Offer #2025-08963

Post-Doctoral Research Visit F/M Lattice-based bosonic quantum error correction

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

Context

Context and working environment
The position is hosted by the QAT team, located at **École Normale Supérieure (ENS)** and **Inria Paris**. The team conducts research in various aspects of quantum information theory, including quantum error correction, quantum resource theories, and the interface between quantum information and cryptography. The team is part of a strong academic environment within the broader Paris ecosystem for quantum science and is involved in multiple national and European projects.

The team values diversity and is committed to building an inclusive environment for people of all backgrounds.

The position is accompanied by a generous travel allowance and is potentially renewable for a third year.
Start date: September 1st 2025 (flexible)

Proposed research project
This position is part of the "Bosonic Lattice Codes" (BoLaCo) project, a French-German collaboration funded by the ANR and the DFG, in partnership with Prof. Jens Eisert's group at Freie Universität Berlin. The project aims to develop new theoretical and practical frameworks for **bosonic quantum error correcting codes**, especially **Gottesman-Kitaev-Preskill (GKP)** codes [1], using tools from lattice theory and coding theory. This builds upon previous work by the project partners that studied the relation of GKP codes to lattices [2] and the use of this connection for the design of new codes [3].

[1] Gottesman, D., Kitaev, A.Y., & Preskill, J. (2000). Encoding a qubit in an oscillator. Physical Review A, 64, 012310. (arXiv:quant-ph/0008040)

[2] Conrad, J., Eisert, J., & Arzani, F. (2022). Gottesman-Kitaev-Preskill codes: A lattice perspective. Quantum, 6(648), 648.

[3] Conrad, J., Eisert, J., & Seifert, J.-P. (2024). Good Gottesman-Kitaev-Preskill codes from the NTRU cryptosystem. Quantum, 8(1398), 1398.

Application documents
To apply, please include:

1. a cover letter
2. a curriculum vitae (including a complete list of publications);
3. a research statement (3 pages maximum), including an overview of your past research and its relation to the proposed program;
4. contacts of 2 potential referees.

Assignment

Assignments :
The postdoctoral researcher will contribute to the development of quantum error correcting codes and fault tolerant primitives (state preparation, syndrome extraction, logical gates) for bosonic systems and explore their mathematical and practical properties in relation to different experimental platforms leveraging tools from lattice theory.

In addition to work within the BoLaCo project, the postdoc will have the opportunity to contribute to other ongoing activities of the QAT team: https://qat.inria.fr/projects

The postdoc will also be involved in the supervision of interns and PhD students. While there is no teaching requirement, teaching activities may be arranged for interested candidates through ENS-PSL or affiliated institutions.

For a better knowledge of the proposed research subject :
related works include

Ansgar G. Burchards, Steven T. Flammia, Jonathan Conrad, Fiber Bundle Fault Tolerance of GKP Codes, arXiv:2410.07332

Mao Lin, Christopher Chamberland, Kyungjoo Noh, Closest lattice point decoding for multimode Gottesman-Kitaev-Preskill codes, arXiv:2303.04702

Collaborations :
Besides the members of the Bosonic Lattice Codes project, the postdoc will profit from existing collaborations with theoretical and experimental teams both in France and internationally.

Main activities

- Contribute to the mathematical characterization of bosonic quantum error correcting codes, especially GKP.
- Propose and develop new schemes for state preparation, decoding, and fault-tolerant logical operations.
- Help in the supervision and mentoring of interns and PhD students within the QAT team.
- Participate in scientific outreach and dissemination activities

Skills

Essential:

- PhD in quantum information, mathematical physics, quantum optics, theoretical computer science, or related field.
- Research experience in quantum error correction, ideally with a focus on bosonic codes.
- Previous exposure to continuous-variable systems, lattice theory, or fault-tolerant quantum computing.
- Excellent communication and collaboration skills.
- Fluent in English (written and spoken).

Desirable:

- Experience in interdisciplinary or international research collaborations.
- Familiarity with numerical and/or or symbolic computation tools (Python, Julia, Mathematica, Sage, ...).

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

General Information

- **Theme/Domain :** Algorithmics, Computer Algebra and Cryptology Information system (BAP E)
- **Town/city :** Paris
- **Inria Center :** Centre Inria de Paris
- **Starting date :** 2025-09-01
- **Duration of contract :** 2 years
- **Deadline to apply :** 2025-08-01

Contacts

- **Inria Team :** CASCADE
- **Recruiter :**
  Arzani Francesco / francesco.arzani@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

The keys to success

We are looking for motivated candidates who are confortable working both independently and in a team.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.