Multifrequency HBT measured with LinoSPAD2

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Future Prospects of Intensity Interferometry Workshop

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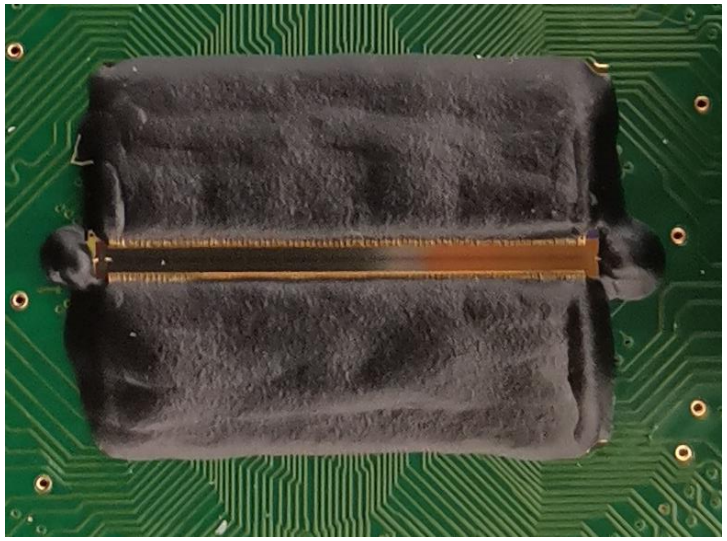
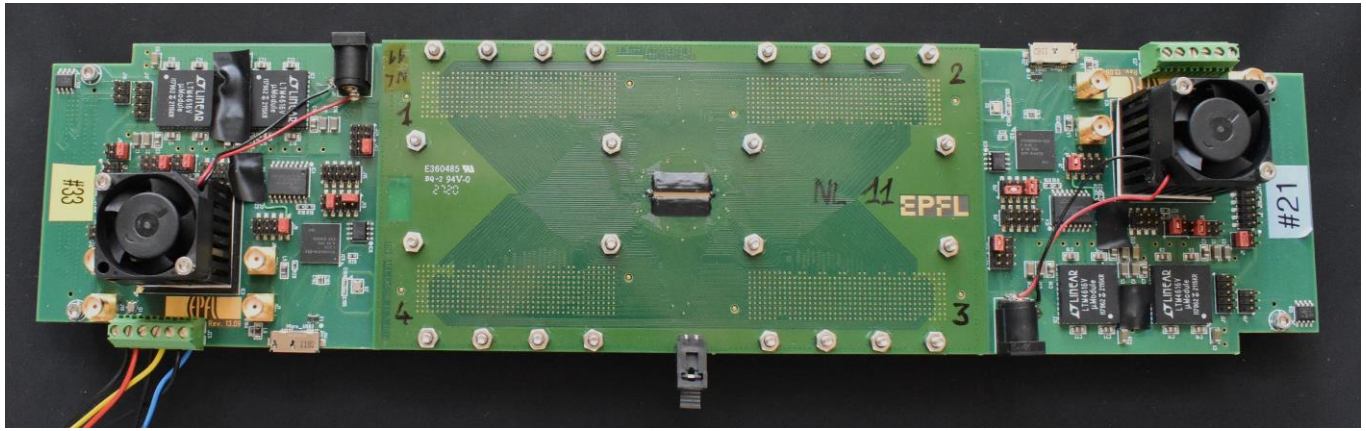
The LinoSPAD2 detector

LinoSPAD2 (1)

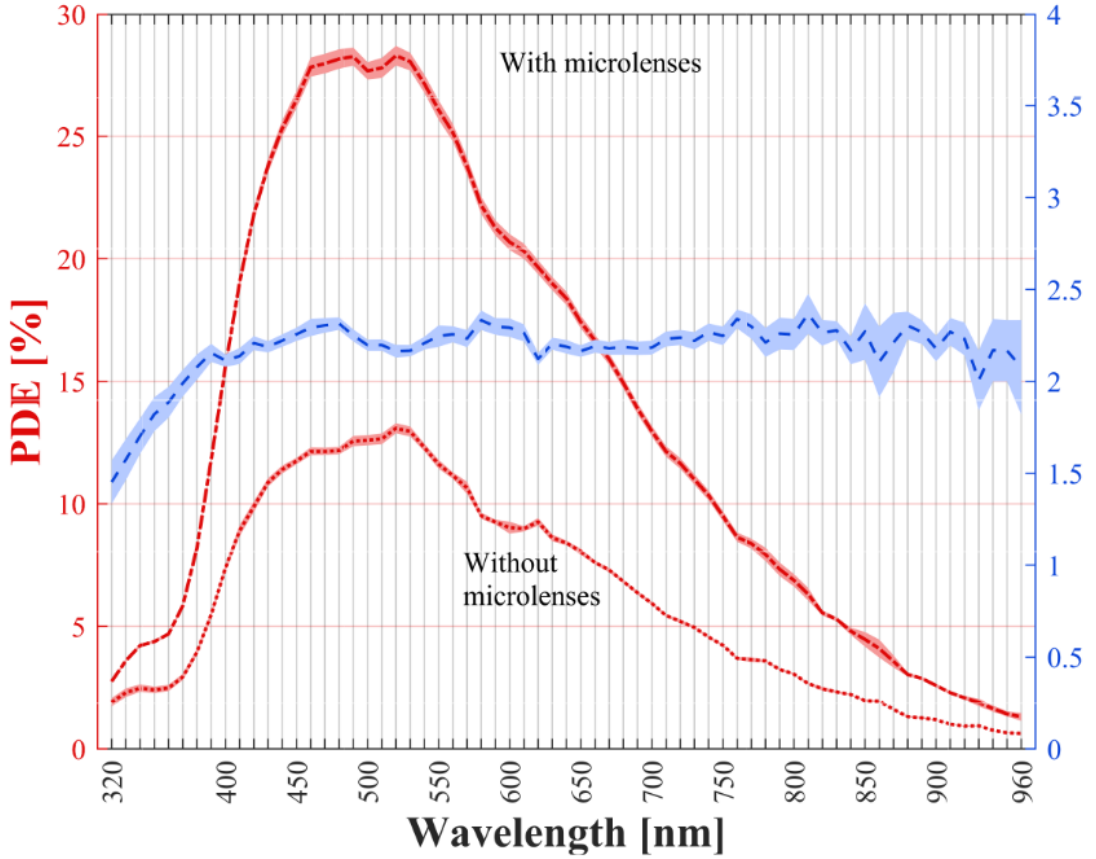
- Designed by AQUA lab, EPFL, Neuchâtel
- 512 x 1 SPADs
- Single-photon sensitivity
- 26.2 um pitch (~13 mm sensor)
- TDCs for timestamping
- 40 ps rms timing resolution
- ~ 20 ns dead time





