Parcours d'un IR : de la thèse sur les plasmas froids aux diagnostics laser avancés

Laurent Invernizzi

Research Engineer

27/10/2025

Academic path

09/2015 - 09/2016	Master 2	Plasma and fusion physics
10/2016 - 11/2019	PhD thesis	DPHE: laser absorption spectroscopy, optical emission spectroscopy, intensified imaging
01/2020 - 02/2022	Post-docs	YPI + LSPM: TALIF/LIF
03/2022 - present	IR	LSPM: TALIF, LaSPM platform and collaborations

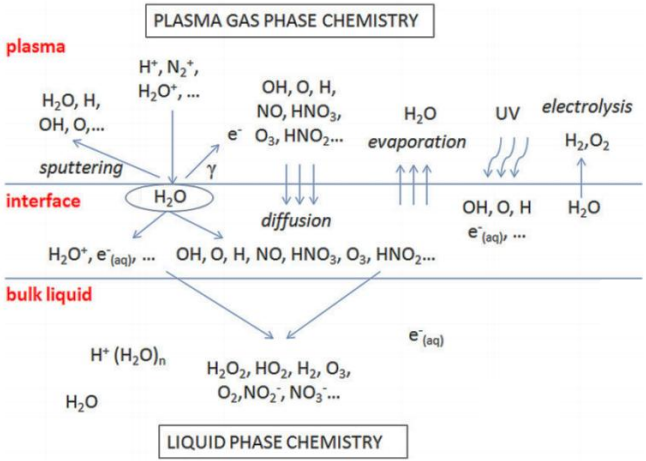
PhD thesis (DPHE)

Institut National Universitaire Champollion

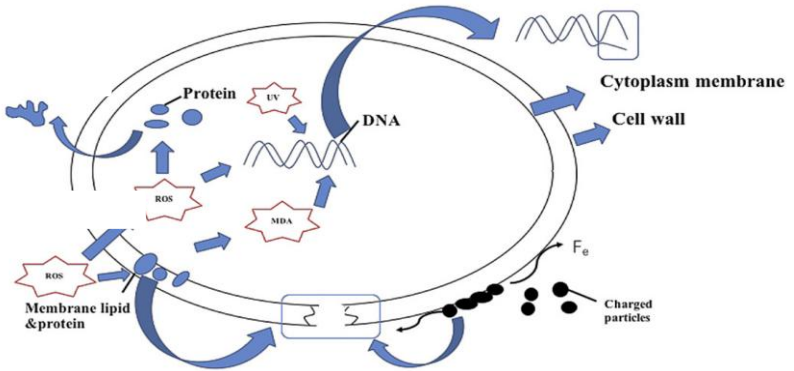
UNIVERSITÉ TOULOUSE III PAUL SABATIER — Université de Toulouse

Région OCCITANIE Pyrénées-Méditerranée

Development, characterization and optimization of a plasma source for liquid treatment

