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Electric-field-resolved infrared spectroscopy of biological systems

Dr. Ioachim Pupeza, Max-Planck-Institut für Quantenoptik, Ludwig-Maximilians-Universität München

In the past few years, developments in high-repetition-rate, near-infrared femtosecond laser technology have spawned a new generation of broadband sources of coherent infrared (IR) radiation, along with efficient detection via nonlinear sub-IR-cycle gating. The first part of the talk will review recent highlights from our lab, including the generation of few-cycle pulses in the molecular fingerprint region with a brilliance exceeding that of IR beamlines at 3rd-generation synchrotrons by ~3 orders of magnitude, and attosecond pulse-to-pulse electric-field jitter, as well as time-resolved optical field detection with a sensitivity approaching the fundamental single-photon limit. This novel regime of high-dynamic-range, broadband, electric-field-resolved spectroscopy affords exciting opportunities for the (time- and space-resolved) study of biological systems in their native aqueous environment/state, some of which will be surveyed in the second part of the talk.