PhD on Quantum Nano-Photonics with 2D Materials

The 2D+ Research Group at CRHEA – located in the French Riviera (Côte d'Azur) near Nice, France – is seeking a highly motivated and skilled student to join our cutting-edge research in quantum nano-photonics. This internship offers a unique opportunity to work on foundational quantum technologies, with a clear pathway to extend the project into a funded PhD position as part of the ANR project "NEAR-2D."

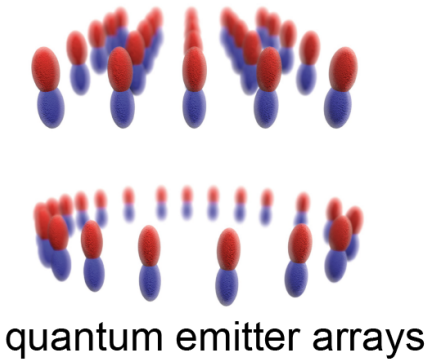
Research Focus

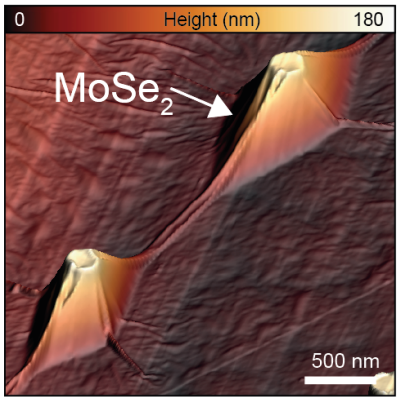
The primary objective will be **coupling two quantum emitters** using 2D materials like $MoSe_2$. This initial project will serve as the foundation for further exploration of **quantum emitter arrays** during the PhD. By leveraging **near-field interactions and quantum collective effects**, this work aims to pave the way for new methods of controlling light-matter interactions at the nanoscale.

As part of the PhD, the candidate will expand this research by creating **sub-λ arrays of quantum emitters** and exploring **quantum collective effects** like sub-radiance and super-radiance, which have vast potential in nano-photonics and quantum technologies.

Facilities and Equipment

Our **state-of-the-art cryo-optics lab** covers 100m² and includes cutting-edge tools such as a fully functional cryostat for **micro-photoluminescence, reflection spectroscopy and single-photon statistics measurements**. We also have a fully equipped **FabLab** dedicated to building custom van der Waals heterostructures, which are essential for the assembly of quantum devices. These advanced facilities will enable the intern to directly contribute to groundbreaking experimental research.





Responsibilities

- Perform literature review, experimental planning, and data analysis on coupling two quantum emitters.
- Develop experiments to control single-photon sources in 2D semiconductors, focusing on precise near-field interactions.
- Contribute to developing and optimizing 2D quantum devices in the cryo-optics lab.
- Progress towards the creation of quantum emitter arrays.
- Investigate quantum collective effects such as super-radiance and sub-radiance in 2D materials.
- Advance towards developing new applications in quantum photonics, entanglement manipulation, and integrated quantum technologies.
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Desired Skills and Qualifications

- Currently enrolled in a Master's degree (or equivalent) in physics, photonics, or condensed matter.
- A strong interest in quantum photonics, nanofabrication techniques, and experimental physics.

- Familiarity with Python, Arduino/robotics, 3D printing is a plus, though not required.
- Excellent organizational and communication skills, with a collaborative mindset.
- A strong desire to pursue a PhD in quantum nano-photonics and contribute to long-term research goals.

Opportunities for Professional Growth

- Present your research findings at international conferences and publish in high-impact peer-reviewed journals.
- Collaborate with leading researchers in quantum photonics, both within CRHEA and internationally.
- Gain hands-on experience in a well-equipped cryo-optics lab and FabLab, acquiring skills that are critical for a successful academic or industrial career in quantum technologies.

How to Apply

Interested candidates are encouraged to send a CV, cover letter, and academic transcript to Dr. Antoine Reserbat-Plantey (arp@crhea.cnrs.fr). For further details on the project opportunities or other projects in the team, do not hesitate to get in touch.

References:

- **Quantum Nanophotonics in Two-Dimensional Material**s. A. Reserbat-Plantey *et al.* ACS Photonics. 2021
- **Valley-hybridized gate-tunable 1D exciton confinement in $MoSe_2$**. M. Heithoff *et al*. ACS Nano. 2024
- **Strain Superlattices and Macroscale Suspension of Graphene Induced by Corrugated Substrates**. A. Reserbat-Plantey *et al*. Nano Letters. 2014
- **Large-scale quantum-emitter arrays in atomically thin semiconductors**. C. Palacios-Berraquero *et al*. Nature Comm. 2017
- **Exponential Improvement in Photon Storage Fidelities Using Subradiance and "Selective Radiance" in Atomic Arrays**. Asenjo-Garcia et al. PRX 2017.