Dynamical phase transitions in electronic systems
induced by ultra-fast optical pumping.

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I shall report on several studies of phase transformations in cooperative electronic systems achieved by means of a femto-second optical pumping.
1. Experiments on charge density waves recovered coherent unharmonic undulations of the order parameter, critical slowing down of the collective mode, and evolution of the particle-hole gap. The numerical modeling reproduced the dynamical phase transition, and the waves emitted by “earthquakes” from in depth annihilation events of topological defects.\*)**2. The bistable switching to a “hidden” state has been achieved in a “polaronic Wigner-crystalline Mott insulator” 1T-TaS2. The theory** focuses upon evolution of electrons and holes as mobile charge carriers, and the crystallized electrons modifiable by intrinsic defects.\*)3. The special case of resonance optical pumping to excitons is realized in systems with a neutral-ionic ferroelectric transition. The modeling of the quantum-coherent quasi-condensate of excitons interacting with the order parameter recovers the dynamical realization of the “excitonic insulator” state and spacio-temporal patterns with self-focusing, domains segregation, and local dynamical phase transitions.\*\*)

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\*)After collaboration with D. Mihailovic group at the Jozef Stefan Institute, Ljubljana, Slovenia.

\*\*) After collaboration with N. Kirova, LPS, University Paris-Sud, Orsay, France.