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| <b>Beamline:</b><br>Id32   | <b>Experiment title:</b><br>The search for the 50 meV resonance in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ | <b>Experiment number:</b><br>HC/2696 |
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| <b>Shifts:</b><br>18   | <b>Local contact(s):</b><br>Dr Kurt Kummer  | <i>Received at ESRF:</i>             |
| <b>Names and affiliations of applicants (* indicates experimentalists):</b><br><br><b>HAYDEN Stephen M.*</b><br>University of Bristol<br><b>BARTHELEMY Maud*</b><br>University of Bristol<br><b>ZHOU Kejin*</b><br>Diamond Light Source<br><b>ROBARTS Hannah*</b><br>University of Bristol |   |                                      |

## Report:

### The search for the 50 meV resonance in $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$

Collective spin excitations are widely believed to cause superconductivity in high temperature cuprate superconductors. Of particular importance are the low-energy ( $<100$  meV) excitations which show the strongest wavevector dependence. Here we proposed to use the improved resolution of ID32 to resolve new features in the spin excitations of optimally doped  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ . Specifically, inelastic neutron scattering suggests that there may be a resonant mode near  $q=(0,0)$  with an energy of about 50 meV. The observation of this mode would place constraints on theories of spin fluctuations in the cuprates.

We grew  $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$  ( $x=0.16$ ) crystals via a float-zone method. Samples have previously been used for inelastic neutron scattering measurements. Samples were cut to form posts and cleaved in-situ to yield the (001) face. RIXS Measurements were performed at the Cu  $L_3$  edge at based temperature.

Fig 1 shows examples of RIXS data collected in single photon mode with error bars derived from the number of counts. Strongly dispersing excitations are observed along the  $(h,0)$  direction. We also collected data in a systematic fashion on a grid using the vacuum goniometer to obtain the plot in Fig. 2.

The experiment was a great success: high quality data was obtained which provides strong constraints on the nature of the charge/spin excitations observed with RIXS. There is evidence for the “low energy resonance” which motivated the experiment in that there is strong scattering in the 50-150 meV range for  $h=0.1$  in Fig. 1. The experiment allowed a detailed mapping on the  $q$ -dependence of intensity of the excitations throughout the Brillouin zone (see Fig. 2). Detailed analysis of the  $q$ -dependence spectral line shape in in progress.

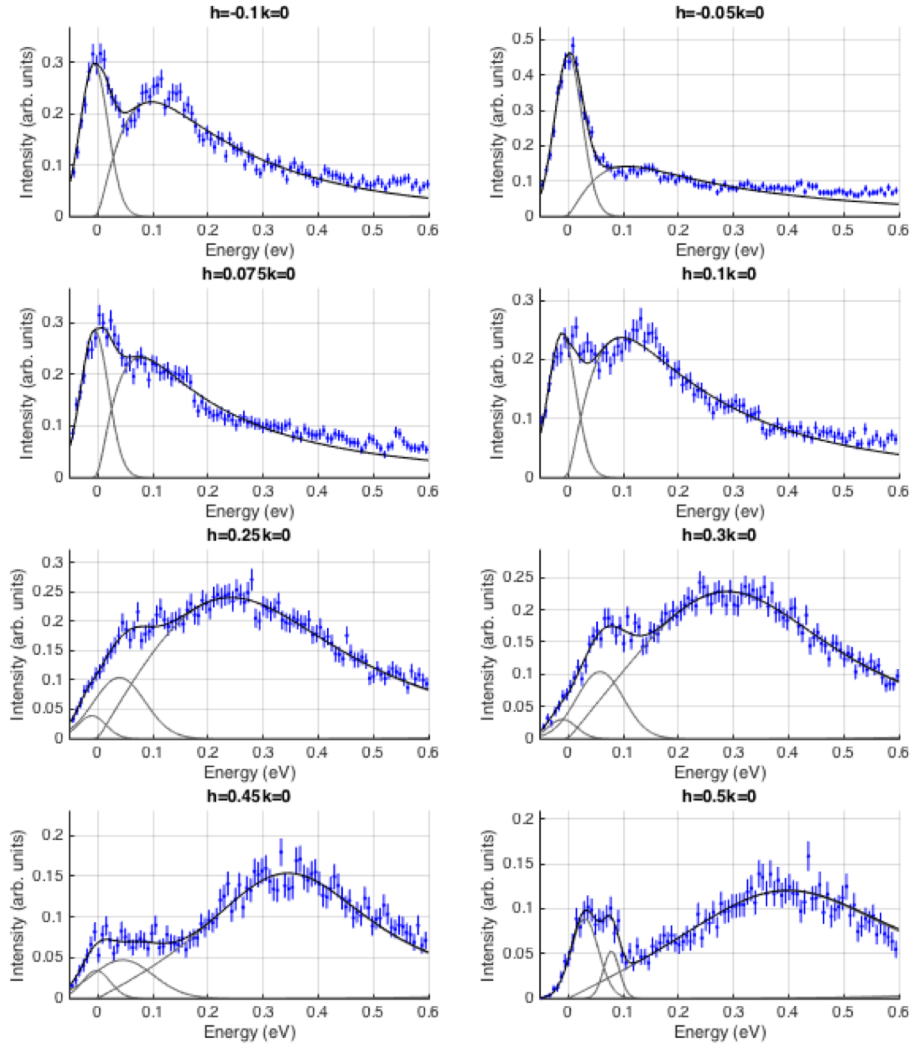


Fig. 1. Typical RIXS spectra from LSCO ( $x=0.16$ ). Data collects for wavevectors along the  $(h,0)$  direction. Strongly dispersing excitations are observed.

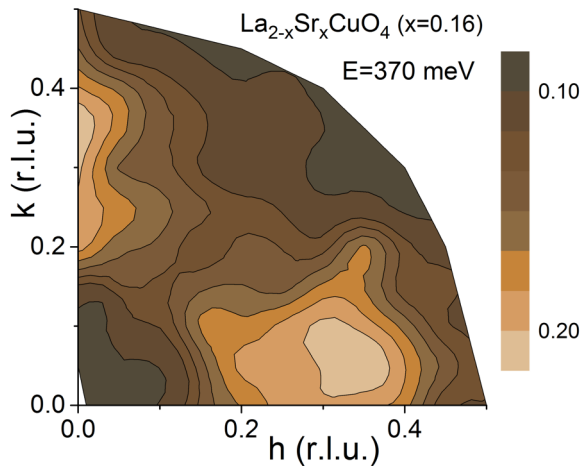


Fig. 2 Wavevector dependence of the high-energy magnetic excitations in LSCO ( $x=0.16$ ).