Observation of Spin-Orbital Separation in Sr_2CuO_3 pin Chains with Resonant Inelastic X-ray Scattering

Resonant Inelastic X-ray Scattering (RIXS) is a powerful probe of excitations from the electronic ground state of correlated materials involving lattice, charge, orbital and spin degrees of freedom [1]. In this talk we present high-resolution RIXS studies of magnetic and electronic excitations in the low dimensional spin chain system Sr_2CuO_3 performed at the ADvanced RESonant Spectroscopies (ADRESS) beamline of the Swiss Light Source with the SAXES spectrometer [2].

In general, quantum effects become important when the space symmetry is lowered. In the extreme case of one-dimensional-materials the electron can break up into separate quasi-particles, i.e., spinons, holons and orbitons that carry their respective spin, charge and orbital degrees of freedom [3]. Sr_2CuO_3 is an ideal realization of the one-dimensional Heisenberg spin-1/2 chain. When an electron is removed from this spin-chain one can for instance observe how spin and charge degrees of freedom are splitting in the so called spin-charge separation mechanism [4].

Our Cu L_3-RIXS measurements on Sr_2CuO_3 reveal the fractionalization of magnons into two-spinons and higher order excitations as previously reported from neutron scattering [5]. Furthermore, we observe the splitting of an orbital excitation into the independently propagating spinon and orbiton quasi-particles [6]. This newly observed spin-orbital separation phenomenon gives thereby rise to strongly dispersive orbital excitations (orbitons) [6,7].

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