Non-equilibrium dynamics of condensed matter in the time domain

Uwe Bovensiepen

Universität Duisburg-Essen, Fakultät für Physik, Sonderforschungsbereich 1242

On the one hand Condensed Matter Physics is commonly discussed in the thermodynamic limit and few parameters like the temperature *T* and the chemical potential μ are sufficient to describe the state of a system with 10^{23} particles. On the other hand microscopic interactions are decisive for coupling of charge, spin, and lattice degrees of freedom and lead to emergent phases due to cooperative phenomena like charge density wave formation, superconductivity, and magnetic order. To provide new insights into these interactions we expose the system of interest to a sufficiently short, external stimulus which excites the system into a highly dynamic, non-equilibrium state. In response to such an excitation the system relaxes and analysis in the time domain facilitates access to various regimes of complexity from the many particle wave function to single particle distribution functions back to the thermodynamic ground state. In addition, particular stimuli allow generation of unique, non-equilibrium states of matter which are otherwise not accessible.
After a brief overview of research activities within the Collaborative Research Center 1242 selected examples of collaborative efforts on energy transfer dynamics across interfaces in $[Fe/MgO]_n$ heterostructures and electron dynamics in the strongly correlated transition metal dichalcogenide 1*T*-TaS_2 will be presented.