



Quantum Electronics Final Project Presentation

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Team #3

Deliverables

- #1: Time synchronization
- #2: SPD Statistical Analysis
- #3: Experimental Statistics and Probabilities
- #4: Comparison of The Theoretical Probabilities and The Experimental Probabilities
- #5: Apply Tasks 1-4 on The Next Part

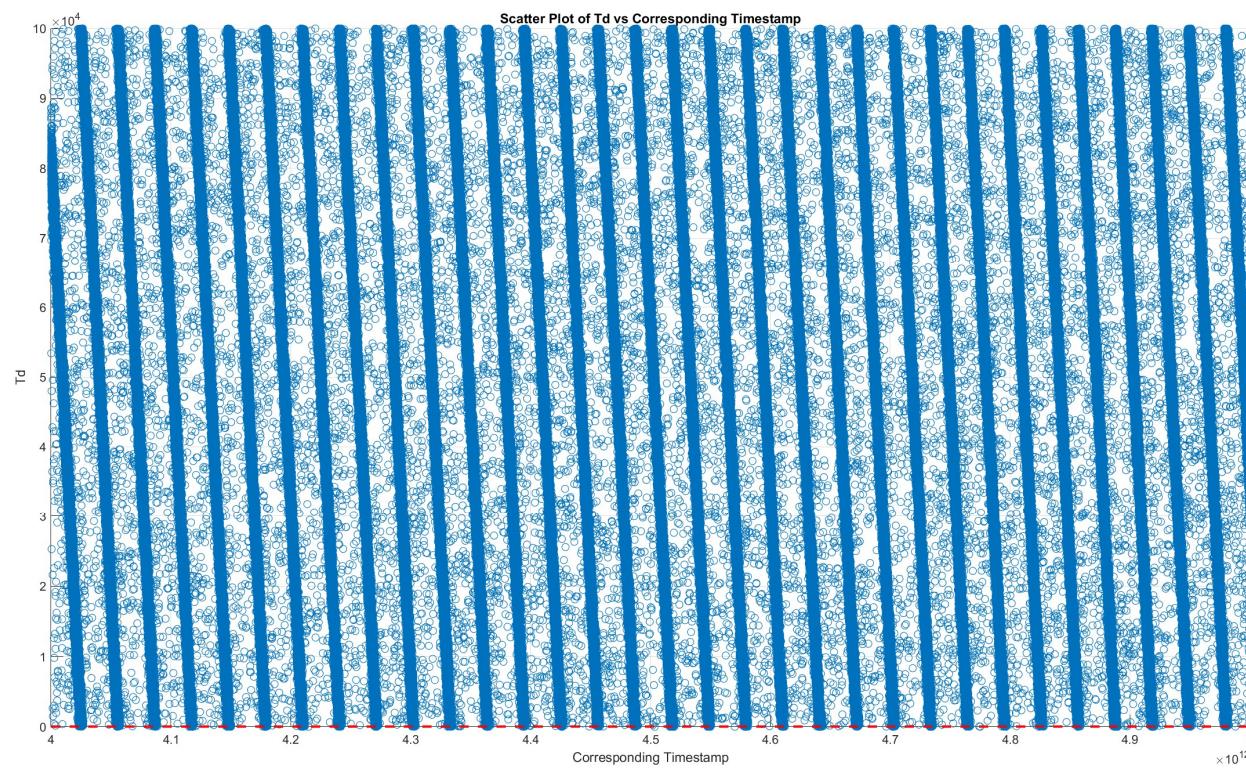
Task #1: Time synchronization

- Trep is the period of the pulses
- We need to find the exact Trep value

Trep exact = Trep given – alignment variable

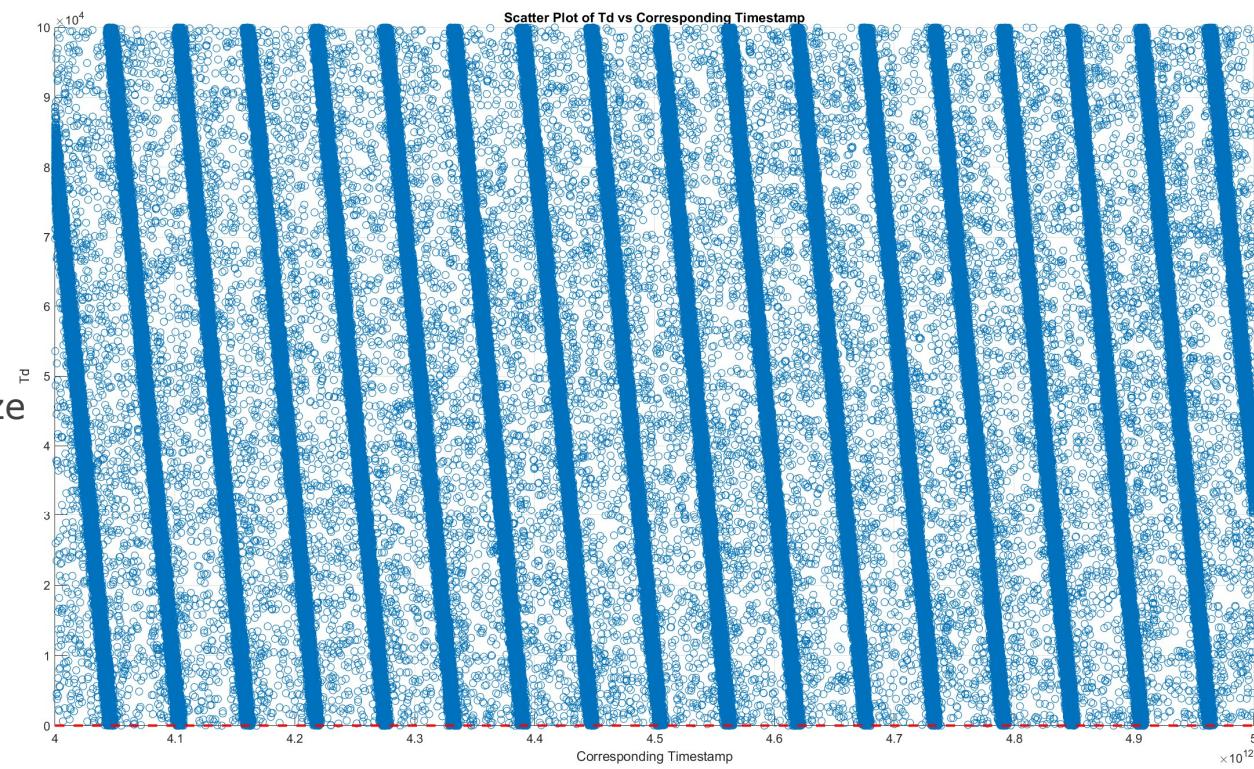
Task #1: Time synchronization – No Alignment

