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:** Measuring the dynamical spin response of Chromiun	**Experiment number**: HC 1833
Beamline:	**Date of experiment**: from: 10/06/2015 to: 10/14/2015	**Date of report**: 11/23/2015
Shifts:	**Local contact(s)**: Dr. Kurt Kummer	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

***Dr. Miao, Hu** **Brookhaven National Laboratory**

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Dr. Springell Ross **University of Bristol Interface Analysis Center**

Dr. Hill, John P **Brookhaven National Laboratory**

Report:

1. Measuring the dynamical spin response of Chromium:

The primary goal of this experiment is aimed to measure the high-energy spin excitations of Chromium, which remains deeply mysterious because of its very steep spin wave dispersion and concequent lack of reasonable neutron scattering data.

Chromium is very sensitive to air, we therefore prepared two 200 nm thick single crystal Cr-film on an MgO substrate and capped it with 5 nm of niobium, in order to protect it from oxidization. The spin and charge density wave (SDW/CDW) vectors are pinned to be parallel to the surface normal of the thin film. The incident photon energy is tuned to Cr L_3 edge at 574 eV. In order to achieve a resonable photon flux, the beam slit is set to 40, its corresponding energy resolution at 574 eV is 60 meV, which is more than sufficient to resolve the 600 meV spin excitation expected in Cr.

Our experimental results are summarized in figure 1. Fig. 1(a) shows the energy scan at tth = 150, δ= -5 (corresponding to high **Q** position). Besides the most pronounced elastic and flurescences features, we observed a Raman like excitation at 1 eV energy loss which is clearly visible at the resonance energy 574 eV. To further check if this excitation has magnetic origin, we perform the polarization dependent measurement shown in Fig. 1(b) and 1(d), Q-dependent measurement shown in Fig. 1c and temperature dependent shown in Fig. 1(e) and 1(f). Unfortunately, the spectra taken under different conditions are almost identical and no well-defined magnetic features are observed.

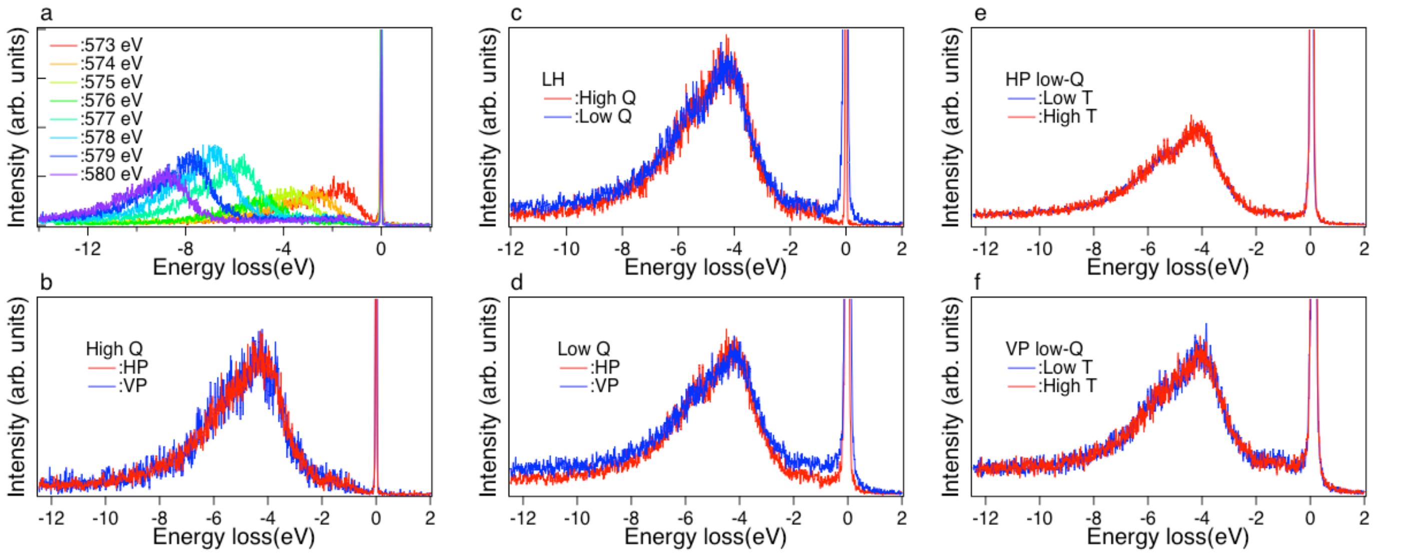

Figure 1: Chromium

The possbile reasons for the absence of well-defined magnetic feature can be manifold: first, Cr is a good metal with small ordered magnetic moment. The spin excitations will be quickly damped at high energy. Moreover, due to the steepness of the spin wave, the line width of the magnetic excitation is expected to be extremely broad; finaly, although the Cr-thin film is capped with 5 nm of niobium, it is not garanteed that the Cr is not oxidized.

