Experimental report

16/10/2020

Proposal: 5-42-501 **Council:** 4/2019

Title: Short-range elastic correlations in the frustrated system Yb3Ga5O12

Research area: Physics

This proposal is a new proposal

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Samples: Yb3Ga5O12

Instrument	Requested days	Allocated days	From	To
D7	5	5	22/01/2020	27/01/2020

Abstract:

The use of magnetic frustrated compounds has been proposed for low temperature refrigeration applications. Indeed, the presence of soft modes in such systems enhances magnetocaloric effects as compared to usual paramagnets. The garnet Yb3Ga5O12 (YbGG) is a potential candidate for these applications. It is proposed to investigate the magnetic elastic diffuse scattering of YbGG as a function of temperature on a single crystal sample using polarized neutron on D7.

Experimental setup

The single crystal sample of $Yb_3Ga_5O_{12}$ was mounted in a dilution insert. The sample of cylindrical shape with long axis near [001] was embedded in a Cu foil glued with Fomblin oil and tighten with Teflon tape in order to ensure good thermalization. The scattering plane is [100]-[010].

The wavelength was 4.8 Å and a polarization along the z axis was used.
A 4/1 time ratio was used between the spin flip and non spin flip channel measurements.
Measurements were performed on a 120° range, with steps of 1° for two positions of the detector banks, resulting in 0.5° between each measured position.

Measurements were first performed at the minimum temperature (52 mK), then at 200 mK, 500 mK and 5 K, a temperature high enough to suppress the magnetic correlations and get rid of the background via a subtraction.

Results

No magnetic Bragg peaks were observed (the Néel temperature is 54 mK). Instead, we oberve unconventional magnetic correlations, centered on the (1/2,1/2,0) and (3/2,3/2,0) positions, as shown in Figure 1. In addition a small signal is observed at the (1/2,3/2,0) and symmetry related positions.

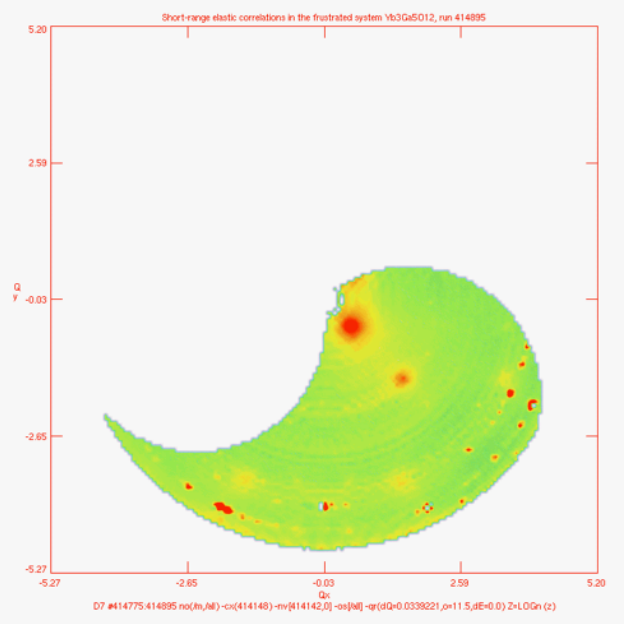

Figure 1: Map in the [100]-[010] scattering plan measured in the spin-flip channel at 52 mK. The intensity scale is logarithmic.

The temperature dependence shows that the magnetic signal decreases when increasing the temperature, and is almost zero at 500 mK (See Figure 2).

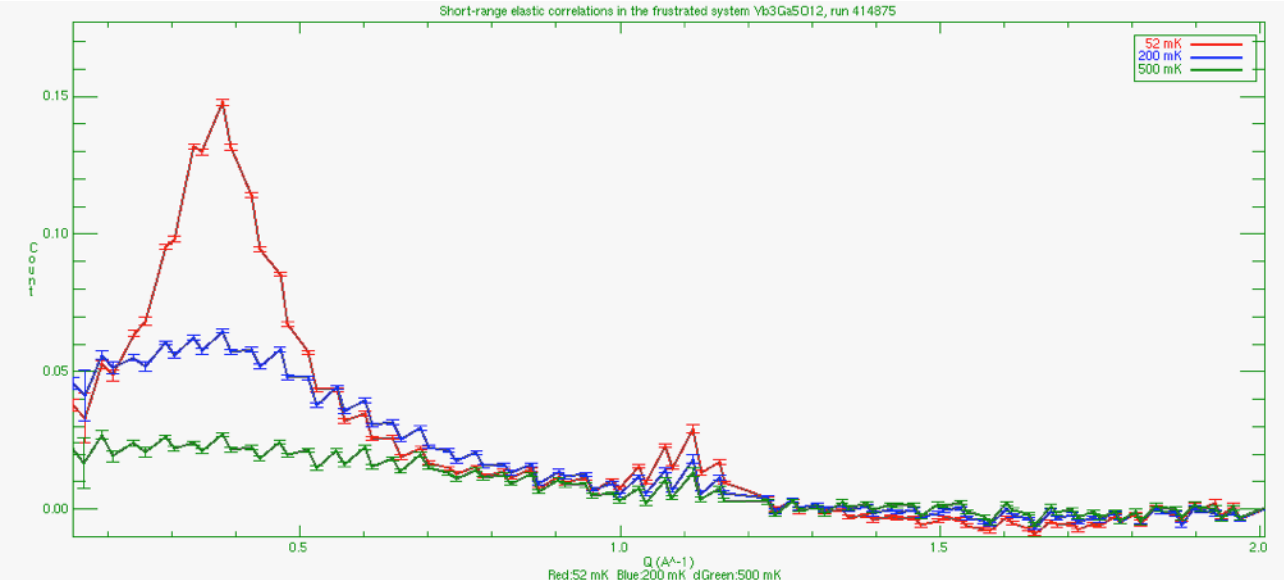

Figure 2: Integrated spin-flip intensity as a function of Q at 52, 200 and 500 mK. 5K data were substracted.

The understanding of these correlations is not achieved yet. The analysis is ongoing, combining these dara with the Thales inelastic neutron scattering measurements as well as the macroscopic measurements already done. Future experiments planned on IN5 will help to further map the excitations in the reciprocal plane.