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Mapping of Picoscale Lattice Displacements in Charge Density Wave Systems to Measure Local Symmetry, Elasticity, and Disorder¹ BENJAMIN H. SAVITZKY, ISMAIL EL BAGGARI, Cornell University, ALE-MAYEHU ADMASU, JAEWOOK KIM, SANG-WOOK CHEONG, Rutgers University, ROBERT HOVDEN, LENA F. KOURKOUTIS, Cornell University — We present direct, local measurement of picometer scale periodic lattice displacements (PLDs) in charge density wave systems using scanning transmission electron microscopy (STEM) data. Our approach combines picometer precision, real-space tracking of atomic nuclei with Fourier analysis to reveal the local symmetry, elasticity, and disorder of emergent lattice ordering. By investigating both manganite oxides and transition metal dichalchogenides, we uncover the atomically resolved lattice response about multiple PLD defect structures, including topological singularities in the PLD phase. We observe elastic deformations of the PLD field, and consider their energetics by isolating the contributions of PLD phase and amplitude variations. Further, we extract maps of individual modulations in the presence of multiple, coexisting modulation vectors, revealing a complex domain structure of locally stripe-ordered regions. Our work isolates and locally interrogates the collective behavior of the atomic lattice in multiple strongly correlated systems, demonstrating a potent new tool for the systematic examination of ordered phases.

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