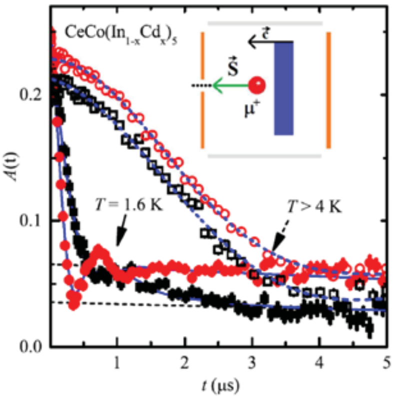

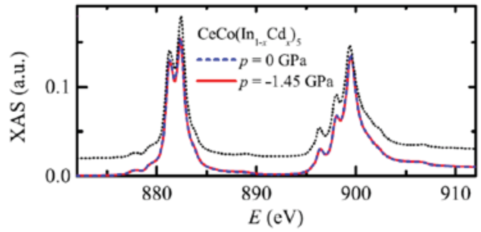

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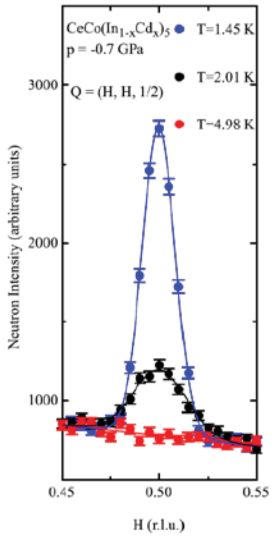
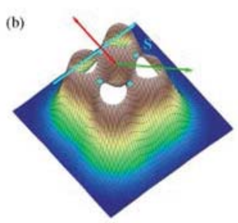
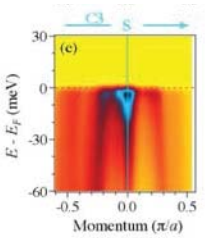






SLS Symposium on

Superconductors

Tuesday, November 10th, 2015

10:00 to 12:15, WBGB/019

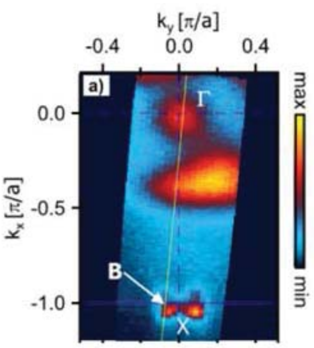
10:00 Element specific imaging of coupled superconducting-ferromagnetic vortex in high Tc superconductor
Anna. K. Suszka, N. S. Bingham, S. Gliga, J. D. S. Witt, P. Wohlhüter, P. Warnicke, J. Raabe, S. Wintz, L. J. Heyderman

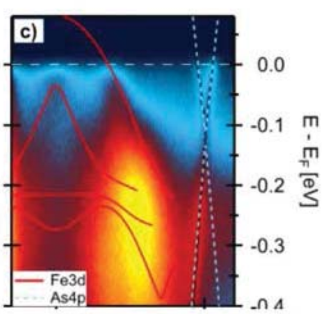
10:30 The effect of As-chain layers on the electronic structure in ‘112’ iron-pnictides – a high-resolution ARPES study
Christian E. Matt, N. Xu, J. Ma, Z. Wang, Z. Ristic, N.C. Plumb, M. Radovic, J. Mesot, M. Shi

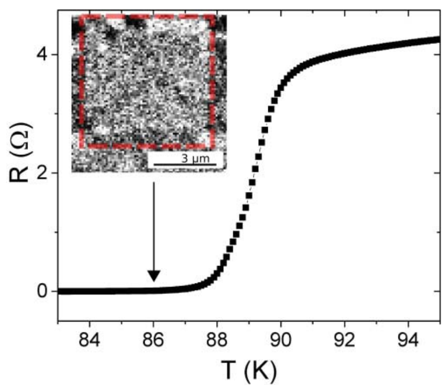
11:00 Coffee

11:15 Evidence for Coexistence of Bulk Superconductivity and Itinerant Antiferro-magnetism in the Heavy Fermion System $CeCo(In_{1-x}Cd_x)_5$
Ludovic Howald, E. Stilp, P. Dalmas de Réotier, A. Yaouanc, S. Raymond,C. Piamonteze, G. Lapertot, C. Baines and H. Keller

11:45 Camelback-shaped band reconciles heavy-electron behavior with weak electronic Coulomb correlations in superconducting $TlNi_2Se_2$
N. Xu, C. E. Matt, P. Richard, A. van Roekeghe, S. Biermann, X. Shi, S.-F. Wu, H. W. Liu, D. Chen, T. Qian, N. C. Plumb, M. Radovic, H. Wang, Q. Mao, J. Du, M. Fang, J. Mesot, H. Ding and M. Shi







