Offer #2025-09127

Research internship on bosonic quantum error correction

Level of qualifications required : Bachelor's degree or equivalent

Fonction : Internship Research

Context

More details on the research project :

Gottesman-Kitaev-Preskill codes are promising candidates for quantum error correction in bosonic platforms.

To obtain exponential error suppression with higher mode numbers single-mode codes are typically concatenated with qubit-level stabilizer codes. The hexagonal code is known to be the best single- mode code because it correspond to the lattice with the best packing constant. However, denser packings are possible in higher dimensions. This induces the question whether concatenating the optimal two- or three-mode GKP code with a stabilizer code might lead to better performances.

The main goal of this project would be a numerical exploration of the threshold improvements that would be possible with this approach, if any. For example, one might look at encoding a single qubit in a surface code and looking at the error rate scaling with the number of modes (for example through Monte Carlo simulations).

A secondary goal would be to propose native, potentially experimentally friendly, preparation and syndrome extraction techniques when the base code is higher dimensional.

Finally, the tools developed during the process might be also used to explore the meaning ofault tolerance in the context of GKP codes, as these are more sensitive (in terms of conversion of correctable to uncorrectable errors) to the operations being non-linear, rather than being non- transversal.

Collaboration :The successful candidate will work in collaboration with members of the QAT team at INRIA Paris.

Assignment

The selected candidate will carry out analytical and numerical calculations to establish the performance of concatenated GKP codes.

Main activities

Main activities : formalization of the problem, design of the error correcting codes, Monte-Carlo simulations of code performance

Additional activities : dissemination of the results in scientific workshops and conferences

Skills

Technical skills and level required : working knowledge of a modern programming language (Pyrhon, Julia, ...)

Languages : good English communication skills Relational skills : willingness to work in a team

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
- **Town/city :** Paris
- **Inria Center :** Centre Inria de Paris
- **Starting date :** 2025-10-01
- **Duration of contract :** 4 months
- **Deadline to apply :** 2025-08-10

Contacts

- **Inria Team :** CASCADE
- **Recruiter :**
  Chabaud Ulysse / ulysse.chabaud@inria.fr

About Inria

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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 :
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