LinoSPAD2 (2)

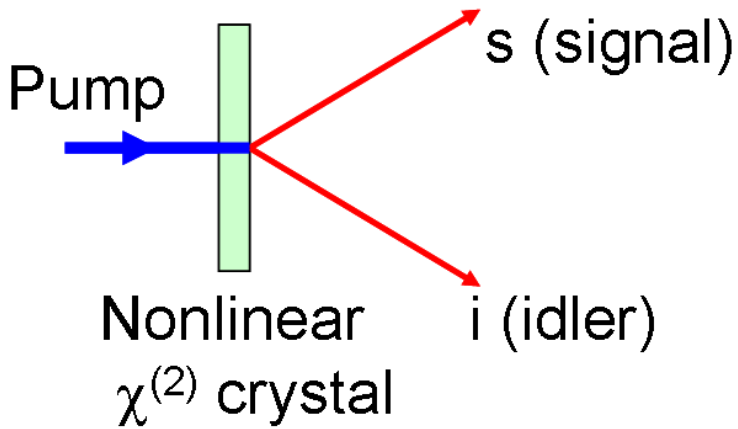
- Designed by AQUA lab, EPFL, Neuchâtel
- 512 x 1 SPADs
- Single-photon sensitivity
- 26.2 um pitch (~13 mm sensor)
- TDCs for timestamping
- 40 ps rms timing resolution
- ~ 20 ns dead time



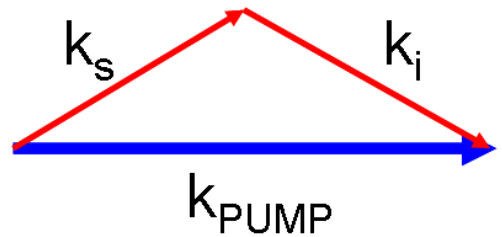
LinoSPAD2 timing resolution

Measurements with SPDC (1)

