TT 31: Correlated Electrons: Other Materials

Time: Tuesday 14:00–16:00 Location: HSZ 103

TT 31.1 Tue 14:00 HSZ 103

Dipolar effects on the critical fluctuations in Fe: Investigation by MIEZE — •Steffen Säubert[1,2], Jonas Kindervater[3], and Peter Böni[1] — [1]Physik Department, Technische Universität München, Garching, Germany — [2]Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Garching, Germany — [3]Institute for Quantum Matter and Department of Physics and Astronomy, Johns Hopkins University, Baltimore, USA

Iron is one of the archetypical ferromagnets to study the critical fluctuations at a continuous phase transition thus serving as a model system for the application of scaling theory. We report a comprehensive study of the critical dynamics at the transition from the ferro- to the paramagnetic phase in Fe, employing the high-resolution neutron spin echo technique MIEZE. The results show that the dipolar interactions lead to an additional damping of the critical spin fluctuations at small momentum transfers **q**. The results agree essentially with scaling theory if the dipolar interactions are taken into account by means of the mode-coupling equations. However, in contrast to expectations, the dipolar wavenumber q_D that plays a central role in the scaling function $f(\kappa/q, q_D/\kappa)$ becomes temperature dependent. In the limit of small **q** the critical exponent z crosses over from 2.5 to 2.0.

TT 31.2 Tue 14:15 HSZ 103

Electronic Structure of Palladium Determined by Compton Scattering and Electron-Positron Annihilation — •Josef Helmut Schmidbauer, Josef Andreas Weber, Michael Leitner, and Christoph Hugenschmidt — Heinz Maier-Leibnitz Zentrum (MLZ) and Physik Department E21, Technische Universität München, Lichtenbergstraße 1, 85748 Garching, Germany

Compton scattering and the measurement of the angular correlation of electron-positron annihilation radiation (ACAR) offer two complementary techniques for the investigation of the electronic structure of materials. We applied both methods to determine the bulk electron momentum distribution of the 4d transition element palladium. By reconstructing the full Fermi surface from 2D-ACAR projections we reveal all major features of the Fermi surface, predicted by theoretical calculations. Based on our experimental findings and by comparison with theory we discuss correlation effects in Palladium. Moreover, we examine the shape of the so-called L-hole pocket in order to compare the results of different theoretical calculation schemes.

TT 31.3 Tue 14:30 HSZ 103

Importance of Mott physics in manganese pnictides — •Manuel Zingl, Elias Assmann, and Markus Aichhorn — Institute of Theoretical Physics and Computational Physics, Graz University of Technology, Austria

Manganese pnictides, e.g. $BaMn_2As_2$ and LaMnAsO, attract attention due to their exceptional physical properties. Thus, revealing the underlying electronic mechanisms is highly desired. These compounds have a nominally half-filled d shell, and as a consequence, electronic correlations are strong, placing them at the verge of a metal-insulator transition. In addition to electronic correlations, the effective dimensionality is another fundamental factor in understanding their physical properties. We demonstrate that experimentally observed Néel temperatures, band gaps, conductivities and also Seebeck coefficients of the compounds under consideration can be explained by our DFT+DMFT calculations.

TT 31.4 Tue 14:45 HSZ 103

Quantum Oscillations in $CoSb_3$ — •Marcel Naumann[1], Frank Arnold[1], Flipo Sever[1], Mirtha Pillaca Quispe[2], Dan Sun[1], Michael Baenitz[1], Andreas Leithe-Jasper[1], Helge Rosner[1], Peter Gille[2], and Elena Hassinger[1,3] — [1]Max-Planck-Institut Chemische Physik fester Stoffe, Dresden, Germany — [2]Ludwig-Maximillians-Universität München, Germany — [3]Technische Universität München, Garching, Germany

The material class of skutterudites is at the center of attention on the search for new thermoelectric materials. Additionally, they also host a variety of novel electronic properties, such as valence fluctuations and non-fermi liquid behaviour, which are widely studied in condensed matter physics. The skutterudite $CoSb_3$, in particular, is a parent compound, whose doped and "filled" variants are studied in the aforementioned fields. It is characterised by two linearly dispersing bands, which anticross close to the Fermi level at the Γ-point, coexisting with a heavier electron band above the crossing.

Here we present a comprehensive experimental study of the bulk Fermi surface of $CoSb_3$. By means of quantum oscillations, measured in magnetisation and angle-dependent electronic transport, information about topology, charge carrier effective mass and scattering times are gained. Two Fermi surfaces of similar size are observed. Their size and topology fit the charge carrier density determined by Hall measurements and ab-initio DFT calculations for slight electron doping. Furthermore, we show reproducible doping levels and crystal quality throughout a variety of sample batches.

