Experimental report

17/02/2020

Proposal: CRG-2702 **Council:** 10/2019

Title: Low temperature studies of the magnetic ordering in the charge density wave rare-earth tri-telludites (Tb, Er, Sm, Gd, Ho)Te3

Research area:

This proposal is a new proposal

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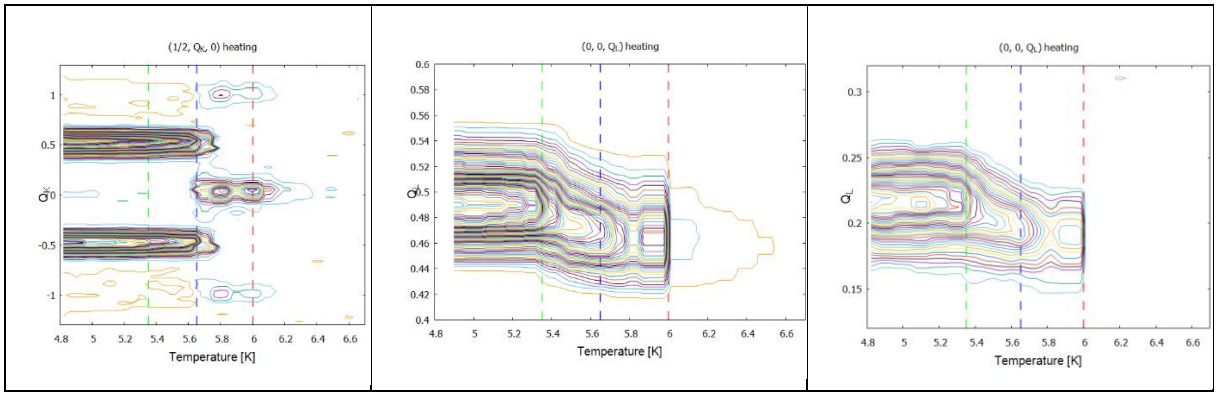
Samples: (Tb, Er, Sm, Gd, Ho)Te3

Instrument	Requested days	Allocated days	From	To
IN22	6	6	01/10/2019	07/10/2019

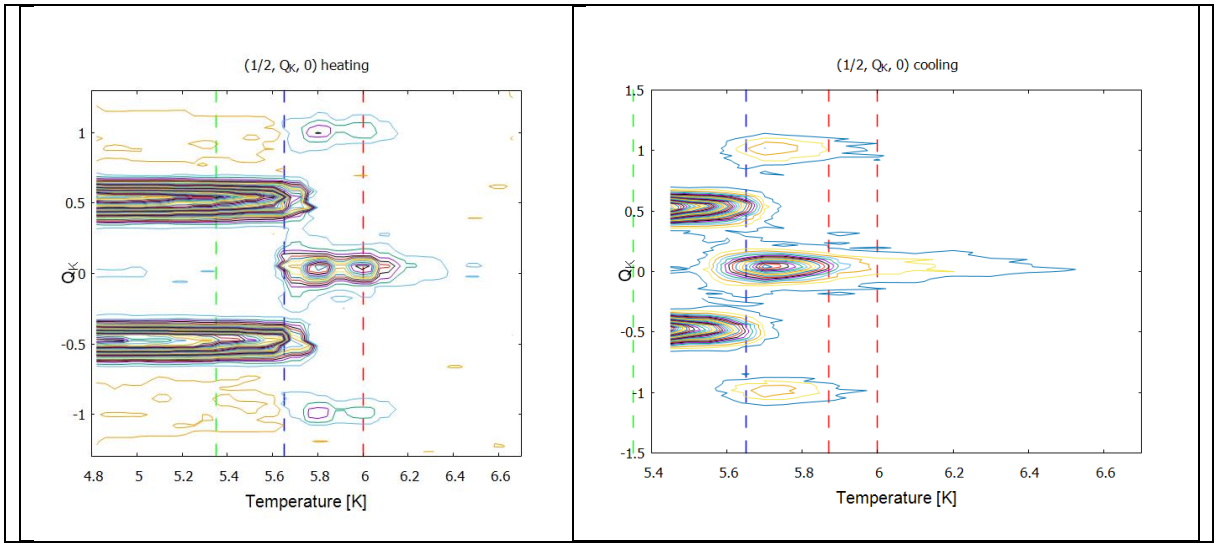
Abstract:

The goal of this internal instrument time was devoted to prepare a forthcoming ILL experiment on ThALES (7-02-188) on the charge density wave phase transition in $TbTe_3$. After checking sample quality on a selected sample of 130 mg, we first looked at the phonon modes likely involved in this phase transition. Very disappointedly we could not find any trace of soft modes, not even of acoustic modes within reasonable counting times. The sample mass was probably not sufficient to observe these modes.

