MA 11 Spin-Structures and Magnetic Phase Transitions II

Time: Monday 15:00–16:30 Room: HSZ 403

MA 11.1 Mon 15:00 HSZ 403

Magneto-optic measurement of magnetic phase transition and domain structure of liquid $Co_{80}Pd_{20}$ — •Lucian M. Stefan and Karl Maier — Helmholtz Institut für Strahlen- und Kernphysik, Rheinische Friedrich-Wilhelms-Universität Bonn, Nußallee 14-16, D-53115 Bonn, Germany

The temperature dependence of the magnetisation of liquid $Co_{80}Pd_{20}$ was obtained and the domain structure of the liquid phase was investigated. The spherical samples (mass: 10 - 11mg) were processed in an electromagnetic levitation device in pure H_2 atmosphere, which allows an undercooling of $\Delta T \approx 360$K below the liquidus temperature ($T = 1610$K). The magnetisation on the surface across the magnetic phase transition was measured via the magneto-optical Kerr effect.

A significant increase of the Kerr-angle was observed at the magnetic phase transition which reflects the appearance of magnetic order in the liquid. The Curie temperature found for the liquid phase is $T_C^l = 1253$K and compares to similar values found in earlier experiments (stray field measurements). All Kerr data indicate a plateau in a region of ≈ 0.5K at the low-temperature end of the magnetisation curve. This is interpreted as the presence of an identical domain structure in all independent measurements (measuring area diameter about 10μm). Our results agree with computer simulations, which predict a vortex structure of domains for a liquid spherical sample. In this structure the spins are oriented parallel to the surface along an imaginary equator due to the absence of domain walls in a ferromagnetic liquid.

MA 11.2 Mon 15:15 HSZ 403

Helimagnetsm and metamagnetic transitions in novel bulk GMR alloys based on MnAu2. — •Sergii Khmelevskyi, Laslo Udvardi, Laslo Szunyogh, Peter Mohn, and Peter Weinberger — Center for Computational Material Science, Vienna University of Technology, Getreidemarkt 5/134, A-1060 Vienna, Austria

Magnetic exchange interactions in helimagnetic MnAu2 compound and their dependence upon alloying with Fe and Cr are studied from first principles using General Perturbation Method within Surface Korringa-Kohn-Rostoker formalism for band structure calculations. The calculated interactions well reproduce the results of neutron diffraction experiments concerning periodicity of the helix in MnAu2 and its weakening with Fe substitution, providing background for conventional model interpretations of metamagnetic processes in this systems responsible for Giant Magneto-Resistance effect. However, for (Mn,Cr)Au2, alloys our results reveal entirely different picture suggesting that experimentally observed magnetization process in the Cr doped alloys may follows a scenario predicted theoretically few decades ago for nearly orthogonal helimagnetics.

MA 11.3 Mon 15:30 HSZ 403

Spin State Transformations of a 3d Ion in the Pyramidal Environment under Lattice Distortions — •Karina Lamonova, Helen Zhitlukhina, Sergei Orel, and Yurii Pashkevich — A.A. Galkin Donetsk Phystech NASU, 83114 Donetsk, Ukraine

The spin state (SS) transitions in the metal-containing pyramidal complexes originated from the crystal structure deformations are the research subject of this work. As the metal ions, we considered the transition metals with the 3d6 and 3d4 configurations. The SS transitions of the metal ions from low spin (LS, S=0) to the intermediate spin (IS, S=1) and high spin (HS, S=2) under change of the metallic ion effective charge Zeff and displacements of the oxygen ions has been investigated in the frame of crystal field approximation. The features of the SS stability have been calculated without spin-orbit interaction accounting, and then with the accounting one. Some critical points over Zeff at which an accident degeneracy of SSs have been revealed. Near these critical points, the negligible distortions can crucially influence on the SS changing. The ground SS of pyramidal Me-O complex is very sensitive to the symmetry and magnitude of the oxygen cage distortions. We probed the breathing like distortions, the displacement of the 3d-ion along Z axis, Jan-Teller like ion displacements, and the displacements like pyramidal plane corrugation. The SS diagrams in the parameter space "effective charge"-"distortion magnitude" have been built. It is revealed the IS ground state exists for all kind considered distortions at the corresponding choice of the Zeff value. Jan-Teller distortions stabilize the IS state in a wide range of Zeff that consistent with experimental data on layered cobaltites.

