Redefining Measurement

# Use Case: Research Institute

## ID281 Cryostat at 0.8K used for detection of photon triplets

MAX-PLANCK-GESELLSCHAFT

**Customer Name:** Max-Planck Institute for Light

**Research Field:** Quantum Optics

**Country:** Germany

| Customer need | Solution | Results |
|---|---|---|
| Reliable cryogenic system to cooldown detectors for Three-fold coincidences measurement | ID281 Cryostat at 0.8K | The preliminary results show Three-fold coincidences from a thermal source |

### Business need

The Max Planck Institute for the Science of Light (MPL) focuses on basic research into all aspects of the interaction between light and matter, from modern optics to photonics, quantum effects and their applications in the “real” world.

One of their ambitious project was on the generation of photon triplets through the direct decay of pump photons. This is a new nonlinear effect, highly desirable in quantum optics as it produces a state of light with extremely counter-intuitive properties like negative quasi-probability.

Although a subject of active search by several groups worldwide, the effect has not been observed so far due to its very low efficiency. Its observation requires detection of coincidences between the clicks of three single-photon detectors, which are few and can be easily masked by dark noise.

### Solution

The institute chose IDQ’s ID281 Cryostat and placed broadband superconducting nanowire detectors into it, providing high quantum efficiency and very low dark noise. The ID281 cryostat, opers at 0.808K and it is consequently remarkably stable (±0.002K) for the whole duration of the measurement: ~24h with running detectors or ~36/40h with detectors off.

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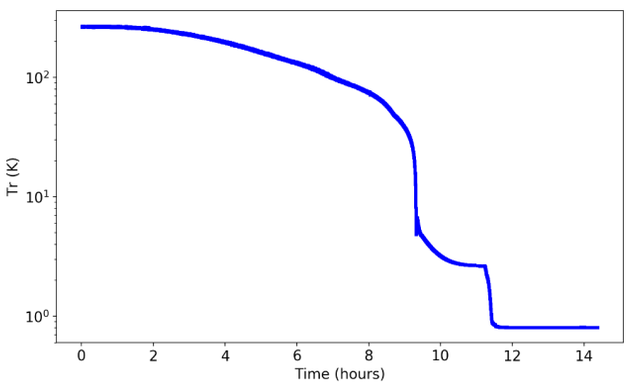
# Use Case

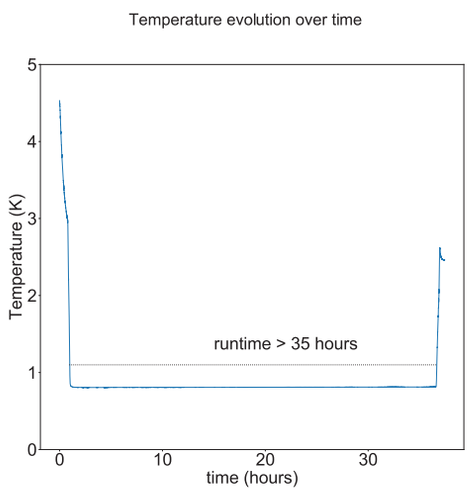
The actual advantage of the Cryostat is that In the sorption, the Helium cycle enables the refrigerator to keep a temperature stability of 0.5mK around a base temperature of 0.8K.

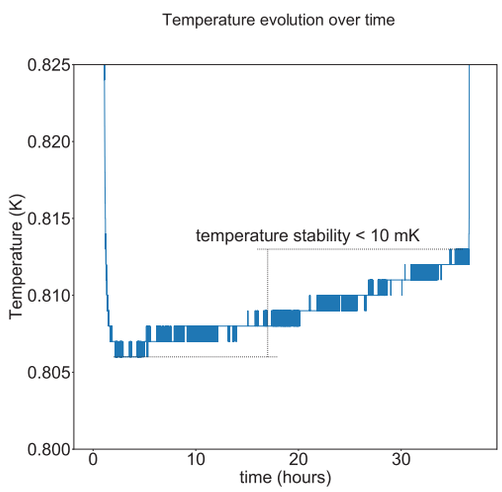
ID Quantique also provides intuitive software (Java based) to control the operation of the cryostat, in particular to schedule and control the evaporation and condensation cycles.

The cooling is managed by a proprietary software that monitors and controls the temperature cycling. The user can command the system to reach 0.8 K on-demand, and then to re-cool automatically back to 0.8 K as soon as the previous cycle completes. Alternatively, the system can be programmed to re-cycle at a predetermined time each day. The recycling time is 1.5 to 2 hours. In this way, the system can be guaranteed to be at 0.8 K during the working hours.




Cool down time < 12 Hours : Tr (K) closed-cycle 4He sorption cryocooler temperature VS time

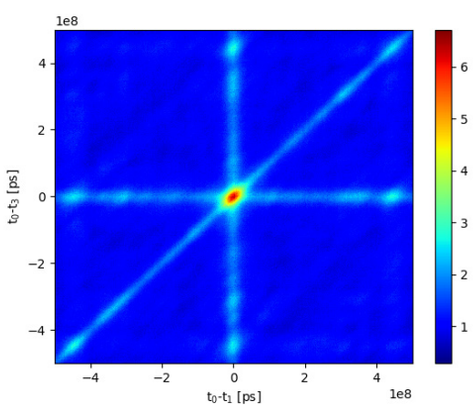



## Results

The Institute chose IDQ's ID281 Cryostat and successfully measured the normalized rate of three-fold coincidences, which is shown in the figure.

The quality of this measurement is remarkable, demonstrating the exact theoretical values of 6 for the simultaneous arrival of three photons and 2 when two out of three arrive simultaneously.




*"Our institute is using ID Quantique's cryostat since more than a year and it kept its outstanding temperature since then. This enables continuous and stable performances for our experiments. Furthermore the training, aftersales support and service quality were and still are very professional ."*

Head of Research Group
Maria Chekhova

&

Doctoral Student
Andrea Cavanna



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