

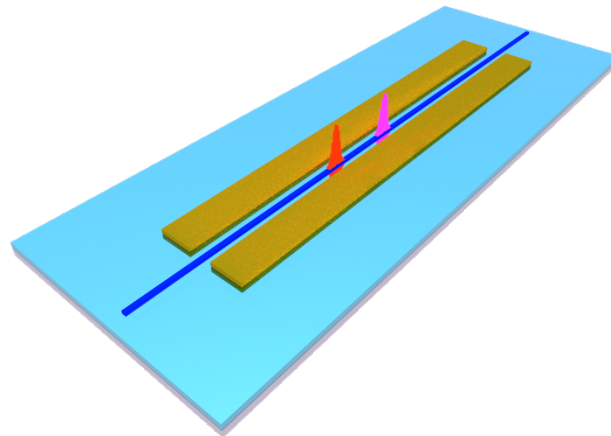
Job title

PhD. Student position in *Cavity quantum electrodynamics in integrated photonics*.

Your mission

The Hybrid Photonics Laboratory at EPFL is seeking for talented and motivated candidates to work in Integrated Quantum Metrology at cryogenic temperatures as part of EU-wide training network [SPARKLE](#). We aim to understand which role vacuum fields play in shaping material properties.

Cavity confined electromagnetic fields have long been a useful tool to establish correlations between otherwise uncorrelated two-level systems through their coupling to the vacuum cavity field. Since in-situ observation of the electromagnetic field and its correlation has long been very challenging, the effect has been rather quantified by read-out of the state of the matter part. Only recently, integrated photonic circuits have enabled for the first time sampling of electromagnetic waves on at-will controlled sub-cycle spatio-temporal scales in the terahertz frequency range by means routing of optical probes



along well-defined waveguides (with well-defined linear and non-linear properties) into highly confining terahertz elements. These not only strongly enhance the vacuum field and therefore any light-matter interaction, but also can be geometrically constructed such that they strictly delimit the probed space-time volume. In this project, you will leverage brand-new terahertz-optical integrated chips to

1. Study their quantum optical properties and
2. Apply them to the investigation of long-range correlations in light matter systems.

As a successful candidate of a dynamic team, you will shape the future of photonics-based quantum science and technology. You will develop first-of-their kind hybrid platforms that enable complex metrology functions, quantum sensing or quantum spectroscopy.

You will help kick off diverse aspects of the experimental effort: technical (setting up an optical measurement setup design inside a dilution refrigerator, including design of high-frequency electronics and custom-tailored mechanical components) and conceptual (develop the theory of quantum measurement and generation schemes, explore measurement precision limits as well as advantages of quantum light for sensing).

In the lab, you will learn about integrated and free-space quantum optical technologies and engineering, and nonlinear optics. You will contribute to the automatisisation of measurement routines, comprehensive characterisation of fabricated samples and to bridging the area of microwave/terahertz-optical science and technology with the most modern integrated photonic techniques.

Main duties and responsibilities include

- Develop miniaturised cryogenic optical setups inside a dilution refrigerator, together with their driving software/hardware, automatize measurement procedures.
- Develop and invent novel hybrid optical-microwave/terahertz electronics nanostructures and integrated photonic circuits, using simulations software.
- Characterize samples in the lab.
- Model your experimental findings from first principles in Python for example.
- Write scientific publications, file patents, disseminate work at national and international conferences.
- Maintain collaborations and deliver periodic reports that describe your progress within the project.

Your profile

- Physics background, strong interest in quantum optics and integrated photonics, nonlinear optics, high-frequency electronics, quantum metrology and/or electro-optic transduction are mandatory. Prior experience in any of these fields is a plus, but not mandatory. More important is the interest to learn and drive this as a young scientist in a world-wide research community.
- Knowledgeable in (or interest to learn) Python, Matlab, Labview, Inventor, Illustrator, CST Microwave studio and Comsol.
- Enjoy thinking about difficult problems and solving them step by step.
- Hands-on attitude and an interest for taking on new challenges are mandatory for this new group. In return, you get to witness setting up experiments from scratch!
- Enjoy collaborations with various other scientific groups, take on a leading junior role in international teams.

We offer

- A unique opportunity to contribute and take on entirely new avenues in the field of quantum photonics in a young and dynamic team.
- Excellent infrastructure through the [cleanroom at EPFL](#), the Lausanne center for ultrafast science, and the Quantum Science Center at EPFL
- Competitive salary, coverage of conference costs, a dynamic and inspiring scientific community.

Start date :

1. July 2025 or later till fall

Work rate :

100%

Duration :

(si CDD)

Contact : *(optional / warning : it may trigger a high number of contacts as well as job applications sent outside the e-Recruitment platform)*

To apply for this position, please send your CV and transcript of records (Bachelor and Master) to Prof. Cristina Benea-Chelmsu at cristina.benea@epfl.ch. The position will remain open until filled, and we'll start revising applications from 01.04.2025. It is highly indicated that you write a short statement (max. one page) where you outline why you want to join this group, what your specific interests are, how your skills can contribute to the mission of the lab and how you think you can advance in your own academic/scholarly pursuit while being a part of the Hybrid Photonics Laboratory. PhD. Candidates will need to apply/have applied to the Doctoral School at EPFL (if needed, details will be provided after a successful candidate was selected). Learn more about us at our [EPFL](#) website.