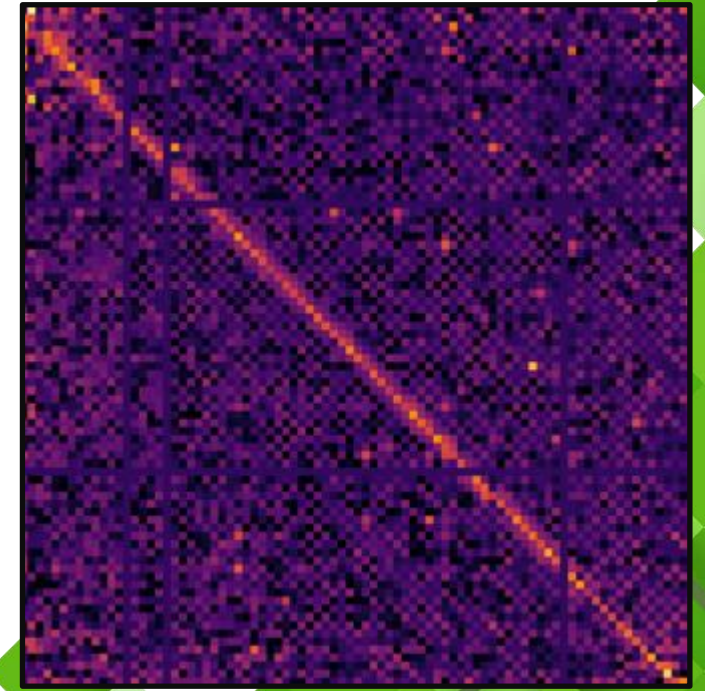


FACULTY OF
NUCLEAR SCIENCES
AND PHYSICAL
ENGINEERING
CTU IN PRAGUE

EPFL



