

Attosecond Light Pulse Source, the Research Infrastructure of Few-cycle Phase Controlled Light Waves

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To obtain short duration electromagnetic signals, the carrier frequency of the waves has to be increased. The first few cycle electromagnetic waves in the optical domain, that is laser pulses lasting less than 10 fs, were generated in the late 80s'. At the turn of the century, a train of attosecond pulses was first demonstrated, now in the soft X-ray regime.

The Attosecond Light Pulse Source (ALPS) facility of the pan-European ELI project is designed to build a laser based research infrastructure in which light pulses of few optical cycles in the infrared or mid-infrared spectral range are generated and used for basic and applied research. These pulses will be acting as driving source for the generation of even shorter extreme ultraviolet pulses with durations that can be as short as a few tens of attosecond.

Four laser systems under implementation deliver pulses with unique parameters: unparalleled fluxes, extreme broad bandwidths, and sub-cycle control of the generated fields. The high repetition rate (HR) system delivers TW peak power, < 5 fs pulses at 100 kHz. The 1 kHz repetition rate future single cycle (SYLOS) system provides 20 TW pulses with a pulse duration of <5 fs. The petawatt-class high-field (HF) laser would operate at 10 Hz repetition rate with close to 15 fs pulse duration. The performance of the above laser systems operating with central wavelength in the range of 700- 900 nm is complemented by the mid-infrared (MIR) laser system, which provides sub-3 cycle laser pulses at 100 kHz repetition rate with over 10 W average power.

The unique source parameters will enable intriguing new insight in valence and core electron science, attosecond imaging in 4D, relativistic interaction, manipulation of matter by intense THz fields, and various biological, medical, and industrial applications.