INTERNSHIP PROPOSAL

(One page maximum)

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Thesis possibility after internship: YES
Funding: YES If YES, which type of funding: QIA project

Theory and simulation of secure delegated quantum computation protocol in a network perspective

Within the development of quantum technologies, secure delegated quantum computing stands out as a promising application. The aim of delegating a computation is to allow a Client with few ressources to have its computation securely executed by a more powerful Server. One of the targeted applications of the Quantum Internet Alliance (QIA) European project is precisely to implement such a delegated quantum computation protocol that guarantees that the Client is protected against malicious behaviour of the Server while ensuring that its data and algorithm are blind to anyone else. The protocol chosen to develop both the network and the protocols is the robust, verifiable and blind protocol (rVBQC) protocol which provides lower verification overheads compared to the literature as well as robustness to noise which is inevitable in the near term. Implementing such a protocol requires both a precise understanding of the theoretical aspects of the protocol and a knowledge of the current hardware limitations.

To do so, we plan to use detailed high-level modeling (noise and imperfections included) and simulation of the setup that allows to investigate the main functionalities of the protocol. Several tasks are to be conducted among which high-level modelling of the setup and its imperfections, investigating modifications to both the setup and the protocol in order to increase feasability while retaining the theoretical guarantees, assessing the performances of all the versions of the protocol and the hardware via quantum information theory tools as well as numerical simulations (density matrix numerical calculations using simulation frameworks such as graphix or StrawberryFields, global network simulations using SquidASM and/or NetSquid (both provided and developed by QIA).
The succesful applicant will work within the newly created Quantum Applications and Theory QAT Inria team working at the interface between computer science, quantum information theory and physics. The project may lead to interaction with other stakeholders (startup companies, end-users, ...) within the QIA project. You will participate in a truly ambitious and vibrant European project. Master-level quantum background mandatory, quantum information training appreciated.
Taste and skills for programming required (mostly Python).
Depending on the results and the candidate, the internship may lead to a PhD or a software engineer position.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: NO Soft Matter and Biological Physics: NO
Quantum Physics: YES Theoretical Physics: YES