ESRF	**Experiment title:** Study of phonon renormalizations in $(La,Nd)_{2-x}Sr_xCuO_4$ superconducting cuprates	**Experiment number**: HC 2190
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Report:

The discovery of charge fluctuations [1] and unusual electron-phonon coupling in superconducting cuprates [2] has revived the interest in the role of competing charge and spin [3] modulations in high temperature superconductivity. However, unlike the Fermi surface nested driven CDW in YBCO, no low energy phonon anomalies were detected in 214 stripe cuprates so far.

The goal of this proposal was to map out the temperature dependence of the low energy phonon dispersions (acoustic) of $(La_{1.48}Nd_{0.4})Sr_{0.12}CuO_4$, T_C= 5 K, to investigate by means of IXS phonon renormalization through the charge and spin ordering and superconducting transitions. We collected inelastic X-ray scans between $-5 < \hbar\omega < 20$ meV using the Si (999) (Ei=17.9 keV) setup at a number of reciprocal space positions, mainly focusing around the CDW ordering wavevector δ_{CDW}=0.23 rlu. The BZ investigated was chosen around the Q=(2.23 0 5.5) position as it had been shown that the CDW structure factor was strong in this area [4]. Data were collected between $1.9 < T < 150$ K.

Figure 1 shows the IXS spectra at different Q around Q_{CDW} at 1.9 K. The data have been fitted to a damped harmonic oscillator lineshape. As can be clearly seen in the raw data, there is a broadening of the low energy phonons at δ= 0.23 rlu which is visible in the raw data (Fig. 2, left) and pops up in the fitting. The broadening is enahnced in the SC state of LNSCO and survives up to the maximun temperature mesured, 60 K. At 150 K, the phonon anomaly is absent. The dispersion of the acoustical branch follows the theoretical calculations performed by Rolf heid at KIT (colour map at Fig. 1).

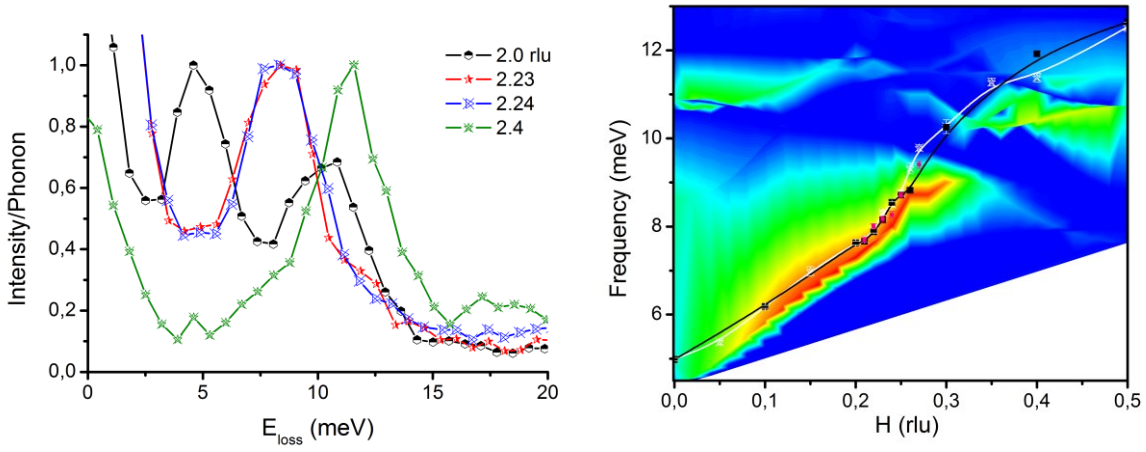

Fig. 1. **(Left)** Momentum dependence of the acoustic phonon mode in LNSCO around the CDW Q_{CDW}=(2.23, 0, 5.5) at T= 1.9 K (T_C= 5K). A broadening is observed at H= 2.23-2.24 rlu. (Right). Experimental phonon dispersion at 1.9 K (white dots), 10 K (black dots) and 60 K (red dots) on top of the colour map representing the DFT calculations.

The presence of a phonon broadening in the SC state differs from the results obtained by M. LeTacon et al. [2] and points towards a superconducitvity enhanced fluctuating charge stripe order in 214 superconducting cuprates. Studying samples with different doping levels will clarify this issue.

References.

[1] G. Ghiringelli et al., *Science* **337**, 821-825 (2013)
[2] M. Le Tacon et al., *Nature Physics* **10**, 52 (2014)
[3] S. Blanco-Canosa et al. *Phys. Rev. Lett.* **110** 187001 (2013)
[4] T. P. Croft et al. *Phys. Rev. B* **89**, 224513 (2014)