The scientific scope of Ultrafast Science research unit (D4) is the studies of dynamics of electrons, lattice, and spins in condensed matter on the ultrafast timescales ranging from attoseconds ($10^{-18}$ s) to picoseconds ($10^{-12}$ s). Advanced experimental techniques used in our research unit range from attosecond XUV spectroscopy to femtosecond nano-optics to terahertz spectroscopy, implemented in many different modalities. All our research methods rely on highly-elaborate femtosecond laser infrastructure, established within the research unit.

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Selected Publications

H. A. Hafez et al., *Extremely efficient terahertz high-harmonic generation in graphene by hot Dirac fermions*  

X. Li et al., *Observation of Dicke cooperativity in magnetic interactions*  
A. Tomadin et al., *The ultrafast dynamics and conductivity of photoexcited graphene at different Fermi energies*

M. Grechko et al., *Coupling between intra- and intermolecular motions in liquid water revealed by two-dimensional terahertz-infrared-visible spectroscopy*

K.-J. Tielrooij et al., *Out-of-plane heat transfer in van der Waals stacks through electron–hyperbolic phonon coupling*

H. Kim et al., *Direct observation of mode-specific phonon-band gap coupling in methylammonium lead halide perovskites*

T. Seifert et al., *Efficient metallic spintronic emitters of ultrabroadband terahertz radiation*

H. Tu et al., *Stain-free histopathology by programmable supercontinuum pulses*

Z. Jin et al., *Accessing the fundamentals of magnetotransport in metals with terahertz probes*

Z. Mics et al., *Thermodynamic picture of ultrafast charge transport in graphene*

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**Terahertz Physics**

Prof. D. Turchinovich

**Ultrafast Nanooptics**

Prof. W. Pfeiffer

**Attosecond Spectroscopy**

Prof. W. Pfeiffer, Prof. U. Heinzmann

**Molecular and Surface Physics**

Prof. U. Heinzmann, Prof. H. Stiebig, Priv. Doz. N. Böwering
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