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Momentum-dependent snapshots of a melting charge density wave

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Charge density waves (CDWs) underpin the electronic properties of many complex materials. When electrons are uncorrelated, CDW order is driven by the electron-phonon interaction alone, producing linearly coupled lattice and charge-density modulations whose dynamics are understood in terms of collective amplitude and phase modes. However, if electronic correlations dominate, lattice and charge order may de-couple as the CDW can respond on a purely electronic time scale. 1T–TaS2 is a two-dimensional compound with a CDW of controversial origin, where a nesting Fermi-surface geometry coexists with strong electronic correlations. We use time and angle resolved photoemission spectroscopy with sub-30-fs XUV pulses to map the time- and momentum-dependent electronic structure in this material. This allows us to simultaneously resolve the collapse of the Mott gap at the Fermi level, the synchronous collapse of splitting between occupied sub-bands associated with the electronic component of CDW order, and the subsequent unfolding of the Brillouin zone on a structural time scale. Our results highlight the importance of strong electronic correlations in all aspects of the low-temperature ordered phase of this material.

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