

Experimental report

04/03/2024

Proposal: EASY-1088

Council: 10/2022

Title: Magnetic fluctuations across T_c in optimally doped $\text{Ba}(\text{Fe}_{0.94}\text{Co}_{0.06})_2\text{As}_2$

Research area: Materials

This proposal is a new proposal

Main proposer: Frank WEBER

Experimental team:

Local contacts: Paul STEFFENS

Samples: $\text{Ba}(\text{Fe}_{0.94}\text{Co}_{0.06})_2\text{As}_2$

Instrument	Requested days	Allocated days	From	To
THALES	15	15	12/04/2023	13/04/2023

Abstract:

In a previous experiment (7-01-522) we found a strong softening and broadening of a transverse acoustic phonon in $\text{Ba}(\text{Fe}_{0.94}\text{Co}_{0.06})_2\text{As}_2$. Interestingly, the broadening/damping of the phonons seems to correlate with the intensity of magnetic fluctuations thereby providing direct evidence for a dynamic spin-phonon coupling as the likely origin of nematicity in 122 iron-based superconductors. However, the available data for the magnetic fluctuations are sparse (only for $T = 3$ K) below the superconducting transition temperature $T_c = 26$ K. Therefore, we would like to finish our study by a short measurement of about 18 hours to complement the temperature range 5 K - 26 K with a few points at $T = 30$ K - 50 K in order to connect/overlap to previous data. The results would allow us to finish the comparison between nematic phonon softening and magnetic fluctuations.

	Experiment title: Magnetic fluctuations in superconducting $\text{Ba}(\text{Fe}_{0.94}\text{Co}_{0.06})_2\text{As}_2$	Experiment number: Easy 1088
Beamline: ThALES	Date of experiment: from: 2023-04-12 to: 2023-04-13	Date of report: 05.03.2024
Shifts:	Local contact(s): Paul Steffens	

In a previous experiment (7-01-522) we found a strong softening and broadening of a transverse acoustic phonon in $\text{Ba}(\text{Fe}_{0.94}\text{Co}_{0.06})_2\text{As}_2$. Interestingly, the broadening of the phonon is reduced on cooling into the superconducting phase. Here, we studied the evolution of magnetic scattering intensities cooling from $T = 30$ K (above the superconducting transition temperature $T_c = 25$ K) to $T = 5$ K (well below T_c). We studied the magnetic scattering in constant-energy scans at energy transfers of $E = 1$ meV [see Fig. 1(a)] and 4 meV. The evolution of the observed intensities as function of temperature show a strong ($E = 1$ meV) and modest reduction on cooling across T_c [Fig. 1(b)].

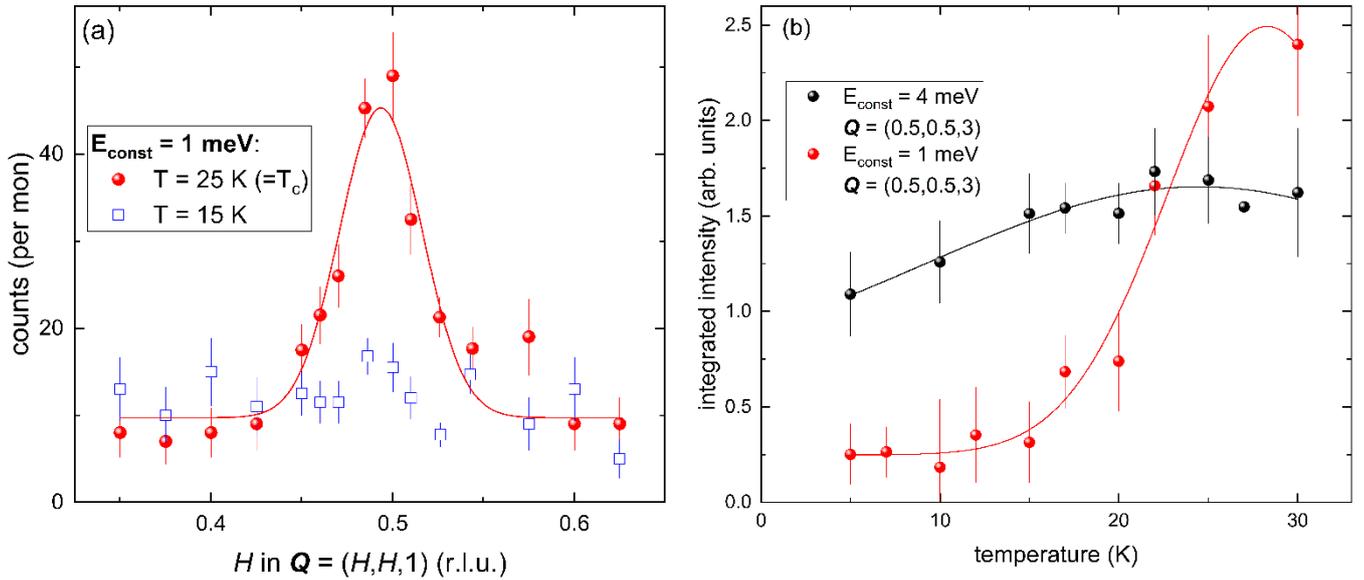


Fig. 1. Magnetic scattering across the superconducting transition temperature in $\text{Ba}(\text{Fe}_{0.94}\text{Co}_{0.06})_2\text{As}_2$
(a) Magnetic scattering at $T = 25$ K (spheres) and $T = 15$ K (open squares) at constant energy transfer of $E = 1$ meV. (b) Evolution of magnetic intensities observed at the given energy transfers and wavevectors.