



Inria Chair of Junior Professor

Supporting institution/organization : Inria Research Center of Paris
Head of the institution/organization : Eric FLEURY
Site concerned : Paris
Academic Region : Île-de-France

Partner institutions/organization : *Ecoles Normale Supérieure - PSL*

Project name :
Quantum Algorithms, Applications and Architectures

Acronym : QAAAT

Scientific topic :
Algorithms, computer algebra and cryptology

Keywords :
Quantum Algorithms, Quantum Cryptography, Architectures for quantum computers

Target duration : 3 to 6 years

Profile required : A PhD or similar is mandatory to apply. A successful postdoc experience of 3+ years is expected but not required to benefit from the possibility to become a senior permanent researcher within a 3 to 6 years time after hiring.

Financial overview: 200,000 € for the duration of the project financed by the ANR and which may be supplemented by Inria via incentive resources.

Section (s) CNU/CoNRS/CSS corresponding : A pluridisciplinary profile is required, with proven skills in computer science (CNU 27, CoNRS 6 ou CoNRS 61, CoNRS 7), and physics (CNU 28, CoNRS2).

Contact : eric.fleury@inria.fr et harold.ollivier@inria.fr

[English version]

Context

INRIA decided to create a new Common Project-Team ENS-PSL and Inria, focused on theoretical aspects of quantum computation while also developing links with physicists. This follows the strategic dialogue initiated between INRIA and its main partners about quantum information processing. The goal -- as stated in the Objectives and Performance Contract of the Institute for the period 2019-2023 -- is to be a major scientific contributor in some selected areas comprising quantum information processing. Given the parisian and french contexts and strategies on this area, INRIA wishes to initiate this Common Project-Team with PSL University, more specifically with DIENS (Computer Science) and LPENS (Physics) laboratories as both aim to create teams able to bridge the gap between their core expertises.

In parallel, *PSL* University is launching a new master devoted to quantum technologies under the management of Carlo Sirtori (PU ENS). This interdisciplinary master will benefit from the wide expertise of PSL quantum physicists (at ENS, Les Mines, L'Observatoire, ESPCI) and is seeking to develop its teaching and supervising abilities on quantum information processing.

The Junior Professor Chair recruitment at INRIA will complement the current efforts and recruitments at DIENS and LPENS. It would allow to reach critical mass to perform excellent research and leverage synergies between computer science and physics:

- For *DIENS*, quantum information processing has been identified as a priority for future development and would support interactions between many of its already existing teams (TALGO for algorithms and complexity, CASCADE for cryptography, PARKAS and ANTIQUE for semantics and languages)

- Since its inception in 2019, *LPENS* has dedicated several recruitments (Adam Nahum and Xiangyu Cao) as well as some additional funding through LabEx ICFP and Philippe Meyer Institute to the development of quantum information. This is in addition to the launch of a Mitsubishi Heavy Industry Research Chair to work more directly on the experimental setups of LPENS and of the QUANTIC ProjectTeam (CNRS, ENS-PSL, INRIA, Mines-PSL).

Summary of the scientific project:

The scientific project of the future Project-Team is focused on models of quantum computations, verified computation, certified performances as well as on algorithms and applications that take into account limitations of quantum computers (size, noise, etc). Without being exhaustive this contains:

- exploration of quantum advantages as well as limits of quantum computing from a complexity and model point of view;
- verification, certification and benchmarking techniques for quantum computers;
- development of new algorithms, especially in the context of NISQ devices.

The scientific project of the candidate is expected to be centered on theoretical aspects of quantum information processing, and to cover one or several of these topics, without being limited to those. It will seek to develop interaction with physicists in order to take advantage of advances in experimental realizations as well as to influence the design of future quantum computers.

Summary of the teaching project :

The teaching project of the candidate will contribute to the theoretical quantum computing aspects of the new PSL master on quantum technologies that will be launched in 2022. This master will target excellent masters students and enroll them in a PhD track (5 years) program to train the "PhD-Engineers" able to develop next generation quantum techs. The candidat could as well contribute to the creation of L3 or M1 courses for ENS students on quantum information and algorithms, and possibly also on quantum cryptography depending on its expertise.