[1] und Eric Jeckelmann[2] — [1]Fachbereich Physik, Philipps-Universität Marburg — [2]Fachbereich Physik, Johannes Gutenberg-Universität

Correlated electrons in one spatial dimension have very unusual properties such as the dynamical separation of spin and charge degrees of freedom. Typically, dynamical correlation functions of these systems are investigated with field theoretical methods that are valid in the limit of vanishingly low energies. However, there are few reliable results at *finite* energies which can be directly compared with spectra of scattering experiments. It has therefore been difficult to find direct spectroscopic evidence of spin-charge separation in experimental realizations of quasi one-dimensional electron systems.

The Dynamical Density-Matrix Renormalization Group [1] can accurately determine spectral properties of correlated one-dimensional lattice models for all energy scales and interaction strengths. We use this method to calculate the one-particle spectral function of Hubbard chains both above and below half-filling [2]. We argue that the ARPES spectrum of the quasi one-dimensional organic conductor TTF-TCNQ [3] can be consistently explained by essentially uncoupled TTF and TCNQ chains with short-ranged Coulomb interactions at electron densities $n = 1.4$ and $n = 0.6$, respectively.

[1] E. Jeckelmann, Phys. Rev. B **66**, 045114 (2002);
[2] H. Benthien *et al.*, Phys. Rev. Lett. **92**, 256401 (2004);
[2] R. Claessen *et al.*, Phys. Rev. Lett. **88**, 096402 (2002).

TT 31.5 Di 15:00 TU H2053

Strong evidence for Luttinger Liquid behaviour in quasi-one-dimensional Lithium purple bronze — •J. Hager and R. Matzdorf — FB 18, Universität Kassel, Heinrich-Plett-Str. 40, 34132 Kassel

We have measured the density of states at energies near the Fermi energy ϵ_F using scanning tunneling spectroscopy on cleaved $Li_{0.9}Mo_6O_{17}$ samples. In literature the discussion about the electronic structure, especially a phase transition at $T = 24$K remains controversial. Localization effects, charge density wave and spin density wave transitions, as well as a Luttinger Liquid scenario are used to explain experiments. Our dI/dV measurements at 5K show strong depression of the dI/dV signal at ϵ_F. Our experimental spectra near the Fermi energy can be explained excellently by Luttinger Liquid theory at low and ambient temperatures. Our data excludes current zero bias anomaly theories for explanation, which would predict a similar behaviour.

TT 31.6 Di 15:15 TU H2053

Thermodynamische Messungen an der Hochdruckphase von $(VO)_2P_2O_7$ — •Andreas Brühl, Michael Lang, Bernd Wolf, Volodymyr Pashchenko, Christoph Gross, Wolf Assmus und Andrei Prokofiev — Physikalisches Institut, J. W. Goethe-Universität Frankfurt, 60054 Frankfurt am Main, DFG-SP 1073

Vanadylpyrophosphat ($(VO)_2P_2O_7$) kann je nach Züchtungsbedingungen in einer Umgebungsdruck- und einer Hochdruckphase hergestellt werden, abgekürzt mit AP–VOPO bzw. HP–VOPO. Nach dem zur Zeit geläufigsten Modell bilden die V^{4+}–Ionen in beiden Phasen S=1/2–Spinketten mit einer alternierenden Wechselwirkung zwischen nächsten Nachbarn. Während zur Beschreibung von AP–VOPO zwei verschiedene Arten dieser Ketten benötigt werden, kommt man bei HP–VOPO mit einer aus, wie es auch durch die einfachere Kristallstruktur nahegelegt wird. In beiden Fällen wird von einer nur schwachen Kopplung der Ketten untereinander ausgegangen.

Messungen der thermischen Ausdehnung, spezifischen Wärme, elastischen Konstanten und der Magnetisierung zeigen jedoch, dass für HP–VOPO dieses einfache Bild nicht ausreichend ist. Insbesondere das Auftreten einer sehr deutlichen Anomalie magnetischen Ursprungs bei $T \approx 15$ K in der thermischen Ausdehnung und die Feld- und Temperaturabhängigkeit der elastischen Konstanten lassen sich nicht durch das genannte Modell erklären.

TT 31.7 Di 15:30 TU H2053

Infrared properties of the quasi-one-dimensional superconductor β-$Na_{0.33}V_2O_5$ under pressure — •C. A. Kuntscher[1], S. Frank[1], I. Loa[2], K. Syassen[2], T. Yamauchi[3], and Y. Ueda[3] — [1]1. Physikalisches Institut, Universität Stuttgart, 70550 Stuttgart, Germany — [2]Max-Planck-Institut für Festkörperforschung, Heisenbergstr. 1, 70569 Stuttgart, Germany — [3]Institute for Solid State Physics, University of Tokyo, Tokyo, Japan

At ambient pressure β-$Na_{0.33}V_2O_5$ shows a quasi-one-dimensional metallic character at room temperature, which can be explained by its highly anisotropic crystal structure consisting of chains and ladders of VO_6 octahedra and chains of VO_5 square pyramids. Upon cooling it undergoes a metal-insulator transition at 135 K due to charge ordering on the V sites. The pressure-temperature phase diagram of β-$Na_{0.33}V_2O_5$ is remarkable, since it shows a superconducting phase for pressures higher than 7 GPa in direct vicinity to the charge-ordered phase [1]. The mechanism of the observed superconductivity and its relation to the charge ordering is not clear. Besides, electron-phonon interaction seems to play a role as well, influencing the conduction mechanism.

We carried out polarization-dependent reflectivity measurements on β-$Na_{0.33}V_2O_5$ at room temperature as a function of pressure (<20 GPa). The results are discussed in terms of the conduction mechanism, pressure-induced structural changes, and charge ordering/redistribution. *Supported by the DFG, Emmy Noether-program.*

[1] T. Yamauchi, Y. Ueda, and N. Mori, Phys. Rev. Lett. **89**, 057002 (2002).

TT 31.8 Di 15:45 TU H2053

Field induced magnetic phase transition in Cs_2CuCl_4 as a magnon Bose-Einstein condensation — •Teodora Radu[1], Heribert Wilhelm[1], Viktor Yushankhai[1], Dmitry Kovrizhin[2], Radu Coldea[3], Thomas Lühmann[1], and Frank Steglich[1] — [1]MPI für Chemische Physik fester Stoffe D-01187 Dresden, Germany — [2]MPI für Physik komplexer Systeme D-01187 Dresden, Germany — [3]Oxford Physics, Clarendon Laboratory Oxford, OX1 3PU, UK

We report on results of specific heat $C(T)$ measurements on single crystals of the frustrated quasi-2d spin $-1/2$ antiferromagnet Cs_2CuCl_4 in the external magnetic field 0 T$\leq B \leq$ 12 T and in the temperature range 0.3 K$< T <$ 6 K. For different orientation of the applied magnetic field, B with respect to the crystallographic axes, the magnetic phase diagrams are obtained and compared with the previous neutron scattering results. For $\vec{B} \parallel \vec{a}$, the magnetic phase transition near the critical field $B_c \simeq 8.44$ T is treated as a magnon Bose Einstein condensation (BEC). In this context, the phase boundary $T_N \sim (B_c - B)^{1/\phi}$ is described with the critical exponent $\phi \simeq 1.5$. This result is discussed in terms of a simple mean-field theoretical study of the magnon BEC.