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Evidence of new mechanism of antiferromagnetic domain selection driven by spin-orbit coupling

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The selection and switching of magnetic domains plays a key role in modern data storage and spintronics [1]. The selection of antiferromagnetic domains using magnetic fields is less straight-forward than for ferromagnetic domains, and often relies on the Zeeman interaction. Recently, another mechanism was proposed for tetragonal two-band metals featuring antiferromagnetic domains described by an ordering wave-vector k in the basal plane plane, as observed in CeCoIn5 [2]. In CeCoIn5, a spin density wave emerges in the superconducting phase with two domains k = (q,+-q,0.5) and a small rotation of the magnetic field direction around [1 0 0] is sufficient to lift the degeneracy of these two domains and provoke a switching [3]. A Zeeman-induced domain selection can be excluded as its origin, because the ordered moments are perpendicular to the field applied in the tetragonal plane. In this context, two other theories relying on the coupling of the magnetic order with the superconductivity were developed to explain the phenomenon [3,4]. In order to distinguish the different proposed theories, we studied the k-domains in Nd1-xCexCoIn5 for x=0.83 and x =0.25 in the absence of superconductivity using neutron diffraction. We observe a domain selection normal conducting states, ruling out the interpretations based on the coupling with superconductivity. This type of domain selection mechanism should be universal across multiband materials with high symmetry crystal structure displaying itinerant antiferromagnetism modulated in the basal plane. Our results emphasize the important role of spin-orbit interactions for CeCoIn5.
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Position

Phd

Primary authors: T . MAIMONE, D. (Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); GAUTHIER, N. (Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); MAZZONE, D. G. (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); SHEN, J. (Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); BARTKOWIAK, M. (Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); YADAV, R. (Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); SIBILLE, R. (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); RAYMOND, S. (Univ. Grenoble Alpes and CEA, INAC, MEM, F-38000, Grenoble, France); NIEDERMAYER, C. (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); GAVILANO, J. L. (Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); RESSOUCHE, E. (Univ. Grenoble Alpes and CEA, INAC, MEM, F-38000, Grenoble, France); LAPERTOT, G. (Univ. Grenoble Alpes and CEA, INAC, PHELIQS, F-38000, Grenoble, France); KENZELMANN, M.

Presenter: T . MAIMONE, D. (Laboratory for Neutron and Muon Instrumentation, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland)

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