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Ultrafast Dynamics of the Symmetry Breaking in Charge-ordered $La_{1.75}Sr_{0.25}NiO_4$ Single Crystals.[1] GIACOMO COSLOVICH, Lawrence Berkeley National Lab, SLAC National Accelerator Lab, ALEXANDER F. KEMPER, Lawrence Berkeley National Lab, North Carolina State University, SASCHA BEHL, BERNHARD HUBER, Lawrence Berkeley National Lab, HANS A. BECHTEL, Advanced Light Source, Lawrence Berkeley National Lab, TAKAO SASAGAWA, Tokyo Institute of Technology, MICHAEL C. MARTIN, Advanced Light Source, Lawrence Berkeley National Lab, ROBERT A. KAINDL, Lawrence Berkeley National Lab — We report equilibrium and ultrafast optical pump-THz probe spectroscopy of the stripe-phase rare-earth nickelate compound $La_{1.75}Sr_{0.25}NiO_4$, unveiling the ultrafast dynamics of the crystal symmetry breaking and of local electronic arrangements. At low temperatures the folding of finite momenta vibrations due to symmetry breaking lead to the appearance of new IR-active resonances, particularly around the phonon bending mode frequency ($\approx$11 THz). Ultrafast experiments in the multi-THz spectral range show sharp THz reflectivity modulations associated with the phonon zone-folding dynamics, while the background conductivity is reminiscent of the opening of the mid-IR pseudogap. We combine experimental data with DFT calculations of the phonon dispersion to reveal the distinct dynamics of the LO and TO phonon modes at finite momenta. This work provides new insight in the role of polar electron-phonon coupling and symmetry breaking in charge-ordered systems.

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