Resonant inelastic x-ray scattering (RIXS) is a powerful tool for determining the energy and symmetry of charge neutral electronic excitations in strongly correlated materials. We report on high-resolution polarization-dependent RIXS at the O 1s resonance of NiO [1], CoO and MnO. The experimental results are compared to multi-site cluster calculations, which are able to describe collective excitations. Tuning the incident X-ray energy to the first absorption peak excites the O 1s electron into empty O 2p states strongly hybridized with the metal 3d states. Thus the de-excitation process reveals contributions from low-energy excitations mediated by the O 1s core-hole. Apart from local oxygen ligand to metal charge transfer excitations and local crystal field excitations, the O 1s RIXS spectra give also rise to non-local metal-to-metal charge transfer excitations and double inter-site spin flip excitations (double-singlet creation).

[1] L.-C. Duda, T. Schmitt, M. Magnuson et al., Phys. Rev. Lett. 96, 067402 (2006).

TT 14.10 Tue 16:45 H19

Study of magnetic ordering in $YTiO_3$ using high-resolution dilatometry — •William Knafo[1,2], Christoph Meingast[1], Alexander Boris[3], Paul Popovich[3], Natalia Kovaleva[3], Petar Yordanov[3], Andrei Maljuk[3], Bernhard Keimer[3], and Hilbert v. Löhneysen[1,2] — [1]Forschungszentrum Karlsruhe, Institut für Festkörperphysik, D-76021 Karlsruhe — [2]Physikalisches Institut, Universität Karlsruhe, D-76128 Karlsruhe — [3]Max-Planck-Institute for Solid State Research, Heisenbergstrasse 1, D-70569 Stuttgart

The perovskite $YTiO_3$ orders ferromagnetically below $T_C = 26.7$ K, whereas $LaTiO_3$ orders antiferromagnetically below $T_N = 150$ K. The origin of this difference is currently being strongly debated and is related to the different types of lattice distortions, e.g. to the $GdFeO_3$-type distortion and to the Jahn-Teller distortion induced by the orbital ordering in these systems [1-5]. We present here a study of the macroscopic distortions associated with magnetic ordering in $YTiO_3$ using thermal expansion and magnetostriction measurements. The uniaxial pressure dependencies of the Curie temperature T_C and of the low temperature ferromagnetic moment are extracted from our data. The coupling of magnetism to the different kinds of distortion (i.e. of $GdFeO_3$- and Jahn-Teller-type) will be discussed.

[1] Ulrich et al., Phys. Rev. Lett. 89, 167202, (2002).
[2] Iga et al., Phys. Rev. Lett. 92, 176403, (2004).
[3] Akimitsu et al., J. Phys. Soc. Jpn. 70, 3475 (2001).
[4] Pavarini et al., New J. Phys. 7, 188 (2005).
[5] Mochizuki and Imada, New J. Phys. 6, 154 (2004).

TT 14.11 Tue 17:00 H19

Ordering and spin waves in vanadium spinels — •Natalia Perkins[1] and Olga Sikora[2] — [1]Technische University of Braunschweig, Braunschweig, Mendellsohnstrasse 3,38106, Germany — [2]Max Planck Institute for Complex System, Noethnitzer Str.38, Dresden, 01187, Germany

We consider the effect of quantum spin fluctuation on the ground state properties of spin-orbital Hamiltonian on a pyrochlore lattice, which is derived to model the ground state properties of vanadium spinel oxides AV_2O_4 (A=Zn, Mg, Cd). As the magnitude of the spin-orbit interaction and that of the exchange one are very similar, both interactions should be simultaneously considered. We show that the low-energy effective Hamiltonian decides about the magnetic interactions of the system and determines the ground state. We also find that the magnetic excitation spectrum obtained by linear spin-wave approach in case of quenched orbital angular momentum differs significantly from one calculated in the magnetic exciton model formulated for the case with unquenched orbital angular momentum. Thus we suggest that the performance of the neutron scattering experiment would help to clarify both the overall picture of the ground state and of the excitation spectrum.

TT 14.12 Tue 17:15 H19

Magnetic properties of the layered cobaltates $La_{2-x}Sr_xCoO_4$ — •N. Hollmann, M.W. Haverkort, M. Benomar, M. Reuther, T. Lorenz, and J.A. Mydosh — II. Physikalisches Institut, University of Cologne

