

# Quantum artificial intelligence with neutral-atom arrays (Graduate students)

Record number : OPR-1043

## Overview

### RESEARCH DIRECTION

Stefanos Kourtis, Professeur - Department of Physics

### INFORMATION

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### ADMINISTRATIVE UNIT(S)

Institut quantique

### LEVEL(S)

2e cycle  
3e cycle

### LOCATION(S)

Institut Quantique Sherbrooke

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## Project Description

### Context

Quantum computation promises advances in computing in the long run for diverse applications with significant economic and societal footprint. To harness the potential of quantum computation in the near-term, new algorithmic blocks are necessary to extract the maximum possible benefit out of limited quantum resources. One of the most promising platforms for near-term quantum computing is based on trapped ultracold atom arrays.

This research project aims to design, implement, and deploy quantum algorithms and quantum simulation protocols for artificial intelligence applications through a partnership between the research group of Prof. Stefanos Kourtis and PASQAL, a world leader in quantum computing with neutral atoms.

### Project

The research goals of this project are to

- develop quantum simulation protocols for the study of complex collective dynamical phenomena,
- design quantum machine learning protocols based on complex quantum dynamics,
- invent and apply new quantum algorithms for the solution of high-complexity combinatorial problems in artificial intelligence, and
- standardize quantum advantage certification through high-performance classical computing.

By achieving these goals, it is expected that the team will enable demonstrations of utility of neutral-atom quantum computing.

### Partner

PASQAL is a world-leading manufacturer of quantum processors built out of trapped atom arrays. Based in France, PASQAL has a strong presence in the Quantum Innovation Zone in Sherbrooke, with an assembly line already established in the city's Espace Quantique 1.

### Team & environment

The selected students will be joining a dynamic team of 15 students, postdocs, and researchers, led by Prof. Stefanos Kourtis. The team's

research activities enjoy generous financial support from a Research Chair in Quantum Computing awarded by the Ministère de l'Économie, de l'Innovation et de l'Énergie du Québec and funding agencies (NSERC, Mitacs).

Our research team is embedded in the Faculty of Science at Université de Sherbrooke, a vibrant and diverse body of students, educators, and scientists. We are part of the dynamic research environment of the Institut quantique, a research institute comprised of more than 30 research groups from the Faculty of Science, the Faculty of Engineering, the Faculty of Humanities and the School of Management, 25 technical and professional staff members, and over 200 students and postdocs.

#### Roles available

Two graduate student roles are open. Graduate students will be enrolled in the PhD program in physics or computer science. The roles will be remunerated competitively.

The positions are based at the Université de Sherbrooke campus, with flexibility for remote work.

Candidates who identify as women, members of gender, sexual, visible or ethnic minorities, Indigenous people, and people with disabilities are encouraged to apply. Accommodations for maternity / paternity are available. A mentoring and professional development plan will be established for all team members.

#### Main tasks:

- Perform research on quantum computing, quantum simulation, and / or tensor network methods
- Develop and implement quantum algorithms and classical simulation protocols
- Collaborate with PASQAL team

#### Qualifications:

- MSc in physics, computer science, or mathematics, preferably on quantum information
- Familiarity with at least one of the following: ultracold atom physics, quantum algorithms, tensor network methods
- Demonstrated coding capabilities (Python and / or C preferred; experience with GPUs a bonus)
- Desire to support a dynamic and diverse research team
- Exceptional BSc students will also be considered for an accelerated MSc-to-PhD passage.

#### Application

Interested applicants should provide the following:

- Letter of motivation; where possible, provide concrete examples of qualifications and strong suits
- CV including (i) publication list and (ii) names and contact information of 2 references; where possible, provide concrete examples of qualifications and strong suits
- Sample of independently authored research manuscript or code repository
- Transcripts of most recent degree

Application material should be sent to

quantum.ai@usherbrooke.ca

## Discipline(s) by sector

Sciences naturelles et génie

Informatique, Physique

## Partner(s)

Pasqal

The last update was on 6 May 2024. The University reserves the right to modify its projects without notice.