

Ph.D. Position

Whispering gallery modes microsphere visible light sources based on rare earth ions

The Institut FOTON is offering a 36-month Ph.D. scholarship in the area of visible light microsphere laser for metrological and quantum optics applications.

Starting date: between 1 September 2023 and 1 November 2023

Supervisor: Stéphane Trebaol and Yannick Dumeige

Research team: Photonic Systems (laser physics & applications group), at ENSSAT-Lannion

Keywords: High-Q microresonator, rare-earth ions, laser, visible light, cavity quantum electrodynamics, photon counting regime

Project description:

Compact highly coherent visible light sources are cornerstones for metrological applications like the implementation of integrated atomic clocks, or for quantum optics applications: sensing, storage, communications or computing. The footprint reduction of quantum photonics components relies on the availability of integrated narrow-linewidth lasers and efficient room-temperature single photon sources. The main difficulties to reach robust room temperature single photon sources lies in the weak fluorescence emission for quantum emitters. To overcome this, one solution consists in introducing quantum emitters in a high finesse optical resonator to enhance the spontaneous emission rate. Thanks to their high-Q factor and small mode volume, microresonators have been identified as model systems to study on the one hand, cavity quantum electrodynamics phenomena and on the other hand, narrow-linewidth and low threshold laser emission. In the near infrared, rare earth doped microsphere resonators have demonstrated their ability to produce optical storage and laser emission. Nevertheless, at visible wavelengths, to date direct in band-pumping scheme has not been reported yet in rare-earth doped microresonators for neither laser emission observation nor single photon source demonstration. We propose through this project to develop compact whispering gallery modes (WGM) microsphere visible light sources based on single quantum emitters. Various materials will be involved like polymer, silicate and fluoride glasses to determine the optimal host matrix to reach the demonstration of a narrow linewidth visible light microsphere laser. In a second step, the single photon counting regime will be investigated through fluorescence measurement of single ions. The objective of this project is to follow up the early stage of lab-to-market technology transfer of integrated atomic clock and quantum optics for which, compact room temperature photonic sources is still lacking.

Qualifications

Candidates should have a master degree in photonics, preferably including documented qualifications in the areas of laser physics, laser characterization, optical fibers, instrumentation (relative intensity noise and frequency noise measurements), control or servo-loop. The ideal profile would combine interest for experimental work and, in a second place, for modelling and simulation work. Good communication skills in English are required.

Partnership

The Institut FOTON will collaborate through this project with national (Exail, Le Verre fluoré, Photonics Bretagne) and international partner (University of Cochin, India).

About the Institut FOTON (CNRS, UMR6082)

The Institut FOTON is a research unit of the French National Centre for Scientific Research (CNRS) associated to University of Rennes 1 and the National Institute for Applied Sciences (INSA) of Rennes. FOTON is composed of three research teams: the "Optoelectronics, Heteroepitaxy and Materials" team, the "laser Dynamics, microwave photonics, Polarimetry, terahertz, imaging" team located in Rennes, and the "Photonic Systems" team located in Lannion. The successful candidate will carry out research in Lannion. More information about FOTON can be found at: <http://foton.cnrs.fr>. Related information about visible light activities at Foton can be found at: <https://combo.foton.cnrs.fr/>

Further information-Contact

Further information may be obtained from Yannick Dumeige and Stéphane Trebaol at: yannick.dumeige@enssat.fr, stephane.trebaol@enssat.fr

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Application procedure

Please submit your application at your earliest convenience by e-mail to:

<mailto:stephane.trebaol@enssat.fr>

Your application should include:

- Cover letter
- Detailed CV
- Copy of M.Sc. degree or equivalent
- Grade transcripts
- List of publications, if applicable
- Contact details of two references

All qualified candidates are invited to apply.