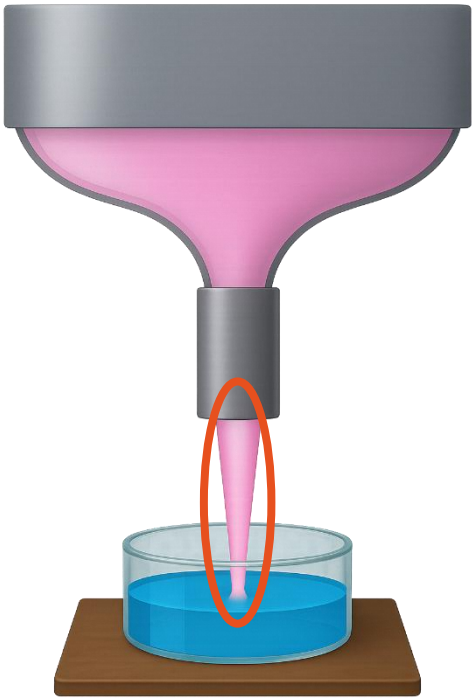


Plasma/liquid/bacteria interaction



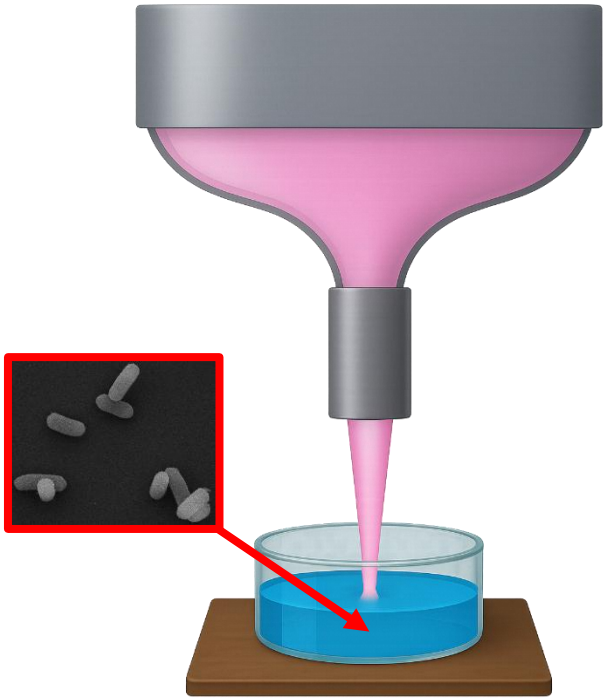
PhD thesis (DPHE)

1. Plasma He^M characterization



2. Liquid target characterization

3. Decontamination mechanisms

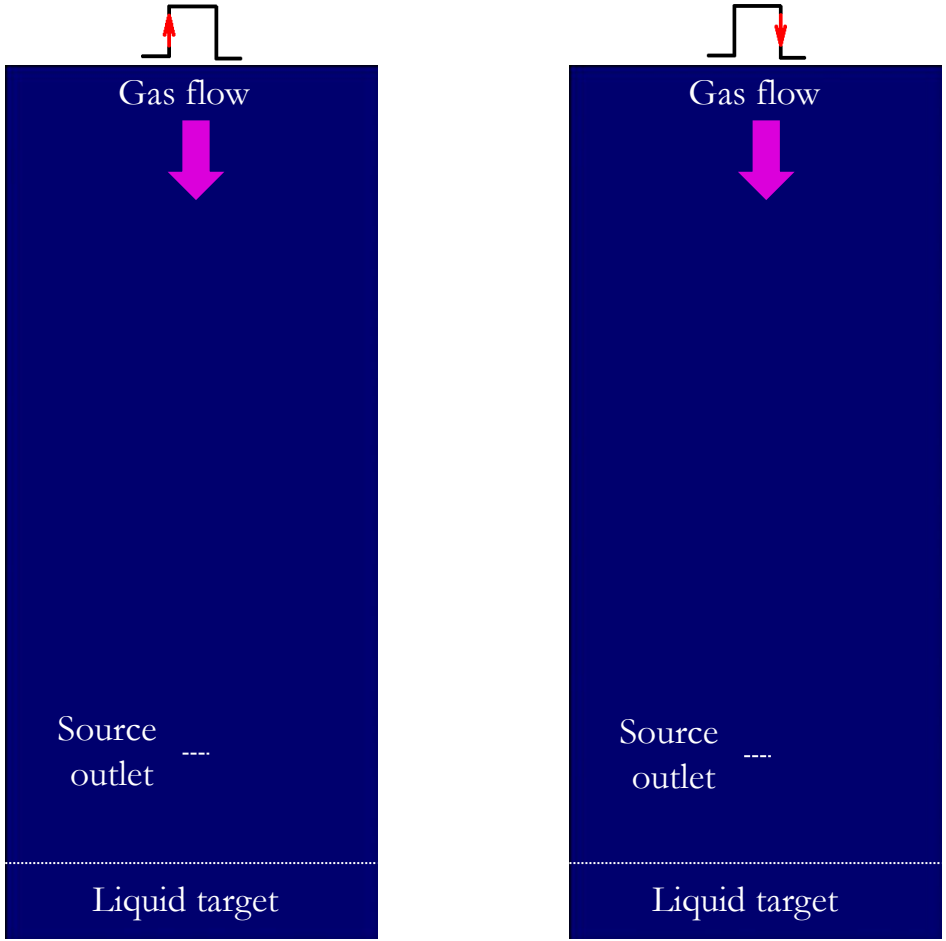


PhD thesis (DPHE)

