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 using the **Electronic Report Submission Application:**

http://193.49.43.2:8080/smis/servlet/UserUtils?start

Reports supporting requests for additional beam time

Reports can now 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.

	Experiment title: Magnetic order and displacement waves in GdB_6		**Experiment number**: HS-1773
Beamline: ID20	**Date of experiment**: from: 15 may 2002	to:22 may 2002	**Date of report**: sep 2002
Shifts: 18	**Local contact(s)**: Carsten DETLEFS		*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

DR. Galéra R. M.*, Laboratoire Louis Néel/CNRS, BP 166 F-38042 Grenoble Cedex

DR. Amara M.*, Laboratoire Louis Néel/CNRS, BP 166 F-38042 Grenoble Cedex

Luca Sorana*, Laboratoire Louis Néel/CNRS, BP 166 F-38042 Grenoble Cedex

Marinescu Simona*, Laboratoire Louis Néel/CNRS, BP 166 F-38042 Grenoble Cedex

DR. Givord F.*, DRFMC/SPSMS/MDN, CENG, 17 avenue des Martyrs 38054 Grenoble Cedex 9

Report:

Normal Thomson scattering experiments have been undertaken on GdB_6 below the ordering temperature T_N = 15 K, in order to study the atomic displacement waves associated with the magnetic order. Two successive spontaneous antiferromagnetic phases exist, separated by a transition at T = 8 K and the measurements have been performed in the two phases, at 1.8 K and 12 K. As the magnetic propagation vector ***k*** belongs to the <1/4, 1/4, 1/2> star, satellite reflections are expected at the following high symmetry points in the first Brillouin zone: (1/2, 0, 0), (1/2, 1/2, 0), (1/4, 1/4, 0), (1/4, 1/4, 1/2) and (1/2, 1/2, 1/2). Preliminary X-ray diffraction measurements on that compound [1] had shown that satellites of the form (*h/2, k, l*) and (*h/2, k/2, l*) exist in the low temperature phase, and that only the satellites of type (*h/2, k, l*) remain above 8 K.
The single crystal used for this experiment was cut with a surface perpendicular to a [110] axis and oriented with this twofold direction parallel to the φ axis of the goniometer, so that (*h, h, 0*) reflections are specular. It was mounted into a cryostat in order to reach the low temperatures. At T = 1.8 K, satellites associated with propagation vectors (1/2, 0, 0) and (1/2, 1/2, 0) have been observed, confirming the previous results. Satellites associated with propagation (1/4, 1/4, 1/2) could also be measured, with an intensity being one order of magnitude smaller. No other satellite could be observed. At T = 12 K, satellites of type (1/2, 0, 0) have increased, satellites of type (1/2, 1/2, 0) have decreased and satellites of type (1/4, 1/4, 1/2) have disappeared. Figure 1 shows the ω scans performed on the (4, 4, -1/2), (9/2, 9/2, 0) and (17/4, 17/4, -1/2) reflections at the two temperatures 8 K and 12 K. The thermal variation of the square root of their normalized intensity is represented in Figure 2. Up to 10

K, they present exactly the same thermal dependence, indicating that they are related to the same physical mechanism.

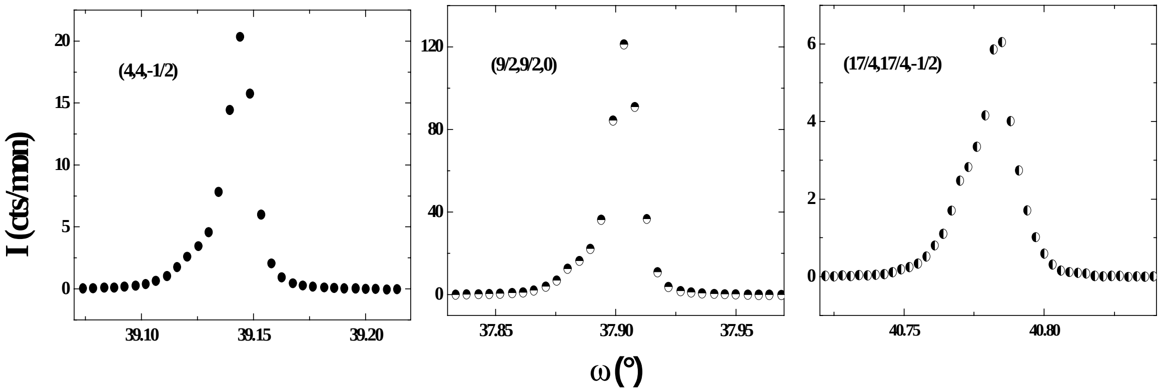

Figure 1 : *w scans for the (4,4,-1/2), (9/2,9/2,0) and (17/4,17/4,-1/2) satellites.*

As illustrated in Figure 3 for the (h/2, h/2, 0) type reflections, the variation of the satellite intensities with the scattering vector $|\boldsymbol{Q}|$ is quite specific of an atomic displacement wave. As pointed out by T. Kasuya [2], such a displacement may originate from an "exchange-pair Jahn-Teller effect ". The absence of the (*h/4, h/4, l*) reflections is in agreement with what can be predicted on the hypothesis of isotropic exchange. On the same basis the displacement waves are straightforwardly related to the magnetic structure. Therefore the analysis of the data, underway, gives means for an indirect determination of the actual magnetic structure.

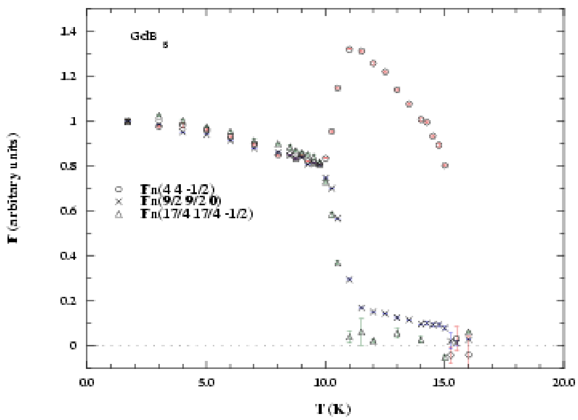

Figure 2 : *thermal variation of the square root of the normalised integrated intensities*

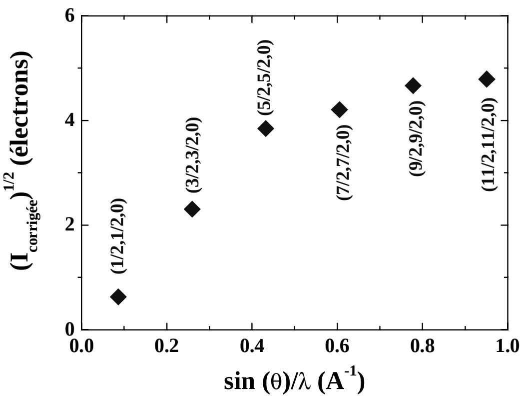

Figure 3 : *scattering vector* $|\boldsymbol{Q}|$ *dependence of the square root of the integrated intensity of specular reflections of type (h/2, h/2, 0).*

[1] R.M. Galéra, D.P. Osterman, J.D. Axe, S. Kunii and T. Kasuya, *J. Appl. Phys.* **63** (1988) 3580.
[2] T. Kasuya, *J. Magn. Magn. Mater.* **174** (1997) L28.