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Orbital excitation in $\text{Sr}_2\text{CuO}_2\text{Cl}_2$ resonant inelastic x-ray scattering at the Cu K pre-edge JUNGHOO KIM, D. S. ELLIS, T. GOG, D. CASA, YOUNG-JUNE KIM, CMC-CAT, APS, ARGONNE NATIONAL LAB. COLLABORATION, UNIVERSITY OF TORONTO COLLABORATION — $d-d$ excitations has attracted much attention due to its fundamental importance in elucidating electronic structure. However, experimental study of these excitations is difficult, since direct optical transition is dipole forbidden. We show that the Cu $1s-3d$ intermediate state, which can be reached via electric quadrupole operator, provides an excellent high-resolution means for studying $d-d$ excitations in cuprates, and complements other well established techniques. Since quadrupole operator is sensitive to the symmetry of the intermediate state, considerable information on the symmetry of $d-d$ excitation can be gained by exploiting this resonance. We have carried out comprehensive angle resolved x-ray absorption spectroscopy experiment, which clearly demonstrates the quadrupole nature of the absorption. We find that our RIXS spectra at this quadrupole resonance exhibit a broad excitation centered at 2 eV. We suggest that the scattering angle dependence of the quadrupole resonance agrees well with the calculated polarization dependence of quadrupole matrix element and information on the symmetry of $d-d$ excitation can be obtained. Our analysis show that the quadrupole resonance at 2eV is consistent with the excitation involving $3d_{yz, zx}$ symmetry.

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