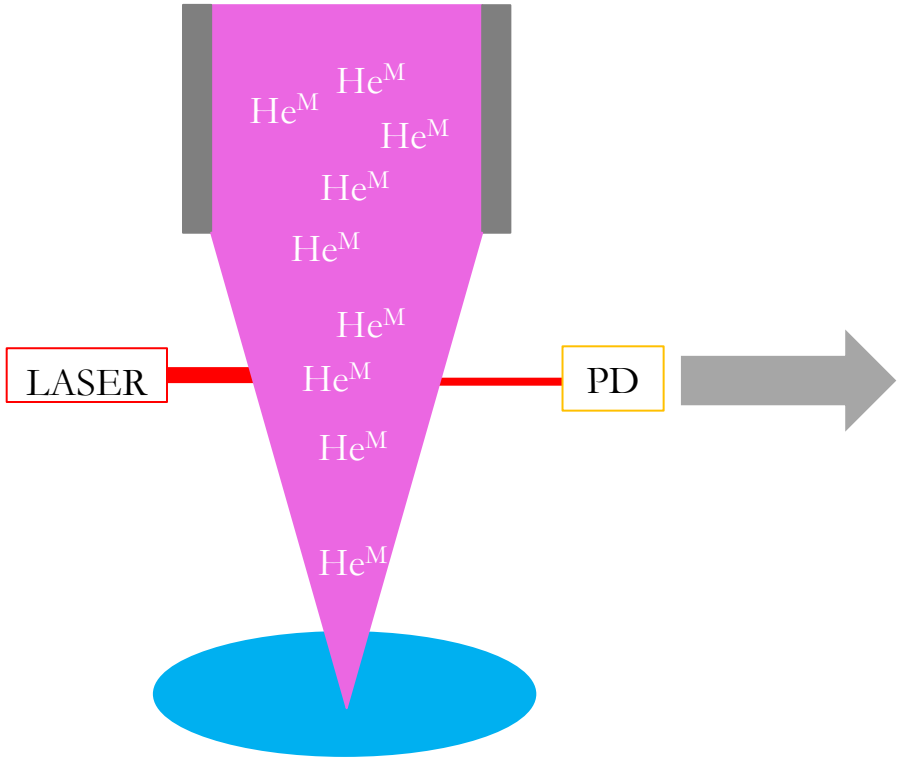
Tube outlet diameter: 3.7 mm
Liquid-source distance: 6 mm
Liquid volume: 12 mL

