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Towards Remote Sensing of Atmospheric Trace Gases in the UV spectral range using Dual-Comb spectroscopy

Clément Pivard, Sandrine Galtier, and Patrick Rairoux
Institut Lumière Matière, France (clement.pivard@univ-lyon1.fr)

The development of increasingly sensitive and robust instruments and new methodologies are essential to improve our understanding of the Earth's climate and air pollution. In this context, Dual-Comb spectroscopy (DCS) appears as an emerging spectroscopy methodology to detect in situ, without air-sampling, atmospheric trace-gases.

DCS is a Fourier-transform type experiment that takes advantage of mode-locked femtosecond (fs) pulses. This methodology appears highly relevant for atmosphere remote-sensing studies because of its very fast acquisition rate (>kHz) that reduces the impact of atmospheric turbulences on the retrieved spectra. DCS has been successfully applied in near-infrared (NIR) spectral ranges for atmospheric greenhouse gas monitoring (water vapor, carbon dioxide, and methane) [1-2].

Its implementation in the UV range would offer a new spectroscopic intrumentation to target the most reactive species of the atmosphere (OH, HONO, BrO...) as they have their greatest absorption cross-sections in the UV range. UV-DCS would therefore be an answer to the lack of variability of today operationnal and in situ monitoring instrument for those reactive molecules.

We will present a potential light source for remote sensing UV-DCS and discuss the degree of immunity of UV-DCS to atmospheric turbulences. We will show to which extent the characteristics of the currently available UV sources are compatible with the unambiguous identification of UV absorbing gases by UV-DCS. We will finally present the performances of UV-DCS in terms of concentration detection limit for several UV absorbing molecules (OH, BrO, NO_2, OClO, HONO, CH_2O, SO_2). This sensitivity study has been recently published [3] and the main results will be presented.

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