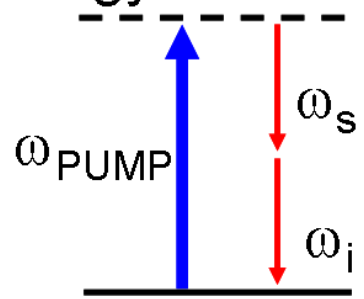
Spontaneous
Parametric
Downconversion



Momentum Conservation

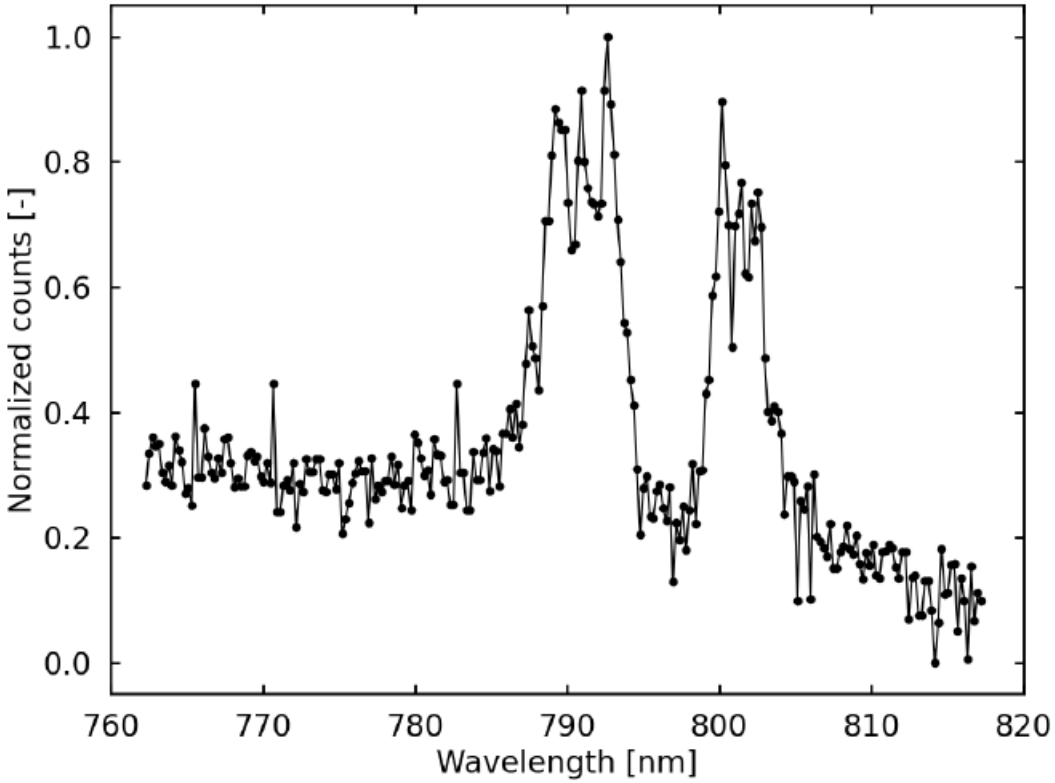


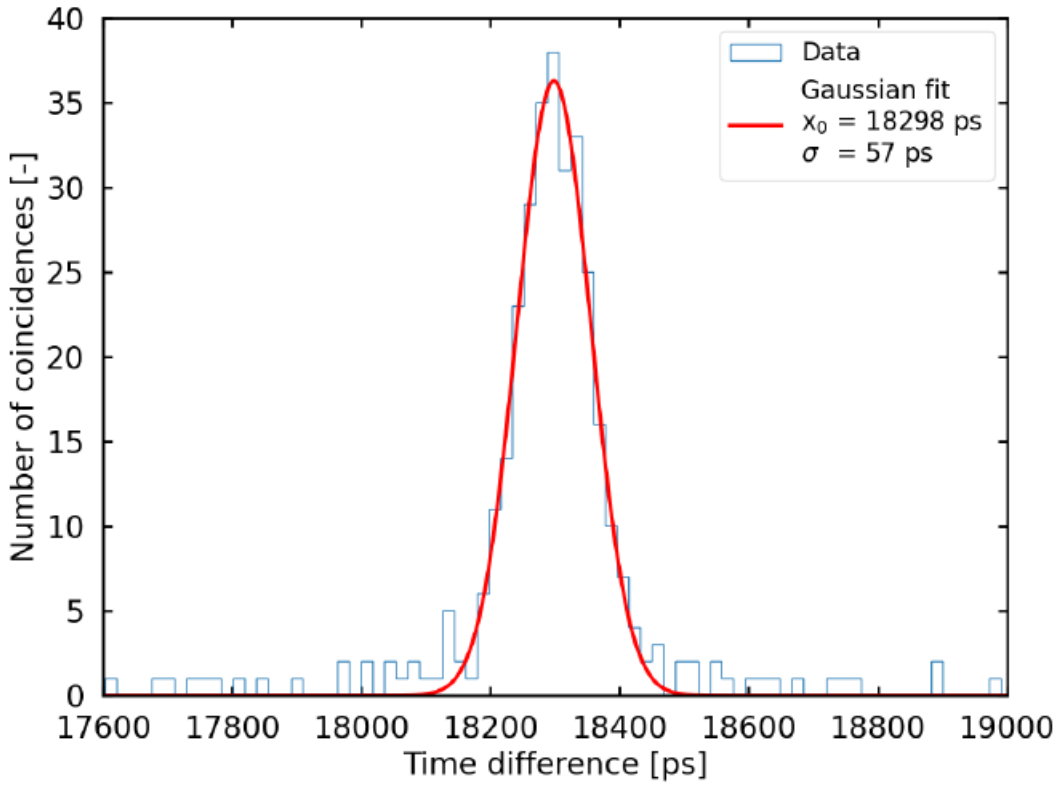
Energy conservation



$$\varphi_{PUMP} = \varphi_s + \varphi_i$$

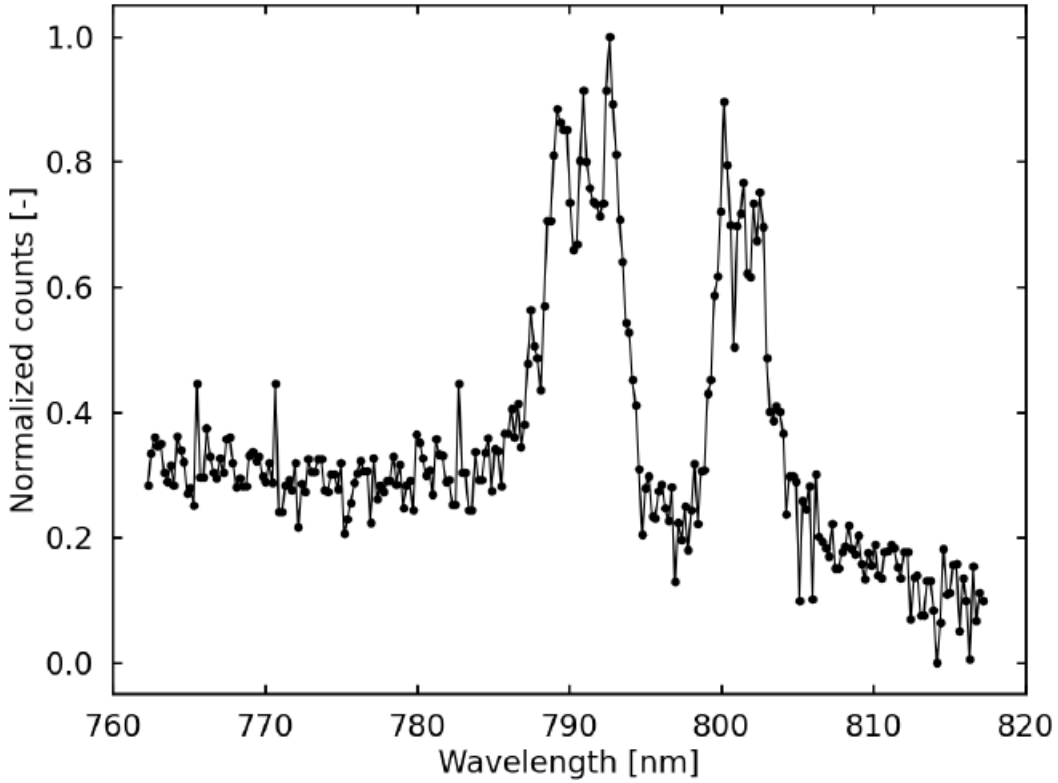
Measurements with SPDC (2)