It is visually obvious that the signal is out of synch



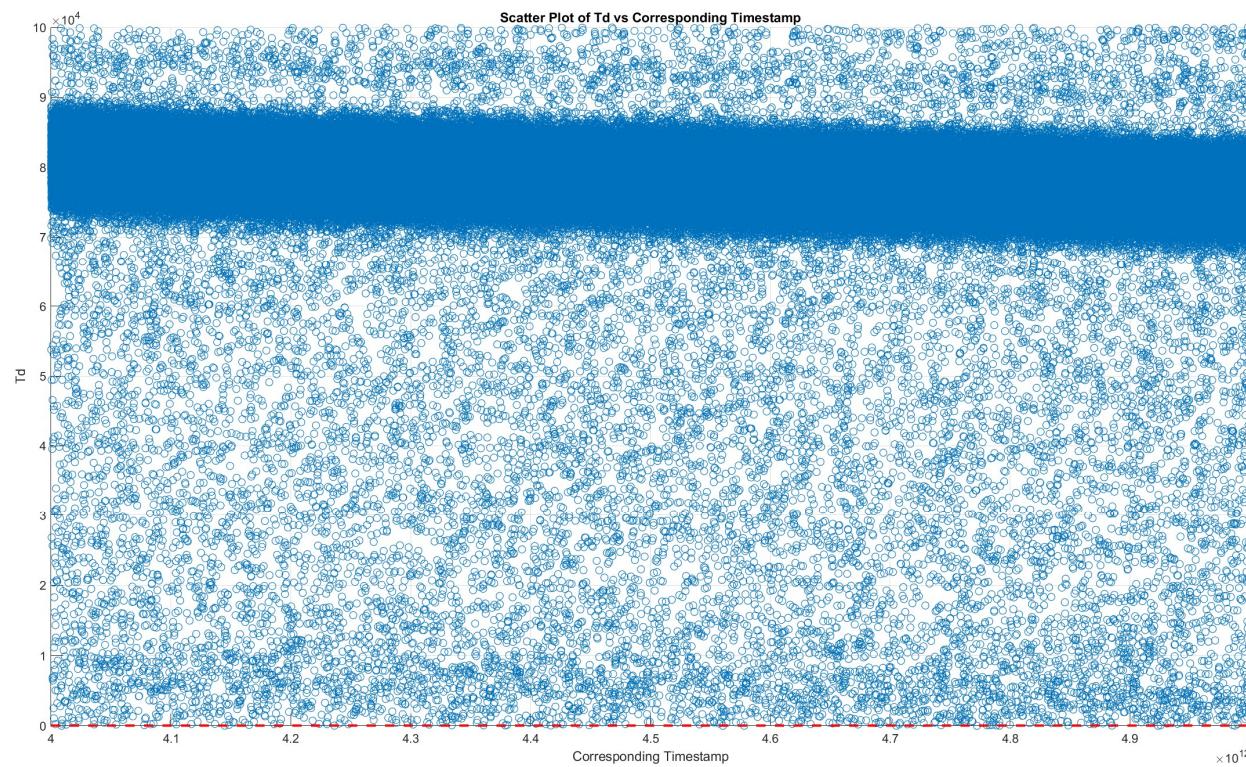
Task #1: Time synchronization – Alignment:-0.15

