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A time-resolved, resonant soft x-ray scattering spectroscopy experiment at the LCLS: Time scale hierarchy in stripe-phase nickelates

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In a hole-doped Mott insulator, spatially-ordered, nano-scale spin and charge patterns can emerge and form “stripes”. In this phase, holes form one-dimensional charge stripes, which serve as anti-phase domain walls between anti-ferromagnetically ordered spin stripes. While the stripe phase has been extensively studied in thermal equilibrium, its dynamics remain largely unexplored. Using the LCLS X-ray FEL, we perform time-resolved optical pump and resonant soft x-ray scattering spectroscopy probe on the stripe phase of doped nickelates. We find that the dynamics of the spin and charge stripe order are distinct from the thermal evolution. Moreover, an analysis of the initial and long recovery times reveals rich hierarchical time scales for charge and spin stripes, shedding new light on the surprising non-equilibrium physics of stripe-ordered systems.

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