How fast can we melt ordered phases in low dimensional materials?

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Low-dimensional crystalline materials tend to undergo phase transitions to new ground states at low temperature, exhibiting long-range order or exotic properties like a condensate of quasiparticles. Such a new ground state is often accompanied by the opening of a band gap in the electronic structure, like in the case of charge and spin density wave phases or superconductivity. Angle-resolved photoemission spectroscopy (ARPES) is a method of choice to investigate these materials, as it directly measures their electronic structure in the reciprocal space and therefore gives access to their electronic band gap.

Here I will address the real-time dynamics after photoexcitation of ordered phase like in charge and spin density wave phases, as well as the case of an exciton condensate. This is experimentally achieved in time-resolved ARPES, for which the investigated sample is perturbed by infrared pump photon pulses and probed subsequently on the femtosecond timescale by ultraviolet probe pulses.

I will discuss how fast the ordered phase can be destroyed by the photoexcitation and how it recovers afterwards. I will also present the case of non-equilibrium phases which can be transiently generated and persist during a few hundreds of femtoseconds.