EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

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:** Measurement of Critical Exponents and studies of Charge Stripe Dynamics in $La_{5/3}Sr_{1/3}NiO_4$ using Very High Energy X-Ray Scattering.	**Experiment number**: HE-904
Beamline: ID15-A	**Date of experiment**: from: 7/2/2001 to: 15/2/2001	**Date of report**: 20/03/2002
Shifts: 18	**Local contact(s)**: T. d'Almedia	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

This material is a model system for the study of strong electron-phonon coupling; it displays no structural phase transitions at low temperatures but three electronic phases due to charge stripe ordering. Charge and spin ordering in direct space have attracted much recent attention due to their link with high temperature superconductivity in the cuprates and colossal magneto-resistance in the manganites. Previous measurements on such samples have been made by neutron diffraction and X-ray diffraction.

Measurement were made on the high energy beamline ID15-A using an incident photon energy of 130 keV. Oxygen precipitated silicon crystals were used for monochromator and analyser set using the (113) reflection. The sample of single crystal $La_{2-x}Sr_xNiO_4$ (x = 0.333) was mounted in a closed cycle He refrigerator mounted on the Eulerian cradle on the 4-circle triple axis diffractometer available on ID15A. The sample was mounted with the <101> axis surface normal. After completing the alignment process the sample was cooled to the base temperature of the cryostat and superlattice reflections were located at a modulation wavevector of (2ε, 0, 1) surrounding Bragg reflection. Having located such reflections, their wavevector (position), inverse correlation length (width) and integrated intensity was measured as a function of temperature upon warming the sample. The temperature was controlled to a stability of ± 0.05K. The peaks were measured by scanning in the three principal directions in reciprocal space, H, K and L and along the 2θ direction which can be approximated to the Q_Z direction for such high energies. The latter has the advantage that only the analyser crystal has to be moved greatly reducing the instrument movement dead allowing for a fast measurement of the lattice spacing.

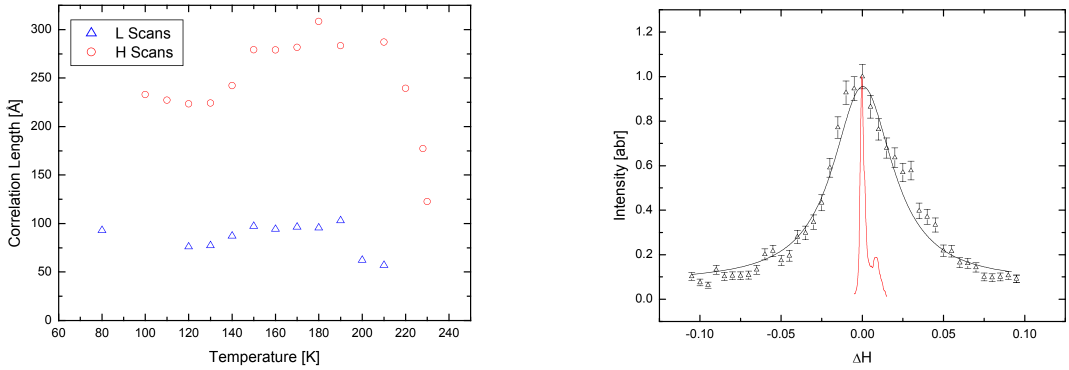

Figure 1 – Integrated Intensity (left) of the Charge Stripe superlattice Reflection as a Function of Temperature and a comparison of the instrumental resoltion (right)

Figure 1 shows measurements of the calculated correlation lengths of the charge stripe superlattice reflections, measured along the *H*- and *L*- directions. The difference of approximately a factor of two suggests that the charge stripes are 2-dimensional in nature, in agreement with our previous published work. The charge stripes are well correlated within the *a*-*b* plane of the crystal but show weaker correlations along the long *c*- axis. In addition an increase in the correlation length can be seen at approximately 130 K, corresponding to the spin stripe ordering temperature. This suggests that when the spin stripes coexist with the charge stripes the correlation of the charge stripes is reduced. Shown on the right of Figure 1 is a comparison along the *H*- direction of the instrumental resolution (measured on the corresponding Bragg peak) and the charge stripe superlattice reflection. In addition scan taken in the temperature range T_C – 10K to T_C displayed two length scales with an addition of a broader component slightly displaced from the main peak position. This indicates that just before melting the charge stripes are correlated over a shorter distance due to increasing vibration disorder of the stripes as suggested theoretically by Kivelson and Emery.

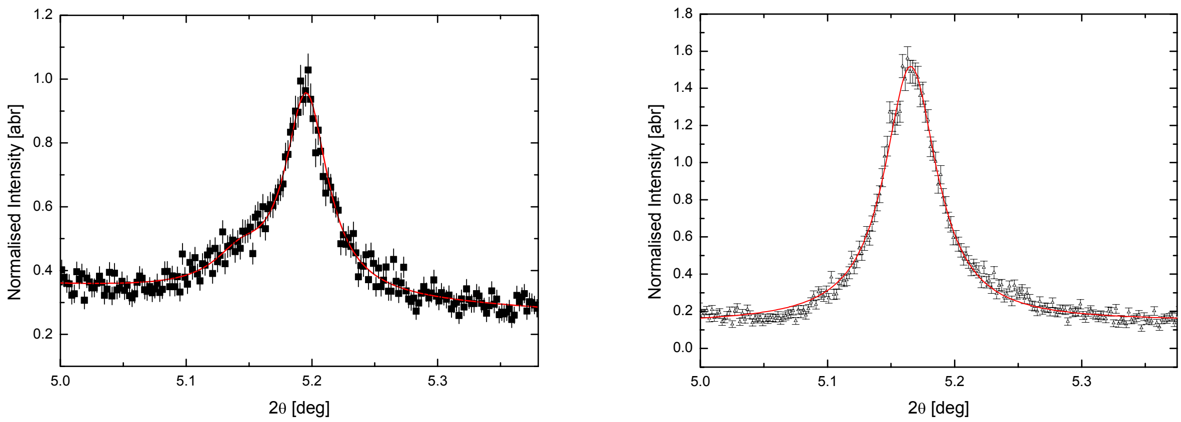

Figure 2 : Scans taken along the 2 Theta direction

This work is being prepared for publication in an internationally recognised, refereed, high impact journal. In addition it will be part of the doctoral thesis of Mr. S. B. Wilkins