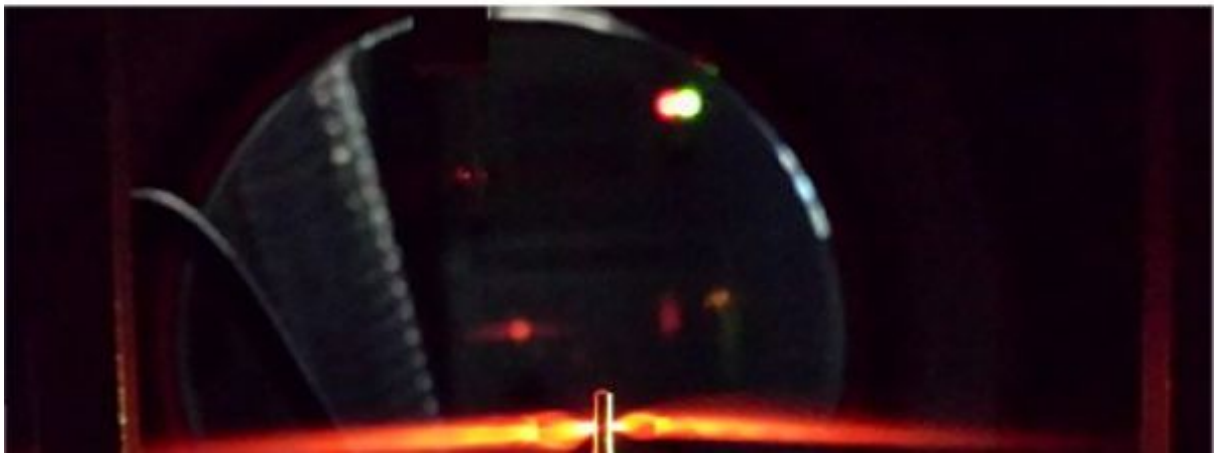
ICFO

in the water window

SETH LUCIEN COUSIN

Advisor: Prof. Dr. Jens Biegert



PhD Thesis Defense SETH LUCIEN COUSIN 'Towards the generation of isolated attosecond pulses in the water window'

SETH LUCIEN COUSIN

September 12, 2016

Monday September 12 , 11:00 h. ICFO Auditorium

SETH LUCIEN COUSIN

Attoscience and Ultrafast Optics

ICFO-The Institute of Photonic Sciences

Attosecond science investigates the realm of processes that happen in fleetingly short passages of time. One attosecond to one second, is what one second is to the age of the universe! Advances in lasers and specifically ultra-short pulsed lasers have opened the door to this extreme frontier of physics.

In this thesis I will describe what is required from a laser system in order to access these time scales. The stringent requirements needed motivated us to extensively study, model, redesign and then finally rebuild our laser system making it capable of delivering the necessary laser pulses. Characterisation of these types of laser pulses is essential in making them usable in the pursuit of a fundamental understanding of ultrashort physical processes. Two new characterisation techniques have been developed to add to the suite of tools available to the scientific community to achieve the complicated goal of characterising femtosecond laser pulses.

To jump from the femtosecond regime to the attosecond regime, high harmonic generation is currently the defacto method of getting there. I will give a detailed description of our high harmonic beamline, which ultimately is used to perform the first water-window radiation range spectroscopy from a high harmonic source. Intrinsic to the radiation generated for spectroscopy is the sub-femtosecond temporal structure of the radiation.

Temporal characterisation of attosecond pulses is traditionally done using the attosecond streaking technique however until now, this technique has not been used in the water-window. X-ray pulses possessing our ultra-broad bandwidth and central photon energy are unprecedented, making this the first time that a streaking experiment is done in this regime.

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Thesis Director: Prof Dr Jens Biegert