

Broadband Pulse Generation by Nonlinear Optics in Multi-pass Cells

Abstract:

The talk will provide a brief overview of the German national lab Deutsches Elektronen-Synchrotron DESY and its large-scale brilliant X-ray sources. In the context of pump-probe experiments with the free electron laser FLASH, multi-pass cells (MPCs) for spectral broadening and subsequent pulse compression of pulsed optical lasers are introduced. Herriott-type MPCs have enabled compression factors of more than 100 at GW peak-power levels, they were operated at kilowatts of average power and they allowed nonlinear pulse compression to terawatt levels with more than 90% efficiency [1]. Further peak-power scaling remains a major challenge because of the linear relation between MPC length and pulse energy. Two solutions to this issue will be presented. The first one targets to compress conventional pump lasers to the ultrafast regime by multi-mirror MPC geometries. The second approach uses divided pulse spectral broadening in combination with passively stable free-path delay lines for energy scaling of MPC-based spectral broadening. Finally, the recently launched activities at DESY in the frame of Germany's "Fusion 2040" program will be outlined and it will be discussed how MPCs can be used for broadband energetic ultraviolet pulse generation.

[1] A.-L. Viotti et al., "Multi-pass cells for post-compression of ultrashort laser pulses", *Optica* **9**, 197 (2022).

Short Bio:

Marcus Seidel studied physics in Rostock and Berlin, Germany, as well as optics and photonics as a Fulbright fellow at CREOL in Orlando, Florida. After receiving his Diplom's and master's degrees (2011, 2012), he joined Ferenc Krausz' group at the Max Planck Institute of Quantum Optics in Garching, Germany. He earned his doctoral degree with the grade "summa cum laude" in 2018. After working for two years as a Marie Skłodowska-Curie fellow at the Institut de Sciences et d'Ingénierie Supramoléculaires in Strasbourg, France, he joined the Laser Science and Technology group at Deutsches Elektronen-Synchrotron DESY in Hamburg, Germany, where he became a young investigator group leader in 2023. In October 2024, Marcus Seidel was among the first winners of the "Fusion Talent Competition" called by the German Ministry for Science and Education. With the support of this individual grant, he is now leading a research team that focuses on laser development and nonlinear optics with potential applications to inertial confinement fusion.