Spectrally multiplexed HBT

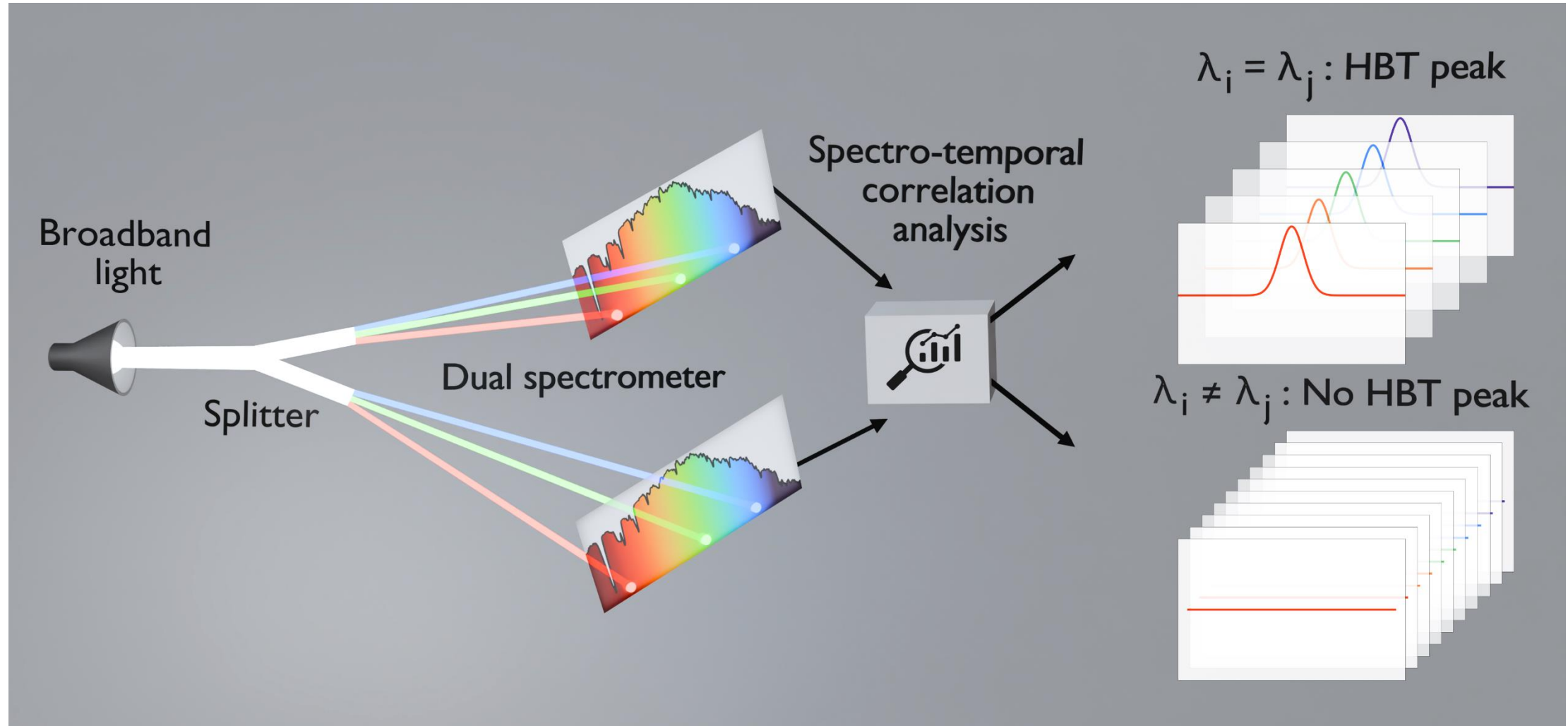
16.10.2025

Sergei Kulkov, Andrei Nomerotski

