Highlights

Superconducting and correlated low dimensional materials and devices for quantum electronics and spintronic - 2019

Dynamical charge density fluctuations pervading the phase diagram of a Cu-based high-Tc superconductor

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Science 365 (2019) 906

The phase diagram of the high-T_c cuprate superconductors (HTS) is characterized by the spontaneous emergence of various ordered states, tuned by doping and driven by competition between charge, spin, orbital and lattice degrees of freedom.The identification of all these ordered states is a crucial step towards the understanding of high-temperature superconductivity, one of the grand challenges in solid state physics. Recently, synchrotron-based X-ray scattering provided evidence of a new charge order, theoretically predicted already in the 90s, in all cuprate superconductors. However, it remains unclear to what extent the charge order influences the unusual properties of these systems, since it was reported - in the shape of incommensurate Charge Density Waves (CDW) - only in underdoped samples (with doping p = 0.08 – 0.16 holes/Cu) and at relatively low temperatures (below 170-200 K). The manuscript demonstrates for the first time the presence of a sort of precursor of the quasi-2D CDW signal, characterized by an almost temperature-independent evolution. The result was achieved thanks to the higher sensitivity of the resonant inelastic X-ray scattering (RIXS) instrumentation now available at ID32-beamline of ESRF (Figure 1). The results have been surprising. While sharing with the 2D-CDW the same incommensurate wave vector q_c, this broad peak is present also above the pseudogap temperature, up to 270 K , and even in optimally doped and overdoped samples (p > 0.16 holes/Cu). Furthermore, it is not sensitive to the presence of the superconducting order. The result has been interpreted as *dynamic-charge-density-fluctuations* compatible with the picture provided 23 years ago by Castellani *et al.* [2] of an inherent charge instability in HTS cuprates. Charge density fluctuations can be thus regarded as pervasively present at all T for superconducting cuprates and might therefore have a crucial role in determining the peculiar properties of these compounds both in the normal and superconducting states

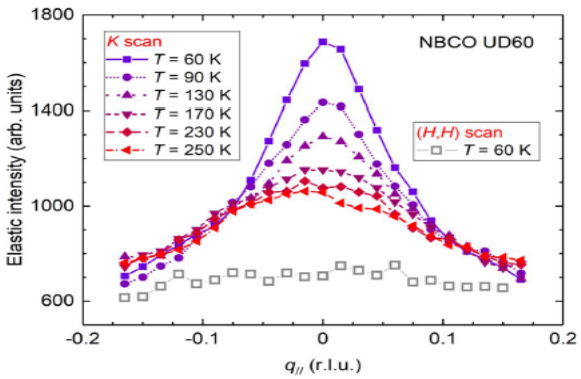

Figure 1. Elastic intensity, from integration of the the quasi-elastic region of the Cu L3 RIXS spectra measured at different $q_{//}$ values along the (H,0) direction.