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 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.

ESRF	**Experiment title:** Orbital and Electric Polarons in the Bilayer Manganites	**Experiment number**: 28-01-713
Beamline: BM28	**Date of experiment**: from: 15/02/06 to: 21/02/06	**Date of report**: 23/10/06
Shifts: 18	**Local contact(s)**: Dr. S. Brown	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Prof. Peter Hatton*

Dr. Thomas Beale*

Mr Gordon Pearce*

Report:

The beamtime was awarded in order to look at the effects of previously observed ordering in the bilayer manganites, using resonant scattering and in addition with an applied magnetic field. As such, this was one of the first user experiments using the 4 T magetic field specicifally developed. We therefore expected that we would encounter difficulties due to using a new piece of equipment.

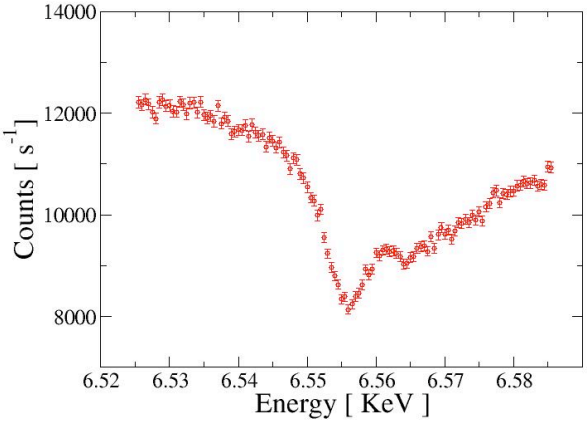

Fig. 1 Energy dependence of the polarons measured in $La_{1.2}Sr_{1.8}Mn_2O_7$

The experiment was split into two sections, studying the bilayer manganites $La_{2-2x}Sr_{1+2x}Mn_2O_7$, initially with x=0.4, and then x=0.5. The initial section concerned the polaron ordering that we have previously obserbed using very high energy x-ray diffraction. This ordering is not very highly ordered, and as such forms weak diffuse scatter within the brillion zone. Because of the nature of the ordering, we were unsure as to whether we would be able to see it using incident x-rays at the Mn K edge. The aim of the experiment was to perform energy scans at the Mn K edge, as well as observe any magnetic field dependence. With no field, it was possible to use a Bicron detector (field sensitive), and we were able to observe the weak diffuse scatter. The energy dependence of the polarons was measured in the

vicinity of the Mn *K* edge (Fig. 1), suggesting that these are not simply uncorrelated charge ordering of the manganese ions, as there is no Mn resonant enhancement. In order to use a magnetic field, a suitable, non-field sensitive detector was needed, however these detectors measured a lower signal due to a reduced size. As such, it was impossible to measure the weak diffuse polarons with these detectors.

The second section of this experiment concerned the charge and orbital ordering in the half doped bilayer $LaSr_2Mn_2O_7$. This ordering has been measured extensively, although not with an applied magnetic field. Superlattice reflections were observed with the sample at 180 K, at both the charge order (*h*±0.5,*k*±0.5,l) and orbital order (*h*±0.25,*k*±0.25,l) positions. The intensity of these signals was measured with respect to an applied field. Both of these signals were observed to decrease in intensity significantly (~30%), in contrast to the crystallographic Bragg peaks.

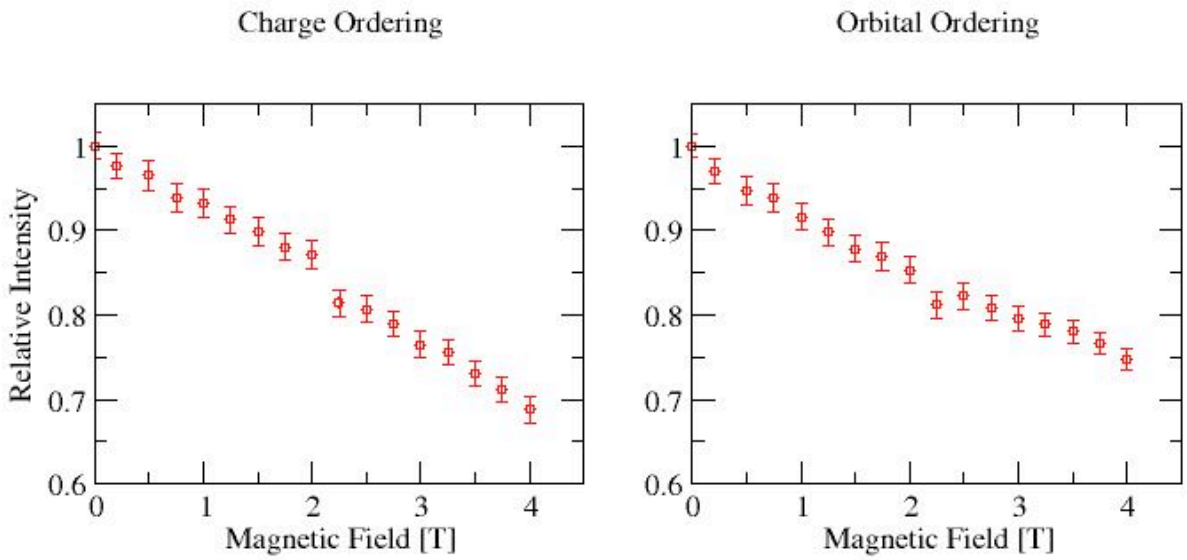

Fig 2: Variation of the charge and orbital order superlattice peaks, upon the application of a 4 Tesla magnetic field. No variation was observed in the control Bragg peak.

In addition to observing the intensity of the superlattice peaks, we monitored their energy dependence with increased magnetic field. No change was observed with applied field.

These results complement earlier results taken using high energy x-ray diffraction. The observed magnetic field dependence suggests that a ferromagnetic influence can be induced into the bilayer magnetics with a relatively low field, as such magnetic ordering has been shown to reduce the long range ordering.

Despite a few configurations with the magnet and cryostat, the experiment was on the whole succesful. We intend to publish these results in the near future in J. Phys. Cond. Matter.