Superradiant THz Radiation: Sources and Applications

Michael Gensch[1,2]

[1]*Institute of Optical Sensor Systems, German Aerospace Center (DLR), Rutherfordstr. 2; 12489 Berlin, Germany.*

[2]*Technische Universität Berlin, Institute of Optics and Atomic Physics, Straße des 17. Juni 135, 10623 Berlin, Germany.*

e-mail:michael.gensch@dlr.de

Control of materials properties by means of high-field THz pulses is an emerging field in ultra-fast science. When the field is tuned in resonance with a chosen low energy excitation, such as a vibrational mode or a magnon, nonthermal nonequilibrium states in the electronic ground state can be prepared and their evolution probed on ultra-fast timescales [1,2]. The electric or magnetic field component of the THz wave can furthermore directly interact with collective phenomena such as free carriers or ensembles of molecules and enable coherent control on sub THz cycle timescales.

Superradiant THz facilities such as the TELBE facility recently emerged as intense, high repetition-rate sources of ideally suited THz light pulses. The TELBE user facility [3] provides tunable narrow-band, multicycle pulses as well as single-cycle pulses with fields beyond 100 kV/cm at unprecedented repetition rates in the few 100 kHz regime and thereby enables to either (i) perform common experiments with superior signal quality, (ii) employ new duty-cycle hungry probe techniques such as time-resolved angle-resolved photoelectron spectroscopy (TR ARPES) and time-resolved scanning nearfield optical microscopy (TR SNOM) or make use of the high repetition rate to perform groundbreaking experiments in complex sample environments such as liquid jets and (pulsed) high-field magnets. The potential of superradiant THz sources is discussed based on recent experiments studying THz control of magnetic properties [4], polar liquids or Dirac electrons in e.g. Graphene [5].

REFERENCES

[1] D. Nicoletti and A. Cavalleri, *Adv. Opt. Phot.* **8**, 401 (2016).
[2] T. Kampfrath et al., *Nat. Phot.* **7,** 680 (2013).
[3] B. Green et al., *Sci. Rep.* **6**, 22256, (2016).
[4] S. Kovalev et al., *J. Phys. D.* **51**, 114007 (2018).
[5] H.A. Hafez et al., *Nature* **561**, 507 (2018).