Plenary Talk PV III Tue 9:15 V53.01

Attosecond physics: the first decade — •Ferenc Krausz — Max-Planck-Institut für Quantenoptik, Garching, Germany — Ludwig-Maximilians-Universität München, München, Germany — www.attoworld.de

Electron motion and light waves form the basis of life: the microscopic motion of electrons creates light, which supplies our globe with life-giving energy from the sun; electrons transform light into biological energy during photosynthesis and into biological signal endowing us with the capability of seeing the world around us. Upon their motion inside and between atoms, electrons emit light, carry and process information in biological systems and man-made devices; create, destroy, or modify molecules, affecting thereby biological function. Consequently, they are key players in physical, chemical, and life sciences; information, industrial, and medical technologies likewise.

During the past ten years (2001-2011), advances in laser science opened to door to watching and controlling these hitherto inaccessible dynamics: the motion of electrons at the atomic scale and light wave oscillations (being mutually the cause of each other) evolving on attosecond time scales.

Key tools include waveform-controlled few-cycle laser light and attosecond pulses of extreme ultraviolet and soft-X-ray light. They provide a force capable of steering electrons inside and between atoms and a probe for tracking their motion. Insight into and control over microscopic electron motion are likely to be important for developing brilliant sources of X-rays, understanding molecular processes relevant to the curing effects of drugs, the transport of bioinformation, or the damage and repair mechanisms of DNA, at the most fundamental level, where the borders between physics, chemistry and biology disappear. Once implemented in condensed matter, the new technology will be instrumental in advancing electronics and electron-based information technologies to their ultimate speed: from microwave towards light-wave frequencies.