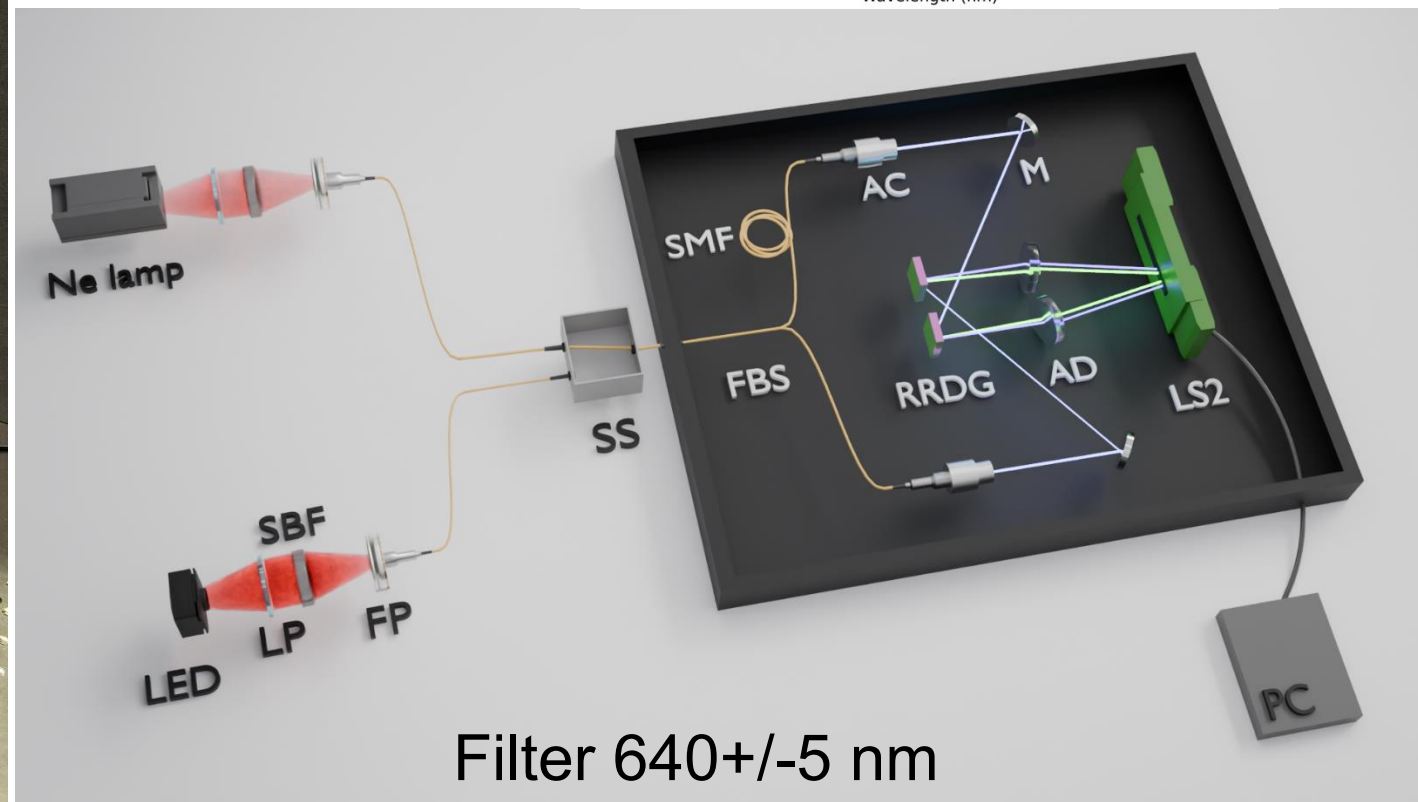
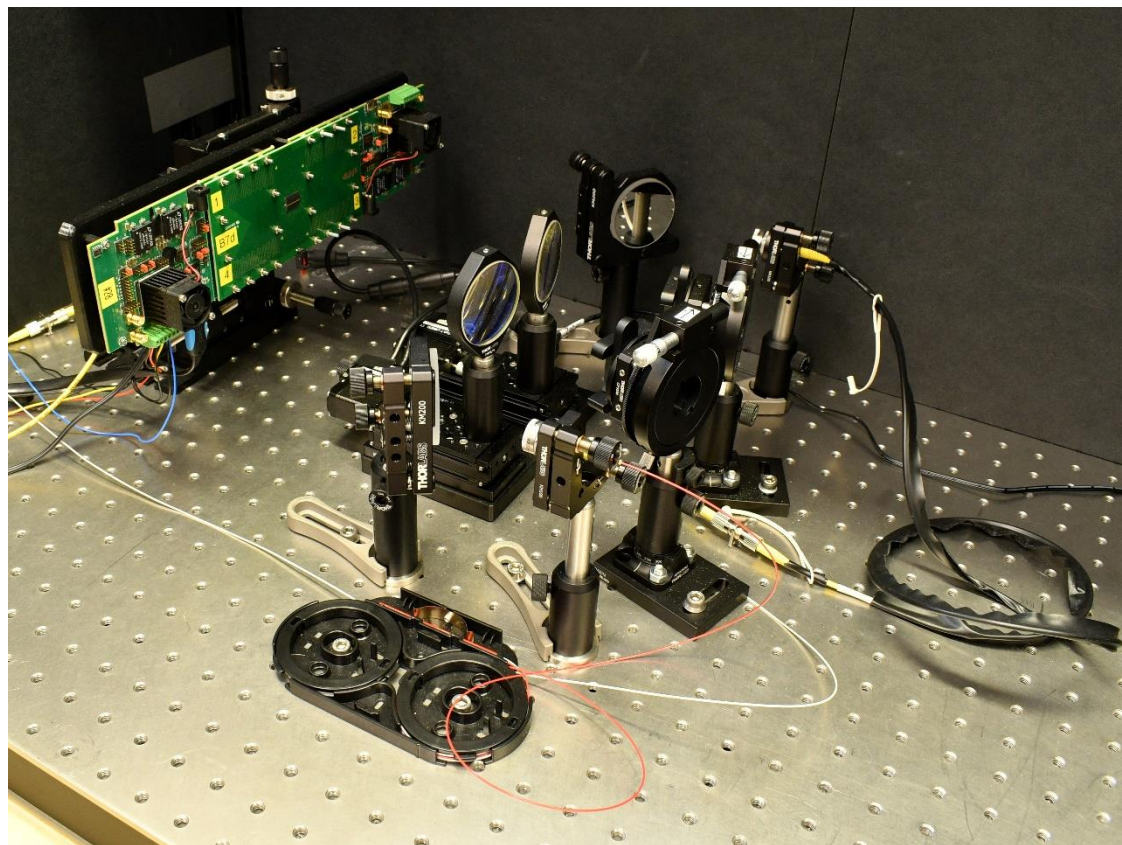
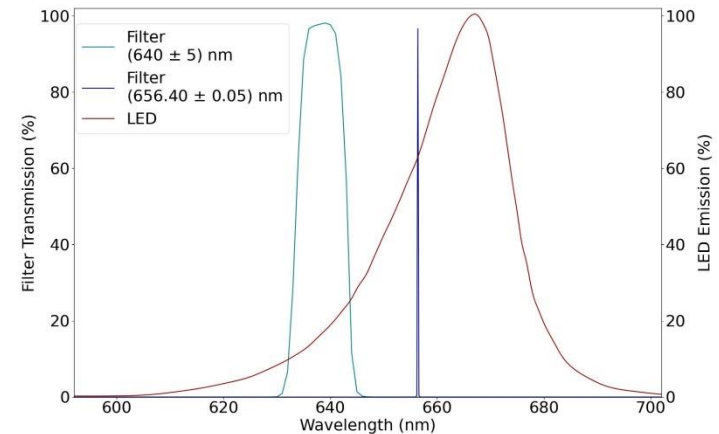