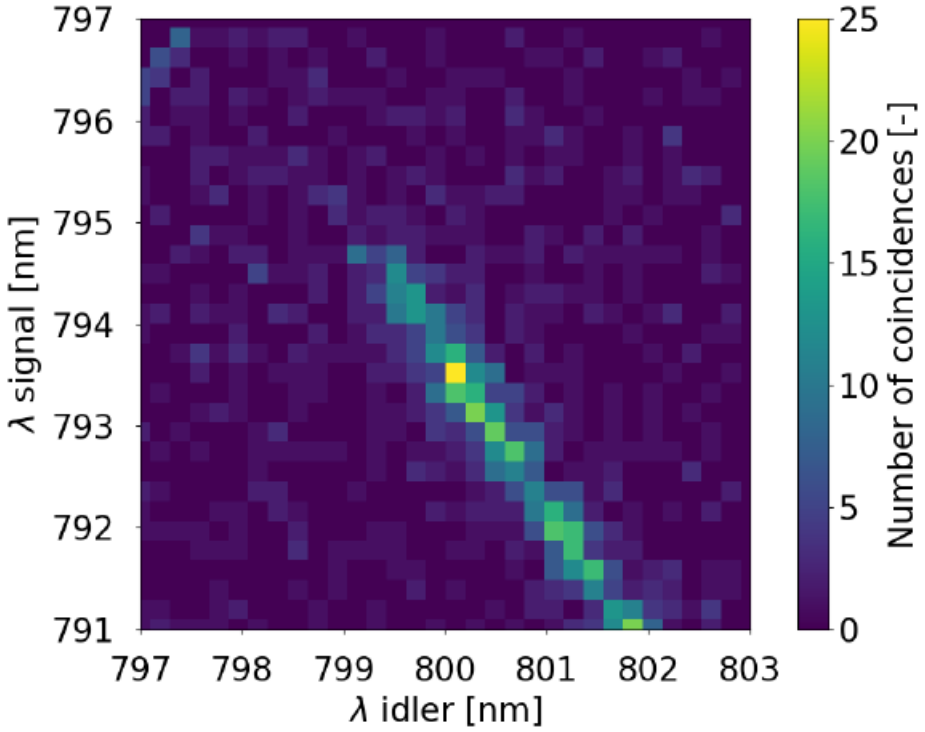




Measurements with SPDC (3)

Arxiv
2304.11999





Measurements with SPDC (3)

