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Phase interference and sub-femtosecond time dynamics of resonant inelastic X-ray scattering from Mott insulators L. ANDREW WRAY, SLAC National Accelerator Laboratory, SHIH-WEN HUANG, Lawrence Berkeley National Laboratory, YUQI XIA, M. ZAHID HASAN, Princeton University, CHARLES MATHY, ITAMP, Harvard-Smithsonian Center for Astrophysics, HIROSHI EISAKI, Nanoelectronic Research Institute, National Institute of Advanced Industrial Science and Technology, ZAHID HUSSAIN, YI-DE CHUANG, Lawrence Berkeley National Laboratory — Resonant inelastic X-ray scattering (RIXS) is a powerful technique for observing the energy states of many-body quantum materials. The core hole resonance states that make RIXS possible are strongly correlated, and undergo complex time evolution that shapes scattering spectra. However, current inelastic scattering measurements cannot be converted to a time resolved picture, because techniques that determine relative phase information from elastic scattering have not been adapted to the greater complexity of inelastic spectra. We will show that inelastic scattering phases can be identified from quantum interference in sharply resolved (dE $<$ 35meV) M-edge RIXS spectra of Mott insulators (e.g. $SrCuO_2$ and NiO), and provide new information for identifying excitation symmetries and many-body time dynamics.

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