We started playing
with the alignment
variable to synchronize
the signal



Task #1: Time synchronization – Alignment:-0.324

Looks okay,
but we need
a fine adjustment



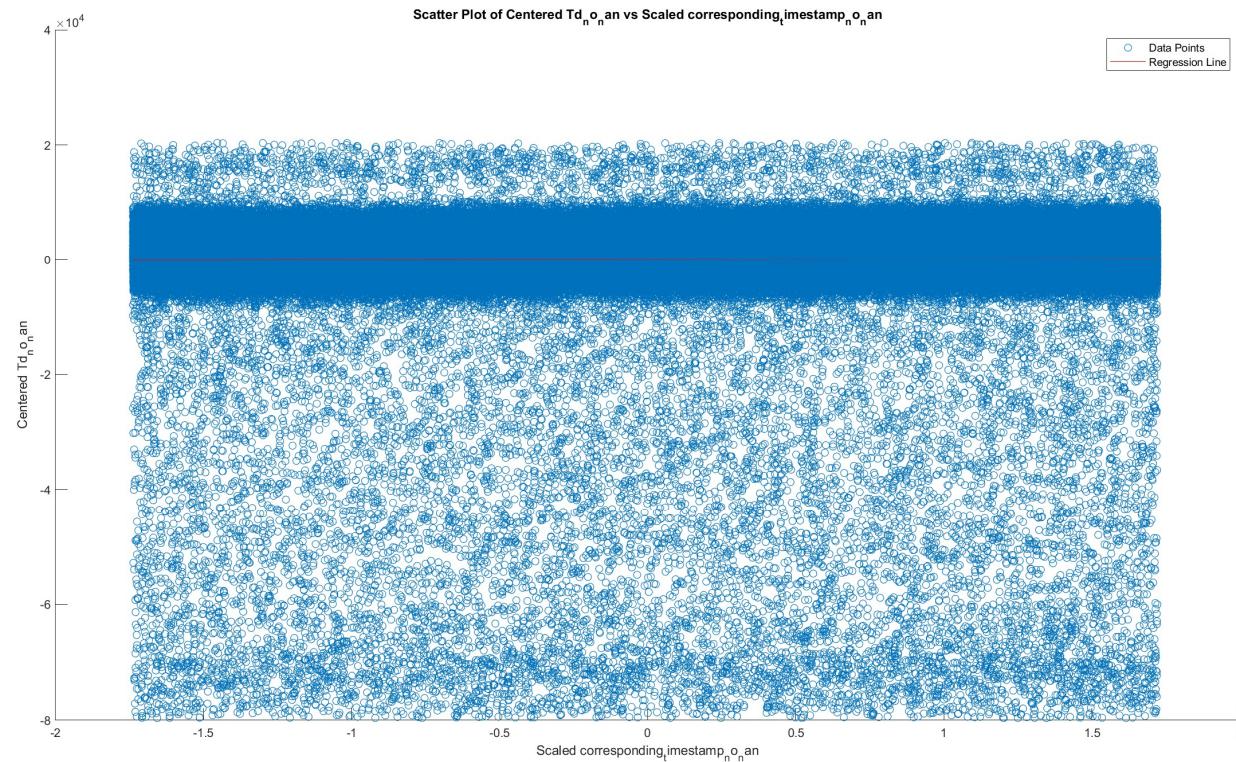
Task #1: Time synchronization

- To synchronize the signal precisely we need a mathematical approach
- Our solution was to use the slope of the regression line to find the small offset on the frequency