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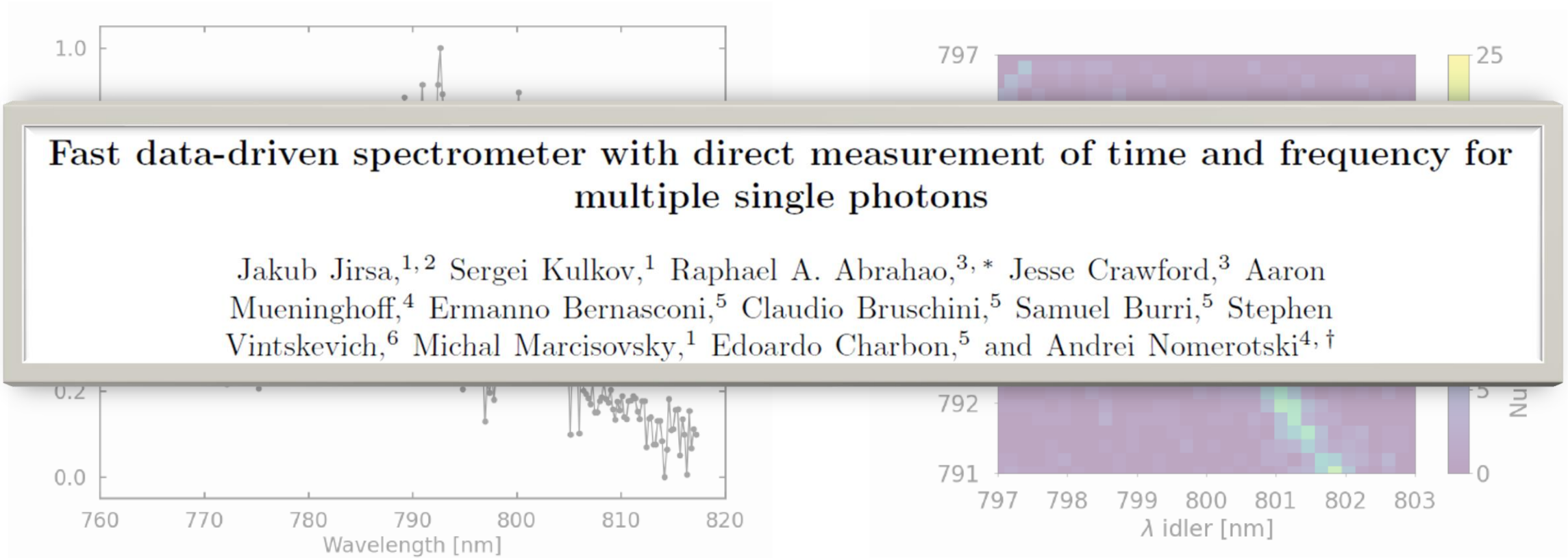
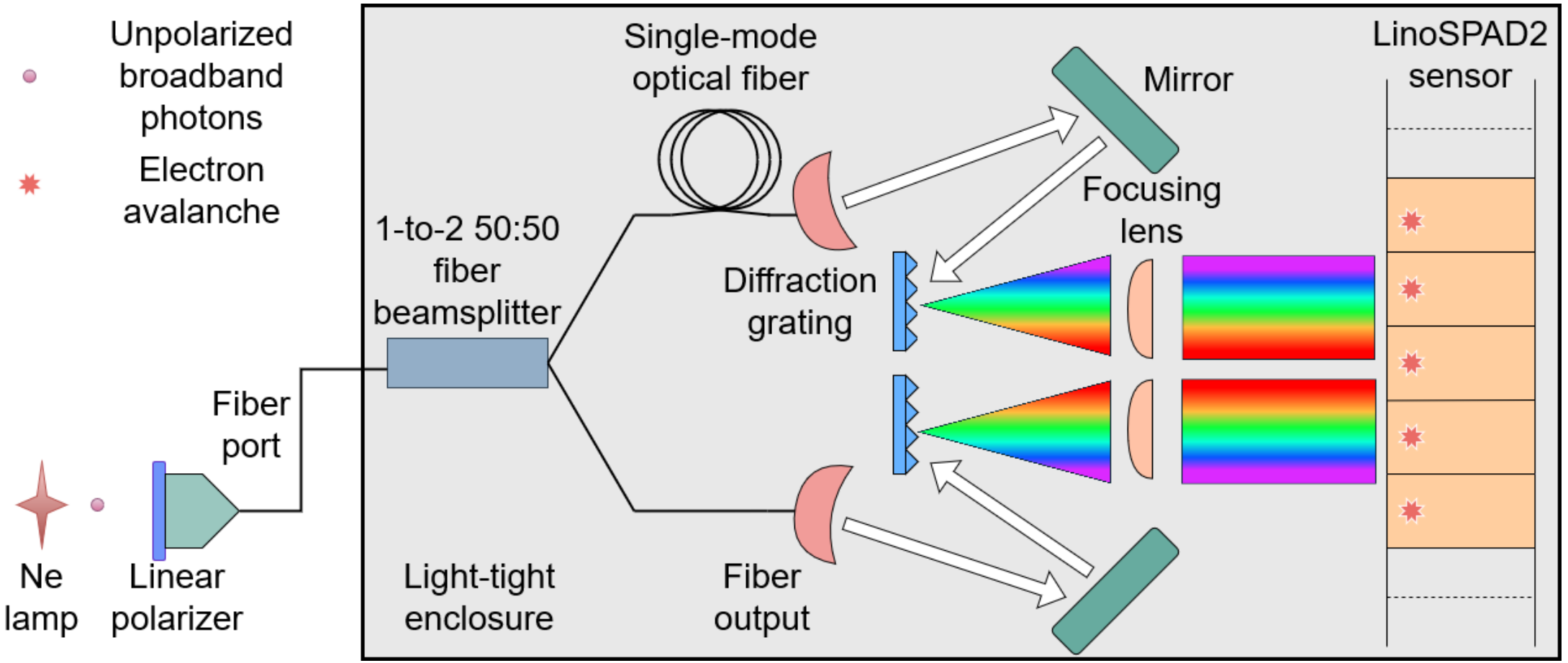


Fast data-driven spectrometer with direct measurement of time and frequency for multiple single photons

