

PhD Proposal

at the Institut de Physique de Nice
CNRS & Université Côte d'Azur

Integrated Solid-state quantum memories

Experimental work / Starting date: Autumn 2026

Context.— Rare-earth ion-doped crystals constitute a unique platform to implement a wide variety of protocols for storage and manipulation of photonic quantum information. This is notably due to their record coherence properties and the scalability they offer. Storage time of the order of one hour could be demonstrated with ‘non-Kramers’ ions, with a protocol opening the way to frequency multiplexed storage: the atomic frequency comb. The solid-state nature of the platform enabled the development of integration methods, which to date all alter the coherence properties with respect to bulk measurements.

Objectives.— The objective of this thesis is twofold:

- Develop a fabrication protocol for integrating ridge waveguides in rare-earth ion-doped yttrium orthosilicate (YSO) crystals.
- Identify optimal magnetic conditions to implement spin-wave storage of quantum states of light in a Praseodymium-doped yttrium orthosilicate crystal.

In order to reach these objectives, the work will rely on a currently developed fabrication protocol, which allowed us to bond YSO crystals to silica substrates (project funded by an ANR JCJC program, see figure for a world first realization). The samples will then be cooled down to $<4\text{K}$ for spectroscopic characterization in an in-house built cryostat. The magnetic study will be conducted in collaboration with theoretician researchers from INRIA-Ljad.



Work environment.— The PhD will be done at the Institut de Physique de Nice. The applicant will work in the team ‘Quantum Information and Photonics’, a world-wide renowned team in quantum photonics. This project will be done within the program ‘Matériaux Innovants’ of IdEx, **ensuring funding for the PhD**. The experiment is also part of the PEPR Quantique via the project Qmemo, ensuring a favorable environment for purchasing both equipments and consumables.

Required background.— The applicant should have a solid background on quantum physics, in particular in light-matter interaction, quantum optics and non-linear optics. An experience in experimental optics would be a strong asset.

Contacts.— Applicants must send a CV and a motivation letter to Jean Etesse :
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Scientific advisor of the PhD will be Sébastien Tanzilli :
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