Task #1: Time synchronization – Regression Line

Slope of the regression line = 0.00082418

Alignment:-0.3245

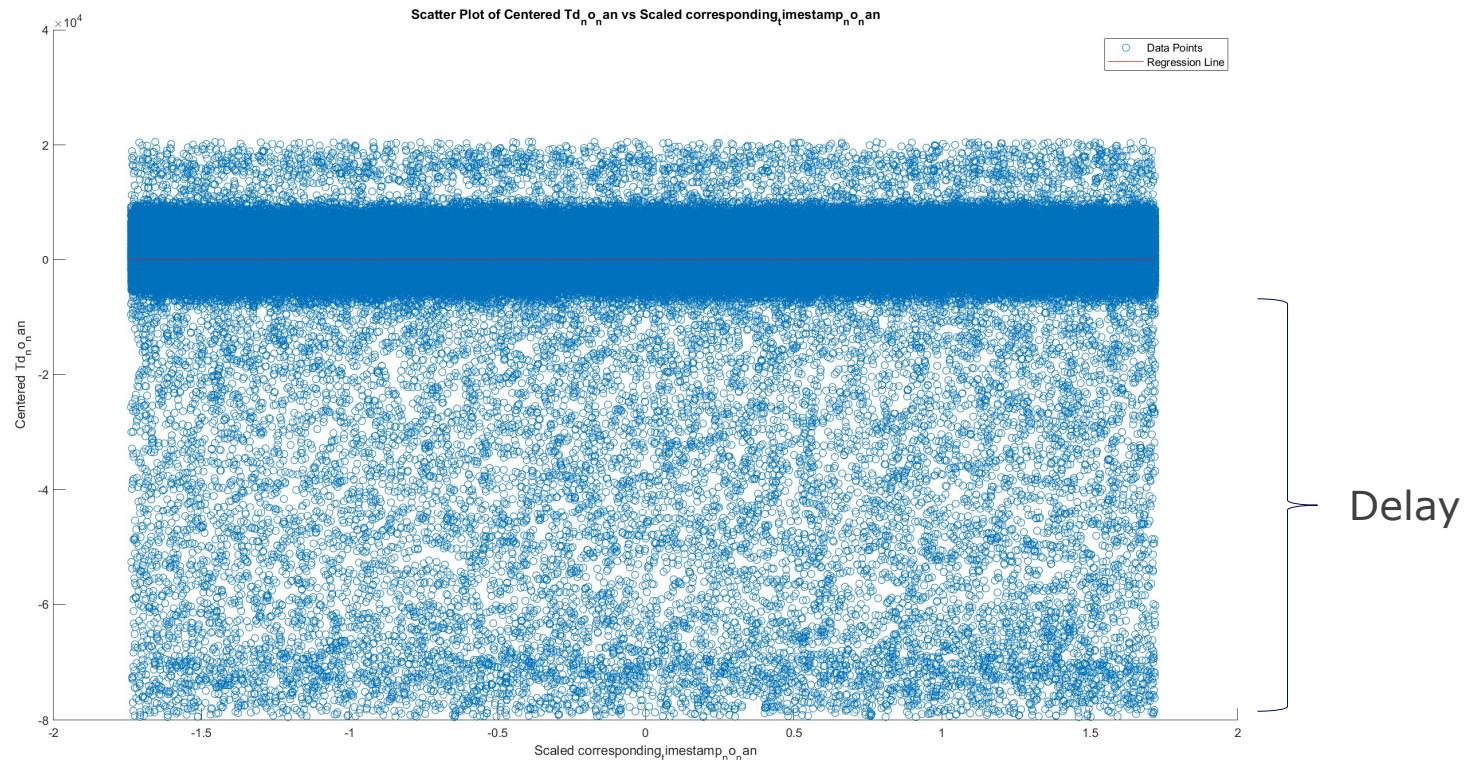


Task #1: Time synchronization – Regression Line

Slope of the regression line = 0.0000040097

Alignment:- 0.324465

Now it is almost perfectly flat

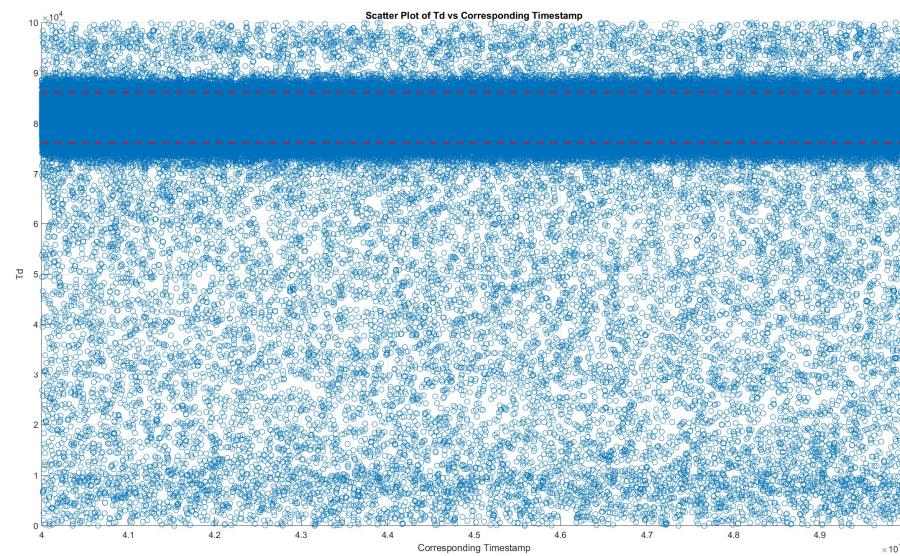


Task #1: Time synchronization – Find Delay Time

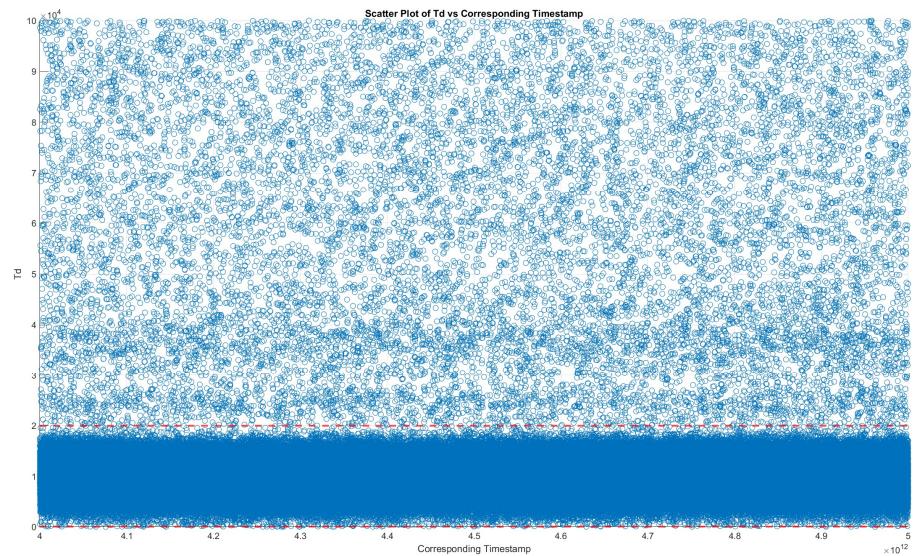
- Now, we can obtain the delay on the signal from the graph
- As given in the project description, we need to find the ideal 10ns where the photon detections happened the most

Task #1: Time synchronization

Not Synchronized



Synchronized



Task #2: SPD Statistical Analysis

Detector 1: 153201 counts, 37.56%

Detector 3: 103660 counts, 25.41%

Detector 5: 59597 counts, 14.61%

Detector 7: 91459 counts, 22.42%

Task #2: SPD Statistical Analysis

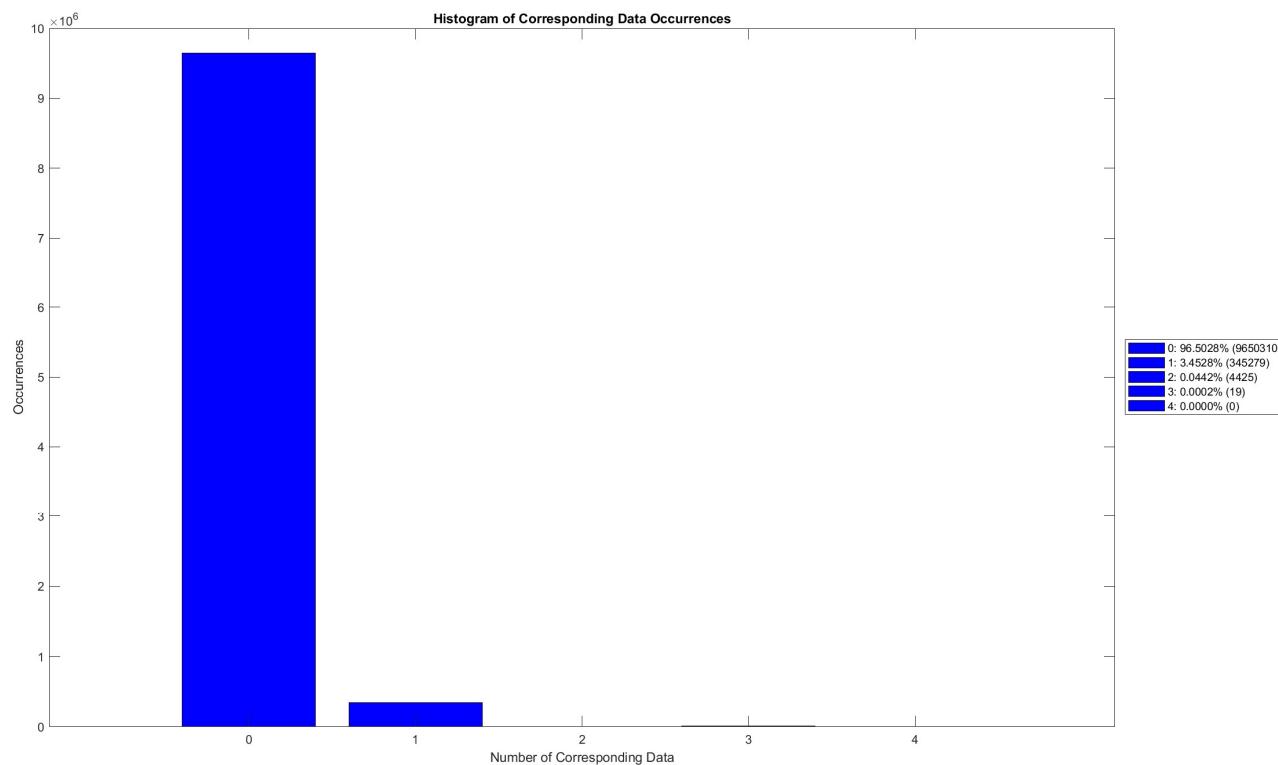
Why the detection numbers are not the same?