2. Magnetic and charge stripe excitations in $La_{2-x}Ba_xCuO_4$ and their relationship to high temperature superconductivity

As a backup experiment, we measured the magnetic and charge stripe excitations in $La_{1.875}Ba_{0.125}CuO_4$. Based on the RIXS data we obtained this cycle, we made significant progress on the magneitc and charge stripe excitations in the next beamtime. We successfully observed the magnon softening in the CDW state with a fresh cleaved sample and identified the precursor-CDW above the nominal transition temperature.

Part of the data is shown in Figure 1. These panels show the RIXS intensity map along the H and the K direction at 54 K, 59 K and 90 K. A peak in the quasi-elastic intensity is clearly seen in the vicinity of Q_{CDW}, hence proves the existence of precursor CDW above the nominal CDW transition temperature at 55 K.

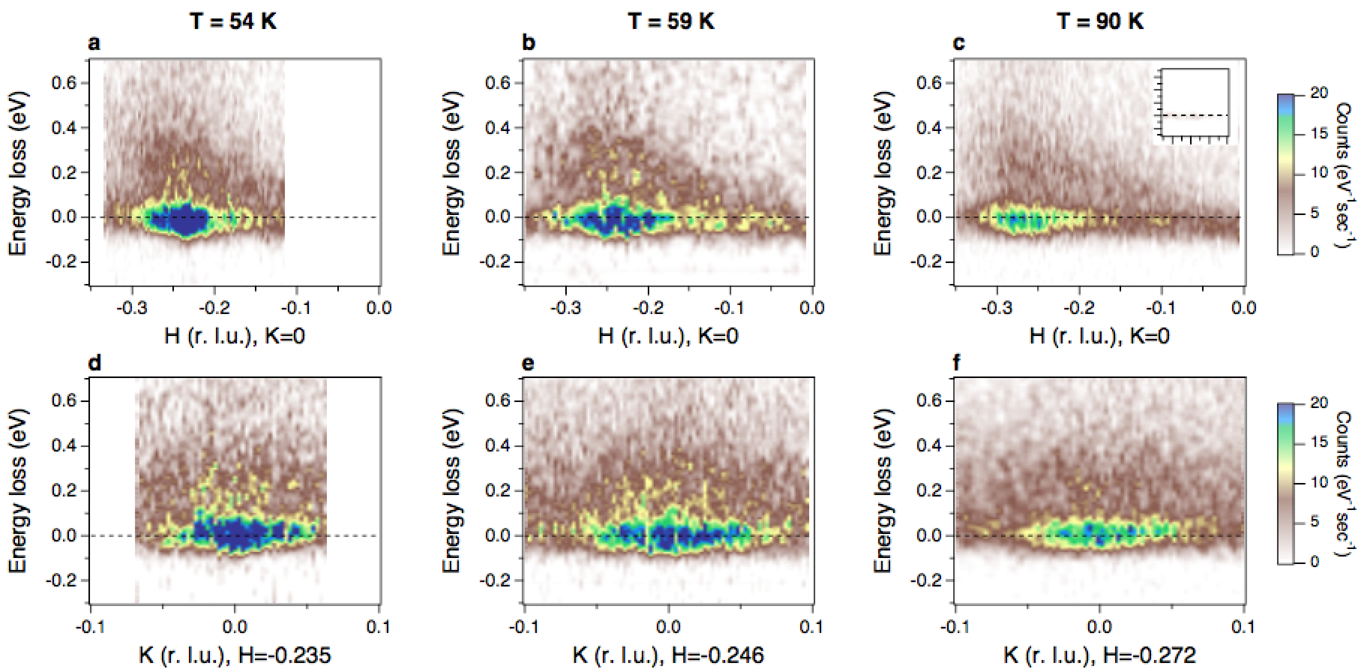

Figure 1: Identification of precursor CDW

We will submit the exciting results to ***Nature Materials*** this month. The title of our paper and the authorlist is shown below:

Precursor Charge Density Waves in $La_{1.875}Ba_{0.125}CuO_4$

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(Dated: September 7, 2016)