Tridimensional magnetism in Superconducting Infinite-Layer $PrNiO_2$ studied with Resonant Inelastic X-ray Scattering

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Infinite-layer (IL) nickelates have been reported as superconductive in 2019, coming to the forefront as one of the most promising class of cuprate-akin compounds[1,2]: the general interest in their electronic structure has pointed out both analogies and differences with copper oxides[3,4]. In this context, particular attention has been addressed to spin order: recent RIXS works[5,6,7] have reported the presence of magnetic excitations both in hole-doped and undoped compounds, with the former showing a much larger damping of the (para)magnon peak due to progressive hindering of magnetic correlations by the doping holes. Because p-doping is, at present, a necessary ingredient to obtain superconductivity in these compounds, this has been interpreted as a sign of intrinsic competition between magnetism and superconductivity. In this work, we question this interpretation by taking advantage of the recent report of superconductivity caused by self-doping in nominally undoped $PrNiO_2$ (PNO)[8]. We performed extensive RIXS measurements on the very same PNO samples at a temperature close to the SC onset, exploiting both the momentum and polarization resolution provided by the technique. Our results shown a rather sharp magnon dispersion over the whole Brillouin zone. The presence of a gap at the Γ point revealed an interlayer exchange coupling between the NiO_2 planes, showing the inadequacy the bidimensional Linear Spin Wave models previously employed in literature[3,5,7]. We fitted the dispersion with a tridimensional model explicitly including such coupling, and compared the result to the Infinite-Layer cuprate $CaCuO_2$. An exchange coupling of few *meV* in the direction orthogonal to the planes was then retrieved for both compounds. Our results have a double valence: (1) they hint at the possible coexistence between superconductivity and magnetism in PNO, and (2) they demonstrate the tridimensional nature of the latter, providing an estimate of the interlayer exchange coupling.

Keywords: magnetism, nickelates, RIXS, cuprate

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