MA 29: Spin Structures / Magnetic Phase Transitions

Time: Thursday 17:45–19:00 Location: H 1012

MA 29.1 Thu 17:45 H 1012

XAFS investigation of the light and thermally induced low-spin to high-spin transition in metallo-supramolecular assemblies — •Bahia Arezki[1], Yves Bodenthin[2], Ronald Frahm[3], Ralph Wagner[3], Dirk Lützenkirchen-Hechta[3], and Ullrich Pietsch[1] — [1]Fachbereich 7- Physik- Universität Siegen, Walter-Flex-Straße 3, 57072 Siegen, Germany — [2]) Paul Scherrer Institut, CH-5232 Villigen, Switzerland — [3]Fachbereich C - Physik, Bergische Universität Wuppertal, Gaußstr. 20, 42097 Wuppertal, Germany

We have investigated the structural changes associated with the low spin to high spin transition (ST) of Metallo-supramolecular polyelectrolyte-amphiphile-complexes (PAC) induced by temperature and light. For this purpose, X-ray absorption near the edge (XANES)has been used to probe the structural changes in the local FeN6 octahedra, before and after a temperature induced ST. The PACs contain 2 (PAC6E16_12) and 6 (PAC6E16_16) amphiphiles per metal ion and are composed by Fe and Ni ions in order to identify any structural changes solely induced by the magnetic process. Our results clearly show changes in the profiles of both spin states indicating a structural modification during the ST. In next experiment, we will investigate if the same structural changes can be induced by light (LIESST-Light-Induced-Excited-Spin-State-Trapping). In case of success, this experiment, will be the first proof of LIESST in a metallo-polyelectrolyte embedded into an amphiphilic matrix. It will answer the question how the coordination shell of the Fe2+ ions looks after light irradiation.

MA 29.2 Thu 18:00 H 1012

Magnetic Structure of $GdMnO_3$ — •Anne Möchel[1], Jörg Voigt[1], Martin Meven[2], Jong-Woo Kim[3], and Thomas Brückel[1] — [1]Institut für Festkörperforschung, Forschungszentrum Jülich GmbH, 52425 Jülich, Germany — [2]Technische Universität München, ZWE FRM II, 85748 Garching, Germany — [3]Ames Laboratory, Ames, Iowa 50011, USA

We present the results of a combined neutron diffraction and X-ray resonance exchange scattering study of a $GdMnO_3$ single crystal carried out in order to clarify the magnetic structure. Below the Néel-Temperature T_N=41.6K, we find an incommensurate structure with a spin polarisation aligned parallel to the c-direction. At low temperatures (T≈15K) we have a step-like change of the propagation vector τ to an near commensurate τ=0.245 associated with a strong increase in intensity.

The onset of magnetic order is reflected by a λ anomaly in the specific heat, which shows no anomaly at 15K, where the propagation vector shows the sudden change. The magnetic susceptibility reveals a reduced paramagnetic effective moment as compared to the moments expected for free Gd^{3+} and Mn^{3+}. A possible model for the magnetic structure is proposed based on the above observations.

MA 29.3 Thu 18:15 H 1012

Direct Experimental Observation of Fermi-Surface Nesting in Tb and Dy Metal — •Kristian Döbrich[1], Aaron Bostwick[2], Kai Rossnagel[2], Jessica McChesney[2], Eli Rotenberg[2], and Günter Kaindl[1] — [1]Institut für Experimentalphysik, Freie Universität Berlin, Germany — [2]Advanced Light Source, Lawrence Berkeley National Laboratory, UC Berkeley, USA

Some of the lanthanide metals develop antiferromagnetic phases with a helical arrangement of the localized $4f$ electron spins. The magnetic coupling is mediated by the valence electrons (RKKY interaction). The commonly accepted nesting hypothesis links the formation of helical ordering to the existence of parallel sheets of the Fermi surfaces (FS), the so-called FS nesting. For Y and Y-Gd alloys, FS nesting was observed with positron annihilation. However, for a pure lanthanide metal, nesting had not been observed prior to this work.

Angle-resolved photoemission as performed at beamline 7.0.1 of the Advanced Light Source, Lawrence Berkeley National Laboratory, USA, gives access to the occupied part of the electronic structure over a wide region of momentum space, covering several Brillouin zones. We studied Gd metal that orders ferromagnetically as well as the two metals Tb and Dy, which exhibit helically-ordered antiferromagnetic phases. The photoemission data on Gd presented here confirm the absence of FS nesting in this metal, while our data on Tb and Dy give clear evidence of FS nesting in these two metals. The present results therefore provide strong support for the correctness of the nesting hypothesis.

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MA 29.4 Thu 18:30 H 1012

Quantum Phase Transition of a Magnet in a Spin-bath — •Conradin Kraemer[1,2], Henrik M. Ronnow[1], Joel Mesot[2], Peter Link[3], Astrid Schneidewind[4], Tobias Unruh[3], Thomas F. Rosenbaum[5], Gabriel Aeppli[6], and Jens Jensen[7] — [1]Laboratory for Quantum Magnetism EPFL, CH-1015 Lausanne — [2]Laboratory for Neutron Scattering ETHZ PSI, CH-5232 Villigen — [3]Forschungsneutronenquelle FRM II, D-85747 Garching — [4]Institut für Festkoerperphysik, TU Dresden, D-01062 Dresden — [5]Department of Physics, University of Chicago, Chicago, IL 60637 — [6]London Centre for Nanotechnology, UCL, London WC1E 6BT — [7]Niels Bohr Institute, University of Copenhagen, DK-2100 Copenhagen

As a physical realisation of the ferromagnetic Ising model with a quantum phase transition in a transverse field of 5T, $LiHoF_4$ is a widely celebrated model system with a thoroughly characterized Hamiltonian. However, the innocently weak hyperfine coupling to the nuclear spins dramatically influence the quantum critical point. Below 600 mK the critical field is extended slightly upwards. More spectacularly, is softening of the principal electronic excitation - the hall mark of a quantum phase transition - forestalled by hybridization, which transfers true softening to the mixed nuclear electronic states at much lower energies. The electronic system thus remain sub-critical with finite quantum coherence. We report the counterintuitive observation that maximum electronic quantum criticality is achieved not as expected at T=0 K but rather at a finite intermediate temperature $0 < T < T_c$.

MA 29.5 Thu 18:45 H 1012

Antiferromagnet — ferromagnet transition in Fe islands on Cu(111) — •Timofey Balashov[1], Albert F. Takacs[1], Markus Däne[2], Arthur Ernst[2], Patrick Bruno[2], and Wulf Wulfhekel[1] — [1]Physikalisches Institut, Universität Karlsruhe, Wolfgang-Gaede Strasse 1, 76131 Karlsruhe, Germany — [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle, Germany

Fe is known for its martensitic phase transition between fcc and bcc configurations. Recently, it has been shown that 2ML Fe islands on Cu(111) show both configurations, an fcc core and a bcc outer rim [1]. We investigated the electronic structure of the Fe islands by scanning tunneling spectroscopy at 4K. By comparison to the local density of states obtained from ab-initio calculations, we were able to show that the core is antiferromagnetic while the rim of the island is ferromagnetic. Hand in hand with this phase change, Fe adopts different out of plane lattice constants as determined by topographic and spectroscopic STM investigations.

Most interestingly, we discovered that the Fe structure can be switched hysteretically between the two states by the presence of the STM tip. The transition occurs at nano Ampere currents and is also visible in topographical data, due to lattice transitions.

[1] A. Biedermann, W. Rupp, M. Schmid and P. Varga, Phys. Rev. B **73**, 165418 (2006)