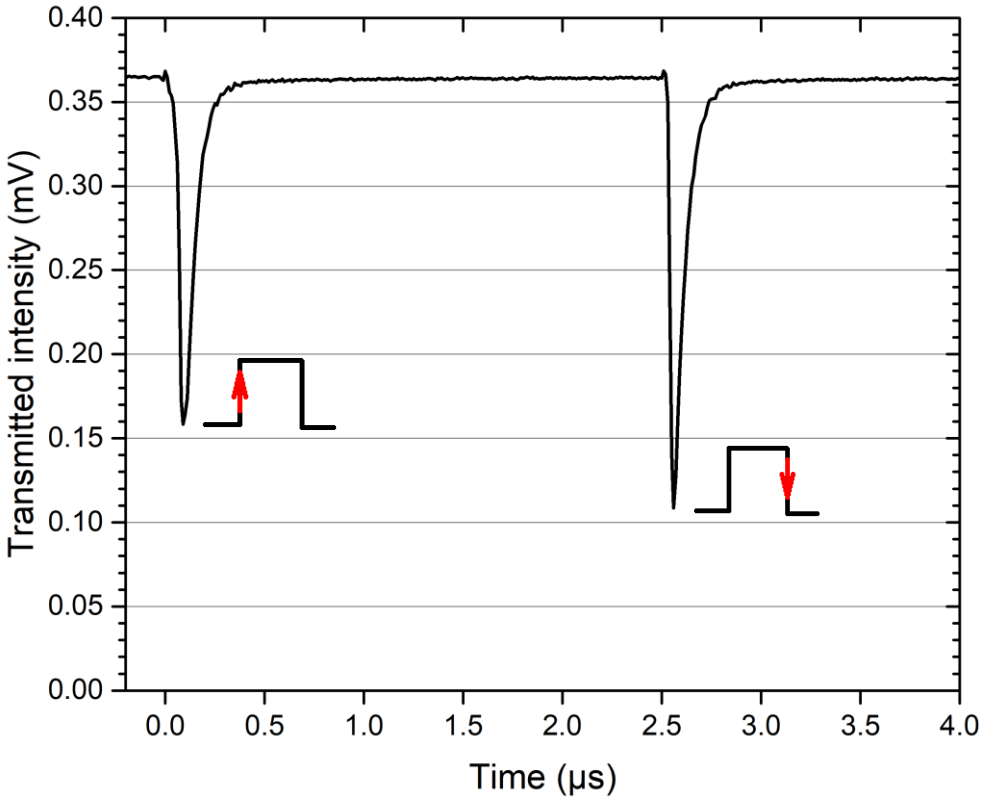
Gas: He + 0.2% O_2
Flow rate: 0.5 $l.min^{-1}$

Voltage: 6 kV
Pulse duration: 2.5 µs
Frequency: 20 kHz



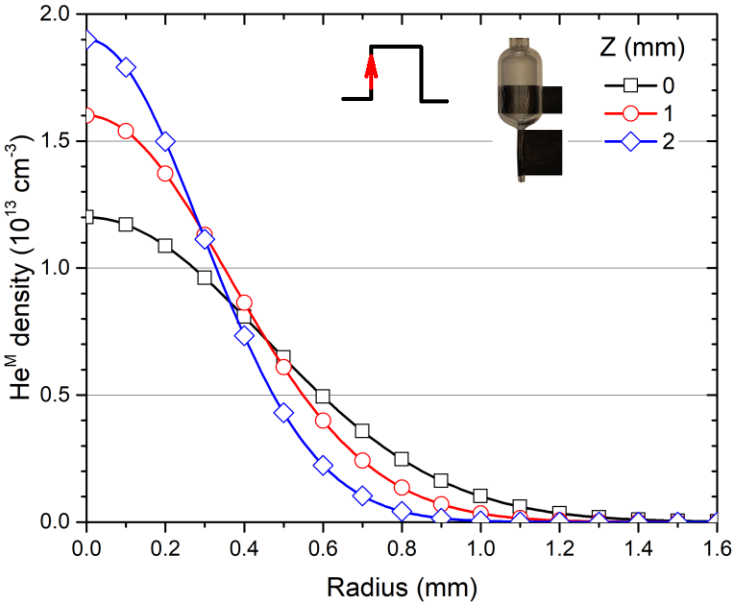
PhD thesis (DPHE)