This talk presents a study on the magnetic properties of the layered perovskite $La_{2-x}Sr_xCoO_4$. This class of materials crystallises in the K_2NiF_4 structure as the high-T_C superconductors $La_{2-x}Sr_xCuO_4$ or the corresponding nickelates $La_{2-x}Sr_xNiO_4$, the latter exhibiting stripe order of both charge and spin. In many cobaltates, the spin state of the cobalt ions is an extra degree of freedom. The non-layered compound $LaCoO_3$ even shows a thermally driven spin-state transition. Much less is known about the spin states of the cobalt ions in $La_{2-x}Sr_xCoO_4$. We prepared a series of single crystals by the floating zone method, covering a strontium doping range of $0.3 \leq x \leq 0.8$. We measured the magnetic susceptibility for a magnetic field applied parallel and perpendicular to the CoO_2 planes. We find a clear deviation from Curie-Weiss behaviour and strong anisotropy. From the direction of the magnetic anisotropy we conclude that χ is dominated by Co^{2+} in the high-spin state, while Co^{3+} is in the low-spin state. These findings are confirmed by full-multiplet crystal field calculations which show that spin-orbit coupling and crystal field effects are essential for describing the magnetic behaviour.

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15 min. break

TT 14.13 Tue 17:45 H19

Orbitally Ordered Phase in $Ca_{2-x}Sr_xRuO_4$ Investigated with Resonant X-ray Diffraction — •Ioannis Zegkinoglou[1], Joerg Strempfer[2], Britta Bohnenbuck[1], Christie S. Nelson[3], John P. Hill[3], Jonathan C. Lang[4], George Srajer[4], Yoshiteru Maeno[5], and Bernhard Keimer[1] — [1]Max-Planck-Institut für Festkörperforschung, Stuttgart, Germany — [2]HASYLAB at DESY, Hamburg, Germany — [3]Brookhaven National Laboratory, New York, USA — [4]APS at Argonne National Laboratory, Argonne, USA — [5]Department of Physics, Kyoto University, Japan

Resonant x-ray diffraction at the Ru L_{II} and L_{III} absorption edges was used to investigate the interplay between the spin, lattice and orbital degrees of freedom in the layered 4d-electron $Ca_{2-x}Sr_xRuO_4$ system [1]. A new orbital ordering phase transition was discovered in single-crystal compounds with Sr-doping x=0 and x=0.1 at temperatures 260 K and 130 K, respectively, at reciprocal space positions (100) and (011). The orbital order is only weakly coupled to the lattice. Its propagation vector is not affected by the change of the low-temperature antiferromagnetic structure upon Sr substitution. The tilt order of the RuO_6 octahedra was also probed in our studies. It produces resonant scattering at the structurally and magnetically forbidden (110) position and follows a different temperature dependence from orbital order.

[1] I. Zegkinoglou et al., Phys. Rev. Lett. 95, 136401 (2005)

TT 14.14 Tue 18:00 H19

Magnetism in single-layered Ruthenates — •Paul Steffens[1], Olaf Schumann[1], Yvan Sidis[2], Peter Link[3], Satoru Nakatsuji[4], and Markus Braden[1] — [1]II. Physikalisches Institut, Universität Köln, 50937 Köln — [2]Laboratoire Léon Brillouin, Gif-sur-Yvette, France — [3]FRM II, Technische Universität München, 85747 Garching — [4]Institute of Solid State Physics, Tokyo, Japan

We present recent results on the magnetism in the single-layered ruthenates $Ca_{2-x}Sr_xRuO_4$. Depending on the Sr-content x, very different properties are observed. In this contribution we focus on the region $0.2 < x < 0.5$. Here, the system is metallic and paramagnetic, but close to magnetic order, and a competition of a ferromagnetic and incommensurate antiferromagnetic instability determines the magnetic behaviour. An applied magnetic field induces a drastic change; we have studied this metamagnetic transition by inelastic neutron scattering, thereby probing the dynamic magnetic correlations at different magnetic fields and temperatures. We find that the ground state without magnetic field is determined by a near nesting instability of the Fermi surface. A magnetic field higher than the metamagnetic critical field suppresses these features and induces strong paramagnon scattering, proving the existence of strong ferromagnetic correlations.

TT 14.15 Tue 18:15 H19

Investigation of Magnetic and Orbital Order in $Ca_3Ru_2O_7$ using Resonant X-ray Diffraction — •Britta Bohnenbuck[1], Jörg Strempfer[2], Ioannis Zegkinoglou[1], Christie Nelson[3], and Bernhard Keimer[1] — [1]Max Planck Institute for Solid State Research, Heisenbergstrasse 1, 70569 Stuttgart, Germany — [2]HASYLAB at DESY, Notkestrasse 85, 22605 Hamburg, Germany — [3]National Synchrotron Light Source, Brookhaven National Laboratory, Upton, New York 11973-5000, USA

We used resonant x-ray diffraction at the L_{II}- and L_{III}- absorption edges of Ru to investigate the bilayered transition metal oxide $Ca_3Ru_2O_7$. This system shows metallic antiferromagnetism between the metal to insulator transition T_{MI}=48K and the antiferromagnetic