Because it is within tolerance of the device

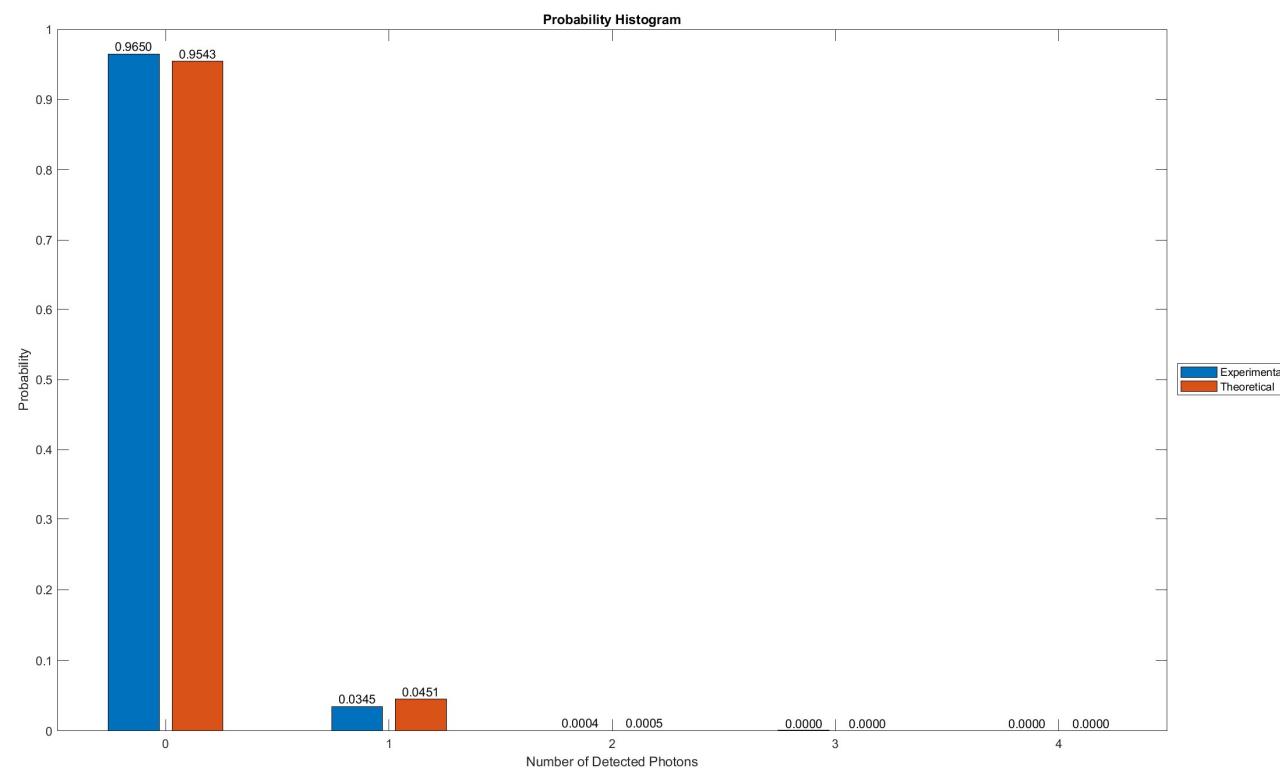
Specifications

TNQ630HF ^a	
Center Wavelength	630 nm
Minimum Bandwidth	±15 nm
Coupling Ratio	25:25:25:25
Coupling Ratio Tolerance	±10.0%
Excess Loss	≤0.6 dB (Typ.)
Insertion Loss	≤7.7 dB (Each Output Port)
Polarization-Dependent Loss (PDL)	≤0.3 dB
Optical Return Loss (ORL) / Directivity	≥60 dB

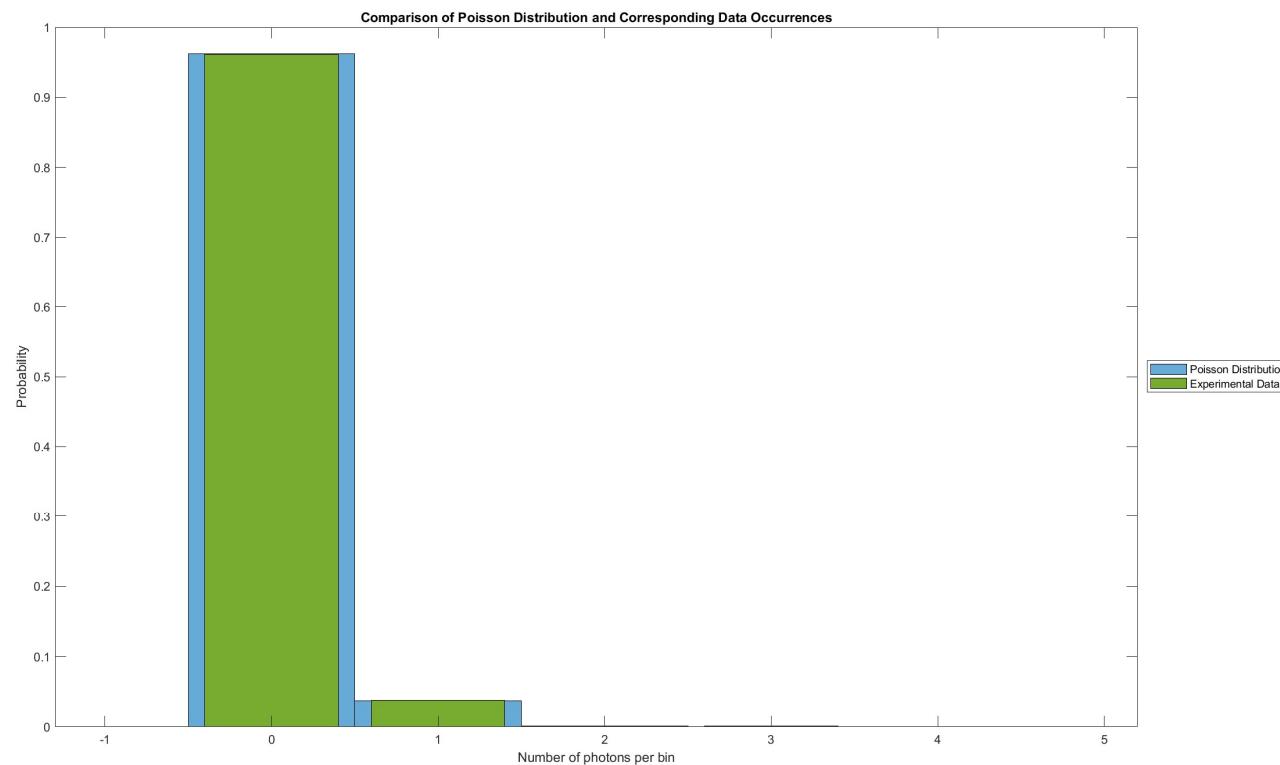
Task #3: Experimental Statistics and Probabilities



