Redefining Measurement

Use Case: Research Institute

High brightness photon-pair source characterisation and optimisation with the ID900 Time Controller

Customer Name: The Institute of Photonic Sciences (ICFO)

Research Field: Quantum Optics or Photonic science

Country: Spain

Customer need

Measurement of photon counts and coincidences at very high rates without saturation.

Solution

ID900 Time Controller to detect up to 100 Mcps per channel with a 100 ps temporal resolution.

Results

Successful optimisation and characterisation of high brightness photon source for a quantum-enhanced microscope.

Business need

ICFO – The Institute of Photonic Sciences is a research centre devoted to the science and technology of light, focusing on fundamental research and applications. The Optoelectronics group at ICFO focuses on multi-disciplinary research to solve real-world problems and develop advanced materials, techniques and devices for the photonics industry.

One ambitious project being coordinated by the Optoelectronics group at ICFO is Q-MIC, a FET Open project of the European Commission, with the aim of building a compact and user friendly quantum-enhanced microscope to be used in real biological and materials metrological inspection tasks.

Although recent years have seen significant research efforts around the world towards developing quantum–enhanced imaging and microscopy, to date there has been no progress beyond proof-of-principle experiments. One of the main limitation of this quantum sensing technique has been associated with the availability of a very high brightness photon source. In order to characterise such a photon source it is necessary accurately measure photon counts and coincidences at very high rates without saturation. Furthermore, it will become necessary to gate experimental components at very high rates based on photo-detections.

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Solution

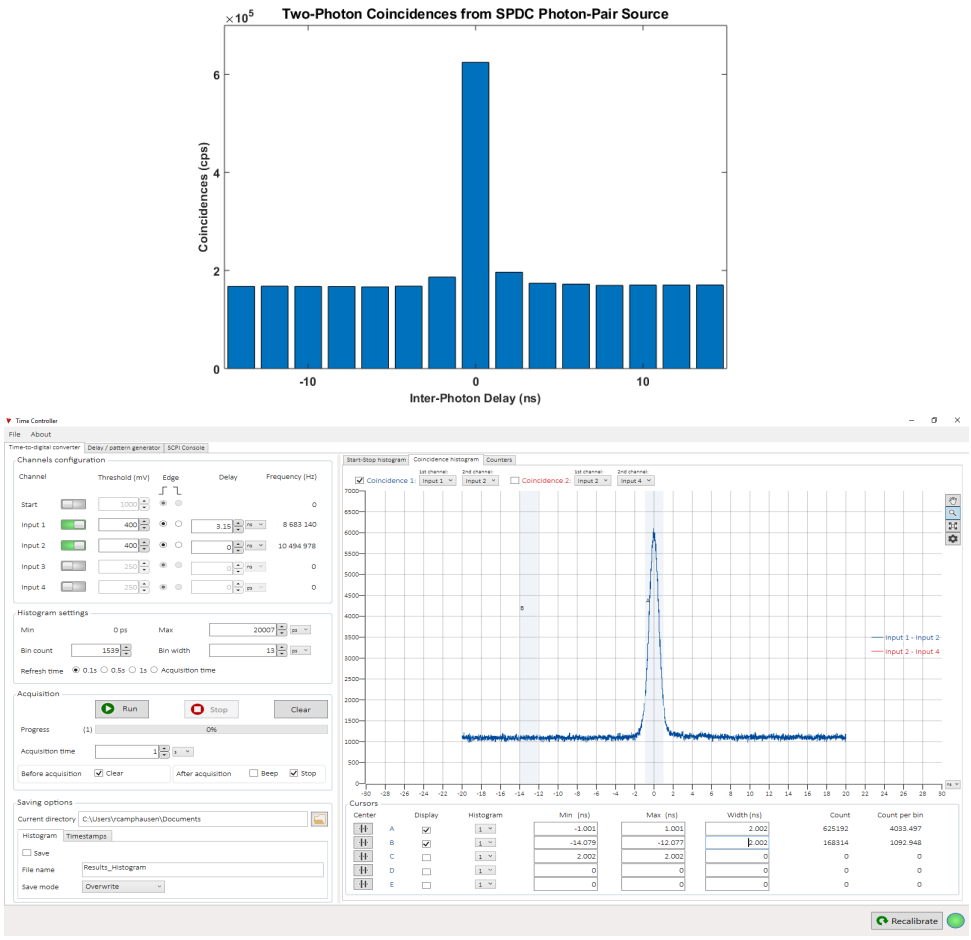
The institute chose to use IDQ's ID900 Time Controller to perform single-photon detection and coincidence counts, since the ID900 has the highest detection rate capability available on the market, being able to detect 100 Mcps per channel with a 100 ps temporal resolution in High Speed Mode. Additionally, in High Resolution Mode the ID900 has a very high temporal resolution of 13 ps. The four reconfigurable outputs can easily be used to synchronise and to provide gating signals to other experimental components.

