

Position Description

1. General Information

Name of the position	(Bio-)Molecular Compounds Detection and Analysis with Innovative Nonlinear Optical Methods
Foreseen enrolment date	1 October 2024
Position is funded by	<ul style="list-style-type: none"> • COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon Europe, European Union • Université Claude Bernard Lyon 1 (UCBL) • Royal Melbourne Institute of Technology (RMIT)
Research Host	Université Claude Bernard Lyon 1
PhD awarding institutions:	Université Claude Bernard Lyon 1 & RMIT University
Locations	Primary: Lyon, France Secondary: Melbourne, Australia
Supervisors	Pierre-François Brevet (UCBL) and Arnan Mitchell (RMIT)
Group of discipline	Physics

2. Research topics (only one of these projects will be funded)

Project 1: *Study of Liquids with Quadratic Nonlinear Optical Methods*

Understanding the molecular organization of liquids is of utmost importance in a broad range of domains, from planetary and environmental sciences to more applied research like solvation and battery electrolytes. This endeavor requires new concepts and new instruments to isolate intermolecular interactions and observe ion solvation or aggregation.

The project aims at conceiving new concepts and designing new instrumentation to achieve these aims using nonlinear optics based protocols. In particular, innovative strategies based on frequency doubling and sum- or difference-frequency mixing will be proposed and enabled, building on the already known skills of the research group where the work will be conducted. A special emphasis will be given towards near-IR and Mid-IR spectral domains where compounds have distinct optical fingerprints.



This project has received funding from the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie grant agreement N° 101081465

Supervisors: Pierre-François Brevet (UCBL), Arnan Mitchell (RMIT), Hong-Duc Nguyen (Axens)

Research Fields: Nonlinear Optics and Nanophotonics

Project 2: Analysis of Compounds with Cubic Nonlinear Optical Methods

Detection and characterization of (bio-)chemical based compounds and materials has become of utmost importance in a broad range of domains, from environmental and security monitoring to climate science and astrophysics. This endeavor requires new concepts and new instruments, with a special emphasis towards near-IR and Mid-IR spectral domains where compounds have distinct optical fingerprints.

The project aims at conceiving new concepts and designing new instrumentation to achieve these aims using nonlinear optics based protocols. In particular, innovative strategies based on third order nonlinear optical methods like two-photon excited fluorescence and nonlinear absorption-refraction fundamental mechanisms will be proposed and enabled, building on the already known skills of the research group where the work will be conducted.

Supervisors: Pierre-François Brevet (UCBL), Arnan Mitchell (RMIT), Hong-Duc Nguyen (Axens)

Research Fields: Nonlinear Optics and Nanophotonics

Project 3: New concepts with Nanoparticles for Sensing with Nonlinear Optical Processes in the NIR-MIR

In order to perform the detection and characterization of (bio-)chemical based compounds and materials at ultra-low level with applications in a broad range of domains from environmental and security monitoring to climate science, one strategy is to use nanoparticles as vectors with high sensitivity and selectivity. This strategy can involve either dielectric or plasmonic nanoparticles and may possibly entail surface chemistry in order to target specific analytes. This endeavor requires new concepts and new instruments, with a special emphasis towards near-IR and Mid-IR spectral domains where compounds have distinct optical fingerprints.

The project aims at conceiving new concepts and designing new instrumentation to achieve these aims using nonlinear optics based protocols. In particular, innovative strategies based on nonlinear optical processes, either quadratic or cubic processes like frequency doubling or nonlinear absorption and refraction will be proposed and enabled, building on the already known skills of the research group where the work will be conducted.

Supervisors: Pierre-François Brevet (UCBL), Arnan Mitchell (RMIT), Hong-Duc Nguyen (Axens)

Research Fields: Nonlinear Optics and Nanophotonics

3. Employment Benefits and Conditions

The Université Claude Bernard Lyon 1 offers a 36-months full-time work contract (with the option to extend up to a maximum of 42 months). The total number of worked hours per week is 37h30.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of an estimated gross annual salary of 28,080.00 EUR. Of this amount, the estimated net salary to be perceived by the Researcher is 1,870.00 EUR per month. However, the definite amount to be received by the Researcher is subject to national tax legislation.



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Benefits include

- Becoming a Marie Skłodowska-Curie fellow and be invited to join the Marie Curie Alumni Association.
- Access to both universities educational resources, as well as ILM and UNSW research facilities and laboratories.
- Tuition fee waiver at both PhD awarding institutions.
- Yearly travel allowance to cover flights and accommodation for participating in AUFRANDE events.
- 10,000 EUR allowance to cover flights and living expenses for 12 months in Australia.
- 47 days paid holiday leave.
- Sick leave.
- Parental leave.

4. PhD enrolment

Successful candidates for this position will be enrolled by the following institutions and must comply with their specific entry requirements, in addition to AUFRANDE's conditions.

Applicants must hold a Master's degree or a diploma that confers the Master grade (5 years).

Applicants must demonstrate an English language proficiency equivalent to an overall IELTS Academic score above 6.5 and no band below 6. Note that the test needs to be completed no more than two years before enrolment. For more information about the tests accepted and scores required, visit: <https://www.rmit.edu.au/study-with-us/international-students/apply-to-rmit-international-students/entry-requirements/english-requirements/english-language-proficiency-tests>

More information on UCBL's requirements

Visit the website: <https://phd-physics.universite-lyon.fr/ed-52-phast/site-francais/navigation/pendant-la-these/inscriptions-reinscriptions/> and the [website of the doctoral school](#).

More information on RMIT University's requirements

Visit the website: <https://www.rmit.edu.au/research/research-degrees/how-to-apply> .



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