ESRF	**Experiment title:** Charge order and correlations in a clean overdoped cuprate superconductor	**Experiment number**: HC/4162
Beamline: Id32	**Date of experiment**: from: 13 Nov 2020 to: 22 Nov 2020	**Date of report**: 1/03/2021
Shifts: 18	**Local contact(s)**: Dr Kurt Kummer	*Received at ESRF:*

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Report:
Charge order and correlations in a clean overdoped cuprate superconductor

Recent RIXS studies on $(Bi,Pb)_{2.12}Sr_{1.88}CuO_{6+\delta}$ (Bi2201) and $La_{2-x}Sr_xCuO_4$ (LSCO) have shown that charge order (CO) persists throughout the phase diagram of high temperature cuprate (HTC) superconductors and, in particular, through the overdoped region. The two compounds studied so far are relatively disordered and scattering is known to strongly suppress the transition temperature and superfluid density. Here we proposed to search for charge order and charge correlations in the overdoped region in the cleaner system $Tl_2Ba_2CuO_{6+\delta}$ (Tl2201) which has a different Fermi surface topology to LSCO and reduced quasiparticle scattering. The results will shed light on the mechanism of charge ordering.

We measured the charge order and CDW fluctuations at the Cu L-edge. Three samples were investigated with dopings p=0.23, 0.25 and 0.28. With T_c's in the range 55-15K. The experiment was a great success: two of the dopings p=0.23, 0.25 showed charge density wave (CDW) correlations while the highest doping p=0.28 did not. This suggests that CDW correlations exist up to a critical doping. Also that the region of the phase diagram where quantum oscillations have been observed does not have charge ordering.

Further details about the data and their interpretation are available at
https://arxiv.org/abs/2109.04279

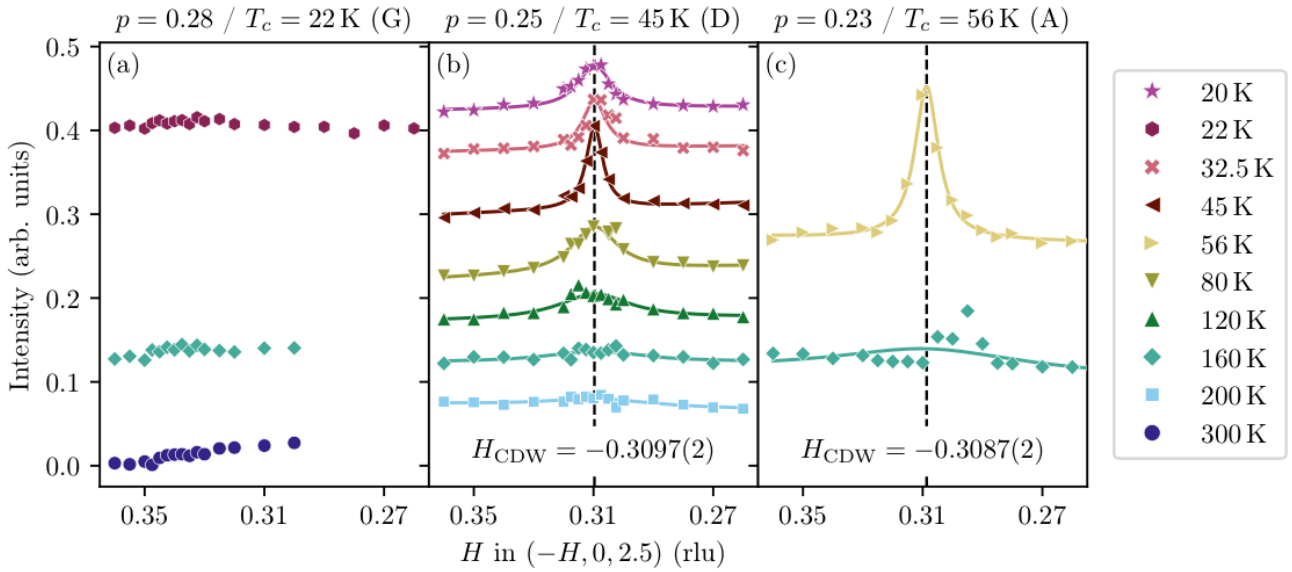

Fig. 1. Elastic intensities, obtained integrating RIXS intensity over energy in the range -50 to 50 meVof three samples of Tl2201 at various dopings, with measurements at increasing temperatures offset for clarity. All intensities are on the same scale. Data in (b) and (c) are fitted to Lorentzians on a linear background, with a fixed centre. The dashed lines mark the position of the fixed centre

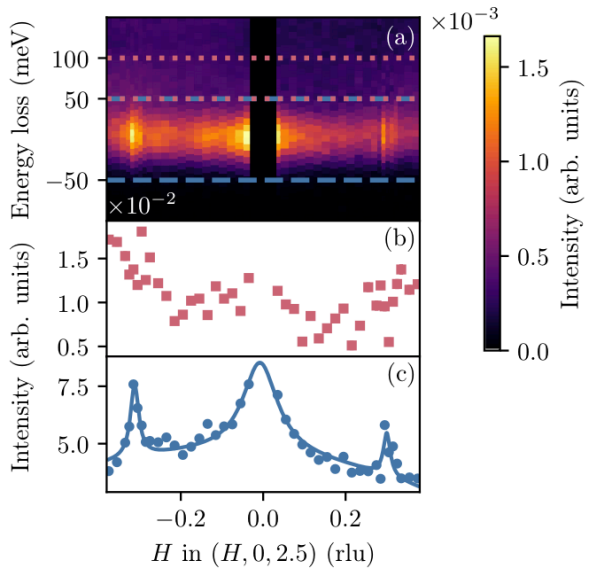

Fig. 2 RIXS intensity of sample D (p=0.25) at (a) 45 K at its most intense, and (b) 160 K when it has almost completely disappeared.

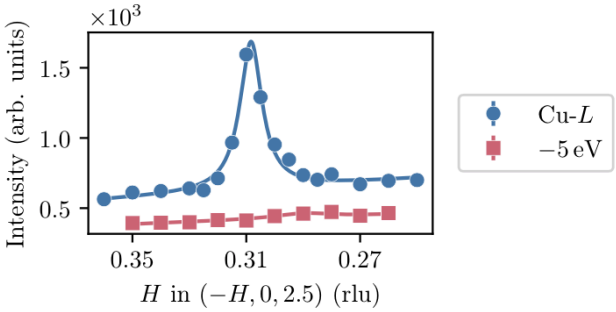

Fig. 3 A resonant scan in blue circles, and scans -5 eV from resonance in red squares, normalised to the storage ring current. Lines are Lorentzian