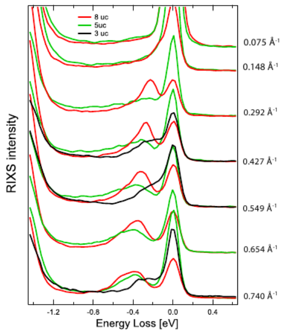

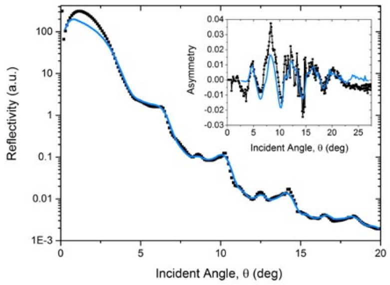

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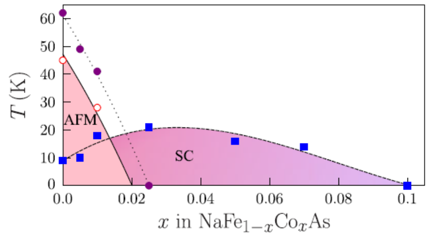

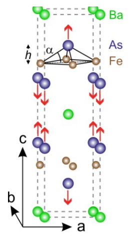

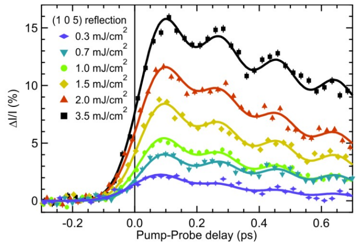

SLS Symposium on

Correlated Electron Systems

Tuesday, February 10, 2015

10:00 to 12:15, WBGB/019

10:00 Persistence of high-energy spin fluctuations in electron doped NaFeAs
Jonathan Pelliciari, Y. Huang, M. Dantz, V. Bisogni, P. Olalde-Velasco, Q. J. Chuang and T. Schmitt

10:30 Ultrafast structural dynamics of the Fe-pnictide parent compound $BaFe_2As_2$
Laurenz Rettig, S. O. Mariager, A. Ferrer, S. Grübel, J. A. Johnson, J. Rittmann, T. Wolf, S. L. Johnson, G. Ingold, P. Beaud, and U. Staub

11:00 Coffee

11:15 X-ray resonant magnetic reflectometry study of the element specific magnetic depth profile in $YBa_2Cu_3O_7/La_{2/3}Ca_{1/3}MnO_3$ superlattices
Aurora Alberca, Y. W. Windsor, M. Ramakrishnan, L. Rettig, M. A. Uribe-Laverde, K. Sen, E. Perret, I. Marozau, J. Stahn, C. Bernhard and U. Staub

11:45 Quenched *long range magnetic excitations by oxygen sub-lattice reconstruction in $SrCuO_2$ thin films*
Marcus Dantz, J. Pelliciari, Y. Huang, D. Samal, V. Bisogni, P. Olalde-Velasco, G. Koster and T. Schmitt

Persistence of high-energy spin fluctuations in electron doped NaFeAs

Pelliciari Jonathan[1], Huang Yaobo[1,2], Dantz Marcus[1], Bisogni Valentina[1], Olalde Velasco Paul[1], Jin Chuang Qing[1,2] and Schmitt Thorsten[1]

1) *Swiss Light Source, Paul Scherrer Institute, Villigen, Switzerland*
2) *Institute of Physics Chinese Academy of Science, Beijing, China*

