Experimental report

30/09/2015

Proposal: 4-01-1434 **Council:** 10/2014

Title: Nematic spin correlations in the tetragonal state of strain-free detwinned BaFe2-xNixAs2

Research area: Physics

This proposal is a new proposal

Main proposer: Jitae PARK

Experimental team: Haoran MAN
Jiri KULDA
Jitae PARK

Local contacts: Alexandre IVANOV

Samples: BaFe2As2
BaFe1.95Ni0.05As2

Instrument	Requested days	Allocated days	From	To
IN8 Flatcone	10	10	30/06/2015	10/07/2015

Abstract:

Recently, we have reported anisotropic spin excitation spectra between at Q1=(pi,0) and Q2=(0,pi) in the tetragonal-phase of detwinned parent and Ni-doped Ba122 system [X. Lu et al., Science 345 657 (2014)]. One of our key observation was that the inequivalent scattering intensity between Q1 and Q2 persists up to a temperature well above compounds' structural transition temperatures. Even though mechanical pressure did not alter Ts, there is an ongoing debate about an additional role of applied external pressure kept during measurements. To clarify such issue, under collaboration with ILL sample environment group we developed an in-situ pressure control sample stick which fits into orange cryostats at ILL. Combining this new device with Flatcone option at IN8, we will be able to measure magnetic excitations at Q1 and Q2 simultaneously in the detwinned single crystals without external pressure. Therefore, we request 10 days of beamtime at IN8 to carry out proposed measurements on parent (Ts = TN = 137K) and Ni-underdoped BaFe2As2 (Ts = 52, TN = 44K) compounds.

"Nematic spin correlations in the tetragonal state of strain-free detwinned $BaFe_{2-x}Ni_xAs_2$" 4-01-1434

Haoran Man, Jitae Park, Jiri Kulda, Pengcheng Dai
Local contact at IN8: Alexandre Ivanov

We have carried out elastic and inelastic scattering measurements in stress-free detwinned $BaFe_2As_2$ and $BaFe_{1.97}Ni0_{.03}As_2$ with the *Flatcone* setup at IN8. The main goal of proposed experiment is to investigate the temperature dependent anisotropy of magnetic excitations without external pressure applied. As a result, we have figured out that the detwinning effect persists at temperatures below T_N and vanishes somewhere between T_N and T_S.

For parent compound, the spin excitations anisotropy vanishes at 138K, which is both T_S and T_N, as shown in Fig 1 and Fig 2.

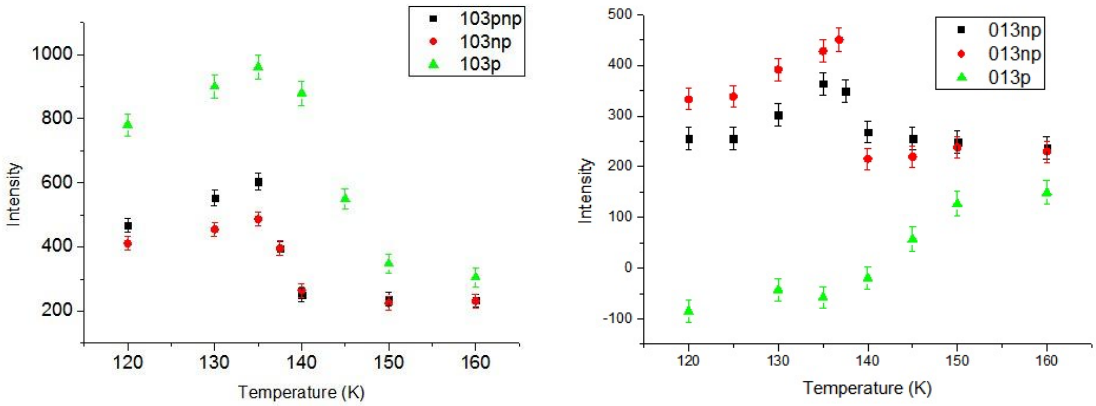

Fig. 1 Temperature dependence of inelastic scattering intensity at (1 0 3) and (0 1 3) at 10 meV in $BaFe_2As_2$. The green is the case of fully detwinned sample under ~ 22 MPa pressure. The black is the detwinned stress-free sample which is cooled down with 22 MPa pressure and then released at 10K. The red is the normal state (twinned).

