



Offer #2024-07527

Doctorant F/H Plan de contrôle et routage dans les réseaux quantiques par intrication F/H

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria research centre in Lyon is the 9th Inria research centre, formally created in January 2022. It brings together approximately 300 people in 16 research teams and research support services.

Its staff are distributed at this stage on 2 campuses: in Villeurbanne La Doua (Centre / INSA Lyon / UCBL) on the one hand, and Lyon Gerland (ENS de Lyon) on the other.

The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

Context

Quantum networks have emerged very recently and are at the heart of a booming research activity. They are at the confluence of networks and one of the most surprising branches of physics, namely quantum mechanics. In particular, quantum networks are based on the strangest phenomenon in quantum physics, namely quantum entanglement. Aside from the application of these exciting concepts to the field of networks, the subject of this thesis is part of an abundant and highly competitive research activity carried out by some of the world's leading laboratories. The combination of knowledge of networks - and in this respect Orange is a very favorable environment - and physics should enable us to lay the foundations for the design of large-scale quantum networks. This ambition is also at the confluence of several fields, in particular security (Quantum Key Distribution) and quantum computing. The thesis is part of a stimulating and highly promising framework for the networks of the future.

The PhD student will be financed by Orange as part of a CIFRE thesis, and will therefore be an Orange employee.

Assignment

Your role is to carry out thesis work on "Control plane and routing in entangled quantum telecommunication networks". More specifically, the thesis focuses on the development of a control plane for entangled quantum communications networks, with the aim of increasing the size of these networks. Research in this field is currently booming, as evidenced by the numerous publications of D. Towsley's group. This research topic is still at a very preliminary stage and not yet ready for operational implementation by operators. However, experiments have been carried out over relatively short distances, for example with Orange's participation in the France QCI network. Numerous studies are also being carried out in the USA and China, where the transmission of qubits over several thousand kilometers is being explored, although this requires thorough verification. This research has given rise to an abundance of specialized literature. At the same time, we're seeing the emergence of start-ups specializing in networks and quantum computing, complementing the big players such as IBM, Google, and other major players in the sector.

Collaboration :

The candidate will be supervised by Fabrice GUILLEMIN (Orange) and Claire GOURSAUD (MARACAS).

Main activities

The aim of the thesis is to study the performance of entangled quantum networks and to develop a

control scheme for these networks (including routing and information distribution between quantum switches/repeaters). The thesis will focus on understanding the physical limitations of quantum networks. In particular, it will analyze physical limitations such as decoherence, qubit storage capacity, Bell state measurement, fidelity and purification, and then assess the impact of these limitations on the control scheme, taking into account constraints such as small storage memories and limited qubit lifetime. The thesis will then focus on developing algorithms for qubit propagation. In particular, the aim will be to design suitable algorithms for qubit propagation, integrating their physical constraints. This work should lead to the creation of a large-scale quantum network simulator capable of reproducing complex environments, in particular physical constraints.

Skills

Skills (scientific and technical) and personal qualities required by the position

- Knowledge of networks (Internet, routing, dimensioning)
- Stochastic processes and queuing theory
- Resource allocation, congestion control, admission control in networks
- Knowledge of physics (especially quantum physics)

Desired experience (internships, ...)

- Internship in networks or physics

Benefits package

- Voir offre publiée sur le site emploi d'Orange :

<https://orange.jobs/jobs/v3/offers/134513?lang=fr>

Remuneration

Voir offre publiée sur le site emploi d'Orange :

<https://orange.jobs/jobs/v3/offers/134513?lang=fr>

General Information

- **Theme/Domain** : Networks and Telecommunications System & Networks (BAP E)
- **Town/city** : Lannion
- **Inria Center** : [Centre Inria de Lyon](#)
- **Starting date** : 2024-09-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-05-31

Contacts

- **Inria Team** : [MARACAS](#)
- **PhD Supervisor** :
Goursaud Claire / claire.goursaud@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

Education required (master's degree, engineering diploma, doctorate, scientific and technical field, etc.)

- Master's degree in mathematics or physics
- Engineering degree with a background in computer science and mathematics or physics

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

Voir offre publiée sur le site emploi d'Orange :

<https://orange.jobs/jobs/v3/offers/134513?lang=fr>

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.