Superconductivity in iron pnictides was discovered in 2008 [1] and since then a lot of effort has been devoted in order to explain their unconventionality. As in other high temperature superconductors (HTSC), magnetism and superconductivity (SC) exhibit proximity, competition and / or coexistence in the phase diagram [2]. This indicates a strong connection between such phases and paved the way for the use of theories explaining SC as arising from magnetic fluctuations [3].
In this context the experimental characterization of static and dynamic magnetism is of vital importance in constraining advanced theoretical models. The $NaFe_{1-x}Co_xAs$ series represents a contrasting case with the most studied $BaFe_{2-x}Co_xAs_2$ compounds because of their much lower magnetic moment (ca 0.1 u_B for NaFeAs vs. ca 1.3 u_B for $BaFe_2As_2$) [2,4]. However, the superconducting critical temperatures of their Co-doped compounds is pretty similar (21 K at x = 0.025 vs. 22 K at x = 0.2 for $NaFe_{1-x}Co_xAs$ and $BaFe_{2-x}Co_xAs_2$, respectively [2, 4]). This situation turns out to be extremely interesting in order to elucidate the relation between static magnetic moments and spin fluctuations and eventually with superconductivity.
Resonant Inelastic X-ray Scattering (RIXS) has proven to be a powerful spectroscopic tool for probing high energy spin fluctuations in HTSCs [5, 6, 7]. We present a high resolution Fe L_3 RIXS study of parent and superconducting $NaFe_{1-x}Co_xAs$. Spectral shape decomposition reveals the persistence of broad dispersive magnetic excitations for all doping levels. In contrast to previous RIXS experiments on hole doped $BaFe_2As_2$ compounds [6] the energy of such modes is not strongly affected by doping and the magnetic weight per iron atom of such magnons and paramagnons remains constant. However, renormalized per formula unit the magnetic weight decreases with doping. We argue that cobalt-doping is mainly tuning the electronic correlations without affecting the dispersion range of the magnetic excitations, only reducing their spectral weight.

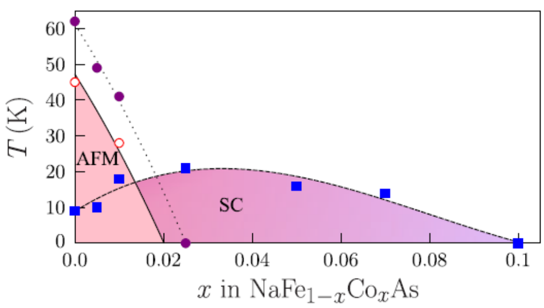

Fig1. Phase diagram from Parker et al, PRL 104, 057007

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Ultrafast structural dynamics of the Fe-pnictide parent compound $BaFe_2As_2$

L. Rettig[1], S. O. Mariager[1], A. Ferrer[2,1], S. Grübel[1], J. A. Johnson[1],
J. Rittmann[3,1], T. Wolf[4], S. L. Johnson[2], G. Ingold[1,5], P. Beaud[1,5], and U. Staub[1]
[1]Swiss Light Source, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland
[2]Institute for Quantum Electronics, Physics Department, ETH Zürich, CH-8093 Zürich, Switzerland
[3]Ecole Polytechnique Fédérale de Lausanne, Laboratoire de
Spectroscopie Ultrarapide, ISIC, FSB, CH-1015 Lausanne, Switzerland
[4]Karlsruhe Institute of Technology, Institut für Festkörperphysik, D-76021 Karlsruhe, Germany
[5]SwissFEL, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland

Understanding the interplay of the various degrees of freedom such as the electrons, spins and lattice is essential for many complex materials, including the high-temperature superconductors. In the case of the Fe pnictides, especially the strong sensitivity of the electronic and magnetic properties to the exact shape and size of the Fe-As tetrahedra plays a crucial role for superconductivity and demonstrates a strong magneto-structural coupling [1]. In addition, antiferromagnetic phases are closely linked to structural distortions in these materials.

Here, we use femtosecond time-resolved x-ray diffraction to investigate the structural dynamics in the Fe-pnictide parent compound $BaFe_2As_2$ [2]. We observe fluence dependent intensity oscillations of two specific Bragg reflections with a period of ~200 fs (Fig. 1, right). Their distinctly different sensitivity to the pnictogen height h demonstrates the coherent excitation of the A_{1g} phonon mode and allows us to quantify the coherent modifications of the Fe-As tetrahedra (Fig. 1, left). By a comparison with time-resolved photoemission data [3] we derive the electron-phonon deformation potential for this particular mode, which is comparable to theoretical predictions. Our results demonstrate the importance of this structural degree of freedom for the electron-phonon coupling in the Fe pnictides and indicate a transient increase of the Fe magnetic moments on an ultrafast timescale.

In addition, in the spin-density wave ground state we investigate the reduction of the orthorhombic distortion by the laser excitation. The orthorhombic splitting of the Bragg reduces on a timescale of several tens of picoseconds, compatible with domain motion. This contrasts with the ultrafast quench of the magnetic ordering in <200 fs [4] and provides further information about the coupling of magnetic and structural degrees of freedom.