Arxiv
2509.05649

The idea

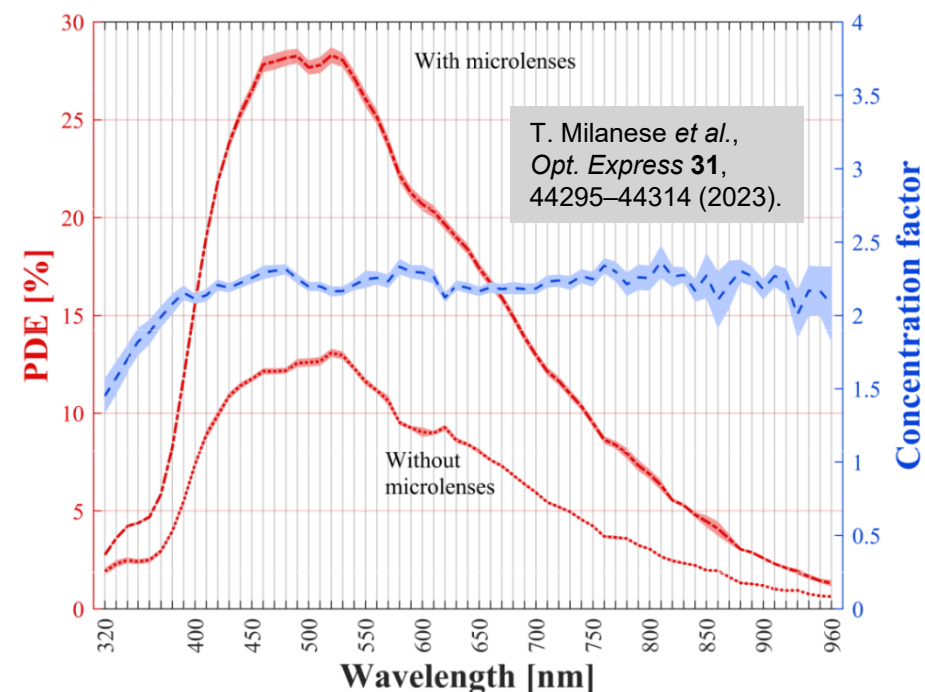
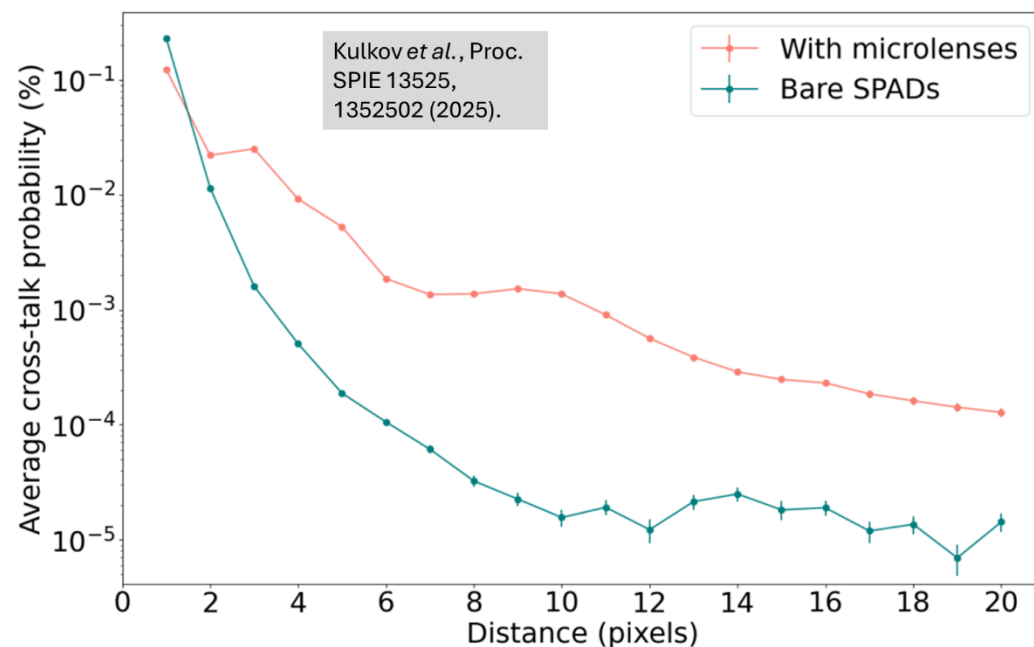