Task #4: Comparison of The Theoretical and The Experimental Probabilities

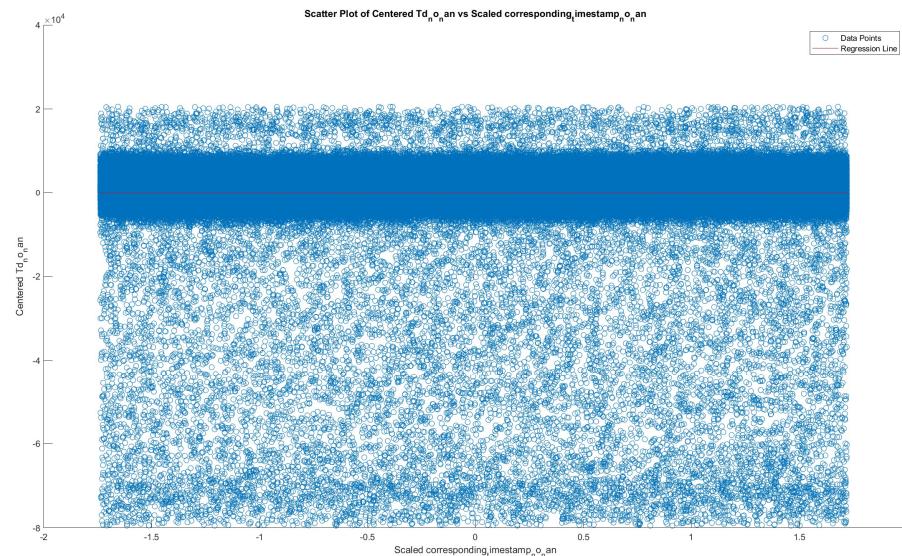


Task #4: Comparison of The Poisson and The Experimental Probabilities

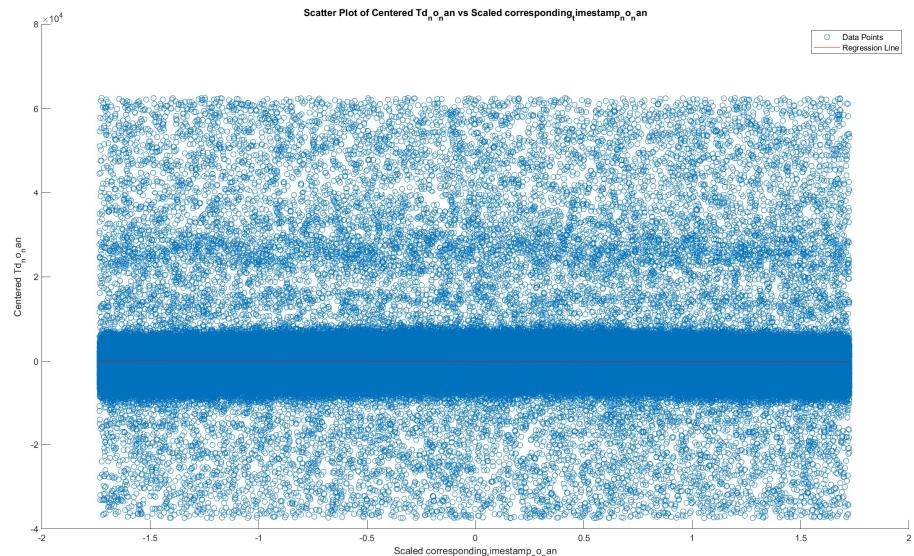


Task #5.1 - Unsyncronized Signals

Time 4-5s

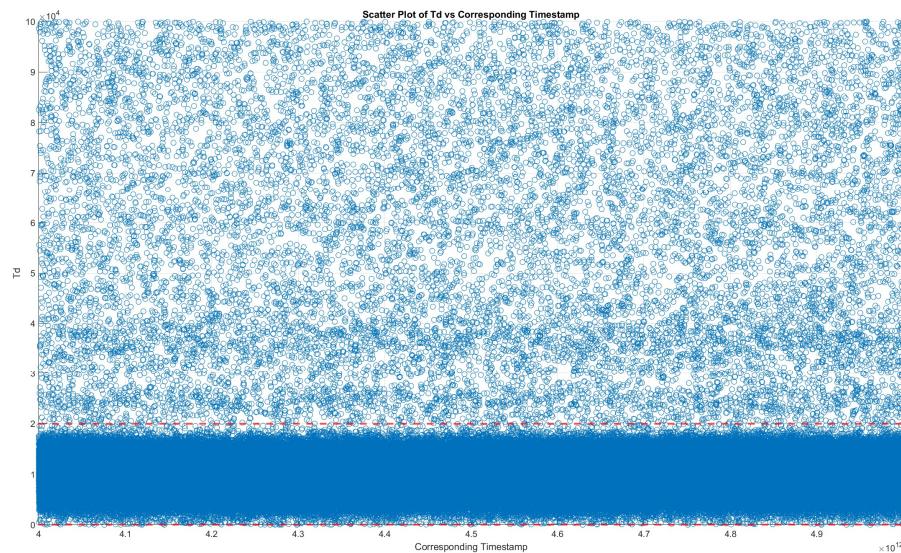


Time 5-6s

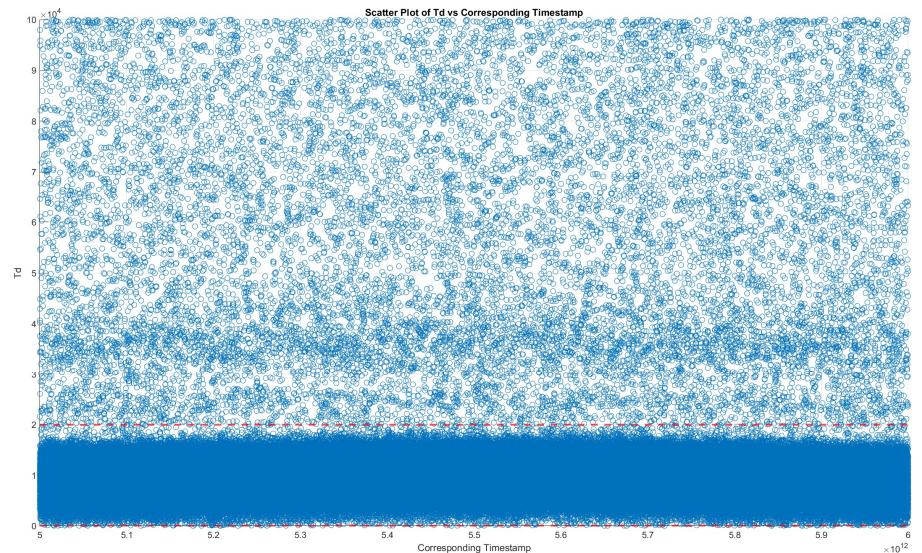