From a previously published paper (1) we learnt that the Tb orders below 6-7K and we set up the spectrometer to study the magnetic ordering. Up to three different magnetic transition were observed with commensurate modulation vectors (0,0, ½), (½, 0,0) and (½, ½,0) and one incommensurate structure, (0, 0, 0.21). Contour plots of these transitions are shown below for heating.

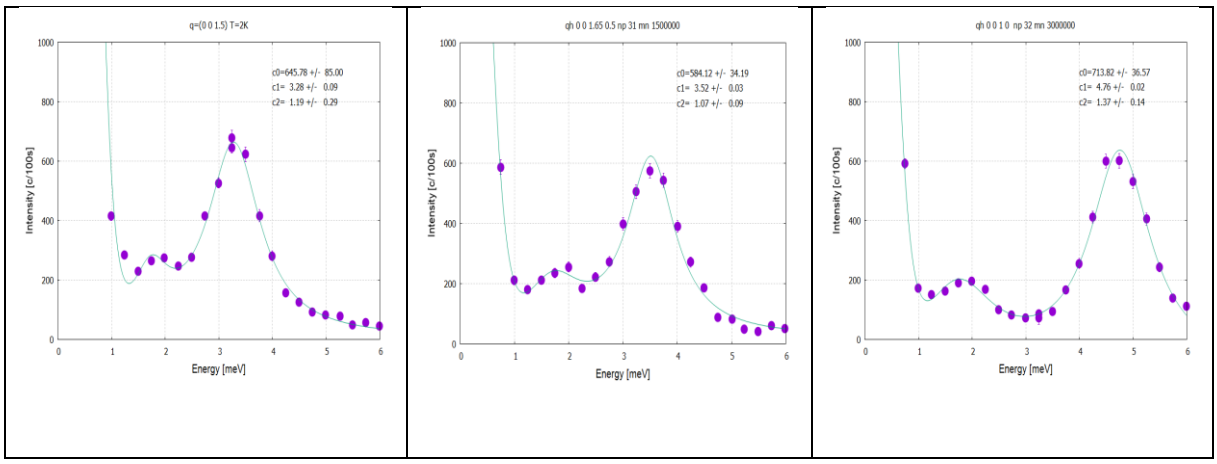


The three vertical lines represent transitions that are seen in all the plots. It is remarkable that three different transitions are observed within less than 1K ! In addition, there is some differences between the healing and cooling regimes, as it is shown below.



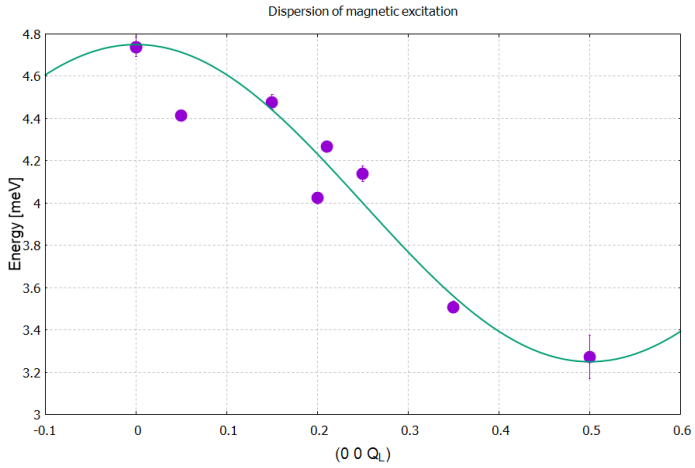
The transition line at 6K on heating is shifted to 5.85K on cooling. Upon further scrutiny we observe the occurrence of two lobes on heating at (1/2, 0,0) the second one can be ascribed to that observed upon cooling. One can tentatively conclude that the intermediate antiferromagnetic ordering state characterized by this wavevector is transient. More work needs to be carried out, a proper determination of the magnetic structure seems mandatory.

In a second stage, we set up to measure the magnetic excitations arising from this antiferromagnetic ordering. We used fixed k_F=2.662 $Å^{-1}$ Preliminary results are shown below.



A peak between 3.3 and 4.8 meV is observed along with a smaller, nearly unresolved, excitation centered at 1.8meV. The fits with a lorentzian function are reasonable

The dispersion along the three directions has been measured. The dispersion along Q_H and Q_L are very much identical, whereas the mode is dispersionless along Q_K.



Much work is needed to resolve these excitations.

(1) F. Pfuner, et al., J. Phys. : Condens Matter 24 (2012) 036001