Setup: spectrometer

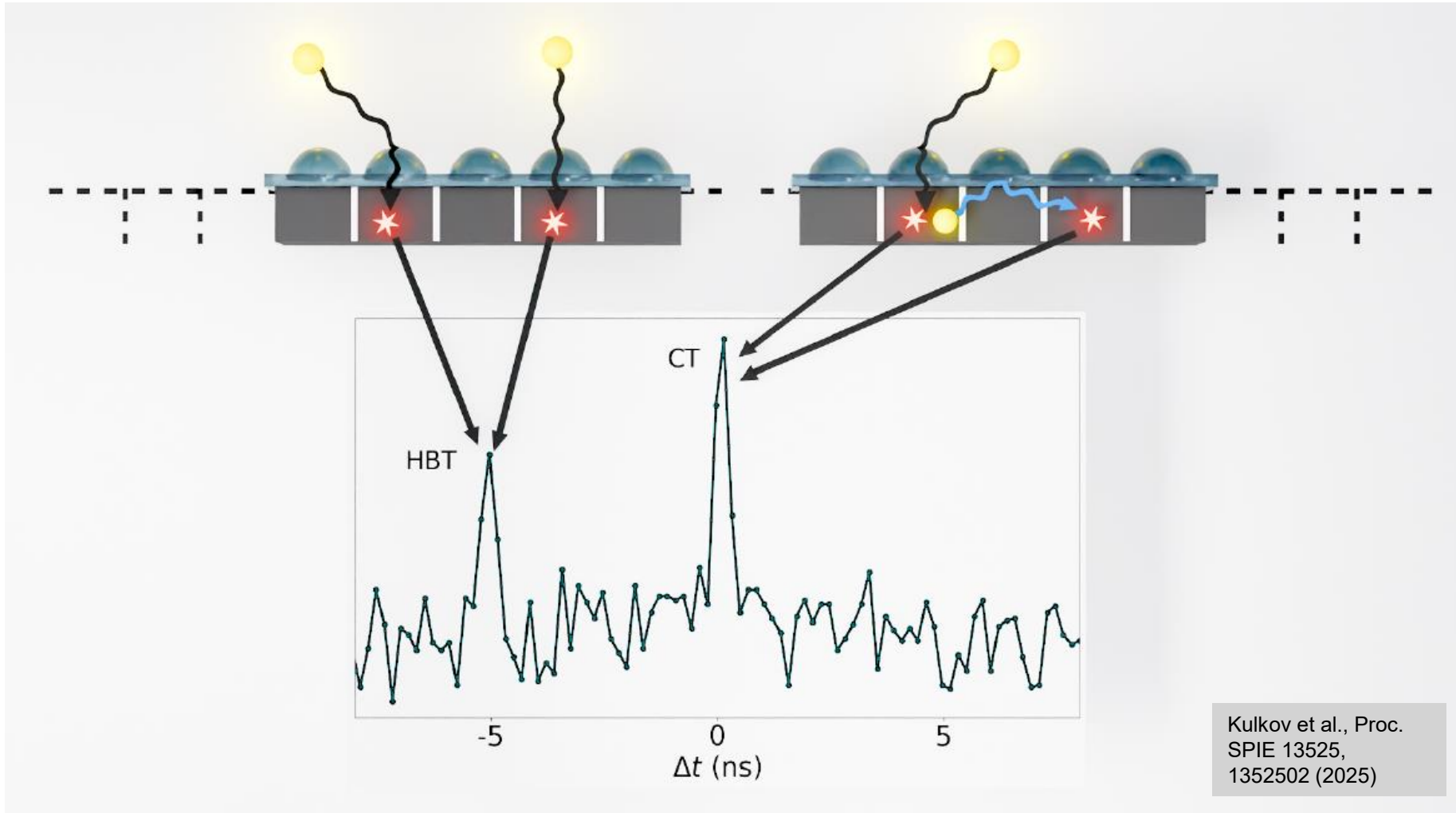


Setup: LinoSPAD2

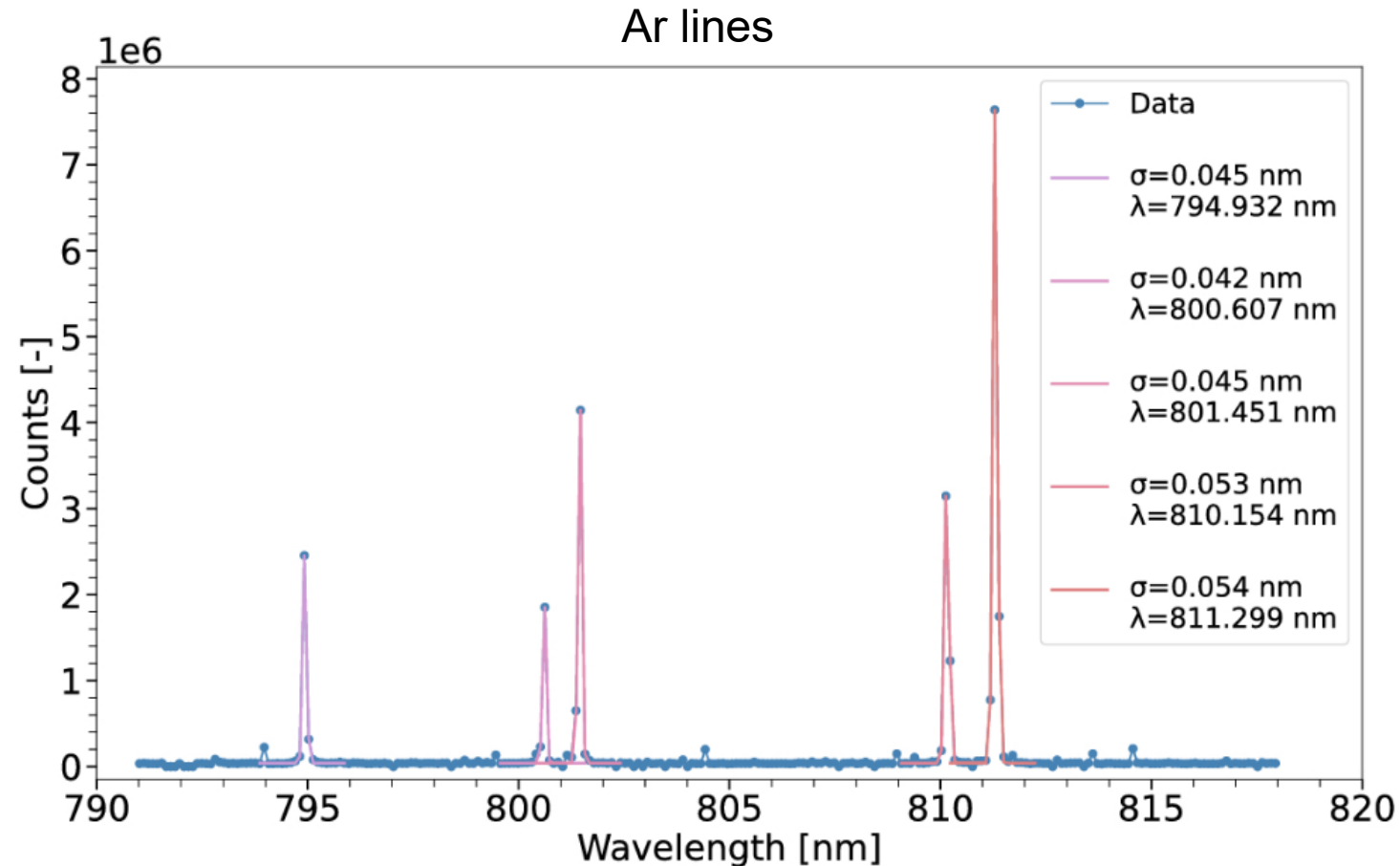
- 256 pixels (out of 512 total),
26.2 μm pitch
- 40 ps rms resolution
- 0.11 nm/pixel $\Rightarrow$ 28 nm range
- DCR: 125 cps @ 28 $^{\circ}\text{C}$



