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Institut FOTON recruits
PhD on Integrated photonics for NV-based quantum sensing

Department :	**Institut FOTON**
Job type :	Full-time, 36-months contract
Starting :	**As soon as possible**
Salary :	24 900 € annual gross salary
Annual leave :	45 days

PhD supervisor: Yannick Dumeige ***PhD co-supervisors:*** Paul Huillery, Mathieu Perrin
Funding: ANR-CPJ Quant-it
Involved Institut FOTON teams: OHM (INSA Rennes), SP (Lannion)
Keywords: Quantum sensing, Diamond NV centers, Integrated photonics.

Work environment:

"Institut FOTON" is a research unit of the French National Centre for Scientific Research (CNRS) associated to University of Rennes and the National Institute for Applied Sciences (INSA) of Rennes. This thematic research institute covering the broad field of Photonics is composed of three research teams: the "Optoelectronics, Heteroepitaxy and Materials" (OHM) team and the "laser Dynamics, microwave photonics, Polarimetry, terahertz, imaging" (DOP) team located in Rennes, and the "Photonic Systems" (SP) team located in Lannion. The successful candidate will carry out research at both the OHM team in Rennes and the SP team in Lannion. In particular, he/she will work within the clean rooms and technological platforms of CCLO (Lannion) and NanoRennes (Rennes), member of the Renatech+ network. More information about FOTON can be found at: http://foton.cnrs.fr.

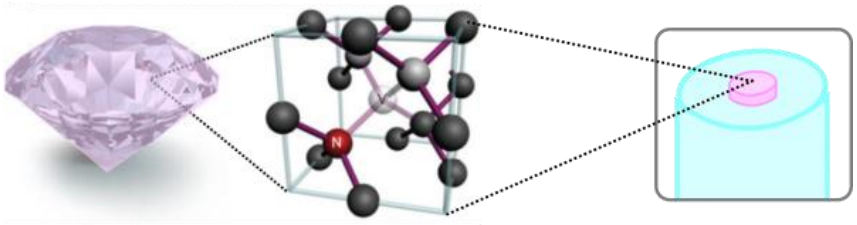
Partnership

The project will benefit from all the already existing national and international collaborations of the group. This includes the members of the equipex+ e-Diamant (coord. J.F. Roch) and in particular the group of Jocelyn Achard (LSPM) for quantum grade diamond fabrication. Our group is also collaborating with the startup Wainvam-e, world leader in NV based quantum sensors, offering ideal conditions for the valorization of the PhD work.

Mission:

Quantum sciences are currently being turned into technological devices that exploit quantum properties of fundamental particles to push further the socially impactful fields of computing, communication or sensing. Among the impressive diversity of quantum systems that are investigated in this context of quantum technologies, diamond Nitrogen-Vacancy (NV) centers play a prominent role. Thanks to a singular interplay between optical and spin degrees of freedom, NV centers proved themselves particularly relevant in the field of quantum sensing and have been for example employed to build sensitive magnetometers having an unprecedented nanometric spatial resolution[1]. The room temperature operation of NV-based quantum sensors together with its solid-state packaging – the diamond – augur further development of a broad range of sensing applications going from biomedical sciences to industrial non-destructive testing.

[1] Maze et al. *Nature* **455**, 644–647 (2008)



To fully realize the potential of NV-based quantum sensors and develop new applications, current challenges are to decrease sensors sensitivity down to spin projection noise[2], to miniaturize their size or again to develop new sensing modalities such as endoscopic or network sensors. Photonic sciences, acting as an enabling technology, represent a clear path to address those challenges. This research direction, which has been recently started at the "Institut FOTON", is the general context of this PhD.
Specifically, during the PhD, the integration of diamond materials onto photonic devices using state-of-the-art cleanroom technologies will be investigated. First development will consist in the integration of diamond microdisks on the tip of optical fibers to realize endoscopic sensors. Diamond-on-Silica photonic guiding structures will also be investigated within the framework of quantum sensing. Alongside these technological developments, the successful candidate will be in charge of setting up the standard tools for NV spin manipulation and to analyze and characterize the sensing performances of the realized devices.

Main duties:

- Bibliographic work on the concepts and state of the art techniques related to NV-based quantum sensing and diamond processing;
- Setup conventional tools for NV magnetometry;
- Develop and realize clean room processes for the nano-structuration of diamond membranes;
- Realization of optical fiber NV sensors;
- Design, simulation and realization of Diamond-on-Silica photonic structures;
- Measurements and analysis of the sensing performances of the realised devices;
- Presentation of the research results in scientific articles and conferences, participation to outreach activities.

Qualifications, Competencies:

The candidate should justify a master's degree. Strong basis in photonic sciences is required. Basis in atomic physics, quantum mechanics or nanotechnologies would be desirable as well as experience with NV center Physics. The applicant should have a strong interest in experimental work together with the ability to perform numerical and analytical simulations. Autonomy, creativity, independent thinking and team work skills are being sought. Fluency in English is required (written and spoken).

Application procedure:

Applications must be sent to job-ref-fogp63inox@emploi.beetween.com by **October 15, 2023** at the latest.
Selected candidates will be invited to an interview in the week of October 23, 2023.

Your application should include:

- Motivation letter
- Detailed curriculum vitae (CV)
- Copy of obtained diplomas
- Educational grades and marks (at university level)
- Publication list if applicable
- Recommendation letters or references of people to contact for recommendation.

More information available from Paul Huillery, Junior Professor: paul.huillery@insa-rennes.fr.

[2] Barry et al. *Rev. Mod. Phys.* **92,** 015004 (2020)

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