# Visualization of photoinduced phase transitions: From molecular systems to many-body problems

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The advances of ultrafast imaging and spectroscopy technologies in the last decades have enabled a new perspective in understanding the fundamental processes at far from equilibrium. Ranging from molecular dissociations to finite systems on the nanometer scale, the transient decoupling between constituents, e.g. electronic, spin and vibrational degrees of freedom, allows the interaction hierarchy to be observed. These photoinduced nonequilibrium dynamics are not only central for understanding the complex interactions, but also may yield new ways for controlling the processes with many technical implications. We will discuss a surprising generality of self-organizing behavior emerging at nonequilibrium in driven systems, from few-atom molecules to large many-body electronic crystals visualized by the ultrafast electron imaging techniques. We will focus on photoinduced phase transitions in charge-ordering systems [1,2,3] while drawing their molecular analog observed in the gas phase chemical reactions [4] to highlight this generality and the potential control. We will also discuss methods to combine diffraction, imaging, and spectroscopy in a single setup to follow many key degrees of freedom at once as a next step to resolve complex dynamics in the development of high-intensity ultrafast electron microscopy systems [5,6].

**References:**

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