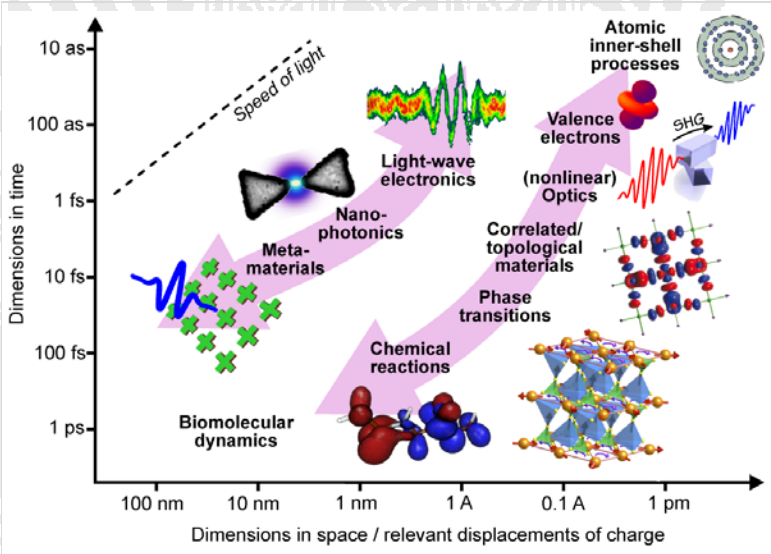
Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg

Physikalisches Institut

PHYSIKALISCHES KOLLOQUIUM

AM 13. MAI 2019 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



SEEING ATOMS AND ELECTRONS IN SPACE AND TIME

PROF. DR. PETER BAUM
UNIVERSITÄT KONSTANZ

Almost any activity and change in the world around us is on a fundamental level defined by the motion of atoms and electrons from initial to final conformations. If light interacts with matter, the relevant dimensions are attoseconds in time (the optical cycle) and picometers in space (atomic and electronic displacements). A movie-like visualization of structural dynamics with sufficient space-time resolution can therefore almost directly provide the atomistic mechanisms of complex macroscopic phenomena. In this presentation, I will give a brief account of our recent progress towards reaching this regime of 4D imaging in an experiment, and also discuss some first results and discoveries. Our unique approach for a direct, real-space visualization of electronic and nuclear motion is pump-probe electron diffraction and microscopy with optical-cycle-controlled single-electron wavepackets. We achieve simultaneously sub-atomic and sub-light-cycle resolution, which allows the attosecond-angstrom visualization of almost any light-matter interaction or transport phenomenon on fundamental length and time scales. Results on strongly correlated materials, metamaterials, graphene and attosecond dynamics in silicon indicate the applicability of our approaches to diverse phenomena in different materials. We are currently adopting a commercial electron microscope to attosecond resolution, in order to study fundamental dynamics in complex materials of almost arbitrary complexity and shape.