Cross-talk mechanism



Setup: camera + spectrometer

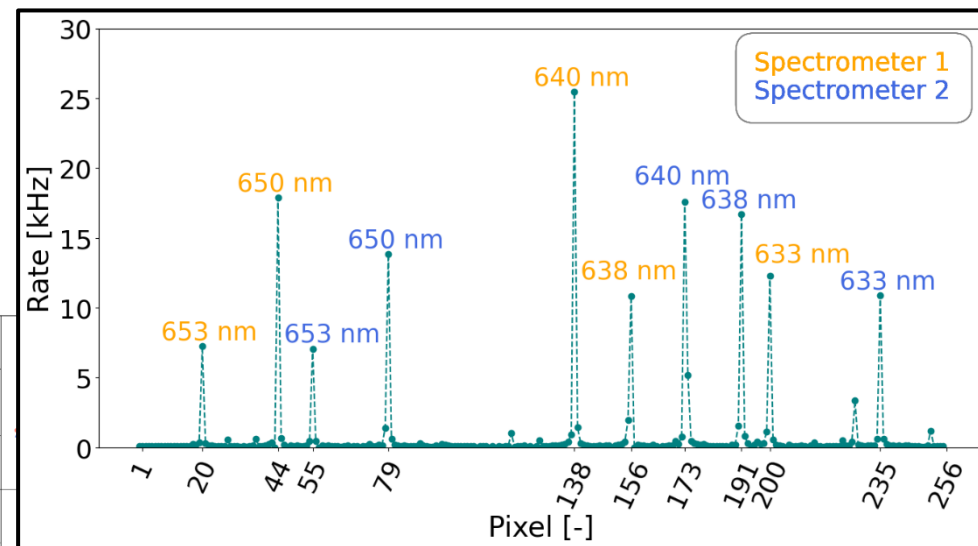
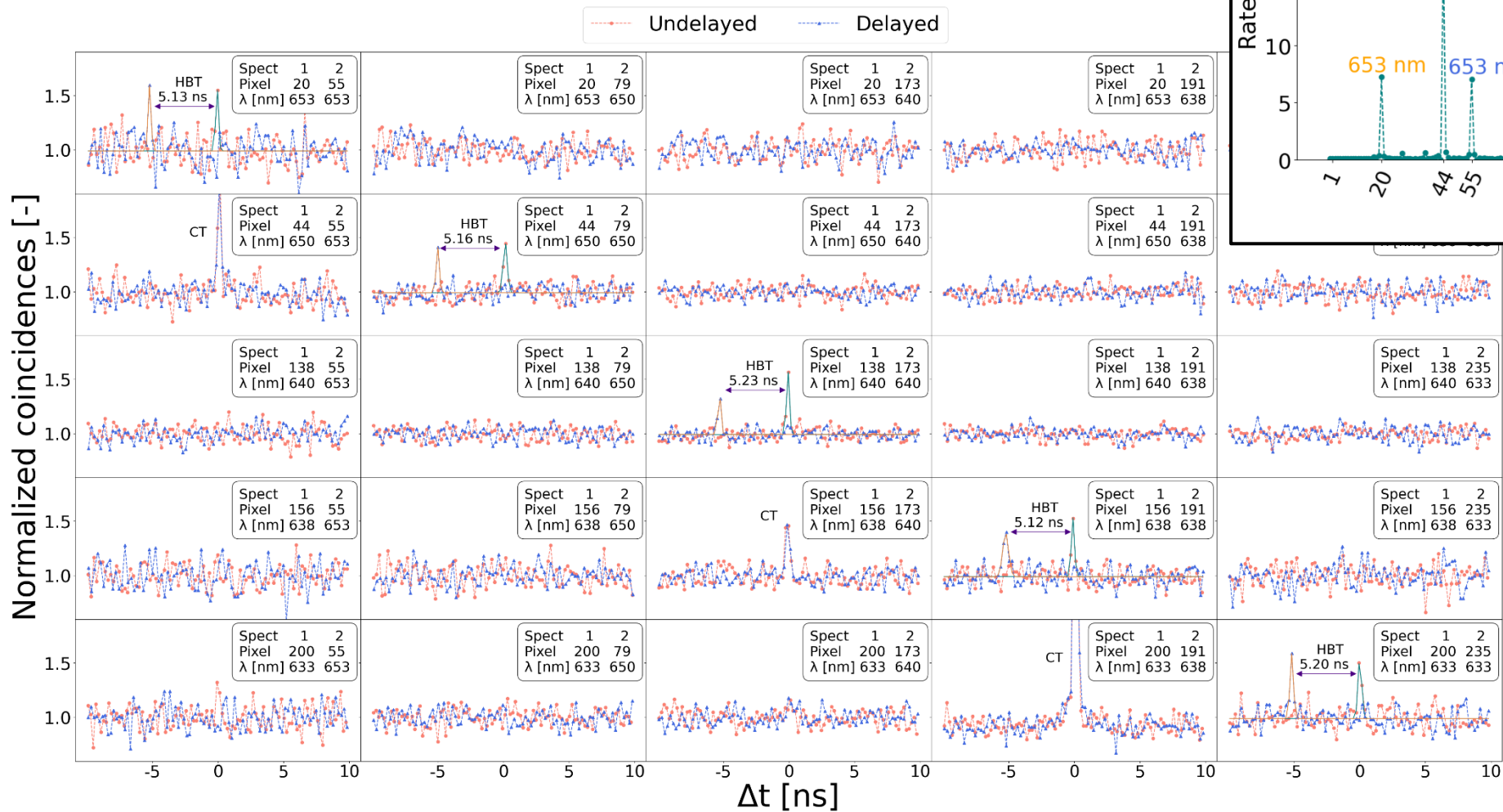


