LABORATOIRE INTERACTIONS, DYNAMIQUES ET LASERS

LIDYL-UMR 9222
CEA, CNRS, Université Paris-Saclay

SEMINAIRE LIDYL

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Attention JOUR et lieu Exceptionnels
Le Jeudi 19 Septembre 2019 à 11h00
- Bâtiment 701 - Salle 17C (Orme des Merisiers)

"A Twist in Strong-Field Physics: Structured EUV Beams and Attosecond Pulses with Designer SAM and OAM for Nanoscale Spectroscopy and Imaging "

Over the past few decades the use of structured light (i.e., light with nontrivial, but programmable, polarization, intensity and phase) has revolutionized our ability to control and enhance light-matter interactions, resulting in a myriad of applications ranging from super-resolution microscopy, telecommunications, optical manipulation, forensic science, and even attosecond physics [1,2]. In particular, light waves with programmable spin and orbital angular momentum (SAM and OAM, respectively) have sparked a revolution in attosecond science, owing to their ability to resolve ultrafast chiral and topological dynamics in emerging material systems with nanoscale spatial and few-to-sub femtosecond temporal resolution [2].

In this talk, I will describe our recent progress in generating extreme ultraviolet (EUV) beams —and attosecond pulses— with designer SAM and OAM properties. By exploiting the nonlinear process of high-harmonic generation, I will describe how we can harness full control of the polarization, divergence, intensity, and topological charge of EUV beams, allowing, for example, the generation of spatially isolated attosecond pulses with opposite circular polarization [3], EUV optical vortices with low, tunable OAM charge and low divergence [3], and coherent EUV light possessing an entirely new optical property associated with a time-varying OAM: the self-torque of light [4]. These unique attosecond waveforms, together with knowledge of how to specifically control their properties, enables new paradigms in extreme light science, ultrafast spectroscopy, and coherent imaging of condensed-matter and chiral dynamics. Finally, I will conclude be describing several ongoing experiments that aim to employ these exotic optical waveforms for enhanced spectroscopy and imaging of ultrafast, nanoscale, and chiral dynamics.

Formalités d'entrée :

Visiteur U.E. *: Se faire connaître au moins 48 heures à l'avance pour l'établissement de votre autorisation d'entrée sur le Centre de Saclay.*
Visiteur hors U.E. *: Se faire connaître au moins 4 jours à l'avance pour les formalités d'entrée et se faire accompagner par un agent CEA.*
Sans autorisation, vous ne pourrez entrer sur le Centre de Saclay. Tél. : 33.1.69.08.74 09- Fax : 33. 1.69.08.76.39 - email : caroline.lebe@cea.fr ou veronique.gereczy@cea.fr
Dans TOUS LES CAS, se munir d'une pièce d'identité (passeport et carte d'identité – pas de permis de conduire)

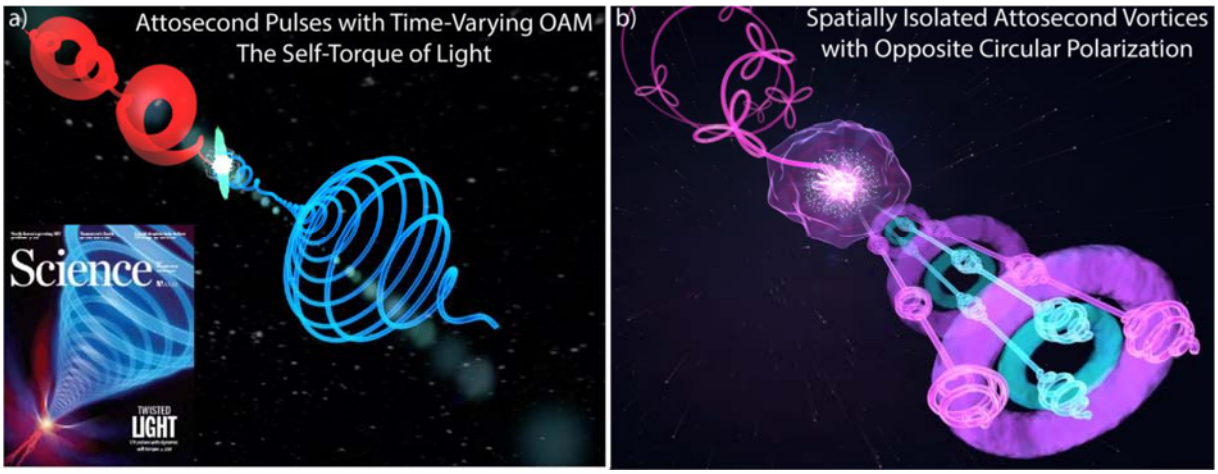

Figure 1. a) A pair of time-delayed vortex laser pulses (red) are coherently up-converted into extreme ultraviolet (EUV) vortex pulses (cyan) that possess a new property of light, self-torque. This manifests as a smooth, temporal increase in orbital angular momentum (represented by the frequency of spatial twists in the EUV beam), progressing from low OAM (lower-right) to high OAM (middle) values as the EUV light beam is emitted. b) High-harmonic generation driven by a 'trefoil' vortex laser yields enhanced control over the SAM and OAM of coherent, attosecond, extreme ultraviolet beams, resulting, for instance, in the emission of spatially isolated attosecond vortices of opposite circular polarization.

References

[1] Rubinsztin-Dunlop, H. et al. "Roadmap on structured light" J. Opt. 19, 013001 (2017).

[2] Dorney, K. M. "A twist in strong-field physics: structured, ultrafast optical and extreme ultraviolet waveforms with tailored spin and orbital angular momentum". PhD Thesis. University of Colorado Boulder, 2019.

[3] Dorney, K. M. et al. "Controlling the polarization and vortex charge of attosecond high-harmonic beams via simultaneous spin-orbit momentum conservation" Nat. Photon. 13, 123-130 (2019).

[4] Rego, L. and Dorney, K. M., et al. "Generation of extreme ultraviolet beams with time-varying orbital angular momentum" Science 364, eaaw9486 (2019).