ID Quantique has developed a very intuitive and reliable graphical user interface which allows real-time monitoring of photon counts and coincidences, which is extremely helpful for alignment of the experimental set-up and its optimization.

One of the main advantage of the ID900 Time Controller over other devices is its extremely high count rates capability, as well as the user-friendly GUI and configuration editor which can be used to set up custom user-defined coincidence or gating configurations.

Results

The IDQ ID900 Time Controller has been set up to successfully optimise and characterise the high brightness photon source to be used in the Q-MIC quantum-enhanced microscope. As shown in the figure, 6.25×10^5 two-photon coincidences per second could successfully be measured with a 2ns coincidence bin width, which when taking accidental coincidences and optical and detection losses into account indicates an extremely high original photon pair generation rate of around 10^8 photon pairs per second.



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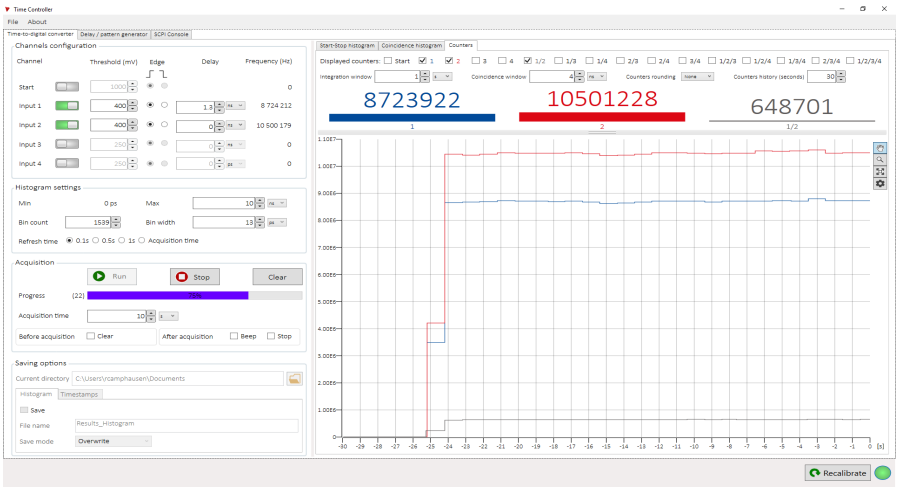
Use Case



ID900's outstanding time resolution of 13 ps (in High Resolution mode) allowed the extremely precise observation of a small wavelength-dependent photon delay in the source. This is attributed to wavelength dispersion in the set-up, causing photons of different wavelengths to propagate at different speeds. As the photon wavelength can be related to the photon source alignment, this phenomenon facilitated a more precise alignment of the source than had previously been achieved.

> *"We have been using ID Quantique's ID900 Time Controller for several months now and in this time it has already allowed us to optimise our quantum imaging experiments by enabling a more precise characterisation of our photon source, with a much higher count rates than before. Furthermore the technical support provided by ID Quantique has been extremely helpful and professional."*
>
> PhD student, ICFO
> Robin Camphausen

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