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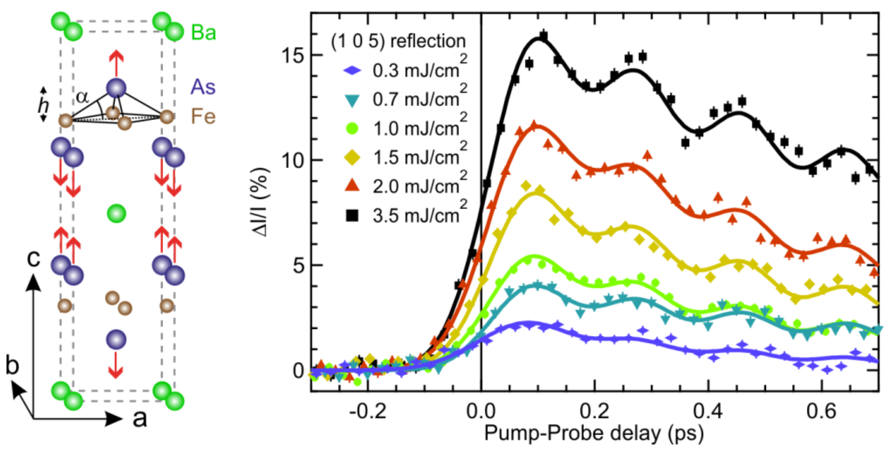

Figure 1. Left: Structure of $BaFe_2As_2$ with the motion pattern of the A_{1g} phonon mode (red arrows). Right: Pump-induced change of diffraction intensity of the (1 0 5) reflection.

X-ray resonant magnetic reflectometry study of the element specific magnetic depth profile in $YBa_2Cu_3O_7/La_{2/3}Ca_{1/3}MnO_3$ superlattices

A. Alberca[1,2], **Y. W. Windsor**[1], **M. Ramakrishnan**[1], **L. Rettig**[1], **M. A. Uribe-Laverde**[2], **K. Sen**[2], **E. Perret**[2], **I. Marozau**[2], **J. Stahn**[3], **C. Bernhard**[2] **and U. Staub**[1]

[1] Swiss Light Source, Paul Scherrer Institut, CH 5232 Villigen PSI, Switzerland
[2] Dept. of Physics and Fribourg Center for Nanomaterials, Univ. of Fribourg, Switzerland
[3] Lab. for Neutron Scattering (LNS), Paul Scherrer Institut, Villigen PSI, Switzerland
aurora.alberca@psi.ch

The interactions arising at the interface between multilayers from complex oxides with strongly correlated electrons are subject of intense research. A prominent example of these interactions is the coupling between the antagonistic superconducting and ferromagnetic orders. In particular, the phenomena observed in superlattices made of high-T_c cuprate superconductors and ferromagnetic manganites, which comprise electronic and magnetic proximity effects (MPE), are yet to be fully understood. These effects are thought to be closely related to the strong electronic correlations and the intimate coupling between the magnetic, orbital and lattice degrees of freedom. For this reason, the study of these interactions and orders in the angstrom scale, with element specificity and with sensitivity to magnetic, orbital and charge orders is vital.

Here, we study the element specific magnetic depth profiles of YBa2Cu3O7/La2/3Ca1/3MnO3 (YBCO/LCMO) superlattices using Soft X-ray Resonant Magnetic Reflectometry (XRMR) [1]. In YBCO/LCMO superlattices, the MPE is characterized by the occurrence of a depleted layer on the manganite side of the interface and a small induced magnetization in the Cu atoms (0.25 µB per interfacial Cu ion) [2, 3, 4]. Using the element specific depth profiling capability we confirm that the Cu moments reside on the YBCO side and originate from the CuO2 layer that is located right at the interface. We also show that the suppression of the Mn moment on the LCMO side is only a partial effect with interfacial Mn moments of 0.9 µB/Mn as compared to 2.4 µB/Mn near the center of the LCMO layer. Finally, our study confirms a strong asymmetry of the MPE, between the YBCO/LCMO and LCMO/YBCO interfaces, that was previously reported from polarized neutron reflectometry measurements.

