EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** The Inelastic Spectra of Magnetic Spirals in Chiral FeGe	**Experiment number**: HC1832
Beamline: ID32	**Date of experiment**: - from: **29/09/2015** to: **6/10/2015**	**Date of report**:
Shifts: 18	**Local contact(s)**: Kurt Kummer	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Peter Hatton, Durham University*

Phil Dean Durham University*

Don Paul, Warwick University*

Kejin Zhou, Diamond Light Source*

Report:

FeGe belongs to the family of B20 chiral cubic crystal systems, analogous to MnSi, which under a small applied magnetic field display a skyrmion spin texture [1]. We set out to measure the inelastic spectra of FeGe at low temperatures in zero magnetic field as the high transition temperature (T_C ~ 280 K) is an indication of strong magnetic interactions.

The beamtime was a success with considerable data collected although some issues were encountered, as is to be expected with a beamline still being commissioned. One problem we encountered was that there is iron contamintion in the beamline. Figure 1 shows the drain current from the final mirror before the sample (which is directly proportional to the incident intensity at the sample) is significantly reduced when tuning the energy to the iron L3 absorption edge (707 eV). has theeffect of reducing the beam intensity at the L3 edge by 4 – 7 fold.

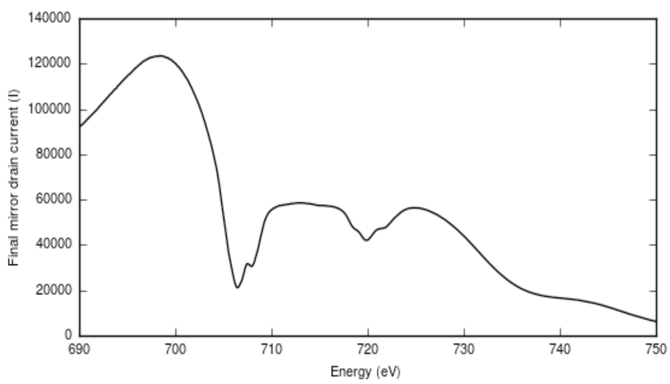

Figure 1.Drain current from the last mirror before the sample around the L3 iron edge edge

The major advantage of the ERIXS end station is the experimental flexibility available to the experimenter afforded by the design. It is very easy to orientate the crystal in reciprocal space and to collect inelastic spectra at different q values and with different x-ray polarisations. We collected scans over the entire range of 2θ from 50° to 140°.

We were able to observe a strong inelastic signal from our sample, Figure 2, which can be seen from the ratio of the peak of the fluorescence to the signal close the elastic line at around -0.5 eV.

The inelastic features extend from the elastic line to around -0.8 eV which could include *d*-*d* excitations. Energy detune measurements were performed, which show a constant energy loss for the double-peak feature. The energy scale is also above that which would be expected for magnons (~25 meV). Further no dispersion was observed for the double-peak feature with increased momentum transfer along both the (010) and (111) directions, ruling out pure magnons as a sole origin [2]. The energy scale is comparable with a crystal-field excitation combined with a spin flip [3], which is of the order of the 3*d* band splitting This would also not be expected to display dispersion as expected for typical crystal-field excitation.

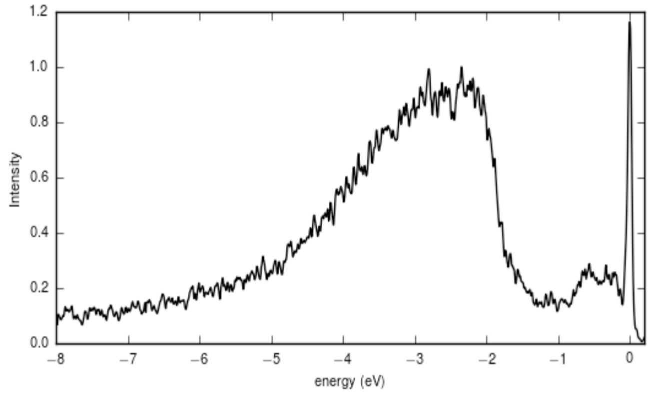

Figure 2. RIXS spectrum along [1,1,1] at a scattering angle of 90 degrees.

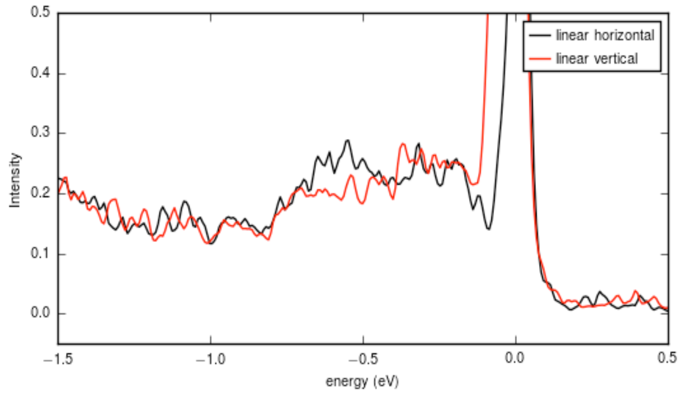

Figure 3 RIXS spectrum along (1,1,1) scattering at 90 degrees with linear vertical polarised light (red) and linear horizontal

While the data is noisy many spectra have been collected and consistently a double-peak feature is observed. This becomes clearer when the incident polarisation is varied as seen in Figure 3. With a scattering angle (2θ) of 90° the peak at ~ -0.3 eV shows no polarisation dependence while the one at ~ -0.6 eV shows an increase in intensity with linear horizontal polarised light. Therefore these processes must correspondingly involve a rotation of the polarisation as a Thompson scattering like (**ε.ε**) dependence would be supressed, and a change in angular momentum of the sample must subsequently be involved. This is consistent with inelastic scattering from an orbital excitation.

We are now planning to undertake density functional theory calculations to provide information on the band structure to help with the analysis of our results.

References

[1] X. Z. Yu *et al.*, Nat. Mater., **10**, 106 (2011) [2] L. Braicovich, *et al.*, Phys. Rev. Lett. **104**, 077002 (2010) [3] Griffith, J.S., 1961, The Theory of Transition-Metal Ions , CUP.