ESRF	**Experiment title:** Uniaxial strain study of the charge density wave and the electron-phonon coupling in underdoped cuprates	**Experiment number**: HC2819
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Shifts:	**Local contact(s)**: S.M. Souliou	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

SOULIOU Sofia-Michaela* (ESRF)
HICKS Clifford* (Max Planck Institute for Chemical Physics of Solids)
KIM Hun-ho* (Max Planck Institute for Solid State Research)
LE TACON Mathieu* (Karlsruhe Institute of Technology, Institut fuer Festkoerperphysik)
MINOLA Matteo* (Max Planck Institute for Solid State Research)

Report:

The objective of the current proposal was to determine the effect of uniaxial pressure on the charge density wave (CDW) instability and the associated phonon anomalies in the $YBa_2Cu_3O_{6.6}$ superconductor.

To this end we used a piezoelectric-based apparatus [1], which was suitably adapted to fit in the He-cryostat available in ID28. We therefore were able to combine uniaxial strain with low temperatures, and to perform for the first time in the ID28 beamline a very successful reference experiment under such conditions. An image of the device in the adaptor ring and in the cryostat is given in Fig. 1.

We prepared ~30 μm thick needles of high quality detwinned $YBa_2Cu_3O_{6.6}$ (p=0.12, T_c= 61 K) single crystals, from the same bunch as the ones used in our earlier ambient and hydrostatic pressure studies [2,3]. The strain was applied along the needle axis and was calibrated using a capacitance sensor and following the position shift of the Bragg reflections. In order to avoid the strong signal from the Cu-O chains along the 100 direction, we measured acoustical and optical phonon dispersions along the 010 direction. We performed temperature and strain dependent inelastic scans, typically in the energy range from -5 to 25 meV. Prior to the strain application, reference spectra were collected at unstrained conditions. The high quality of the obtained data is demonstrated in the spectra of Fig. 2 (a) which were recorded at T_c under 0.1% compressive strain.

We note that as the experiment was carried out very recently, a detailed analysis of the extensive datasets obtained from the 9 different analysers/detectors remains to be finalized and therefore here we will only include preliminary conclusions.

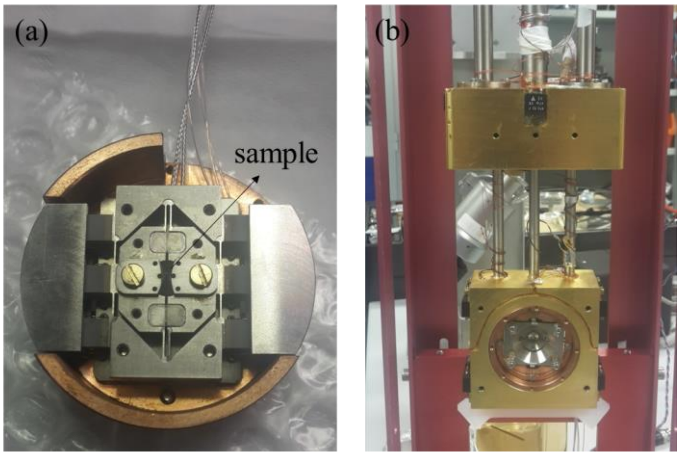

Fig. 1: (a) The piezoelectric based strain device mounted on the adaptor ring of the cryostat. The sample position in indicated. (b) The device mounted on the continuous flow He-cryostat of ID28.

In our earlier IXS study on $YBa_2Cu_3O_{6.6}$, we have observed a low temperature enhancement of the central elastic peak intensity sharply localized around $\boldsymbol{q}=\boldsymbol{q}_{\mathrm{CDW}}$ and maximized at T_c [2]. An important outcome of this experiment is shown in Figure 2: according to the current data which reproduce very accurately our earlier results under unstrained conditions, the application of uniaxial strain seems to have a visible effect on the elastic peak intensity at $\boldsymbol{q}_{\mathrm{CDW}}$, which increases up to ~25% relative enhancement under 0.6% compressive strain.

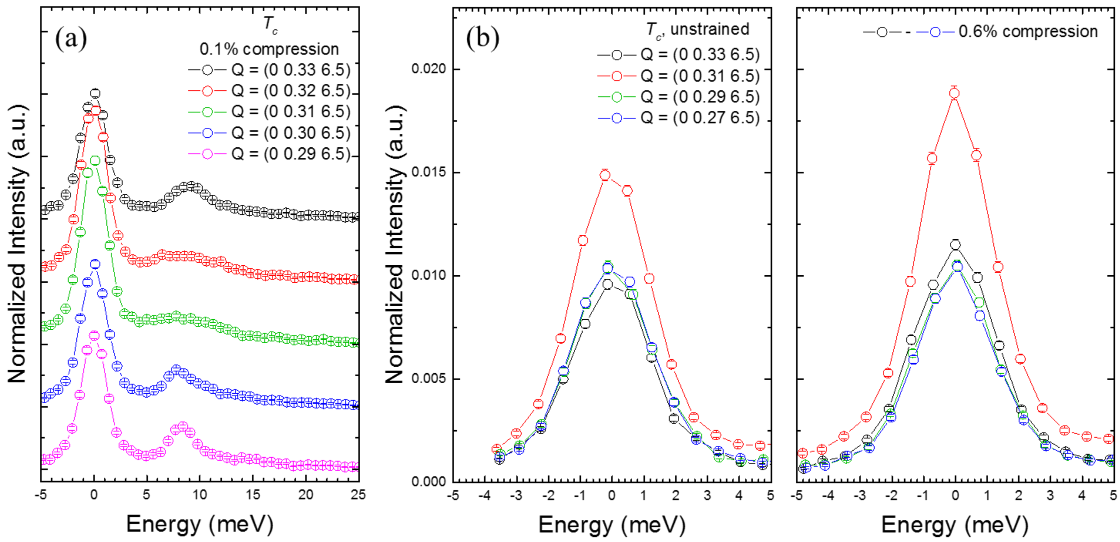

Fig. 1: (a) Momentum dependent IXS spectra recorded at T_c and under 0.1% uniaxial compression. (b) Momentum dependence of the elastic peak at T_c at unstrained (left) and 0.6% compression (right) conditions.

Even though the analysis of the phonon part of the spectra is currently ongoing, already at this stage we can report that there seems to be also a response of the previously observed CDW-related phonon anomalies to uniaxial strain application.

[1] Hicks, C.W., et al., Rev. Sci. Instrum, 85, 065003 (2014)
[2] Le Tacon M., et al., Nature Physics, 10, 52-58 (2014)
[3] see ESRF report HC-2196