PAUL SCHERRER INSTITUT

PSI Condensed Matter Colloquium

Friday, April 26, 2019, 11:15 h,
WHGA/001

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Light induced Phase Transitions in Charge Density Waves

Upon excitation with an intense laser pulse, materials can undergo a non-equilibrium phase transition through pathways different from those in thermal equilibrium. The mechanism underlying these photoinduced phase transitions has long been researched, but many details in this ultrafast, non-adiabatic regime still remain to be clarified. To this end, we investigate the light-induced melting of a unidirectional charge density wave (CDW) in LaTe3. Using a suite of time-resolved probes, we independently track the amplitude and phase dynamics of the CDW. We find that a fast (approximately 1 picosecond) recovery of the CDW amplitude is followed by a slower re-establishment of phase coherence. This longer timescale is dictated by the presence of topological defects: long-range order is inhibited and is only restored when the defects annihilate. Furthermore, after the suppression of the original CDW by photoexcitation, a different, competing CDW along the perpendicular direction emerges. The timescales characterizing the relaxation of this new transient CDW and the reestablishment of the original CDW are nearly identical, which points towards a strong competition between the two orders. The new density wave represents a transient non-equilibrium phase of matter with no equilibrium counterpart. Our results provide a framework for understanding other photoinduced phase transitions and for unleashing novel states of matter that are “trapped” under equilibrium conditions.

Coffee
before the
colloquium

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