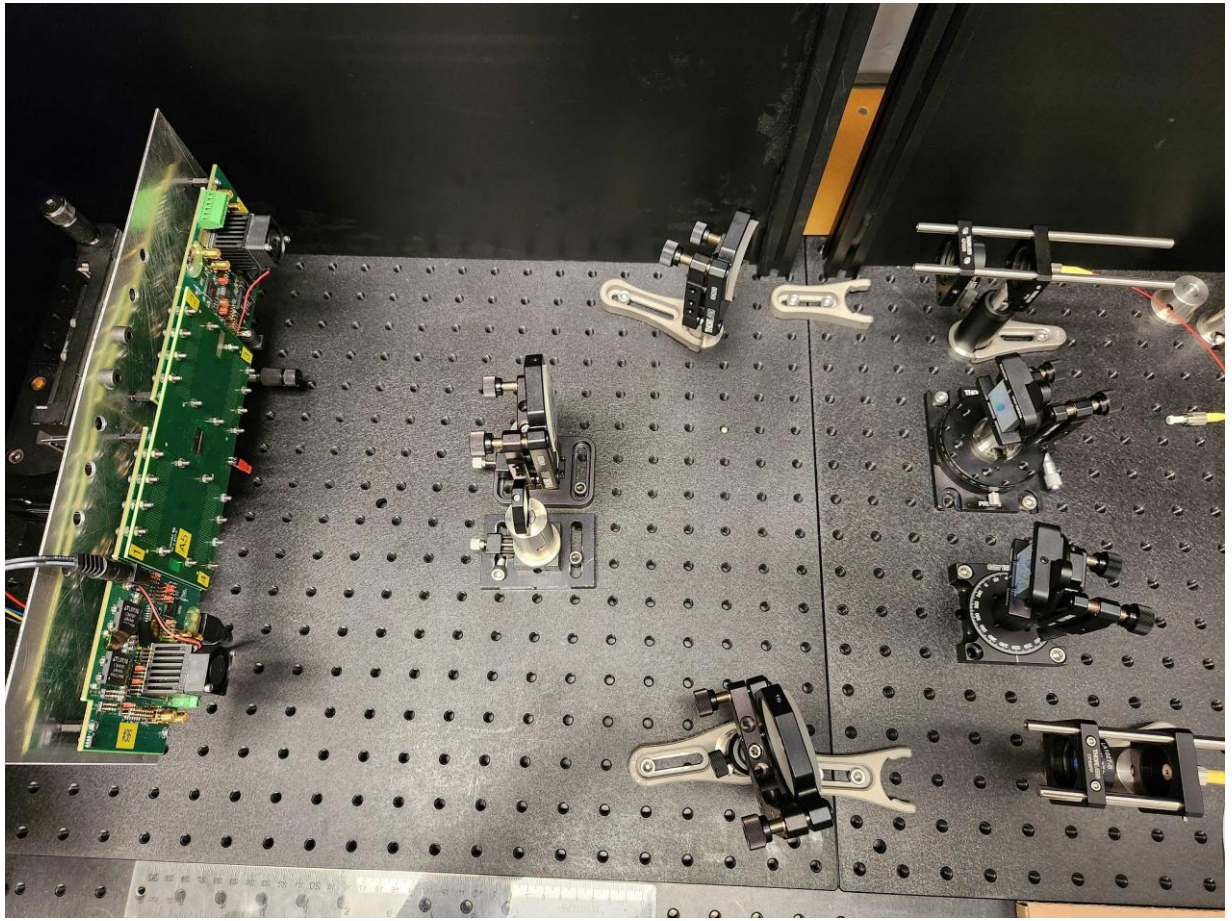
Jakub Jirsa,[1,2] Sergei Kulkov,[1] Raphael A. Abrahao,[3,*] Jesse Crawford,[3] Aaron Mueninghoff,[4] Ermanno Bernasconi,[5] Claudio Bruschini,[5] Samuel Burri,[5] Stephen Vintskevich,[6] Michal Marcisovsky,[1] Edoardo Charbon,[5] and Andrei Nomerotski[4,†]

Multiple-line HBT setup

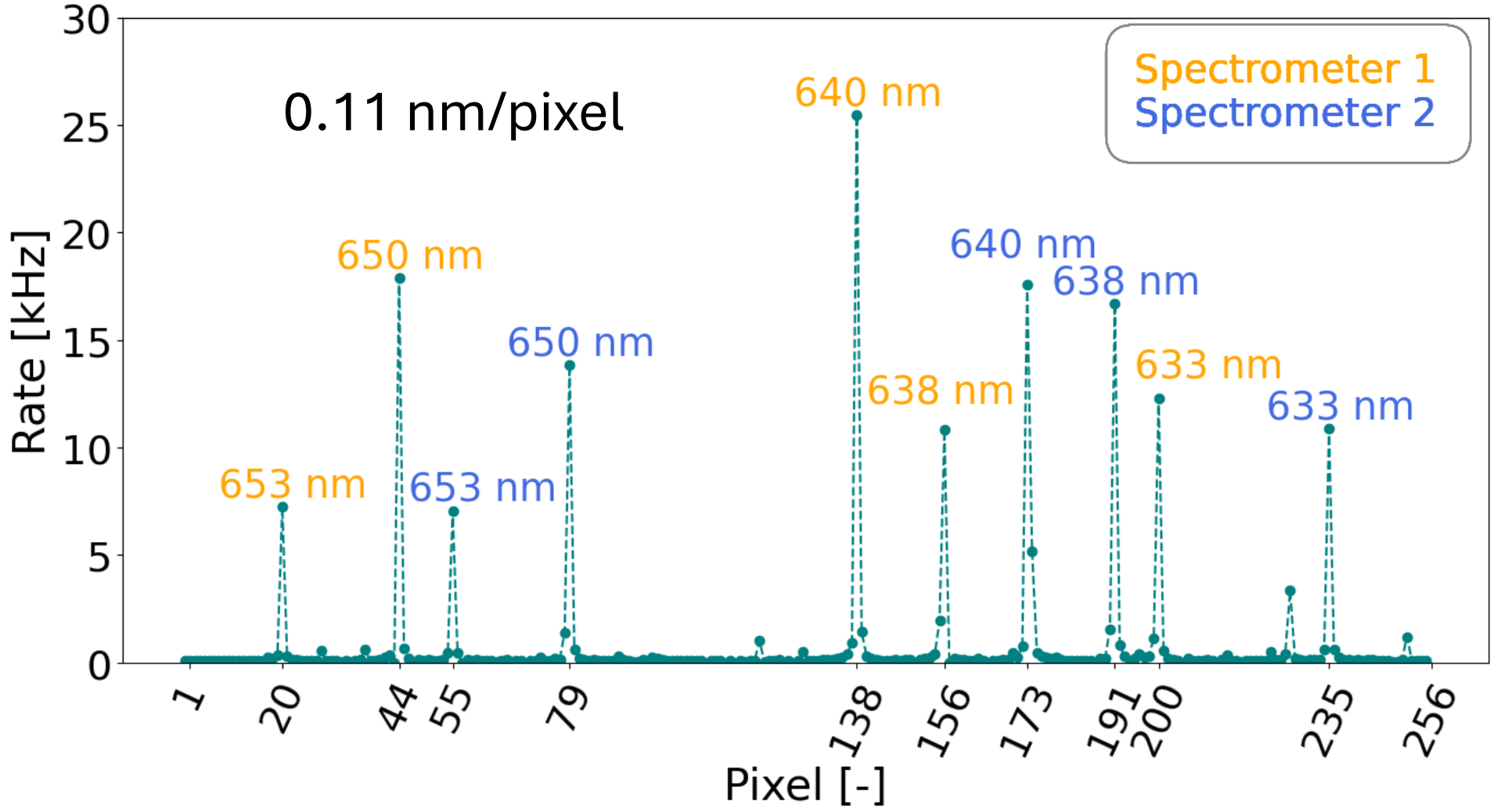
Spectrometer setup with LinoSPAD2 (1)



