

Resonant inelastic x-ray scattering study of charge, orbital and magnetic orders in cuprate/manganite heterostructures

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My talk will evolve around resonant x-ray inelastic scattering (RIXS) studies at the Cu-L₃ edge of PLD-grown heterostructures made from alternating layers of the cuprate high T_c superconductor YBa₂Cu₃O₇ (YBCO) and the magnetic manganite Nd_{1-x}(Ca,Sr)_xMnO₃ (NCSMO). The latter material is an insulator with competing phases that are either antiferromagnetic (AF) and charge/orbital ordered or ferromagnetic [1, 2].

At first, I will show that the NCSMO layer affects the phase competition between a copper charge density wave and superconductivity in the YBCO layers [1, 2] and can even give rise to a new kind of charge density wave in the interfacial CuO₂ layer [3].

In the second part, I will focus on the magnon modes of the YBCO layers and show that they are very different for the bulk-like CuO₂ planes and the interfacial CuO₂ plane [4]. The analysis of the magnon dispersion yields a strong suppression of the in-plane AF exchange interaction from $J \approx 130$ meV in the bulk-like CuO₂ planes to $J \approx 70$ meV in the interfacial CuO₂ plane. Moreover, it reveals an anomalous momentum dependence of the intensity of the interfacial magnon mode which indicates that the AF order is accompanied by an orbital order. Notably, this combined AF and orbital order at the interface yields a quasi-two-dimensional so-called “altermagnetic” state [4]. The latter is of great interest since it can enable new superconducting proximity effects and spintronic applications [5].

References

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