Technology and Applications of Coherent Tabletop EUV/X-Ray Sources

Tutorial

A. Baltuska, Photonics Institute, Vienna University of Technology

The talk will describe the method of ultrafast coherent X-ray pulse generation based on higher-order harmonic generation (HHG) in neutral gas targets and will compare the advantages and disadvantages of this and other techniques used in tabletop and large-scale X-ray sources. Main limitations and scaling laws of extreme nonlinear frequency conversion will be discussed to explain the challenges in the development of appropriate driver laser technology for HHG. We will review the utility of conventional femtosecond Ti:sapphire sources and new sources, based on laser diode pumped Yb-doped solid state media and fibers, as well as hybrid sources, based on parametric amplifiers. Implications of full temporal and spatial coherence to attosecond EUV metrology will be briefly addressed. A case study will outline the current record-holding EUV—soft-X-ray supercontinuum HHG source jointly developed by TU Vienna and JILA (U. Clorado). The source supports a bandwidth of >1.3 keV above the edge of the water window and achieves the shortest fully phase matched wavelength of 7.8 Å indicating potential for coherent imaging applications with a sub-nm-scale spatial resolution.

Andrius Baltuška - Biography

Andrius Baltuška received the diploma in physics from Vilnius University, Lithuania, in 1993 and a Ph.D. degree in chemical physics from the University of Groningen, The Netherlands, in 2000. Since 2006 he is a full professor at the faculty of Electrical Engineering and Information Technology, Vienna University of Technology. His group (http://atto.photonik.tuwien.ac.at) works on the development of intense ultrafast laser and parametric amplifiers and applications of fully controlled optical pulses in ultrafast spectroscopy and high-field physics. He received a European Young Investigator Award (EURYI) from the European Science Foundation (2004), Ignaz L. Lieben Award from the Austrian Academy of Sciences (2006) and a Starting Grant (Consolidator level) of the European Research Council (2011).