MA 11.4 Mon 15:45 HSZ 403

Bulk Properties and Neutron Diffraction of the Magnetic Phase Diagram of MnSi — •Daniel Lamago[1], Christian Pfleiderer[1], Robert Georgii[2], and Peter Böni[1] — [1]Physics Department E21, TU München, D- 85747 Garching, Germany — [2]FRM-II, Lichtenbergstr. 1 D-85747 Garching, Germany

MnSi develops itinerant-electron magnetism below $T_C = 29$ K that supports a long wavelength helical modulation. In recent years the properties of MnSi have attracted great scientific interest:[1](i) well above T_C chiral magnetic fluctuations have been observed; (2) the magnetic ground state appears to switch abruptly from a weakly spin-polarized Fermi-Liquid to an extended non-Fermi liquid (NFL) phase at a pressure of 14.6 kbar; (3) neutron scattering shows that large magnetic moments survive far into the NFL-phase, where the scattering intensity observed everywhere on the surface of a small sphere suggests partial order analogous to liquid crystals. Motivated by recent efforts [2] we revisit reorientational processes of the helical modulation in MnSi at ambient Pressure as funtion of field. We combine small-angle neutron scattering with AC susceptibility, DC and Torque magnetisation data. This provides unexpected, new insights into the nature of the helical modulation and its possible connection to the NFL phase and the partial magnetic order at high pressure.

[1] B. Roessli et al., Phys. Rev. Lett. 88, 237204 (2002); C. Pfleiderer et al., Nature 414, 427 (2001); N. Doiron-Leyraud et al., Nature 425, 595 (2003); C. Pfleiderer et al., Nature 427, 227 (2004).
[2] A.I. Okorokov et al. Physica B 356, 259 (2005).

MA 11.5 Mon 16:00 HSZ 403

Frustration in R_2PdSi$_3$ (R = Tb, Er): Spin-glass or magnetic short-range order? Neutron diffraction studies — •Matthias Frontzek[1], Andreas Kreyssig[1], Jens-Uwe Hoffmann[2], and Michael Loewenhaupt[1] — [1]TU Dresden, Institut für Festkörperphysik, 01062 Dresden — [2]Hahn-Meitner-Institut, 14109 Berlin

The series R_2PdSi_3 (R = rare earth), crystallizing in an AlB_2 derived hexagonal structure, have been found to exhibit strong anisotropic magnetic properties. Below their respective Néel temperatures Tb_2PdSi_3 (24 K) and Er_2PdSi_3 (7 K) feature a second phase transition at 7 K and 2 K, respectively. This second transition shows a strong frequency dependence in ac-susceptibility measurements. Several authors assume a spin-glass state below this second phase transition.

We performed neutron diffraction experiments on E2 at HMI Berlin within a temperature range from 0.4 K to 300 K and magnetic fields up to 6.5 T on Tb_2PdSi_3 and Er_2PdSi_3 single crystals.

Tb_2PdSi_3 orders antiferromagnetically at 24 K with a magnetic moment direction in the basal plane and a propagation vector $\tau = (1/2\ \ 1/2\ \ 1/16)$. Furthermore, we observe additional short-range magnetic order (SRO) at low temperatures. The second phase transition is correlated to the temperature dependence of the SRO. The SRO becomes long range ordered when a magnetic field (>1.5 T) is applied.

Er_2PdSi_3 orders antiferromagnetically at 7 K with a magnetic moment direction along the hexagonal $\boldsymbol{c}$-axis and a propagation vector $\tau = (0.11\ \ 0.11\ \ 0)$. In this case the second phase transition is correlated to a "squaring up" of the antiferromagnetic structure.

MA 11.6 Mon 16:15 HSZ 403

Domain imaging and symmetry reduction in LiNiPO$_4$ — •Bas B. van Aken, Takuya Satoh, and Manfred Fiebig — Max-Born-Institut, Max-Born-Straße 2a, 12489 Berlin

Second harmonic generation (SHG) has been applied to study the magnetic symmetry and domain structure of magnetoelectric $LiNiPO_4$. Up to now a simple collinear AFM spin order was assumed. Our SHG data indicate the symmetry is lower. The lower symmetry allows the presence of additional types of domains and toroidal ordering. The lower symmetry is confirmed by the dependence of the domain structure on the magnetic field. Without field AFM plate-like domains are observed. Field cooling leads to a single domain state, which is not allowed by the simple magnetic model. Measuring the magnetic field - temperature phase diagram reveals a first order phase transition to an incommensurate phase. In a magnetic field this transition temperature is reduced, indicating that the magnetic field stabilises the incommensurate phase, which is unusual.