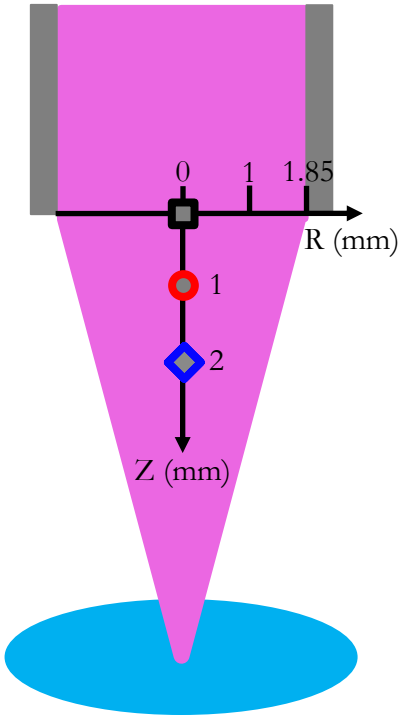


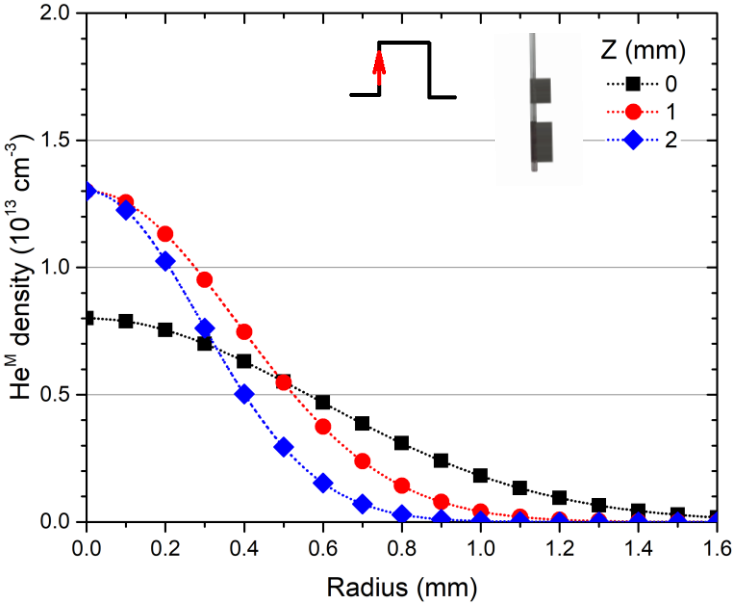


Inverse Abel transform → **radial He^M absolute density**

PhD thesis (DPHE)





