UV-Dual Comb spectroscopy to probe the atmosphere

Probing the atmosphere with laser pulses has revealed great potential for *in situ* characterization of the atmosphere[1]. For example, remote sensing laser-based techniques (as Lidar) enable the determination of the spatial and temporal distribution of trace gases and particulate matter (aerosols) in the atmosphere. Our research group makes use of the laser-matter interaction properties to interrogate the atmospheric system for a better understanding of the fundamental physico–chemical processes taking part into the atmosphere. Such processes occur with an extremely large variability of time scales, from sub-seconds to day.

We here want to investigate events that occurs on very short time scale (sub-second). Indeed, probing short time scale events would give access to the **dynamics of the most reactive molecules** in the atmosphere that plays a central role in the atmosphere. For example, oxidants mostly drives the concentration of gaseous atmospheric pollutants and also greenhouse-gas (CO2, CH_4, HFCs). Their flux is very challenging to measure in *real* atmosphere and particularly in urban area as the large diversity of pollutants makes the atmosphere dynamics study of large complexity.

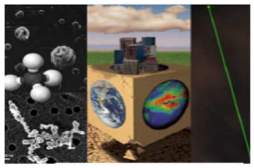
The OET team plans to **probe the fast concentration fluctuations** of some key molecules in urban areas thanks to a laser-based technique recently applied to atmospheric physics: the Dual Comb spectroscopy. This technique consists in interfering two pulsed lasers after their propagation in the atmosphere. As in regular Michelson interferometer, the interferences pattern contains all the information on the absorption of the medium in which they propagated.

During this internship, we will demonstrate the ability of the Dual Comb spectroscopy to detect oxydants in the atmosphere. In this objective, three main aspects have to be address both from the theoretical and experimental part:

1. Generation of two mutually coherent UV femtosecond pulses.
2. Characterization of the propagation of a UV femtosecond pulses in the atmosphere. This aspect includes the generation of UV femtosecond pulses and the implementation of characterization tools for phase, repetition rate, spectrum... characterization. The applicant can also take part of the theoretical modeling of laser beam propagation in the atmosphere
3. Studying of the sensitivity of such a laser-based system to detect trace gas.

We are looking for a candidate with basic knowledge of pulsed laser physics, non-linear optics and with programming skills or familiar with calculation software. Complementary knowledge on atmospheric physics and chemistry will be welcome. This master internship project can be extended to a PhD project.

[1] IPCC, The Physical Basis: Climate Change, (2013).



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