Pump-Probe bio-TEM with optically compressed pulses

Anaswara Ramachandran[1], Peter Baum[1]

Fachbereich Physik, Universität Konstanz, 78464 Konstanz, Germany
anaswara.ramachandran@uni-konstanz.de

ABSTRACT:

All matter transformations involve the motions of atoms and electrons. Many processes like atomic motion, molecular vibrations, photon emission, scattering etc. take place in very fast time scales. For understanding these processes, it is necessary to visualize the motion of atoms and electrons in space and time. For that, we need to achieve femtosecond and angstrom resolutions, therefore we are combining a fs-laser and a transmission electron microscope (TEM). However, the time resolution, given by the electron pulse length, is not good enough due to space charge and wave dispersion. Therefore, I will use terahertz (THz) pulses to compress the electron pulses in time. The planned THz field-controlled electron microscopy will consist of two THz-electron interactions: one is used for electron pulse compression and the other for temporal characterization by streaking. Compression using THz fields provides short electron pulses and provides stability in time. I will then apply this emerging, worldwide unique apparatus to study selected phenomena in ultrafast dynamics. One of my first applications will be the use of THz pulses in biomolecular imaging. We aim at putting a single-cycle THz field onto a phytochrome-A crystal and use time-resolved electron diffraction to look for potential structure changes in the strong excitation field. This integrated approach will allow us to explore the interplay between laser excitation, THz field modulation, and molecular structural dynamics in real time.

Keywords: Compression, Femtosecond, Resolution, TEM, Terahertz (THz)