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TRUMPF Laser Technology

Plenary Talk

Laser as a secondary source

The rapid development and industrialization of diode-pumped solid-state lasers towards high energy levels and ultrashort pulse durations in the past decades has leveraged peak intensities and electrical field strengths of such lasers to manipulate and eventually overcome the Coulomb binding forces of electrons in atoms. In other words, it is possible today to ionize and transfer material entirely into the plasma state by means of laser light illumination. Exotic light-matter-interaction processes like plasma generation, higher harmonic generation, electron Wakefield acceleration, thin sheet normal acceleration of protons and multiple other processes serve as secondary sources for the generation and emission of soft and hard x-ray photons, electrons, synchrotron radiation, protons and potentially also neutrons. As the laser sources for driving such processes are coming of age and reduce in cost, it is very likely that novel and existing photon and particle sources will rely on a laser-drive mechanism in the near and far future. One famous example of an industrialized secondary source even existing today is the EUV generation for highresolution based EUV lithography for the microelectronic industry. In such systems a highintensity CO2 is converted via means of a tin droplet plasma into 13.5 nm photons for the described purpose. In this talk, we will look closer at further application fields of laser driven secondary sources such as e.g. x-ray plasma sources, electron and proton accelerators and the potential of laser driven neutron sources. An in depth understanding of the underlying laser technology at TRUMPF will be given, including the corresponding enabling technology of key components. The impact and importance of chirped pulse amplification, nonlinear spectral broadening, and pulse compression at kW of average output power levels and TW of peak intensities will be described in detail. In this context, physical limitations given by the characteristics of the underlying laser systems will be discussed. The talk concludes with an overview of TRUMPFs involvement in government funded BmbF programs towards laser-driven photon, electron and neutron sources and quickly outlines future potential markets.

About the Speaker

1993 - 1997 Study of Applied Physics at University of Applied Sciences Muenster.
1998 - 1999 Study in the Physics Department at State University of New York, USA.
2005 Doctorate, Friedrich-Schiller-Universität, Jena.
2005 - 2007 Laser scientist, TRUMPF Lasermarking Systems AG, Switzerland.
2007 - 2011 Head of Fiber Group, JT Optical Engine GmbH + Co. KG, Jena.
2011 - 2013 R&D Manager, HIGHYAG Lasertechnologie, Berlin.
2013 - 2016 Head of Diode Laser Group, TRUMPF Laser GmbH, Schramberg.
2016 - 2020 CEO & CTO, TRUMPF Photonics Inc., Cranbury, NJ, USA.
2020 - 2023 CEO, TRUMPF Laser GmbH & Head of Business Laser, Schramberg
since 1.7.2023 Chief Executive Officer for Laser Technology and Member of the Managing Board of TRUMPF SE + Co. KG, Ditzingen