Task #5.1 - Synchronized Signals

Time 4-5s



Time 5-6s



Task #5.2 - SPD Statistical Analysis

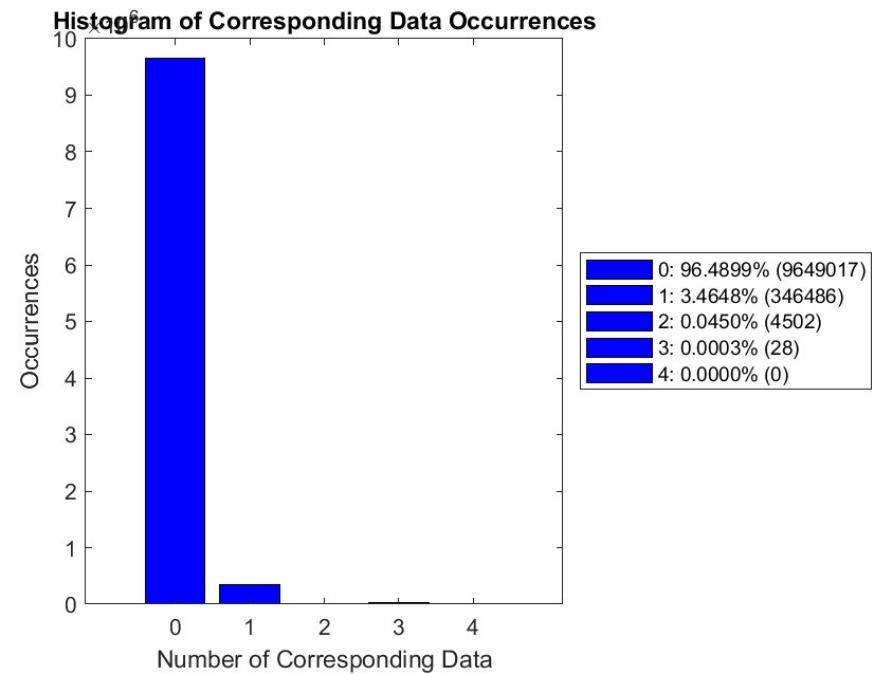
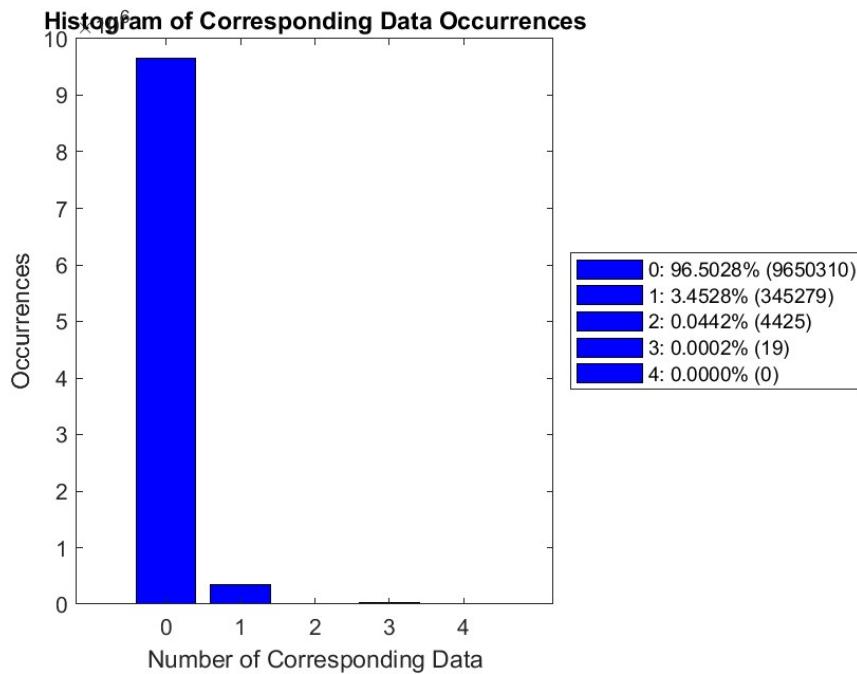
Time 4-5s

- Detector 1: 153201 counts, 37.56%
- Detector 3: 103660 counts, 25.41%
- Detector 5: 59597 counts, 14.61%
- Detector 7: 91459 counts, 22.42%

