Experimental report

01/10/2015

Proposal: **INTER-305** **Council:** 10/2014

Title: Internal time on IN3

Research area:

This proposal is a new proposal

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Samples: MnFe4Si3

Instrument	Requested days	Allocated days	From	To
IN3	6	6	31/07/2015	06/08/2015

Abstract:

Background:

One way for saving energy in daily life is using the magnetocaloric effect (MCE) in magnetic refrigeration technologies. Specific compounds, such as the $Mn_{5-x}Fe_xSi_3$ system, are magnetocaloric materials (MCM), where entropy changes of the magnetic material in a magnetic field is tied to adiabatic changes in temperature. Ferromagnetic $MnFe_4Si_3$ (space group P63/mcm) is of particular interest as it has a T_C near room temperature.

The inelastic neutron scattering experiments on these compounds will help us understand the underlying mechanisms that describe the coupling between the spin and lattice degrees of freedom and thus help us to understand the fundamental mechanism of the MCE.

Aim of the experiment:

The aim of the experiment was to investigate the phonon and magnon dispersion along the [001] symmetry direction at low temperatures (T=5K).

Experimental setup:

The instrument was set up in -1, 1, -1 configuration. We used a PG monochromator vertically curved, a PG filter after the sample and a PG flat analyzer. The data have been taken with a fixed k_f=2.662Å^{-1} with a collimation of 40´ before and after the sample.

The single crystal (with a mass of about 7g) was mounted with the [100] – [001] directions in the scattering plane inside an orange cryostat.

Results:

Inelastic neutron scattering measurements on IN3 were performed on single crystal MnFe4Si3 at T=5K. In order to extract both, magnon and phonon branches, energy scans at constant q and q-scans at constant energies were performed. Scans were performed along [0 0 x] and [x 0 0] directions. Before fitting, every spectrum was analyzed carefully looking for spurions, in particular Al contamination, and the corresponding regions were cut out. Every peak (generated by magnetic or phonon excitation) was fitted with a Gaussian function.

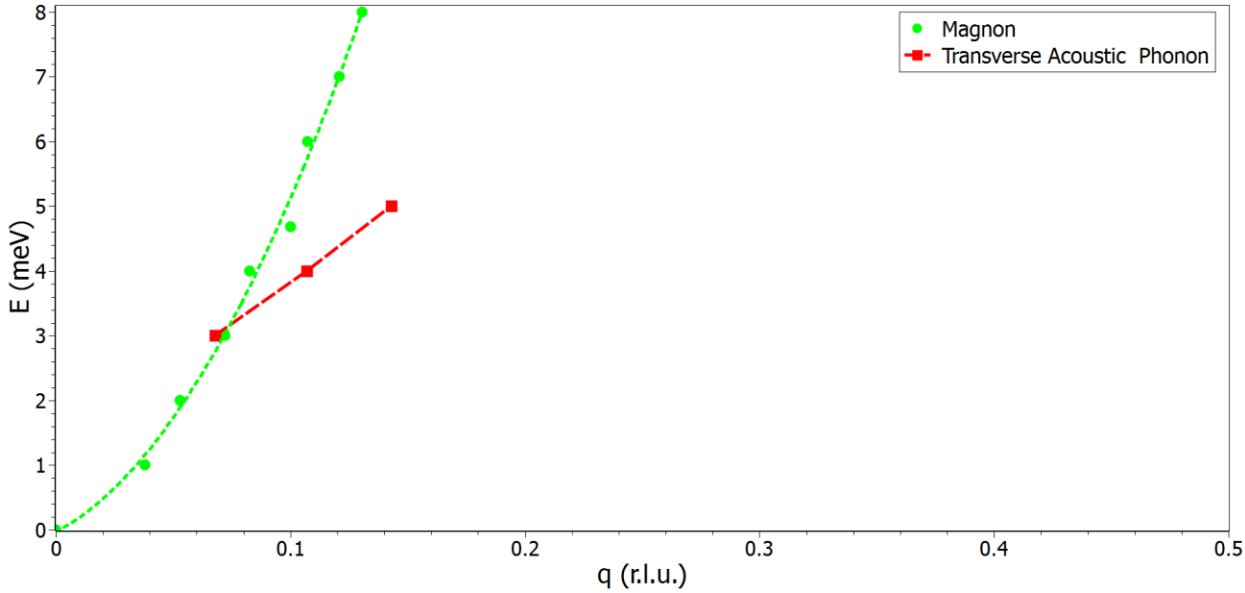

Figure 1: Preliminary phonon and magnon dispersion of $MnFe_4Si_3$ along c direction at T=5 K obtained on the IN3 spectrometer.

Some preliminary results of the dispersion curves along c direction are shown in Figure 1. Peaks observed in purely transverse geometry near the zone center (3 0 0) can be attributed to lattice excitations, i.e. transverse acoustic phonon (T.A., red in Fig. 1). It is expected from estimation of the magnetic form factor, that magnetic excitations generate peaks with significant intensities close to (2 0 0). The first branch (green in Fig. 1) is ascribed to possible magnetic excitations and has been measured in both longitudinal and transverse geometry. In Fig. 1 the dashed lines are used as guides for the eyes.