SPECIFICATION SHEET

CONSULTANCY SERVICE FOR THE “STUDY ON THE TECHNICAL FEASIBILITY AND PROPOSAL OF A DESIGN FOR A QUANTUM MEMORY UNIT” FOR ICFO, THROUGH SIMPLIFIED OPEN PROCEDURE

FILE NUMBER: 2025.SE.002

Contents

CLAUSE 1. Object of the contract

Performing a multi-faceted technical investigation on the feasibility of a compact quantum memory unit based on cryogenically cooled rare-earth doped crystal.

CLAUSE 2. Needs to be satisfied with the contracting

ICFO develops quantum memories based on solid-state rare-earth doped crystals. The current design, based on bulk crystals addressed optically in free space, allows only one or two independent quantum memory crystals to be placed in a single cryostat. The goal of the requested study is to test the feasibility and propose a design for a miniaturized cavity enhanced quantum memory unit allowing the placement of many independent units in a cryostat, ensuring optimal cooling, vibration isolation, electromagnetic shielding and negligible cross talk.

CLAUSE 3. Technical specifications

- The study should focus on the technical feasibility and propose a design for a quantum memory unit featuring the following specifications:
    - The unit should be designed as a stand-alone device, able to store light at the quantum level and release it in an on-demand fashion, for long storage times and with high efficiency.
    - The quantum memory should be based on a short rare-earth doped crystal, cooled to <3.5 K in a closed loop cryostat, where the Atomic Frequency Comb protocol is implemented.
    - The setup should be optically compact, providing optical access for three beams: the input light, the AFC preparation and the on-demand operation. All beams should overlap at the memory.
    - The input light path should include an optical cavity, with the crystal at the centre, which is impedance matched to the losses of the crystal for high-efficiency storage.
    - The unit should be able to perform full electromagnetic control over the memory, delivering RF pulses at 10 MHz to perform dynamical decoupling and applying a weak static magnetic field (<10 mT) to extend the coherence time of the memory.
- The study should identify potential conflicts between requirements, providing a cost-and-benefit analysis for all specifications and provide a final design for the agreed configuration.
- The study will not cover the principles of storage of quantum light in a crystal, but only the effects of the new design on such principles. Because of this, the report should be written in collaboration with the group at ICFO, which will provide additional information and insight into the operation of the quantum memory, and could identify priorities and minimal working specs.
- The progress will be monitored in monthly meetings between the contracted company and ICFO.
- The conclusions of the study will be delivered as a written report.
- **The provider of the study should have proven a minimum of 5 years' experience** in the relevant fields, including cryogenics, electrical engineering and mechanical engineering, as well as experience in projects involving quantum technologies.
- **At least one member of the staff assigned to the study should have proven a minimum of 5 years' experience** in multidisciplinary projects including cryogenics, electrical engineering and

mechanical engineering, as well as experience in projects involving quantum technologies. **Additional years of experience will be evaluated positively as stated in the Annex núm. 2.**

- The study should target these additional mandatory requirements:
    - Cryogenic operation: the unit should be designed for inclusion in a closed-cycle cryostat, with the sample space reaching a temperature < 3.5 K. The sample should maintain operation through many cooling and warming cycles. Vibrations in the 1-50 kHz should be particularly suppressed.
    - Mechanical isolation: the unit, especially the rare-earth doped crystal, should be mechanically isolated, with passive vibration damping.
    - Fibre coupling: all beams should be fibre-coupled, with coupling efficiency and focusing positions robust to thermal cycling.
    - Electromagnetic shielding: the unit should be shielded from electromagnetic noise, both static and dynamic. The electro-magnetic fields generated by the RF pulses should not leak out of the module. This is to ensure that many units can be placed next to each other, with unchanged performances.
- The rights to exploit the intellectual property associated with the study to be conducted by the successful bidder will belong to ICFO.
- Likewise, prior to the start of the study, the successful bidder must sign a non-disclosure agreement with ICFO, which will regulate the confidentiality obligations between the parties.

CLAUSE 4. Duration of the contract

The report must be delivered at ICFO within a maximum period of 18 weeks from the formalization of the contract. Without prejudice to the above, the deadline of the contract will be 15th March 2026.

In the event that this date is exceeded, the contract will be automatically terminated, without the contractor being able to claim from ICFO any concept linked to the contract.

CLAUSE 5. Target price

125.000,00 EUR (VAT excluded).

Castelldefels, on the date of its digital signature

Prof. Dr. Hugues de Riedmatten
GL Quantum Photonics with Solids and Atoms