# Analysis of interferometric hyperspectral images for atmospheric pollutant monitoring

- M2 or last year of engineering school
- Location at the Institute of Planetology & Astrophysics of Grenoble (IPAG), Saint-Martin-d'Hères Campus.
- Starting early 2022, 5 to 6 months
- Supervisor at IPAG: Silvère Gousset (silvere.gousset@univ-grenoble-alpes.fr)
- Supervisor at IGE: Didier Voisin (didier.voisin@univ-grenoble-alpes.fr)
- Founding: ImSPOC-UV project

## Context

Remote sensing of atmospheric gases is a century old. First used from the ground, it has been applied from space since the first weather satellites in the 1970's, giving access to ever more detailed information on the Earth's surface and atmosphere. This technology is now a key component of our observation strategies for environmental monitoring, and is a reasonable option to provide constraints on pollutant emissions for air quality control in the coming decades.

This project focuses on a UV-Vis miniaturized Fourier transform hyperspectral camera developed at the University Grenoble Alpes and ONERA. The camera (which takes the volume of a matches box) could in the future be a building block for small satellites, drone, or ground based measurement platforms.

This camera relies on an array of low finesse micro Fabry-Perot interferometers directly attached to a focal plane array. This produces a series of images of the observed scene that can be recombined into a single image including spectral information for each observed pixel. However, this spectral information isn't directly a spectrum (radiance vs wave-length/number) but a portion of an interferogram which is related to the corresponding spectrum via an optical transform. Thus, raw acquisitions should undergo a signal processing stage in order to provide exploitable data for applications.

## Objectives and environment

Although our understanding of the concept has progressed and prototypes are available, a proof of concept is now required. The internship will focus on the detection of $NO_2$, a marker of human combustion activities potentially detectable for the instrument. On-sky acquisitions will be made in early 2022 (January 18th to 21st), in comparison with the SAOZ[1] instrument at the Observatory of Haute Provence (OHP), an instrument based on a more established concept of spectrometer. If the start dates of the internship do not allow participation in the acquisitions, the student will in any case have access to these data. Other possible acquisitions will also be available, either at OHP, or potentially in Guyancourt. Then, using 1) atmospheric and lab-based instrumental

*ImSPOC zenithal acquisition at OHP 2020-02*

[1] http://saoz.obs.uvsq.fr/

models, and 2) adapted DOAS (Differential Optical Absorption Spectroscopy) technique, the student will analyse them and derive $NO_2$ column monitoring with noise and systematic error analysis. In parallel, the student can model and simulate the signal to understand sensitivity of the instrument, and compare the results to data from SAOZ.

## Background education

- Data analysis & signal processing
- Able to use programming language and scientific computing (Python – notebook Jupyter -, IDL, Matlab, …)
- Tenacity, initiative-taking, team communication skills.
- (Some taste for geosciences)
- (Some taste in Optics and Detection)

## Outlook

- Synergies with other internships on the same instrumental concept.
- PhD opportunity, depending on the student's motivation, the progress of the work during the internship, and financial concerns.
- Participation in a scientific publication according to the obtained results.

## To apply

Send a CV and motivation letter to silvere.gousset@univ-grenoble-alpes.fr ; didier.voisin@univ-grenoble-alpes.fr