Single Photon Avalanche Photodiode applications in Quantum Communication Technologies

Description du projet / Project description

The Institut Quantique (IQ) of Université de Sherbrooke brings together internationally recognized leaders in research and interdisciplinary training in science and quantum technologies. The IQ is a collaborative environment at the interface of quantum computing, quantum materials and quantum engineering offering exceptional scientific and professional perspectives to its students, members and partners.

In 2015, the Canada First Research Excellence Fund (CFREF) awarded $33.5 million over the next seven years to our researchers to support the “From Quantum Science to Quantum Technologies” project. This ambitious strategy will undoubtedly be one of the great industrial revolutions of the 21st Century.

The present proposal’s goal is to study a specific quantum application that would benefit from the unique performance of the single photon photodetectors developed by the GRAMS (Sherbrooke’s Research Group in Medical Apparatus), based on Single Photon Avalanche Diodes (SPAD) and 3D integration process technologies. Although initially motivated by medical imaging application, our group has interest to apply its unique expertise in single photon instrumentation to quantum technologies.

To this end we require a post-doctoral research fellow with specific expertise in quantum optics to scrutinize the state-of-the-art experiments and to propose new approaches based on our detectors. We expect much more than a literature review, with concrete proposals and applications, and possibly a proof-of-principal experiment. We expect from this project to find collaborations/partnerships with other group with needs for fast and sensitive photodetectors. One interesting application for SPAD-based detectors is the QEYSat project at IQC Waterloo (long-range quantum communication).

The project is based at Sherbrooke’s Interdisciplinary Institute for Technological Innovation (3IT), under the supervision of Pr. Jean-François Pratte and Pr. Serge Charlebois, where the detectors are being designed and characterized. The project also requires being in close collaboration with Pr. Thomas Jennewein (Quantum Photonics Laboratory - University of Waterloo). The candidate will interface with the GRAMS’s instrumentation engineering team at 3IT in order to improve its understanding of SPAD devices while he or she will interact with several IQ members. Key roles include:

- Perform theoretical studies and experimental designs using SPAD based technologies (quantum optics, entangled photon pairs, qubit sensing, etc.)
- Find innovative experiments in quantum information that benefit from the SPAD’s fast timing and single photon capabilities
- Improve the group’s expertise in quantum optics for the design of novel sensors
- Work closely with a master student dedicated in the optical lab (femtosecond laser, SHG photon pairs, etc.)

We seek an enrolment of one year on site at 3IT Sherbrooke, with short stays at IQC Waterloo. Details will be discussed at interview.
Directeur(s) de recherche / Research supervisor

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<th>Nom / Last Name</th>
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<tr>
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<td>Charlebois</td>
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<td><a href="mailto:Serge.Charlebois@USherbrooke.ca">Serge.Charlebois@USherbrooke.ca</a></td>
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Caractéristiques du projet / Project description

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Partenaire industriel (s’il y a lieu) / Industrial partner (if applicable)

| Nom du partenaire / Name of industrial partner | Teledyne DALSA Semiconductor Inc |