Element specific imaging of coupled superconducting-ferromagnetic vortex in high Tc superconductor

A. K. Suszka[1, 2], N. S. Bingham[1, 2], S. Gliga[1, 2], J. D. S. Witt[1, 2, 3], P. Wohlhüter[1, 2], P. Warnicke[4], J. Raabe[4], S. Wintz[4], L. J. Heyderman[1, 2]

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The properties of superconducting vortices and their impact on the magnetization profile of adjacent patterned nanostructures in high-Tc superconductors have not yet been fully explored. Using conventional magnetic imaging techniques to investigate the behavior of superconducting vortices generated by coupling a superconductor to a magnetic nanostructure, eliminates the necessity to apply magnetic fields and current across the superconducting thin-film. In this work, the properties of a thin-film of $YBa_2Cu_3O_{(7-x)}$ (YBCO) are investigated via the exploration of static and dynamic properties of ferromagnetic Py ($Ni_{80}Fe_{20}$) nanostructures deposited on the top of YBCO.

Structures consisting of MgO (substrate)/YBCO (150 nm)/Al_2O_3 (1.5 nm)/Py (25 nm)/ AlN (150 nm) were fabricated using pulsed laser deposition, evaporation and sputtering techniques and patterned using electron beam lithography. Superconducting critical temperature of YBCO thin films, T_c = 89 K (Figure 1), was measured using a physical property measurement system. Element specific imaging of the Py nanostructures above and below the superconducting temperature of YBCO was performed using scanning transmission x-ray microscopy combined with luminescence detection at the PolLux beamline, Paul Scherrer Insitute. The x-ray magnetic circular dichroic (XMCD) image of a 6 μm Py square on the surface of YBCO measured at the Ni L_3 edge, at 86 K is shown in the inset of Fig. 1. The position of the Py square is highlighted with a red dashed line. A faint dark cross on the top of the Py square indicates an imprint of magnetic flux distribution in YBCO below the superconducting transition. The temperature- dependence of magnetization is investigated using a Magneto-optical setup and element specific STXM techniques. These results open a new pathway towards the generation and manipulation of superconducting vortices in high-Tc superconductors without the necessity for applying current and magnetic fields.

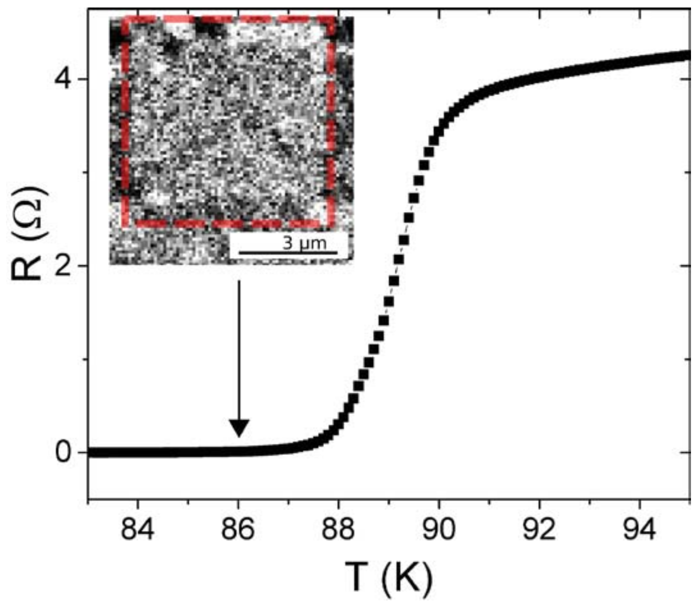

Figure 1: Resistance versus temperature curve of YBCO thin film indicating the Tc of 89 K, Inset: XMCD image of a 6 μm Py square taken at 86 K. The square is highlighted with red dashed line, dark cross corresponds to the out-of-plane magnetization component.

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The effect of As-chain layers on the electronic structure in '112' iron-pnictides – a high-resolution ARPES study

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The recently discovered rare earth substituted $AEFeAs_2$ (AE = Alkaline earth) system differs from all other iron pnictides by its metallic AEAs spacing layer [1-2]. First principles calculations predict that the As-1p states and AE- d sates of the AEAs spacing layer are located around the Fermi level and build an additional Fermi surface sheets around the Γ point and four Dirac cone like cones at the zone boundary [3] close to the X point (π/a,0).

In our recent ARPES study these additionally predicted bands and the Dirac cone like cones have been observed and the full 3D Fermisurface has been measured. Our measurements reveal orbital dependent shift and correlation for different bands imposing strong constraints on theoretical models of High-Tc superconductivity. Effects on SC will be discussed as well as the predicted topological nature of the Dirac cones [4].

