Terahertz- and Ultrafast Spectroscopy Laboratory

Professor Ingrid Wilke

Research participation

Single-shot relativistic electron beam bunch length measurements

**Topic:** Linear accelerators used as drivers for new femtosecond X-ray free electron lasers (FELs), or employed in new Tera eV linear electron-positron colliders for high energy physics, require dense, relativistic electron bunches with bunch lengths shorter than a picosecond. Precise measurements of the electron bunch length and its longitudinal charge distribution are important to monitor the preservation of the beam quality while the electron bunch train travels through the beam pipe, as well as to tune and to operate a linear collider or a FEL. The electro-optic detection of the local non-radiative electric field traveling with the electron bunch has recently emerged as a powerful new technique for electron bunch length measurements. The method capitalizes on the fact that the local electric field of a highly relativistic electron bunch moving in a straight line is almost entirely concentrated perpendicular to its direction of motion. Consequently, the Pockels effect induced by the electric field of the passing electron bunch can be used to produce birefringence in an electro-optic crystal, e.g. ZnTe, placed in the vicinity of the beam. Electro-optic sampling allows non-invasive single-shot electron-beam bunch length measurements with femtosecond time resolution.

**Research:** Experimental and theoretical study of various geometries of electron beam and optical probe beam orientation. Experimental and theoretical study of radiation damage in electro-optic materials.


**Requirements:** Interest in experimental interdisciplinary research between optical and accelerator physics, optics, nonlinear optics, accelerator physics, electron beam applications.

**Training:** The research project provides training in femtosecond Titan-sapphire laser operation, electro-optic sampling, ccd camera operation, time-domain THz-spectroscopy.

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