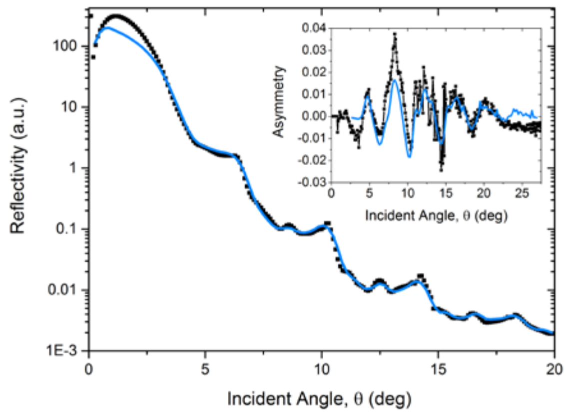

Fig. 1. Reflectometry measured with unpolarized light at 30K and the energy of the Cu L_3-edge. *Inset*: Asymmetry curve (normalized difference between positive and negative x-ray helicity) at 30K. Blue lines show the corresponding fittings.

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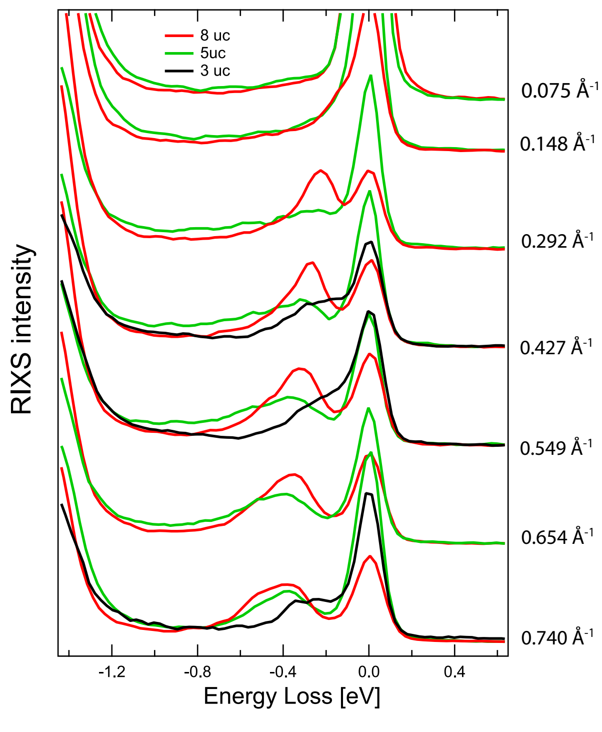
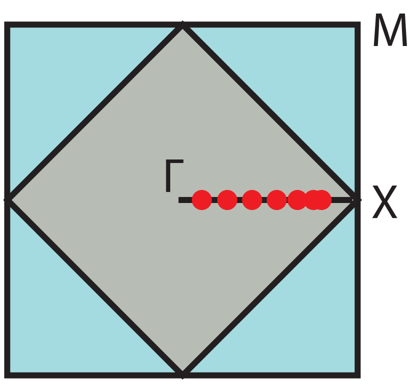
Quenched long range magnetic excitations by oxygen sub-lattice reconstruction in SrCuO2 thin films

<u>M. Dantz[1],</u> J. Pelliciari[1], Y. Huang[1], D. Samal[2], V. Bisogni[1], P. Olalde-Velasco[1], G. Koster[2] and T. Schmitt[1]

1) Swiss Light Source, Paul Scherrer Institut, Switzerland
2) University of Twente, Netherlands, MESA+ Inst. for Nanotechnology

Multi-layered thin films allow investigating the impact of subtle structural changes on the local crystal field and long range excitations.[1][2] In $(SrCuO_2)_n/(SrTiO_2)_2$ cuprate superlattices in particular, a structural transformation from a bulk infinite planar to a sheet-like local domain environment has recently been predicted and subsequently observed observed.[3][4] Here we present results regarding the influence of this subtle structural reconstruction on collective magnetic excitations using high-resolution resonant inelastic x-ray scattering (RIXS) at the Cu L_3 edge. While bulk like infinite layer films exhibit magnon excitations through the whole Brillouin zone, decreasing the thickness of the cuprate layers leads to quenching of the magnons starting from the Gamma point successively to the zone boundary, allowing us to study the coherence length of the collective long range magnetic excitations in the cuprates.





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