Time 5-6s

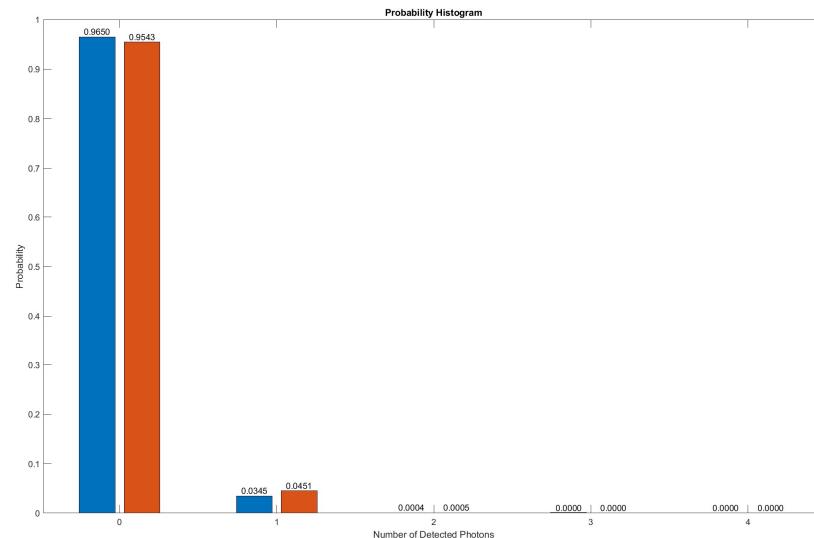
- Detector 1: 155771 counts, 37.58%
- Detector 3: 105045 counts, 25.34%
- Detector 5: 60470 counts, 14.59%
- Detector 7: 93252 counts, 22.50%

Task #5.3 - Synchronized Signals

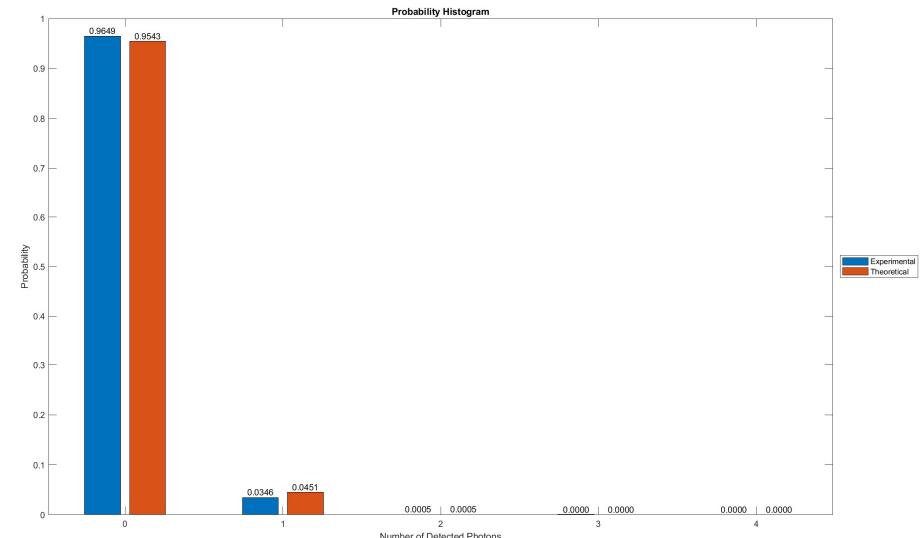


Task #5.4 - Comparison of The Theoretical and The Experimental Probabilities

Time 4-5s

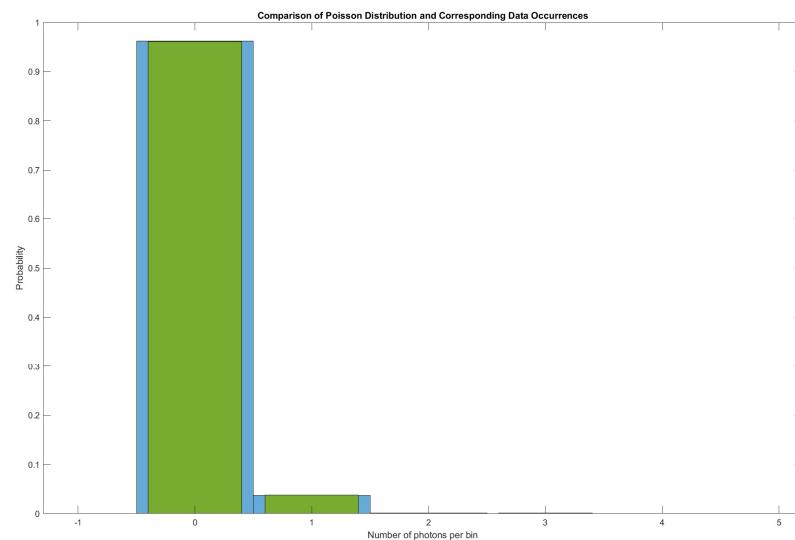


Time 5-6s

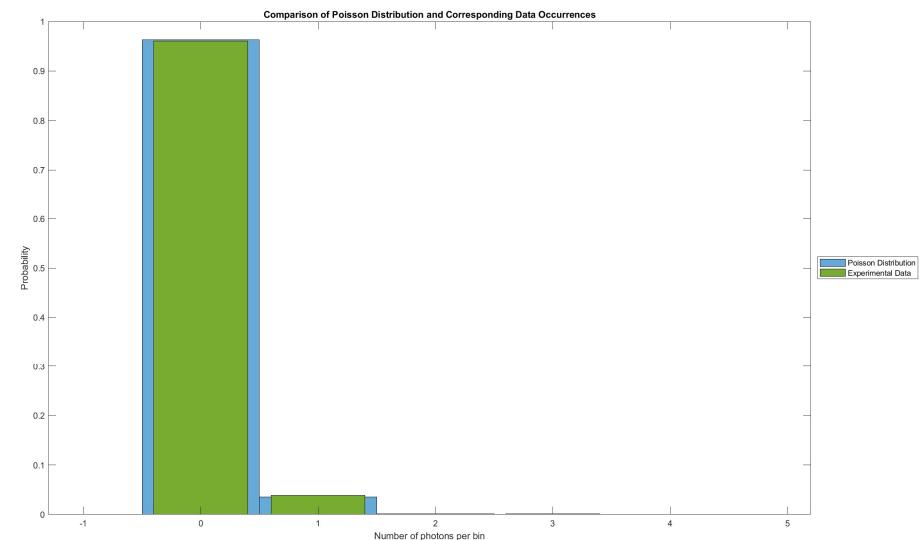


Task #5.4 - Comparison of The Poisson and The Experimental Probabilities

Time 4-5s



Time 5-6s



Thank you for
your attention

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Reference Paper

R Alléaume, F Treussart, J-M Courty, and J-F Roch, "Photon statistics characterization of a single-photon source," Physical Review A, vol. 68, no. 4, 043818, 2003.