ONERA
THE FRENCH AEROSPACE LAB

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INTERNSHIP OFFER

Reference : **DPHY-2024-Numéro d'ordre** Site : Palaiseau

Laboratory: DPHY/SLM Tel. :

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DESCRIPTION

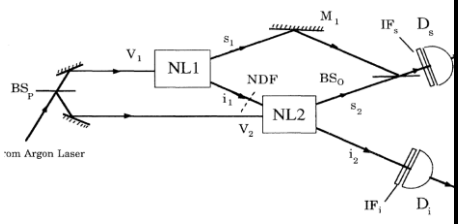
Themes (s) : Laser metrology

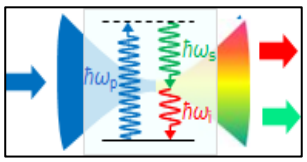
Graduation: ☒ Master 2 ☒ Master 1 ☐ Licence ☐ Baccalaureate

Title: Quantum interferometer for gas detection

Famous experiments involving optical interferometers for the detection of gravitational waves, or atomic sensors (clocks, gravimeters), show that the use of certain quantum states can significantly improve the sensitivity of fundamental metrology experiments. On the other hand, for remote measurements in difficult environments (with losses, background noise, etc.), quantum optics, often relevant at low photon number, have yet to demonstrate a decisive advantage over classical optics, in which photon fluxes can be made much higher when needed.

In this context, we propose to study an interferometer including two optical frequency conversion crystals (i.e. twin photon generators), and compare the key parameters under the quantum and classical regimes. The main asset of this non-linear interferometer is to be able to probe an object in the infrared (like a gas showing strong absorption lines), while detecting all the photons in the visible spectrum, where photodetectors are very sensitive.





The internship will consist in using the current interferometer, which emits at around 1 µm, and compare the quantum and classical regimes, with and without a probed object. The interferometer can then be modified to emit around 2 µm. The internship will provide an opportunity to perfect laser techniques, non-linear optics (frequency conversion) and quantum optics (correlation measurements, coincidences, etc.).

The internship may lead to a thesis, which will involve changing the type of interferometer, going further into the infrared, and testing innovative non-linear crystals manufactured by academic partners (MPQ lab).

Note: ONERA is a Zone à Régime Restrictif (ZRR), requiring administrative inquiry and access clearance from the Ministry of Defense, a procedure which can take up to 2 months.

Pair work? **No**

Type of work:

☐ Theory ☐ Numerical simulation

☒ Experiments ☒ Bibliography

Thesis opportunity: **YES**

Duration: At least: 3 months Up to: 5 months

When: 2024

CANDIDATE PROFILE

Knowledge and know-how:	Soft skills:
Laser, optics, basics of quantum physics	Deft fingers, organized, like to report