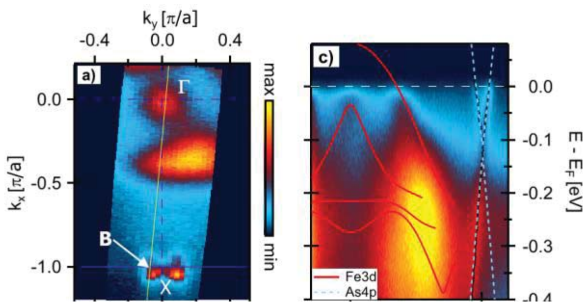

Fig1: a) Fermisurface in k_x-k_y plane of $Ca_{1-x}La_xFeAs_2$ measured by circular polarized photons with hv=23 eV corresponding to $k_z \approx 1$ π/a. **c)** High symmetry cut along Γ – B (yellow line in a). Red lines indicate renormalized DFT calculations of Fe orbitals while dashed line are non-renormalized DFT calculations of CaAs-orbitals.

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Evidence for Coexistence of Bulk Superconductivity and Itinerant Antiferromagnetism in the Heavy Fermion System $CeCo(In_{1-x}Cd_x)_5$

Ludovic Howald, Evelyn Stilp, Pierre Dalmas de Réotier, Alain Yaouanc, Stéphane Raymond,Cinthia Piamonteze, Gérard Lapertot, Christopher Baines and Hugo Keller

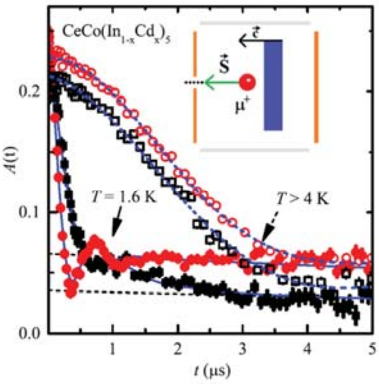
In the generic phase diagram of heavy fermion systems, tuning an external parameter such as hydrostatic or chemical pressure modifies the superconducting transition temperature. The superconducting phase forms a dome in the temperature-tuning parameter phase diagram, which is associated with a maximum of the superconducting pairing interaction. Proximity to antiferromagnetism suggests a relation between the disappearance of antiferromagnetic order and superconductivity.

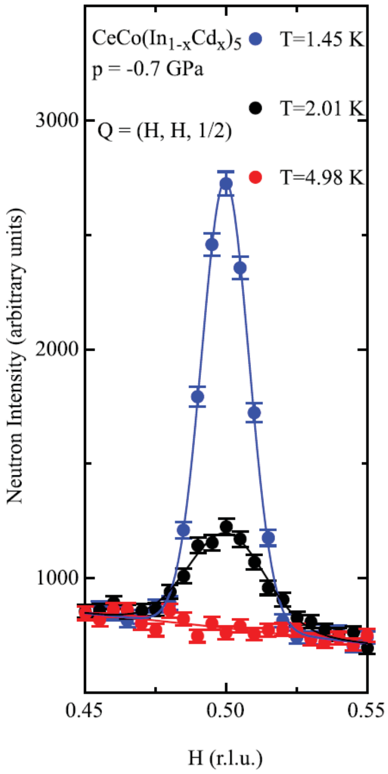
We have investigated the antiferromagnetic state of $CeCo(In_{1-x}Cd_x)_5$ combining three different experimental probes: neutron scattering, muon spin rotation and X-ray absorption spectroscopy. Using neutron diffraction we confirmed the commensurate nature of the long range antiferromagnetic order at short time scales and the absence of secondary magnetic Bragg peak. We established the value of the magnetic moment for a different doping as the one reported in the literature (~0.4 mB for a sample with $T_c=T_N$). We used muon spin rotation to probe the magnetic field at two centers of symmetry of the cerium sublattice. We measured a magnetic field that matches the expected average magnetic field generated by the magnetic moments of amplitude obtained in the neutron diffraction experiment.
We observed that the position of the absorption edge in X-ray absorption spectroscopy is reduced toward lower energies in the case of $CeCo(In_{1-x}Cd_x)_5$ and metallic cerium compared to reference insulating materials. The presence of a narrow electronic band of partial 4f character was identified as a possible reason for this energy shift. Depending of the timescale such a narrow electronic band can display either localized or itinerant properties corresponding to the neutron and muon signals.

The magnetic and superconducting volume fractions (~100 % and ~81 % respectively) were extracted from the muon spin rotation experiment, directly assessing the microscopic coexistence of the two orders. The large magnetic fraction together with the evolution of the internal magnetic field strongly question the proposal of magnetic island for this system and suggests that the concept of non-superconducting island is more appropriate.

