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Resonant Inelastic X-ray Scattering and Electron Energy-Loss Spectroscopy on La1-xSr1+xMnO4

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We present a combined resonant inelastic x-ray scattering (RIXS) and electron energy-loss spectroscopy (EELS) study of the single layered manganite La1-xSr1+xMnO4 (LSMO). The RIXS planes were measured at the Mn K-edge at the ID 26 at the ESRF revealing the presence of intermediate and final states with different symmetries. A strong excitation is observed around 2eV for all doping levels by RIXS. In contrast to this, the excitations measured by EELS in this energy region are strongly doping dependent, revealing the occurrence of doping induced excitations around 1.65 eV. The different behavior observed by RIXS and EELS, shows that both methods probe different excitations occurring in the same energy range. The origin of the spectral weight seen in RIXS and EELS is discussed in terms of intersite dd excitations and doping induced electronic polarons, respectively. Pursuing the comparison between RIXS and EELS further, we calculate the RIXS planes using the ultrashort core-hole lifetime approximation (UCL) and the EELS data. A rough qualitative agreement is found, but many of the characteristic features of the spectral weight distribution within the RIXS planes can not be captured. This is most likely caused by the presence of several intermediate states, which are close in energy. In this case the UCL cannot be used. The presented data shows that RIXS and EELS are powerful complementary methods for the study of correlated electron dynamics.

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RIXS

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