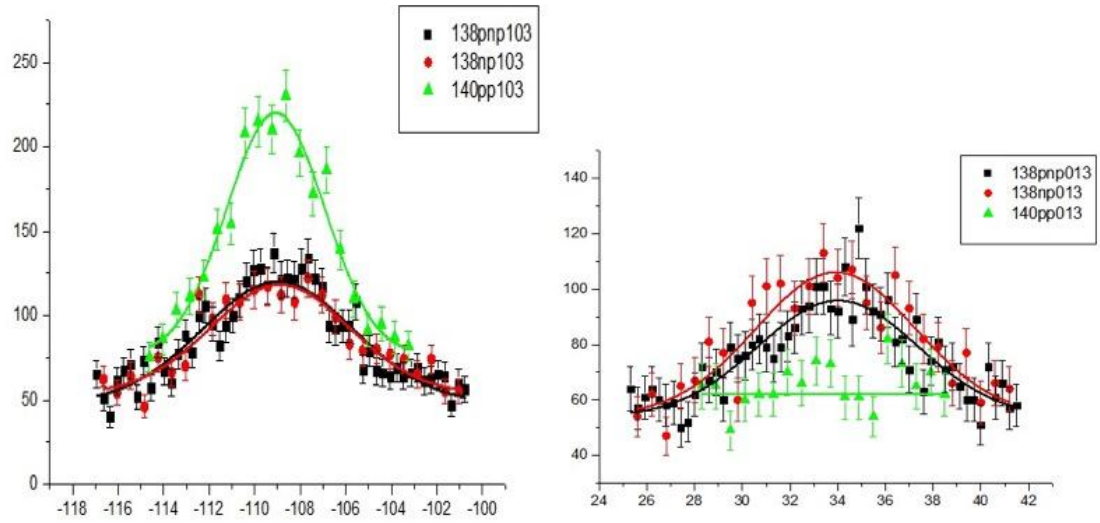

Fig. 2 Rocking scans at 138K of $BaFe_2As_2$. Color scheme is the same as in Fig. 1.

For $BaFe_{1.97}Ni0_{.03}As_2$(Fig 3), in which T_N (109K) and T_S (114K) are well separated, we observed that the difference between the detwinned stress free case and twinned case becomes smaller as T approaches T_N and vanishes at T_N.

Overall, it is very difficult to maintain detwinning in stress-free sample when the temperature is close to T_N, thus the detwinning effect is no longer visible above T_N without external pressure.

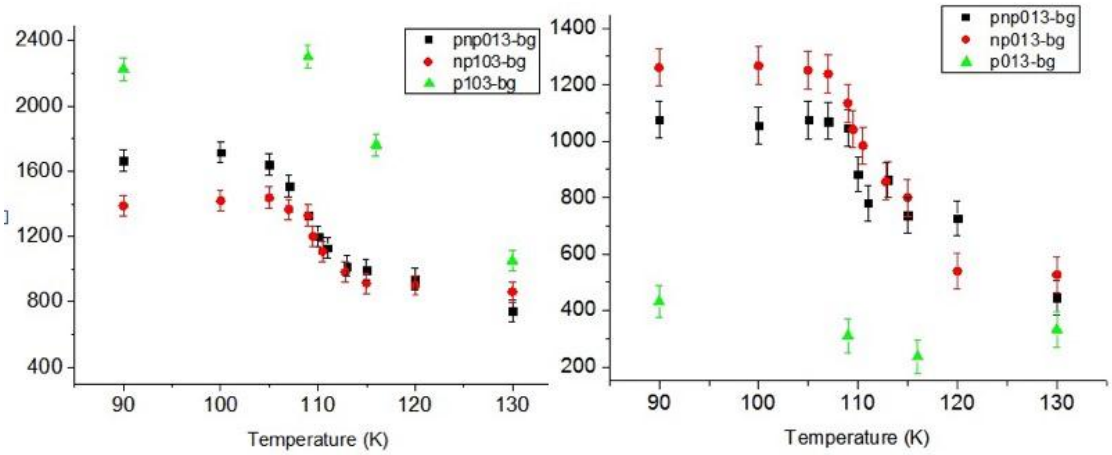

Fig 3 Temperature dependence of inelastic scattering intensity at (1 0 3) and (0 1 3) at 10 meV in $BaFe_{1.97}Ni0_{.03}As_2$ (T_N=109K, T_S=114K). Color scheme is the same as in Fig. 1.