TT 13 Correlated Electrons: Metal Insulator Transition - Part 1

Time: Tuesday 11:45–13:00 Room: HSZ 105

TT 13.1 Tue 11:45 HSZ 105

Multiple ordering processes and the insulator-metal transition in epitaxial PrCaMnO films — •Christian Jooss[1], Peter Moschkau[1], Sebastian Schramm[1], Christine Borchers[1], and Yimei Zhu[2] — [1]Institute of Materials Physics, University of Goettingen, Germany — [2]Brookhaven National Laboratory, Upton NY, USA

$Pr_{1-x}Ca_xMnO_3$ films in the doping range between $0.3 < x < 0.5$ represent an extremely interesting manganite system for the study of the interplay of different kinds of ordering (charge, orbital, lattice and spin) and the related drastic changes of the transport properties. Recently, it was suggested [1] that a possible specific kind of bond-centered charge ordered state could give rice to ferroelectric properties of this material. We have investigated epitaxial PrCaMnO films on (001) $SrTiO_3$ substrates grown by pulsed laser deposition. The films exhibit an insulator metal (IM) transition in applied magnetic and electric fields below the charge ordering temperature T_c ≈230 K with resistivity changes of up to seven orders of magnitudes. Furthermore, an electric field induced remanet resistivity change is observed at temperature above T_c. High-resolution transmission electron microscopy reveals the presence of orbital and charge ordering. In the x=0.3 samples the correlation lengths of the charge and orbital ordering domains differs and we observe an inhomogeneous charge ordered ground state. We discuss the relation between structure, different types of ordering and electronic transport properties of this material.

[1] D. V. Efremov, J. van den Brink and D. I. Khomskii, Nature Materials 3 (2004) 853.

TT 13.2 Tue 12:00 HSZ 105

Resonant soft x-ray diffraction from magnetite thin films — •J. Schlappa[1], C. F. Chang[1], C. Schüssler-Langeheine[1], H. Ott[1], Z. Hu[1], E. Schierle[2], E. Weschke[2], G. Kaindl[2], A. Tanaka[3], and L. H. Tjeng[1] — [1]II. Physikalisches Institut, Universität zu Köln — [2]Institut für Experimentalphysik, Freie Universität Berlin — [3]Department of Quantum Matter, ADSM, Hiroshima University

Magnetite (Fe_3O_4) undergoes a first-order transition at the Verwey temperature, T_V, which is for bulk samples around 120 K. This transition is accompanied by a change of the crystal structure from the cubic to monoclinic. The electronic origin of this transition is still a matter of considerable controversy. Using resonant soft x-ray diffraction at the Fe $L_{2,3}$ resonance from magnetite thin films, we studied spectroscopically the electronic origin of the (001/2) and (001) superstructure peaks, which both occur below T_V. The resonances of the two superstructure peaks differ significantly and indicate that the (001) peak is caused by charge order on the octahedral B sites, while the (001/2) peak, which describes a doubling of the unit cell below T_V, is caused by an order involving only Fe^{2+} ions on B sites.

TT 13.3 Tue 12:15 HSZ 105

Disorder effects in manganites: Griffiths phase regime in $La_{1-x}Sr_xMnO_3$ — •J. Deisenhofer[1], D. Braak[2], H.-A. Krug von Nidda[1], J. Hemberger[1], R.M. Eremina[3], V.A. Ivanshin[4], A.M. Balbashov[5], G. Jug[6], A. Loidl[1], T. Kimura[7], and Y. Tokura[7] — [1]EP V, Center for Electronic Correlation and Magnetism, University of Augsburg, Germany — [2]TP II, Institute for Physics, University of Augsburg, Germany — [3]E.K. Zavoisky Physical-Technical Institute, Kazan, Russia — [4]Kazan State University, Kazan, Russia — [5]Moscow Power Engineering Institute, Moscow, Russia — [6]Dipartimento di Fisica e Matematica, Universita' dell'Insubria, Como, Italy — [7]Department of Applied Physics, University of Tokyo, Japan

By means of electron spin resonance and magnetic susceptibility measurements a novel triangular phase regime has been discoverd in the system $La_{1-x}Sr_xMnO_3$. This phase is characterized by the coexistence of ferromagnetic entities within the globally paramagnetic phase far above the magnetic ordering temperature. The nature of this phase can be understood in terms of Griffiths singularities arising due to the presence of correlated quenched disorder in the orthorhombic phase.

TT 13.4 Tue 12:30 HSZ 105

On the nature of the pressure-induced insulator-to-metal transition in $LaMnO_3$ — •A. Yamasaki, M. Feldbacher, O. K. Andersen, and K. Held — Max-Planck Institut für Festkörperphysik, Stuttgart

Since the discovery of colossal magnetoresistance (CMR), manganites have been intensively studied. In this talk, we focus on the pressure-induced insulator-to-metal (IM) transition which was found experimentally by Loa *et al.* [1] in the undoped parent compound $LaMnO_3$ with configuration $t_{2g}^3e_g$. This transition occurs at room temperature, well above the magnetic ordering (T_N=140 K) and well below the cooperative Jahn-Teller temperature (T_{oo}=740 K at 0 GPa), and at a hydrostatic pressure of 32 GPa where the JT distortion appears to be completely suppressed [1]. The IM transition thus seems to be a bandwidth-driven Mott-Hubbard transition of the e_g electrons and points to the dominating importance of the Coulomb repulsion between two e_g electrons on the same site. We employ the local density approximation combined with static and dynamical mean-field theories (LDA+U and LDA+DMFT) and conclude that the insulator-to-metal transition observed at 32 GPa in paramagnetic $LaMnO_3$ at room temperature is *not* a Mott transition, but is caused by the overlap of the majority-spin e_g bands, orbitally polarized by the Coulomb repulsion.

[1] I. Loa *et al.*, Phys. Rev. Lett. **87**, 125501 (2001).

TT 13.5 Tue 12:45 HSZ 105

DMFT calculations for manganites with electron-phonon Interaction — •Yi-feng Yang and Karsten Held — Max-Planck-Institute for Solid State Research, 70569 Stuttgart, Germany

The metal-insulator transition in manganites such as $La_{1-x}Ca_xMnO_3$ has attracted much interest in recent years, but the mechanism is still not fully understood. There has been a debate whether the local Coulomb interaction or the electron-phonon interaction is more important. We present here the first dynamical mean field theory calculation for two e_g bands, taking into account both interactions, as well as the Hund coupling to the local t_{2g} electrons. For undoped system, our results show that both Coulomb and electron-phonon interaction are necessary to describe $LaMnO_3$. We also show spectra for doped manganites.