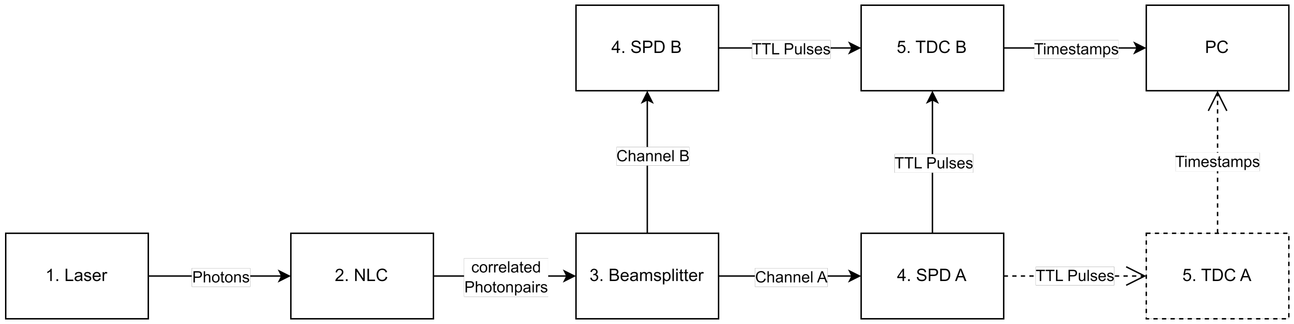
# Time synchronisation using photons

Time synchronisation is an important aspect of various modern technologies. This project focuses on improving the accuracy of persistent synchronisation mechanisms, such as GPS, by observing a special light source. The theoretical limit for the synchronisation accuracy is 162 picoseconds.




Project setup

## Preparation

The project setup is pictured above. The laser (1.) provides the necessary photons. The nonlinear crystal (2. NLC) converts single photons into photon pairs. The beamsplitter (3.) splits the incoming photon pairs onto two separate paths. Single photon detectors (4. SPD) detect the photons at the end of each path.

## Timestamping

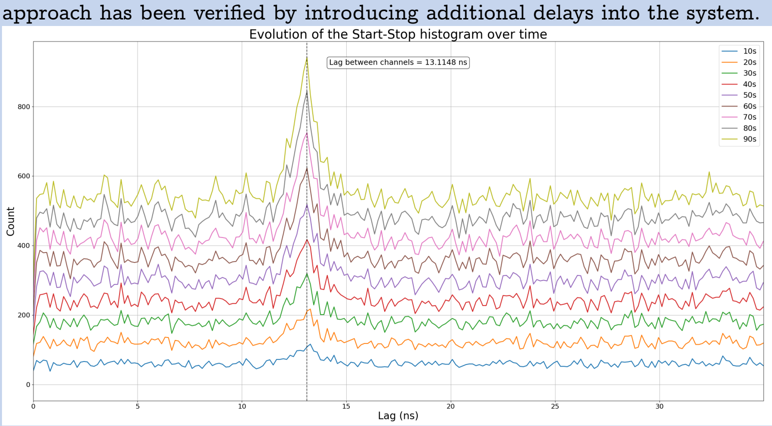
Time-to-digital converters (5. TDC) then store the arrival times of the incoming photons with an accuracy of 162 picoseconds. The timestamps are then transferred to a computer for further calculations.

## Algorithm

One of the channels is defined as start, while the other is defined as stop. The differences in arrival times are plotted as a start-stop histogram. The first iteration yields the physical delay of the system. The next iteration leads to the current delay present in the TDCs.

## Start-stop histogram

The figure below shows the time evolution of the start-stop histogram. After observing the light source for more than 30 seconds, a distinct peak appears. In this case, the peak corresponds to the physical delay present in the system. The approach has been verified by introducing additional delays into the system.




**Project Team:**
Adriano Ritzmann

**Client:**
University of Bern

**Coach:**
Prof. Dr. Christoph Wildfeuer