Design of a coplanar microwave cavity for the control of quantum systems.

Record number : OPR-779

Overview

RESEARCH DIRECTION

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INFORMATION

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ADMINISTRATIVE UNIT(S)

Faculté de génie
Département de génie électrique et de génie informatique
Institut interdisciplinaire d'innovation technologique (3IT)

LEVEL(S)

2e cycle
3e cycle

LOCATION(S)

3IT - Institut interdisciplinaire d'innovation technologique

Project Description

Vision:
A true center of collaborative innovation, the Interdisciplinary Institute for Technological Innovation (3IT) brings together cutting-edge technological capabilities and varied scientific expertise. Here, world-renowned researchers, graduate students, research professionals, technicians and interdisciplinary support staff combine their know-how for a common goal: to create impactful technological solutions. It is part of the Integrated Innovation Chain of the University of Sherbrooke, the Quantum Institute (IQ) and the MiQro Innovation Collaborative Center (C2MI).

The 3IT is continually looking for talented and dynamic people who desire to see the impact of their work contributing directly to the success of the Institute and its partners. We place students and researchers at the center of our activities in an open and collaborative environment to accelerate the transition from science to the technologies of tomorrow.

Context:
This project is part of an international research consortium bringing together the IQ, 3IT, Sherbrooke start-ups Nord Quantique and SBQuantum, the University of Glasgow as well as the English companies Oxford Instrument and Element Six. The partnership aims to exploit the great maturity of micro-nano-fabrication technologies on silicon to develop large-scale quantum computers.
In the field of photonics, defects in diamond can be used as a qubit that are ultra-sensitive to local electromagnetic fields. Among other things, it is possible to control these centers through a microwave resonant cavity with variable capacitance. This system is used as an ultra-sensitive miniaturized magnetometer in the mining and defense sectors and for the development of quantum computers.

Objectives:
The project concerns the development of a miniaturized coplanar microwave cavity, to electronically sweep the resonant frequency of the system in order to locally control the quantum nitrogen-vacancy centers.

Method:
The project consists of continuing the work done by the industrial partners where a 3D variable capacitance microwave cavity has been developed. First, the design and simulation of 2D cavities will be carried out using COMSOL Multiphysics software. This tool will make it possible to clearly define the amplitude and homogeneity of the local microwave field. Secondly, the existing electronic circuit will have to be modified to ensure compatibility with the existing industrial cavity. Third, the 2D cavity will be fabricated and preliminary frequency response tests will be performed. Finally, in collaboration with the rest of the team, the opto-electronic system corresponding to a 2D magnetometer will be assembled. Sensitivity responses will be measured in order to respond to industrial challenges.

Supervision & work environment :
The project will be carried out under the co-direction of Pr. Sylvain Nicolay and Pr. Réjean Fontaine. The manufacture, assembly and characterization of the microwave cavities will be carried out on the premises of the Interdisciplinary Institute for Technological Innovation. The successful candidate will interact regularly with all collaborators but will perform most experiments at 3IT. Individuals will thus benefit from an exceptional research environment combining students, professionals, professors and industrialists working hand in hand to develop the quantum technologies of the future.

Requirements:
The candidate must have a quality academic record, aptitudes for applied physics, manual work in the laboratory, precision work, a sense of creativity, a strong capacity for adaptation and a taste for research and development in RF / photonics / quantum.

Experience in CAD modeling and/or microwave system design and/or micro-manipulations will be an asset.

Discipline(s) by sector

Sciences naturelles et génie

Génie électrique et génie électronique

Funding offered

Yes

Partner(s)

SBQuantum, Nord Quantique, Oxford Instrument, Element Six