550th ASRC Seminar

Date: 16:40 ～17:10, 15 April

Location: Meeting room 103, ASRC Building

Speaker: Dr. Kenji M. Kojima
(KEK, J-PARC)

Title: Discovery of new magnetic phase in high-doping: La-1111-Hx (x~0.5)

A prototypical compound of iron pnictide superconductor LaFeAsO (La-1111) is now been able to dope to x>0.5, with Hydrogens substituting Oxygen sites as O1-x Hx.
The hydrogen takes the hydride negative ion state (H-), serving as an electron dopant.
The superconducting (SC) Tc shows a two-dome structure [1], with a lightly higher Tc (~35K) at the higher doping region centered at x~0.3. The origin of the two dome structure is in debate.

Using muon spin relaxation (muSR), neutron and X-ray diffractions, we discovered a new antiferromagnetic ordered phase following the structural transition in the x>0.4 doping region where the SC dome ends [2]. This observation suggests that the 2nd SC dome may be associated with the magnetic instability at the high doping x~0.5 region which may serve as the "mother compound" of the 2nd SC dome.

The features of this magnetic and structural transition at high doping region are different from those of the the counterpart in the low doping (x~0):
(1) the structure deforms to non-centro symmetric way (Aem2) in high doping, whereas it keeps centro-symmetry (Cmme) about Fe in low doping.
(2) Spin pattern is of stripe type in high and low doping, but the spin orientation is rotated by 90 degrees.
(3) Muon spin relaxation and As/H-NMR observes broad distribution of local fields in the ordered phase of high doping, even though the magnetic Bragg peaks appear at the commensurate position.

We have not reached to a full understanding of the cause of the new magnetic order, but it most likely originates from the multi-orbital nature of the iron pnictide superconductors [3].

[1] S. Iimura et al. Nature Commun. 3, 943 (2012).
[2] M. Hiraishi et al. Nature Physics (2014).
[3] e.g. K. Suzuki et al. arXiv:1311.2413 (2013).

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