TT 31.5 Tue 15:00 HSZ 103

Unconventional superconductivity in unconventional correlated materials? — •Xiaodong Cao[1], Jean Chen[1], Zhicheng Zhong[1], Dirk Manske[1], Thomas Ayral[2], Olivier Parcollet[2], and Philipp Hansmann[1] — [1]Heisenbergstrasse 1,D-70569 Stuttgart, — [2]Institut de Physique Théorique (IPhT), CEA, CNRS, UMR 3681, 91191 Gif-sur-Yvette, France

Rare earth heavy fermion systems or transition metal oxides are probably among the first materials that come to mind when we consider unconventional superconductivity in strongly correlated materials. However, a much less known class of compounds, synthesized by the adsorption of a specific ad-atom species on a semiconductor substrate, have been recently confirmed as highly correlated systems. Depending on the specific ad-atom the materials span a rich variety of correlation physics including Mott insulating ground states or correlation driven charge order. With an effective Hamiltonian derived from ab initio methods, we adapt the dynamical-mean field theory, albeit including also non-local correlations on the level of the three legged electron boson vertex as recently proposed by Ayral and Parcollet. Studying the interplay of effects induced by long range interaction, geometric frustration, we started our search to novel exotic ground states. Interestingly, for the specific case of Pb/Si(111) preliminary results already suggest the presence of a d+id chiral superconductivity as a function of doping.

TT 31.6 Tue 15:15 HSZ 103

Electron spin resonance of the spin chain compound $Cu(py)_2Br_2$: An experimental and theoretical study — Julian Zeisner[1], Stephan Zimmermann[1], Vladislav Kataev[1], •Michael Brockmann[2], Frank Göhmann[2], Andreas Klümper[2], and Alexander Weisse[3] — [1]Leibnitz Insitute for Solid State and Material Research, Dresden, Germany — [2]University of Wuppertal, Germany — [3]Max Planck Institute for Mathematics, Bonn, Germany

We analyze electron spin resonance (ESR) data of the quasi-one-dimensional magnet $Cu(py)_2Br_2$ and compare with theoretical predictions for the spin-1/2 Heisenberg chain with small anisotropic perturbations.

Based on measurements of the angular dependence of resonance shift and linewidth at high temperatures the full g-tensor can be determined and the existence of two anisotropy axes oriented perpendicular to the chain axes is proposed. We further estimate the strength of the anisotropy from several ESR data, in particular from the frequency dependence of the resonance shift at low temperatures, showing that usual field theoretical approaches at zero temperature are not sufficient to explain our low-temperature data. Furthermore, from the angular dependence of the linewidth, the algebraic decay of dynamical correlation functions of the isotropic spin chain can be deduced ($\sim t^{-2/3}$). This result does not agree with the picture of spin diffusion in one dimension ($\sim t^{-1/2}$).

TT 31.7 Tue 15:30 HSZ 103

Hydrodynamic transport in Anisotropic-Dirac Systems — •Julia Link[1], Boris Narozhny[1], and Jörg Schmalian[1,2] — [1]Institute for Theory of Condensed Matter (TKM), Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Institute for Solid State Physics (IFP), Karlsruhe Institute of Technology, Karlsruhe, Germany

We present the transport properties of anisotropic-Dirac fermion systems in the hydrodynamic regime. Anisotropic Dirac-fermions are new and interesting materials similar to graphene. These materials have a

Fermi-Dirac point. However, the energy dispersion is linear along one axis and parabolic in the perpendicular direction. Thus the fermions behave relativistic in one direction and classical in the perpendicular direction. This leads to fascinating transport behavior. Studying one Fermi-point using the qunatum Boltzmann equation, we find insulating behavior in the relativistic regime and metallic behavior in the classical regime. We discuss the implications for TiO_2/VO_2 which is a square lattice and has two Fermi-Dirac points in one Brillouin zone, which are rotated by 90-degrees relative to each other. The conductivity is thus a superposition of the insulating and metallic behavior. In order to disentangle the relativistic and classical transport regimes, we study the magnetoresistivity.

TT 31.8 Tue 15:45 HSZ 103

Casimir forces between two impurities in a lattice — •Andrei Pavlov[1], Dmitri Efremov[1], and Jeroen van den Brink[1,2] — [1]Institute for Theoretical Solid State Physics, IFW Dresden, 01069 Dresden, Germany — [2]Institute for Theoretical Physics, TU Dresden, 01069 Dresden, Germany

One of the fundamental properties of matter is the Casimir force, i.e. interaction of classical objects via quantum fluctuations. It appears in various field, including optics, Bose-condensates, micro-structure geometry compounds, etc. The usual wisdom is that the Casimir force between two atoms decays as $r^{-(2D+1)}$, which is originated from the two boson exchange in the lowest order of the perturbation theory. Stimulated by the recent experiments on the high temperature superconductor H_3S under high pressure, we reconsider the Casimir forces between two impurities in solid state physics via virtual phonons at long and short distances. We found strong deviation from the standard law at short distances which depends on the masses of impurities atoms. At long distances it comes to the standard r-dependence, but the value of the prefactor is much larger than it's expected from the lowest orders of the perturbation theory. These differences become important when the impurity masses differ from the lattice atoms more than twice. Finally we apply our results to impurity atoms of deuterium and tritium in H_3S.