555th ASRC Seminar

Date: 13:15 ～14:00, 23 June

Location: Meeting room 103, ASRC Building

Speaker: Dr. Andrés F. Santander-Syr
(CSNSM, Université Paris-Sud and CNRS/IN2P3)

Title: Momentum-resolved 'hidden-order' gap structure, symmetries, and entropy loss in URu_2Si_2

Due to their exceptionally strong correlations, *f*-electron systems present a wide realm of original phase transitions and often poorly understood states of matter. One of the most intriguing is the so-called hidden-order (HO) state forming below T_{HO} =17.5 K in URu_2Si_2. Extensive macroscopic characterizations gathered during the last 30 years show a reduction of almost 60% in the electronic specific heat across the transition, and suggest that a gap of about 10 meV opens over more than 50% of its Fermi surface. However, the identification of the associated broken symmetry and gap structure remain longstanding riddles.

In this talk, I will present our state-of-the-art ARPES measurements imaging the reconstruction of the electronic structure of URu_2Si_2 across the hidden-order transition [1-3]. We observe a change of the electronic structure symmetry from body-centred tetragonal in the paramagnetic state to simple-tetragonal in the ordered state, described by the ordering vector Q_0 = (1, 0, 0) (reciprocal-lattice units). This is accompanied by the opening of a gap of 7 meV over 70% of a large heavy-fermion Fermi surface, and the formation of four small “Fermi petals” at the incommensurate wave-vector Q_1 = (0.6, 0, 0) showing another gap of 5 meV with respect to the states that defined the heavy-fermion Fermi surface above T_{HO}. Furthermore, the Fermi sheets measured in the HO state are in quantitative agreement with those determined by Shubnikov–de Haas experiments. Thus, our results provide a unified microscopic picture of the large entropy loss in the HO state, of the emergence of sharp inelastic peaks in the magnetic excitation spectrum at Q_0 and the gap of magnetic excitations at Q_1 observed by inelastic neutron scattering, and of the similarity found by magneto-transport measurements between the HO phase and the high-pressure antiferromagnetic phase, which would then be a consequence of both phases having the same simple-tetragonal electronic symmetry described by the ordering vector Q_0.

[1]A. F. Santander-Syro *et al*. Fermi-surface instability at the 'hidden-order' transition of URu_2Si_2. *Nature Phys.* 5, 637-641 (2009).

[2]F. L. Boariu *et al*. Momentum-resolved evolution of the Kondo lattice into “hidden-order” in URu_2Si_2. *Phys. Rev. Lett.* 110, 156404 (2013).

[3]C. Bareille *et al*. Momentum-resolved “hidden-order” gap structure, symmetries, and entropy loss in URu_2Si_2. *Nature Communications* (Accepted, 2014).

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