LABORATOIRE INTERACTIONS, DYNAMIQUES et LASERS
EMR9000 CEA, CNRS, Université Paris-Saclay

SEMINAIRE LIDYL

C.M. HEYL
Helmholtz-Institute Jena & Deutsches Elektronen-Synchrotron DESY

Attention jour et horaire exceptionnels

Le Mercredi 1er Juin 2022 à 14h00
Orme des Merisiers Bât.701, Pièce 17 (Salle de séminaires)

Post-compressed high-power lasers for HHG, spectroscopy and electron acceleration

Ultrafast lasers reaching extremely high powers within short fractions of time enable a plethora of applications. They grant advanced material processing capabilities, are effective drivers for secondary photon and particle sources, and reveal extreme light-matter interactions. They also supply platforms for compact accelerator technologies, with great application prospects for tumor therapy or medical diagnostics. Many of these applications benefit from sources with higher average and peak powers. Following mode-locked dye and titanium-doped sapphire lasers, broadband optical parametric amplifiers have emerged as high peak- and average power ultrashort pulse lasers. A much more power-efficient alternative is provided by direct post-compression of high-power diode-pumped ytterbium lasers—a route that advanced to another level with the invention of a novel spectral broadening approach, the multi-pass cell technique. The method has enabled benchmark results yielding sub-50-fs pules at average powers exceeding 1 kW, has facilitated femtosecond post-compression at pulse energies above 100 mJ with large compression ratios, and supports picosecond to few-cycle pulses with compact setups [1,2]. The striking progress of the technique in the past five years puts light sources with tens to hundreds of TW peak and multiple kW of average power in sight—an entirely new parameter regime for ultrafast lasers.
In this presentation, I will provide an overview of our works utilizing ultrafast lasers employing nonlinear multi-pass cells including ongoing efforts targeting novel parameter regimes for laser-plasma acceleration, high-harmonic generation and free-electron laser sciences. Within the presented works, multi-pass cells are utilized not only for post-compression but also for versatile frequency-tuning of high-power femtosecond laser sources, promising exciting perspectives for ultrafast lasers and applications demanding wavelength outside the gain-bandwidth of standard ultrafast lasers.

[1] M. Hanna et al., "Nonlinear optics in multipass cells," Laser Photon. Rev. 15, 2100220 (2021).
[2] A.-L. Viotti et al., " Multi-pass cells for post-compression of ultrashort laser pulses", Optica (2022).