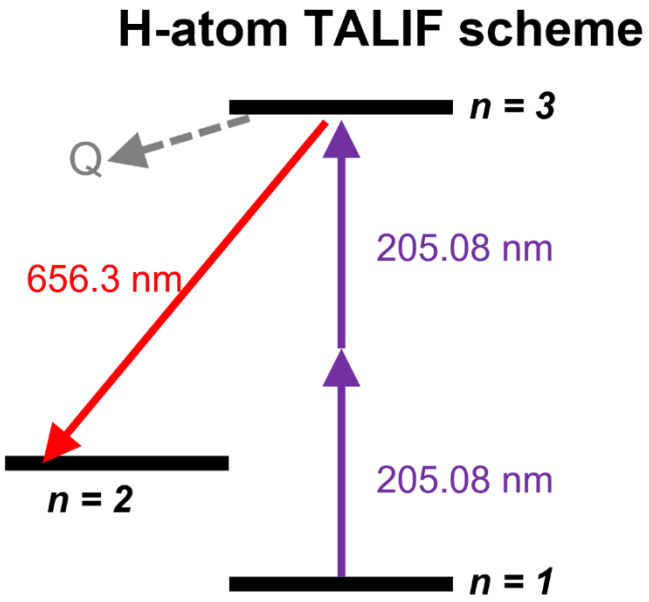


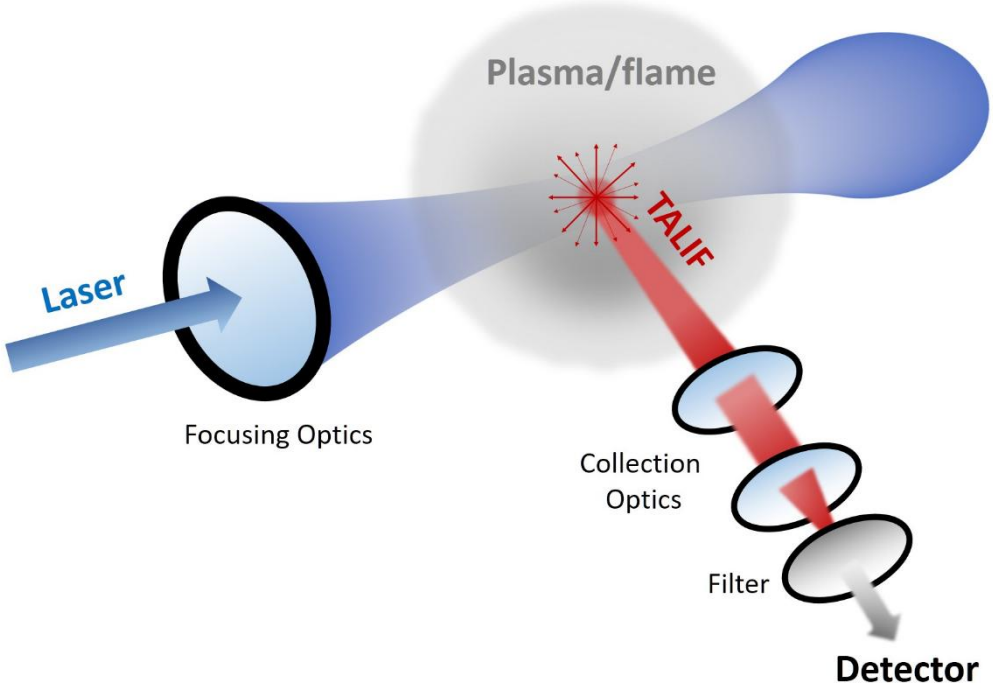
Maximization of He^M production with the asymmetric source

→ the reservoir retains the plasma-forming gas for a longer time, and therefore undergoes a much higher number of pulses (35000 compared to 200 in the grounded electrode region).

Research engineer and platform (LSPM)

TALIF: **T**wo-photon **A**bsorption **L**aser **I**nduced **F**luorescence
→ Absolute density measurements of **H, O, N**, etc. in plasmas!





Research engineer and platform (LSPM)

Picosecond system

Highly collisional plasmas

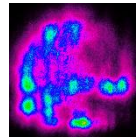
EKSPLA

Picosecond pump laser: Nd:YLF

$\tau_{laser} \approx 10$ ps FWHM

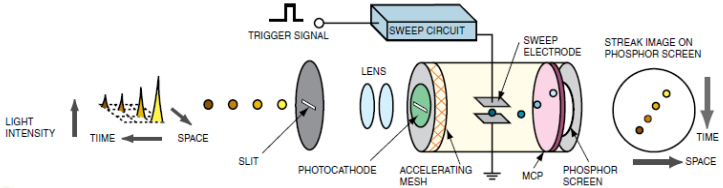
$f_{laser} = 5$ Hz

Optical parametric oscillator (OPO): 193-2000 nm



HAMAMATSU

Streak camera: minimal temporal resolution = 1 ps



Z-translation: spatial resolution = 1 µm

LABVIEW: automated measurement

PYTHON: data processing (including deconvolution)

Research engineer and platform (LSPM)

