Master's Internship – Fiber-Integrated Quantum Light Sources

Quantum Emitters Coupled to Optical Nanofibers

LKB – NanoOptics Group

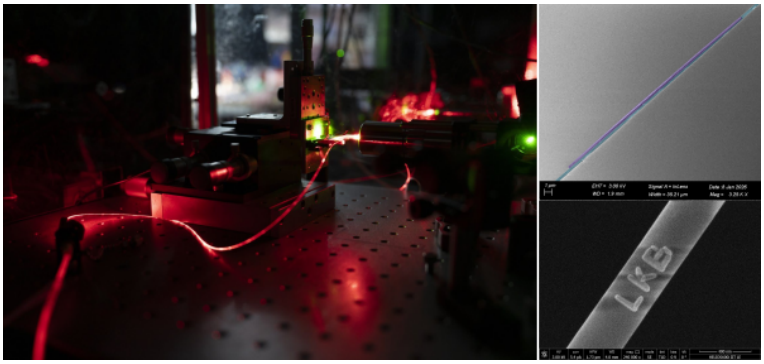
Possibility of continuation towards a PhD

Institution: Laboratoire Kastler Brossel (CNRS, Sorbonne University, ENS-PSL)
Team: NanoOptics Group – Hanna Le Jeannic, Alberto Bramati and Quentin Glorieux
Location: Jussieu Campus, Paris, France
Duration: 4–6 months **Starting date:** Flexible (2027)
Website: lejeannic.quantumoptics.fr

Quantum Light-Matter Interfaces at the Nanoscale

Efficiently interfacing quantum emitters with optical fibers is a key challenge for quantum technologies. Beyond single-photon generation, coupling an emitter to a one-dimensional waveguide enables **strong light-matter interactions at the single-photon level**, where a single emitter can modify the propagation and quantum statistics of light [1, 2, 3].

Our group develops **hybrid interfaces combining solid-state quantum emitters and tapered optical nanofibers**. These ultrathin fibers (typically 300 nm in diameter, transmission $> 98\%$) collect photons directly into a guided optical mode, providing a compact, low-loss and fiber-compatible platform. Our recent work includes nanocrystal single-photon sources [4, 5], emitter positioning on nanofibers [6], and plasmonic nanostructures fabricated directly on the fiber surface [7].



Internship Project

The student will contribute to the development of a **fully fiber-integrated quantum light source** based on individual solid-state emitters coupled to tapered optical nanofibers.

The internship will combine hands-on experimental work with fundamental quantum optics. Depending on the student's background and interests, the project may focus on one of the following directions:

- **Strong light-matter coupling:** Explore ways to enhance emitter-waveguide interactions using hybrid photonic-plasmonic structures integrated onto nanofibers.
- **High-quality single-photon emission:** Characterize quantum emitters and investigate their optical properties, including at cryogenic temperatures.
- **Quantum nonlinear optics:** Study photon correlations and the interaction of individual photons with quantum emitters in one-dimensional waveguides [2, 3, 8].
- **Nanoscale sensing:** Explore the use of nanofiber evanescent fields for sensitive optical measurements, including Raman spectroscopy and magnetic-field sensing.

The precise internship topic will be defined together with the student, taking into account their interests and previous experience.

Training and Research Activities

The student will work closely with researchers and PhD students in the group and receive training in experimental quantum optics. Depending on the project, activities may include:

- Building and aligning optical setups, including lasers, detectors and optical fibers.
- Fabricating and characterizing tapered optical nanofibers and hybrid nanostructures.
- Performing optical spectroscopy and single-photon measurements.

- Analyzing experimental data and performing numerical simulations.
- Participating in group meetings and scientific discussions.

The internship offers an opportunity to gain practical experience in a research laboratory and contribute to an ongoing scientific project.

Candidate Profile

We welcome applications from **Master's students (M2 or equivalent)** in physics, quantum optics, photonics, nanoscience or related fields.

An interest in experimental physics and quantum technologies is essential. Previous experience in optics, programming (Python), laboratory work or numerical simulations is appreciated but **not required**.

We particularly value scientific curiosity, motivation, teamwork and a willingness to learn.

Research Environment and PhD Opportunities

The NanoOptics group at Laboratoire Kastler Brossel (Paris, Jussieu Campus) offers an international research environment in quantum optics and nanophotonics, with access to advanced experimental facilities.

This internship can serve as **the first step towards a PhD in our group**. We are particularly interested in students motivated to continue developing this research over the longer term.

We are a group of friendly and welcoming scientists and aim to create **an inclusive and supportive research environment**. We strongly believe in the value of diversity and inclusion in quantum physics and encourage **women and individuals from underrepresented groups** to apply.

Applications

To apply, please send a **CV, a short motivation letter and academic transcripts** to **hanna.le-jeannic@cnrs.fr**.

Please indicate your preferred internship dates and whether you would be interested in pursuing a PhD afterwards.

Informal inquiries are welcome.

References

[1] H. Le Jeannic, T. Ramos, S. F. Simonsen, T. Pregnolato, Z. Liu, R. Schott, A. D. Wieck, A. Ludwig, N. Rotenberg, J. J. García-Ripoll, and P. Lodahl. Experimental reconstruction of the few-photon nonlinear scattering matrix from a single quantum dot in a nanophotonic waveguide. *Physical Review Letters*, 126:023603, 2021. doi:10.1103/PhysRevLett.126.023603.

[2] H. Le Jeannic, A. Tiranov, J. Carolan, T. Ramos, Y. Wang, M. H. Appel, S. Scholz, A. D. Wieck, A. Ludwig, N. Rotenberg, L. Midolo, J. J. García-Ripoll, A. S. Sørensen, and P. Lodahl. Dynamical photon–photon interaction mediated by a quantum emitter. *Nature Physics*, 18:1191, 2022. doi:10.1038/s41567-022-01720-x.

[3] M. Staunstrup, A. Tiranov, Y. Wang, S. Scholz, A. D. Wieck, A. Ludwig, L. Midolo, N. Rotenberg, P. Lodahl, and H. Le Jeannic. Direct observation of a few-photon phase shift induced by a single quantum emitter in a waveguide. *Nature Communications*, 2024. doi:10.1038/s41467-024-51805-9.

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[5] M. D'Amato, N. Fu, Q. Glorieux, E. Giacobino, H. Le Jeannic, S. Ithurria, E. Lhuillier, and A. Bramati. Room-temperature efficient single-photon generation from CdSe/ZnS nanoplatelets. *ACS Nano*, 2025. doi:10.1021/acsnano.5c01971.

[6] S. Pierini et al. Highly photostable perovskite nanocubes: toward integrated single photon sources based on tapered nanofibers. arXiv:2005.09359, 2020.

[7] A. Balena, M. D'Amato, M. F. Kashif, C. Ding, L. Belzane, G. de Marzo, H. Le Jeannic, M. De Vittorio, F. Pisanello, and A. Bramati. Deterministic fabrication of plasmonic nanostructures on optical nanofibers via blurred electron beam deposition. *Advanced Science*, 2025. doi:10.1002/advs.202507004.

[8] N. V. Hauff, H. Le Jeannic, P. Lodahl, S. Hughes, and N. Rotenberg. Chiral quantum optics in broken-symmetry and topological photonic crystal waveguides. *Physical Review Research*, 4:023082, 2022. doi:10.1103/PhysRevResearch.4.023082.