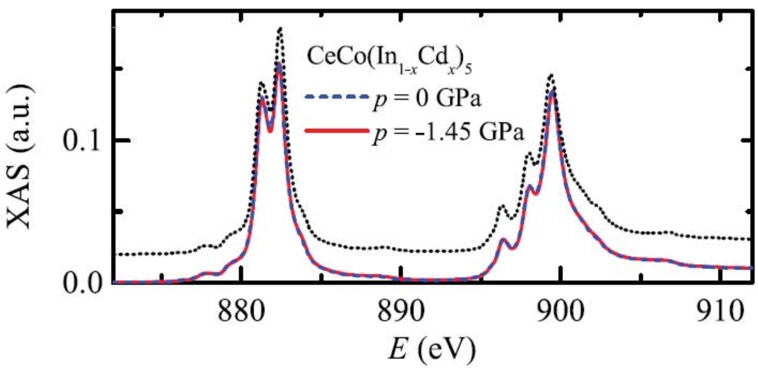
A detailed analysis of the mixed valence in $CeCo(In_{1-x}Cd_x)_5$ demonstrated the absence of valence variation with doping and under magnetic field, notably across the quantum critical point. The evolution of fine structures in the X-ray absorption spectra indicate that the α-γ phase transition in metallic cerium has a different nature than the magnetic phase transition in $CeCo(In_{1-x}Cd_x)_5$. Assuming that the Kondo effect dominates the physic of metallic cerium we conclude that a broadening of the Ce 4*f* band is the main reason for the suppression of the magnetic order in $CeCo(In_{1-x}Cd_x)_5$.

Howald, L. *et al.* Evidence for Coexistence of Bulk Superconductivity and Itinerant Antiferromagnetism in the Heavy Fermion System $CeCo(In_{1-x}Cd_x)_5$. *Sci. Rep.* **5**, 12528; doi:10.1038/srep12528 (2015).





FIGS: Neutrons and muons spectrums in the normal and antiferromagnetic phases of $CeCo(In_{1-x}Cd_x)_5$. X-ray absorption spectra show the mixed valence and absence of valence phase transition with Cd doping.



Camelback-shaped band reconciles heavy-electron behavior with weak electronic Coulomb correlations in superconducting $TlNi_2Se_2$

N. Xu,[1] C. E. Matt,[1] P. Richard,[2] A. van Roekeghem,[3] S. Biermann,[3] X. Shi,[1] S.-F. Wu,[2] H. W. Liu,[2] D. Chen,[2] T. Qian,[2] N. C. Plumb,[1] M. Radovic,[1] Hangdong Wang,[4] Qianhui Mao,[4] Jianhua Du,[4] Minghu Fang,[4] J. Mesot,[1] H. Ding,[2] and M. Shi[1]

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Combining photoemission spectroscopy, Raman spectroscopy, and first-principles calculations, we characterize superconducting $TlNi_2Se_2$ as a material with weak electronic Coulomb correlations leading to a bandwidth renormalization of 1.4. We identify a camelback-shaped band, whose energetic position strongly depends on the selenium height. While this feature is universal in transition metal pnictides, in $TlNi_2Se_2$ it lies in the immediate vicinity of the Fermi level, giving rise to a pronounced van Hove singularity (VHS). The resulting heavy band mass resolves the apparent puzzle of a large normal-state Sommerfeld coefficient in this weakly correlated compound. The correlation effect evolution in pnictides upon *d*-shell filling in the presence of significant Hund's exchange coupling will also be discussed.

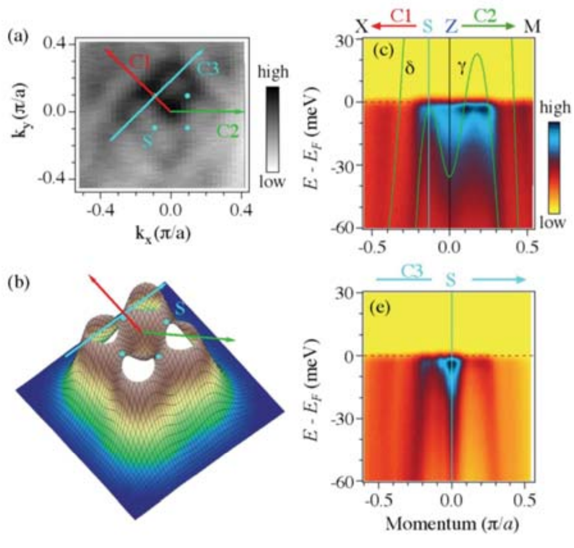

Figure Caption:

(a) ARPES results on the Fermi surface near the VHS. **(b)** Illustration of the band structure near the VHS. **(c)** and **(e)**, ARPES results on the band structure passing the VHS, along C1-C3.

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