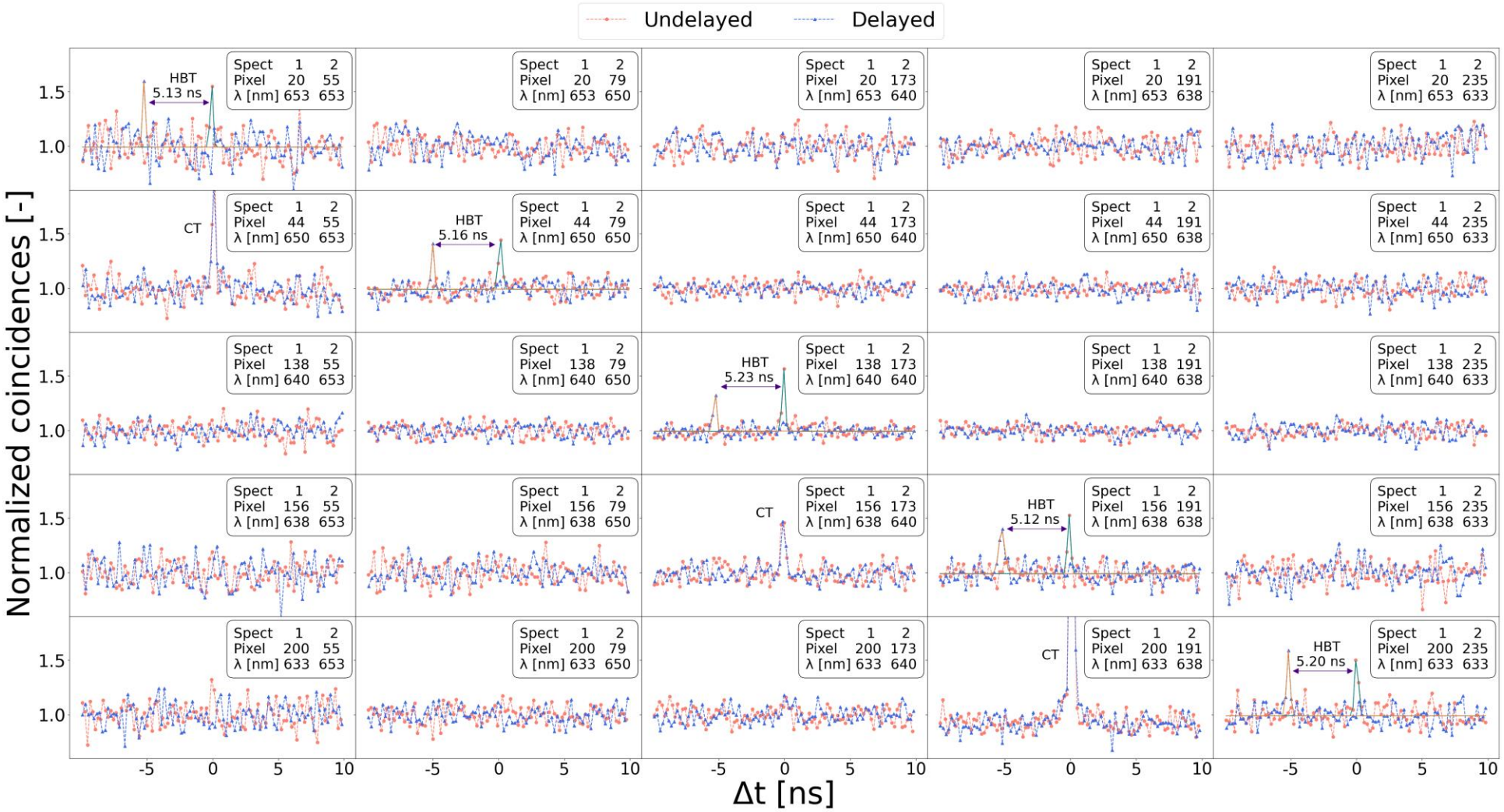
Spectrometer setup with LinoSPAD2 (2)



