TT 4: Solids at Low Temperature - Materials

Time: Monday 11:30–12:45 Location: H18

TT 4.1 Mon 11:30 H18

The ADRESS project at the Swiss Light Source: A beamline for RIXS and ARPES studies on correlated and nanostructured materials — •Thorsten Schmitt[1], Vladimir Strocov[1], Thomas Schmidt[1], Uwe Flechsig[1], Juraj Krempaski[1], Giacomo Ghiringhelli[2], Claudia Dallera[2], Lucio Braicovich[2], Marco Grioni[3], and Luc Patthey[1] — [1]Paul Scherrer Institut, Villigen PSI, Switzerland — [2]Politecnico di Milano, Italy — [3]EPFL, Switzerland

Resonant inelastic X-ray scattering (RIXS) is a powerful bulk-sensitive probe of the electronic structure of condensed matter with atomic and orbital sensitivity. Soft X-Ray Angle-Resolved Photoelectron Spectroscopy (ARPES) allows k-resolved investigations of the electronic structure and correlation effects with enhanced bulk sensitivity. New instrumentation for both, RIXS and Soft X-Ray ARPES, will become available at the ADvanced RESonant Spectroscopies (ADRESS) beamline at the Swiss Light Source (SLS) beginning from spring 2007. We report on construction and planned capabilities of the ADRESS beamline, following an optical scheme with a plane grating monochromator. The ADRESS beamline will deliver soft X-rays with variable polarization (circular and linear) between 0.4 and 1.8 keV at high resolving power of ˜28000 near 1 keV. The undulator for this beamline adopts an Apple-type scheme with 4 arrays of permanent magnets with a fixed magnetic gap. The RIXS end-station with an ultra-high resolution soft X-ray spectrometer (resolving power ˜12000 around 1 keV) will be installed on a rotating platform in order to study low-energy excitations as a function of momentum transfer.

TT 4.2 Mon 11:45 H18

Spin-phonon coupling in chromium spinels probed by infrared spectroscopy — •Torsten Rudolf[1], Christian Kant[1], Franz Mayr[1], Joachim Hemberger[1], Vladimir Tsurkan[1,2], and Alois Loidl[1] — [1]Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, D-86135 Augsburg, Germany — [2]Institute of Applied Physics, Academy of Sciences of Moldova, MD-2028 Chisinau, Republic of Moldova

The B-site spinels ACr_2X_4 with A=Cd, Zn, Hg and X=S, O and Se were systematically investigated by Fourier Transform Infrared Spectroscopy. The temperature and magnetic field dependence of the phonon spectra in a range from 5 K to 300 K and in fields of up to 7 T where studied. At the magnetic ordering temperature most compounds show significant splittings of the phonon modes, driven by spin-phonon coupling. $CdCr_2O_4$ and $ZnCr_2O_4$ are geometrically frustrated, $ZnCr_2S_4$ [1] is bond frustrated and $ZnCr_2Se_4$ [2] is bond frustrated, but dominated by ferromagnetic exchange. The pattern of splittings is different for the different compounds and crucially depends on the nature of frustration and of the resulting spin order. $HgCr_2S_4$ is almost a ferromagnet and exhibits no splitting of the eigenfrequencies, whereas $ZnCr_2Se_4$ is a prominent example of a spin-driven Jahn-Teller effect, where the splitting of the low-energy phonon mode can be fully suppressed in an external magnetic field.

[1] J. Hemberger *et al.*, Phys. Rev. Lett. **97**, 087204 (2006)
[2] T. Rudolf *et al.*, Spin-phonon coupling in $ZnCr_2Se_4$, *Preprint* cond-mat/0611041

TT 4.3 Mon 12:00 H18

Europium Tunneling in $Eu_8Ga_{16}Ge_{30}$ — •Raphaël P. Hermann — Institut für Festkörperforschung, Forschungszentrum Jülich GmbH, 52425 Jülich * — Dept of Physics, B5, Université de Liège, B-4000 Sart-Tilman, Belgium — Dept of Materials Science and Engineering, The University of Tennesee, Knoxville, Tennessee, 37996-2200, USA

We report on Mössbauer spectral and microwave absorption experiments that reveal the atomic tunneling of Eu in the ferromagnetic phase of the $Eu_8Ga_{16}Ge_{30}$ clathrate[1]. Single crystal neutron diffraction had revealed that Eu reside off-center in the clathrate cages[2] and a signature of the tunneling was found in elastic constant measurements[3]. Our measurements reveal the ground state tunneling of 75% of the Eu with a frequency of ∼450 MHz in good agreement with the expected frequency for an isolated tunneling atom in a double well potential. The presence of such well defined ionic tunneling in a crystalline solid may open the route to solid-state technological applications of the associated Rabi oscillations.

[1] Hermann R. P. *et al.*, Phys. Rev. Lett. 97, 017401 (2006).
[2] Sales B. C. *et al.*, Phys. Rev. B 63, 245113 (2001).
[3] Zerec I. *et al.*, Phys. Rev. Lett. 92, 185502 (2004).
* Current address

TT 4.4 Mon 12:15 H18

Effects of Nuclear Spins in Amorphous Glycerol on the Amplitude of Dielectric Polarization Echoes — •Masoomeh Bazrafshan[1], Gudrun Fickenscher[1], Kathrin Reinhold[1], Marek Bartkowiak[2], Herbert Zimmermann[3], Andreas Fleischmann[1], and Christian Enss[1] — [1]Kirchhoff-Institut für Physik, Universität Heidelberg — [2]Forschungszentrum Rossendorf, Dresden — [3]Max-Planck-Institut für Medizinische Forschung, Heidelberg

The properties of amorphous solids below a few Kelvin are determined by tunnelling systems. It has been shown that coupling of nuclear quadrupole moments to the tunnelling motion leads to magnetic field effects in non-magnetic glasses. We find that, in smaller B-fields, the presence of nuclear magnetic dipole moments interacting with each other by the magnetic dipole-dipole interaction results in similar magnetic field effects.

Both effects have been studied systematically with dielectric two-pulse polarization echoes on a series of partially deuterated glycerol samples. Decay measurements at very low temperatures show quantum beating with two different groups of frequencies, which can be attributed to the quadrupole energy splittings (˜130kHz) and the dipole-dipole splittings (˜30kHz). In addition, the beating amplitudes feature an unexpected temperature-dependent damping.

We present the measured data and compare the results with detailed numerical simulations. On this basis we draw possible conclusions about the microscopic nature of tunnelling systems in amorphous glycerol.

TT 4.5 Mon 12:30 H18

Relaxation mechanisms in low mechanical loss materials for interferometric gravitational wave detectors occurring at low temperatures — •Anja Zimmer[1], Ronny Nawrodt[1], Daniel Heinert[1], Christian Schwarz[1], Matthias Hudl[1], Wolfgang Vodel[1], Andreas Tünnermann[2], and Paul Seidel[1] — [1]Institut für Festkörperphysik, FSU Jena, Helmholtzweg 5, 07743 Jena — [2]Institut für Angewandte Physik, FSU Jena, Albert-Einstein-Straße 15, 07745 Jena

Interferometric gravitational wave detectors are highly sensitive instruments. To reduce the thermal noise of their optical components the operating temperature could be lowered which calls for materials offering low mechanical losses at these cryogenic temperatures. Therefore, systematic measurements have been done in a high precision experimental setup providing the ability to observe losses of at least 10^{-9} at the resonant frequencies of the samples in the temperature range of 5 to 300 K. Relaxation mechanisms leading to the mechanical losses are discussed for different materials.

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