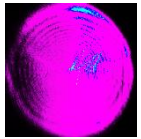
SPECTRA PHYSICS and SIRAH

Nanosecond pump laser: Nd:YAG

$\tau_{laser} \approx 10$ ns FWHM

$f_{laser} = 10$ Hz

Dye + crystals KPD/BBO: 197-900 nm



PRINCETON INSTRUMENTS

Monochromator: spectral resolution = 0.4 nm

HAMAMATSU

PMT with gate function: temporal resolution = 2 ns

3-axis translations: spatial resolution = 1 µm

LABVIEW: automated measurement

PYTHON: data processing

Nanosecond system

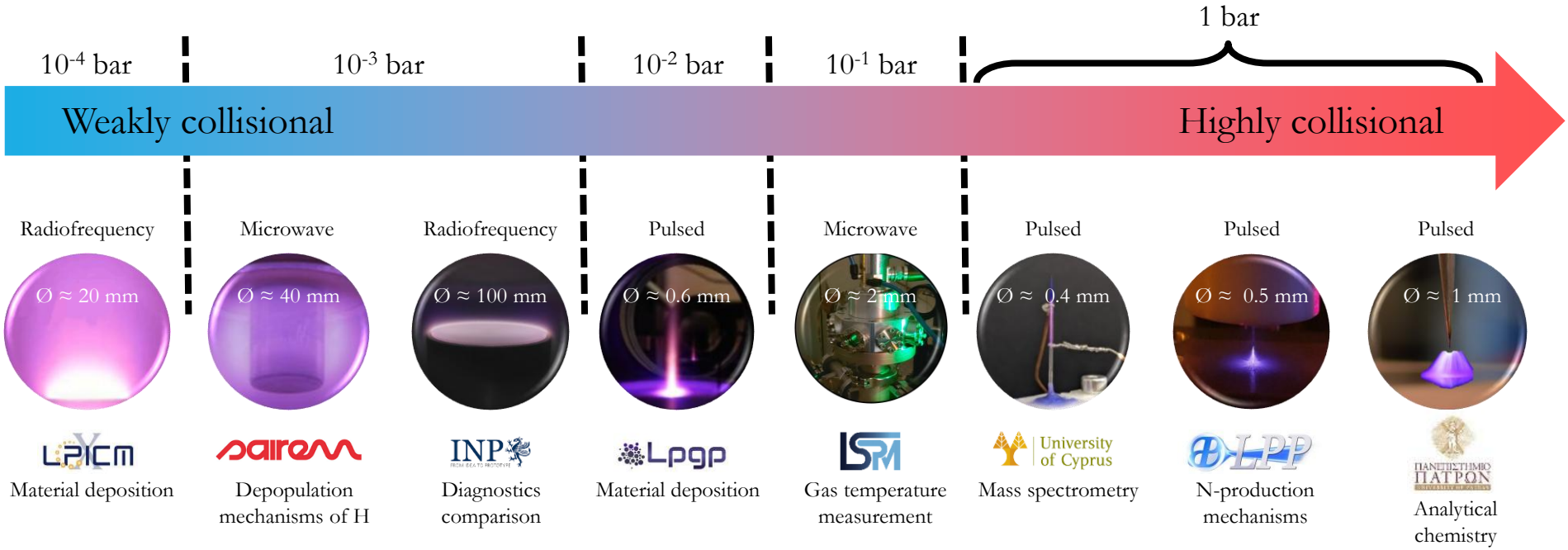
Weakly collisional plasmas

Research engineer and platform (LSPM)

Laser and **S**pectroscopy diagnostics in **P**las**M**as

*"**National platforms** are physical or virtual places offering **services or tools** shared with the entire research community.*
*They enable us to optimize investments and the use of **equipment and human expertise** to better develop tomorrow's **innovations**."*

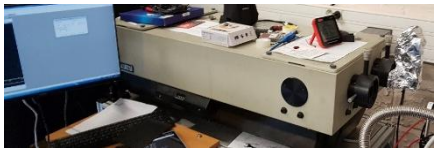
Research engineer and platform (LSPM)



Research engineer and platform (LSPM)

Space/time resolved optical emission spectroscopy

500 pm — 50 pm — **Spectral resolution** — 20 pm — 4 pm

Global spectrum	Molecular band spectrum	Atomic line spectrum
E.g.: *species identification*	E.g.: *ro-vibrational temperature*	E.g.: *electron density*
		
4096	Shamrock 500i	THR1000
AVANTES MEMBER OF THE NYNOMIC GROUP	OXFORD INSTRUMENTS ANDOR	JOBIN YVON HORIBA

Sopra — Réseau Plasmas Froids

Thank you for your attention

LSPM - CNRS
Université Sorbonne Paris Nord
99 Av J. B Clément
93430 Villetaneuse
France

www.lspm.cnrs.fr