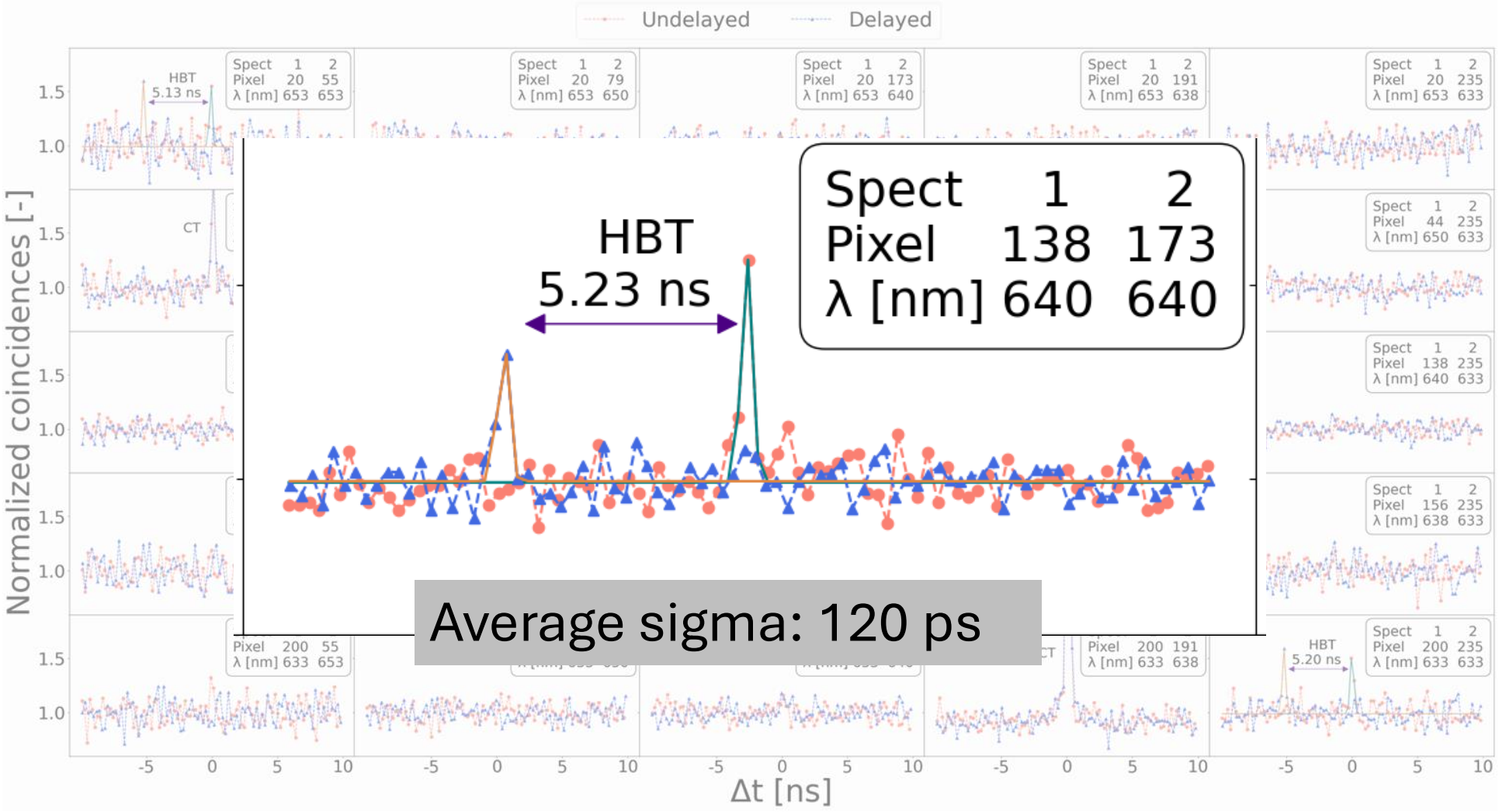
Five-line HBT: sensor occupation



Five-line HBT: coincidences (1)



Five-line HBT: coincidences (2)



The paper

https://arxiv.org/abs/2406.13959

Multifrequency-resolved Hanbury Brown–Twiss Effect

Joseph Ferrantini,[1,a)] Jesse Crawford,[1,a)] Sergei Kulkov,[2,a)] Jakub Jirsa,[2,3] Aaron Mueninghoff,[4] Lucas Lawrence,[1] Stephen Vintskevich,[5] Tommaso Milanese,[6] Samuel Burri,[6] Ermanno Bernasconi,[6] Claudio Bruschini,[6] Michal Marcisovsky,[2] Peter Svihra,[2] Andrei Nomerotski,[2,7] Paul Stankus,[1] Edoardo Charbon,[6] and Raphael A. Abrahao[1,b)]

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(Dated: 21 June 2024)

Abstract: The Hanbury Brown-Twiss (HBT) effect holds a pivotal place in intensity interferometry and gave a seminal contribution to the development of quantum optics. To observe such an effect, both good spectral and timing resolutions are necessary. Most often, the HBT effect is observed for a single frequency at a time, due to limitations in dealing with multifrequencies simultaneously, halting and limiting some applications. Here, we report a fast and data-driven spectrometer built with a one-dimensional array of single-photon-sensitive avalanche diodes. We report observing the HBT effect for multifrequencies at the same time. Specifically, we observed the HBT for up to 5 lines of the Ne spectrum, but this can be improved even further. Our work represents a major step to make spectral binning and multifrequencies HBT more widely available. The technology we present can benefit both classical and quantum applications.

Summary

- LinoSPAD2 is great for HBT measurements
- Simultaneous HBT measurement at multiple Ne spectral lines

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Future plans

- Broadband HBT
- Broadband HBT from multiple spectral lines: LED + spectrometer
- Stellar intensity interferometry with LinoSPAD2

Summary

Arxiv papers on HBT with LinoSPAD2	**2406.15323** **2406.13959** **2304.11999**

- LinoSPAD2 is great for HBT measurements
- Simultaneous HBT measurement at multiple Ne spectral lines

Future plans

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Thank you for your attention!