ICFO

PLIEGO DE PRESCRIPCIONES TÉCNICAS

SUPPLY, INSTALLATION AND STARTING-UP OF A SUPERCONDUCTOR NANOWIRE SINGLE-PHOTON DETECTION SYSTEM FOR THE OPTOELECTRONICS GROUP

NÚMERO D'EXPEDIENT:

Unió Europea
Fons Europeu
Next Generation
Pla de Recuperació, Transformació i Resiliència
Next Generation Catalunya
Generalitat de Catalunya
Departament de Recerca i Universitats

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1. Justificació de la necessitat

ICFO Optoelectronics Group (OptoGroup) needs new single-photon detectors to perform a variety of experiments in the field of secure quantum communications. For new planned experiments in high dimensional quantum communications, several new detectors are needed, with high quantum efficiency, short dead time and jitter, and low dark count rate. Therefore, the acquisition of new detectors will then allow to perform simultaneously several independent experiments ranging from high-dimensional multiplexed quantum communications to high-dimensional quantum distillation and high-dimensional quantum key distribution. Related measurements are based on parallel two-photon coincidence detections at very low levels of light, and more critical, under high transmission losses. For these reasons, superconductor nanowire single-photon detectors (SNSPDs) are needed. In the following lines minimum requirements for SNSPDs are described.

2. System overview

SNSPDs will be used to detect quantum light, which comprises single-photon states, but also various quantum correlations between these ones. The system must provide a reliable and fully equipped platform, having:

1. Performance
2. Operation
3. Power, consumables and safety
4. Transportation, installation and start-up
5. Training
6. Documentation
7. Tools and system spares
8. Warranty and support
9. Additional optional improvements
10. Technical proposal structure

3. Performance

List of essential requirements:

3.1. One SNSPD detection module, 1 cryostat, 1 vacuum compressor, additional electronics drivers and software/controllers for full operation.

3.2. The cryostat must have a total of 20 accessible channels and a 24/7 continuous operational system. The cryostat must be air-cooled.

3.3. For the detection module, only 8channels optimized for 1550 nm are requested with installed SNSPDs.

3.4. The detection efficiency of each SNSPD must be above 85% at 1550 nm.

3.5. The dark count rate of each SNSPD should not be higher than 100 Counts per second (Cps).

3.6. The temporal jitter of the SNSPD should be equal or lower than 40 ps.

3.7. The maximum count rate of each SNSPD should at least reach 5-10 Mcps.

3.8. All modules must have an optical input entry FC/PC or FC/APC, that will be determined in the future.

3.9. For each SNSPD channel, deadtime must be smaller than 80 ns.

3.10. All proposals must include a bias current to tune the dark count rate an efficiency.

3.11. Each SNSPD channel output must be accessible through SMA ports and compatible with time-tagger systems.

3.12. The cryostat must work in continuous mode and with no external consumables apart from electric current. Water cooling is not an option.

4. Operation

List of essential requirements

4.1. Communication with a PC station must be provided through standard ports (USB and/or Ethernet).

4.2. Each SNSPD channel needs to have a remote turn on/off option and control of the bias current through a GUI.

4.3. An initial report with the characterization of the optimal values for each independent SNSPD needs to be prepared and delivered by the awarded company. The report needs to at least include bias current values, for the optimal dark counts and efficiency values.

4.4. A process qualification guide must be provided so users can test the equipment performance periodically.

5. Power distribution and safety

List of essential requirements:

6.1. Power system compatible with standard Spanish voltages, frequencies and configurations and with all Spanish laws and regulations.

6.2. CE marking.

6.3. Appropriate hardware and software safety interlocks. Extended error diagnostics.

6.4. The equipment must be protected in case of unexpected power cuts, providing a safe Cryostat warmup and SNSPDs deactivation.

6.5. The equipment must provide diagnostic tools to verify the proper functioning after power cuts.

6. Initial transportation, installation and start-up

List of essential requirements:

7.1. The proposal will include transportation to ICFO's facilities and all export/import and customs duties.

7.2. The equipment will be placed in the selected location by ICFO. Contract winner will cover all costs, organization and coordination of machine placement, including any required specialized equipment or vehicle, and any required component dis-assembly and re-assembly for systems unloading and transportation inside the building, following the route specified by ICFO. Depending on the size and weight of the equipment, disassembly of the system might be needed for better transportation before installation. If that is not possible, transportation route inside ICFO building will be established according to the indications given by ICFO. The contract winner will be responsible for taking accurate measurements of the route and plan in advance any required component dis-assembly and re-assembly.

7.3. The contract winner will be responsible for checking the selected location and for taking any required measurements to guarantee the suitability of it for the offered system, for instance in terms of temperature dissipation from the cryostat/compressor system. The compatibility with the operation of the systems already installed in the lab and the mobility of users will have to be guaranteed as well.

7.4. Installation and start-up of the system, including system checking, functional tests and process qualification.

7.5. The contract winner will be responsible for the removal and proper disposal of the packaging when the machine is delivered and unpacked, or its storage during the warranty period in case the original packaging needs to be kept.

7. Documentations

9.1. Complete set of manuals, drawings, schematics and layouts about system assembly and configuration.
9.2. Complete systems user manual, including routine servicing, troubleshooting and basic repairs.
9.3. Systems components spare list, specifying quantity, manufacturer, part number, etc.
9.4. All the above documentation will be supplied in English, in electronic format (USB drive) and in paper copy.

8. Warranty and support

10.1. A 2-year full warranty, starting at system acceptance. The warranty will include the replacement of any faulty or damaged part(s) during the normal use of the system, no matter the manufacturer of the component(s). It will cover any cost related with the disassembly, transportation, reparation and re-assembly of the damaged component(s), including all travelling and living costs of the required service engineer(s). An on-site repair, or a justified alternative to reduce the system down time to the minimum, will always be the first service option. A team of properly qualified and skilled service engineers will have to be available. It will also cover the costs and the maintenance related to the machine move and installation on the new building.
10.2. System lifetime support:
- By phone and e-mail with a response within 48 hours (within warranty period).
- During the warranty period, upon a system breakdown, Service visits can be arranged upon mutual agreement with the Engineers team: warranty repair of broken detectors or electronics channels will be provided within 30 days, unless the issue was caused by system misuse, which could require a more sophisticated maintenance/repair.

10.3. Spare parts will be available during, at least 10 years after system supply.
10.4. An estimation of the cost of a warranty extension after warranty period will be included.

9. Additional optional improvements

The equipment must provide access for potential upgrades, comprising the replacement of individual SNSPDs without affecting other channels, the addition of more SNSPDs within the cryostats up to 20 total units, and the replacement of the optical fibre channels.

10. Delivery time

The entire equipment must be delivered than no later than December 2025.

11. Technical proposal structure

The proposal has to follow as much as possible the structure of this technical requirements document to facilitate evacuation. Any optional accessories not included in the proposal will have to be put in a separate section and not mixed with the included items.

12. Financing

This equipment was supported by Complementarias.

13. Target price

- 210.000 euros (VAT excluded)

Castelldefels, a fecha de su firma digital

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