Institute of Applied Physics
Friedrich-Schiller-Universität Jena

Laser-driven high-order harmonic generation

Theme / Problem definition:

The generation of high-order harmonics (HHG) of an ultrafast driving laser is an elegant way to produce coherent short-wavelength radiation with table-top setups. Due to their compactness and well-controlled spatial as well as temporal properties, these sources find numerous applications in spectroscopy, atomic and molecular physics, microscopy, and many others. A particularly relevant spectral region is located around 90 eV. The corresponding wavelength of 13.5 nm is of high interest in lithography and semiconductor industry. Furthermore, generating coherent radiation within the so-called water window (between the carbon and oxygen K-edge at 283 eV and 530 eV) is of paramount importance for the next generation of ultra-high-resolution bio-imaging.
While many proof-of-principle demonstrations of HHG and subsequent applications exist, real-world applications in science and industry require high photon flux and robust operation from the sources. Therefore, our research is aimed at advancing the existing state-of-the-art in terms of power and spectral coverage by an optimization of the conversion efficiency and an increase in the driving laser power.

Tasks / Aim:

The goal of this project is to understand the existing HHG-based sources and to develop strategies for their power and performance scaling. We work as a team and in close collaboration on the following work packages:

- Refinement and scaling of the driving laser systems
- Understanding and simulation of the laser-matter interaction in the target region
- Design of noble-gas targets
- Analyzation of the generated short-wavelength radiation
- Applications in spectroscopy and imaging

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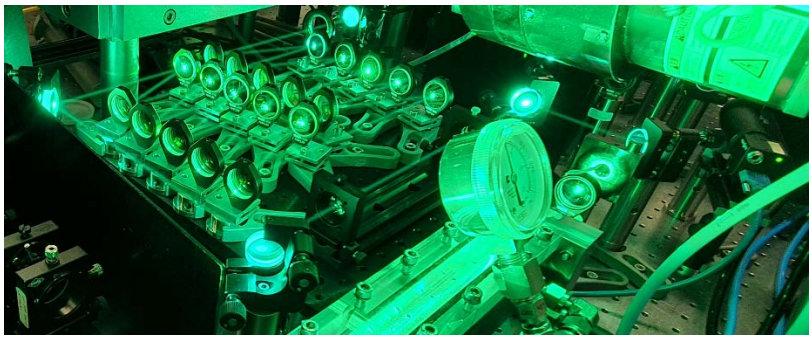

Literature:

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- *J. Miao, R. L. Sandberg, and C. Song, "Coherent X-Ray Diffraction Imaging," IEEE J. Sel. Top. Quantum Electron. 18(1), 399–410 (2012).*