ID de Contribution: **381** Type: **Contribution orale**

Hidden magnetic texture in the pseudogap phase of high-Tc superconducting YBa2Cu3O6+x

vendredi 7 juillet 2023 09:15 (15 minutes)

Despite decades of intense researches, the enigmatic pseudo-gap (PG) phase of superconducting cuprates remains an unsolved mystery. In the last 15 years, condensed matter physicists discovered that this phase hosts symmetry breaking states as an intra-unit cell (or q=0) magnetism, interpreted in terms of loop current patterns [1], preserving lattice translation (LT) and breaking time-reversal and parity symmetries, followed, upon cooling, by an additional incipient charge density wave [2] breaking the LT symmetry. However, none of these states can (alone) account for the partial gapping of the Fermi surface.

Our recent polarized neutron diffraction measurements in YBa2Cu3O6+x single crystals with different hole-doping levels [3-4] reveal a novel hidden bi-axial magnetism that may be crucial to elucidate the PG puzzle. This short-range magnetism (typical correlations over 5-6 unit cells), carried by the CuO2 layers, settles in at the PG onset temperature. Distinct from the q=0 magnetism, its planar propagation wave vector is $(\pi,0)\equiv(0,\pi)$, yielding a (2x2) quadrupling of the magnetic unit cell (q=1/2 magnetism). It further displays a strong out-of-plane anisotropy of the associated magnetic moments, predominantly pointing perpendicular to the CuO2 planes.

We discovered that the q=0 and q=1/2 magnetisms could be embedded within a single complex and highly spread-out magnetic texture. This phase could correspond to the smallest possible domain of LC supercell breaking LT, recently proposed to account for the PG opening [5]. The existence of such a broad magnetic texture reveals an unexpected aspect of the PG physics that may modify our understanding of that state of matter.

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Classification de Session: Mini-colloques: MC21 Matériaux quantiques : des prédictions à l'observation

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