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Quantum interference between multi-triplon continua and bound states in quasi-one-dimensional cuprate Sr14Cu24O41

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In atomic physics, interactions between single-particle state and multi-particle continuum leads to distinct ionization processes interfering with each other, leads to the so-called Fano resonance. Similar concepts have also been materialized in nanostructured systems, such as semiconducting quantum dots or frustrated magnets. The later shows renormalized energy levels of the single-particle bound state to repel from the continuum boundary. Here we demonstrate an experimental realization from two-triplon (2T) excitations in quasi-one-dimensional ladder Sr14Cu24O41 probed by resonant inelastic X-ray scattering (RIXS). The energy-dependent RIXS spectra reveals the the collective triplon excitations distinct from the incoherent particle-hole-like continua, which well describes the renormalized energies of ΔS=1 (ΔS=0) 2T bound state away from the lower boundary of 2T continuum at Cu L3-edge (O K-edge). Furthermore, we clearly observe a suppressed spectral weight of ΔS=0 bound state for qLadder < 0.15 (2π/cLadder), which matches the crossing region with continuum boundary where the bound state ceases to exist. These findings are in good agreement with theoretical works using continuous unitary transformation (CUT) method. Moreover, our RIXS study on 2T excitations in Sr14Cu24O41 spin ladder demonstrates a novel approach for investigating interacting quantum systems in micro-scale.

Position

Phd

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