Resolutions:
40 ps
40 pm
0.11 nm/pixel =>
28 nm range

Jirsa J, Kulkov S *et al.*,
Opt. Express 33, 9962
(2025).



Last year: 5 Ne HBT

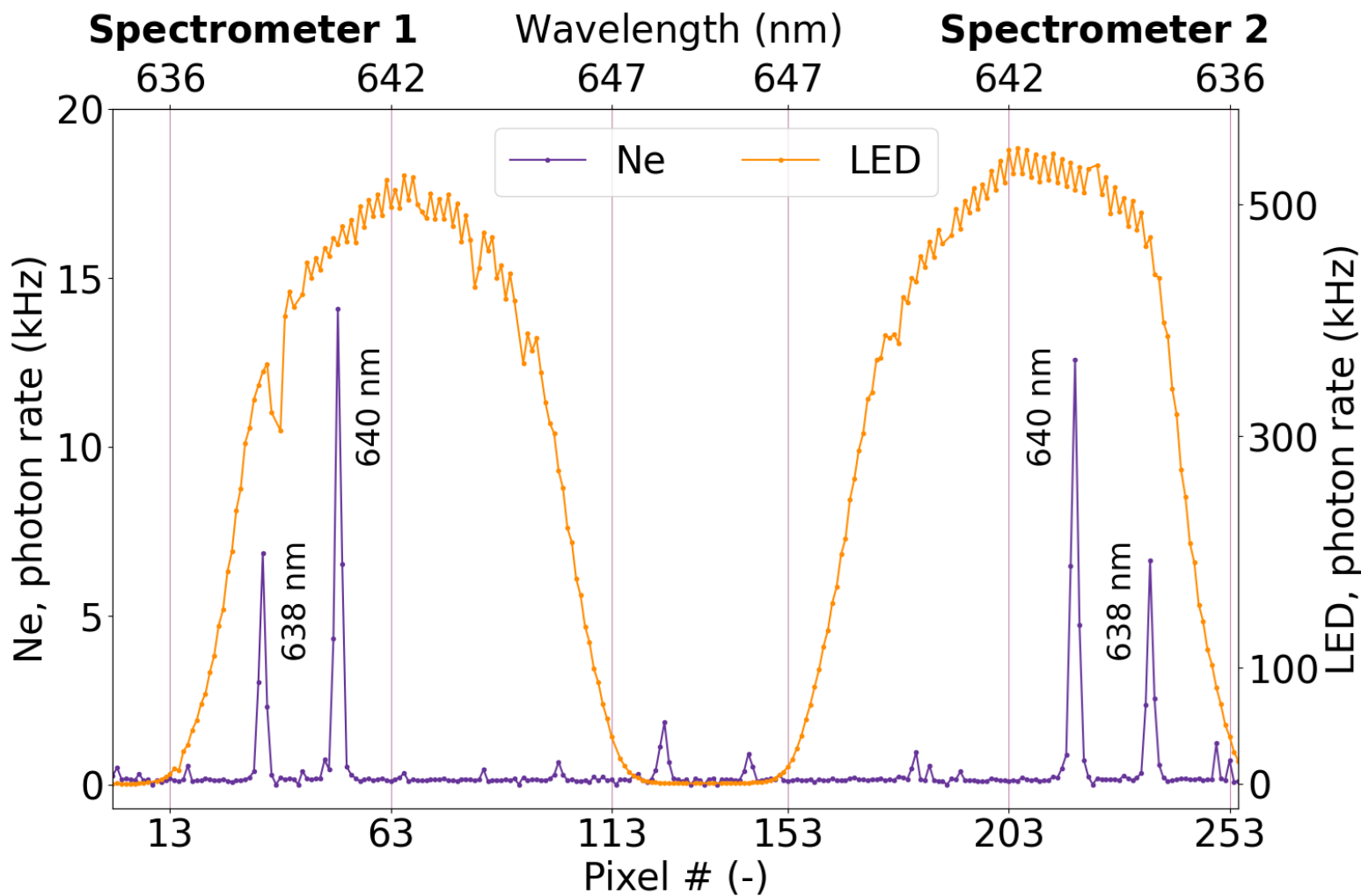
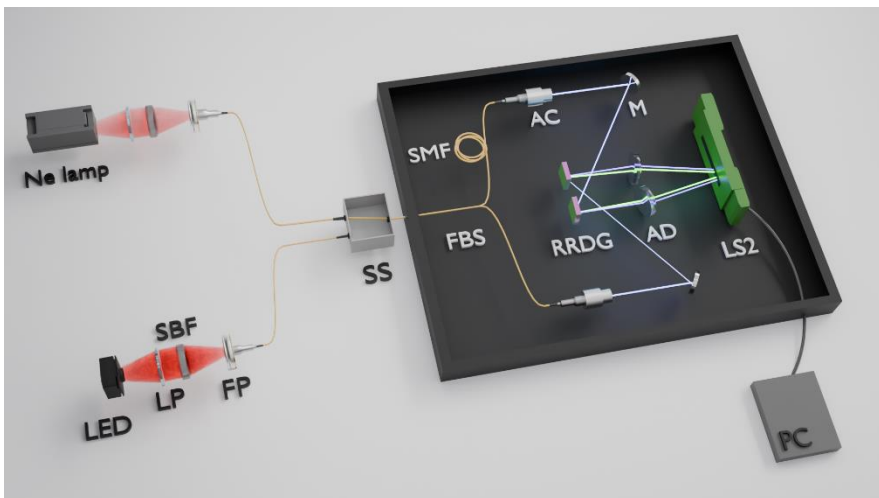


J. Ferrantini, S. Kulkov
et al., *APL Photonics*
10, 026101 (2025).



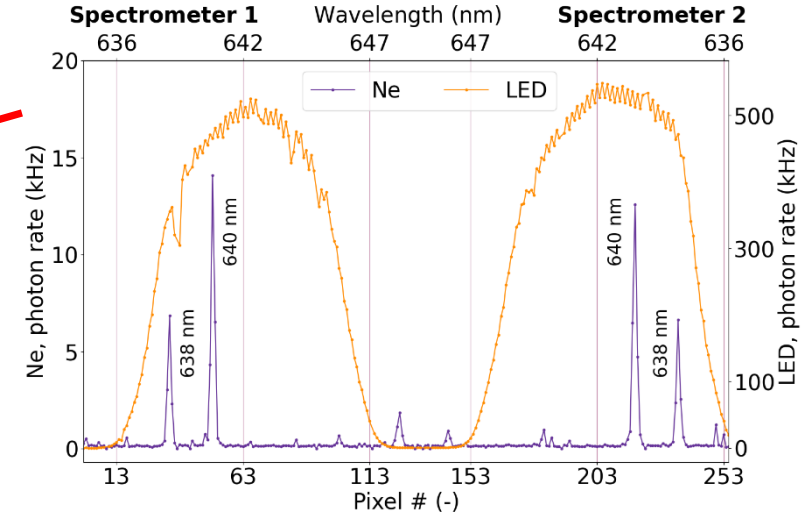
2x Ne and LED spectra

S. Kulkov *et al.*,
arXiv:2509.05649
(2025).

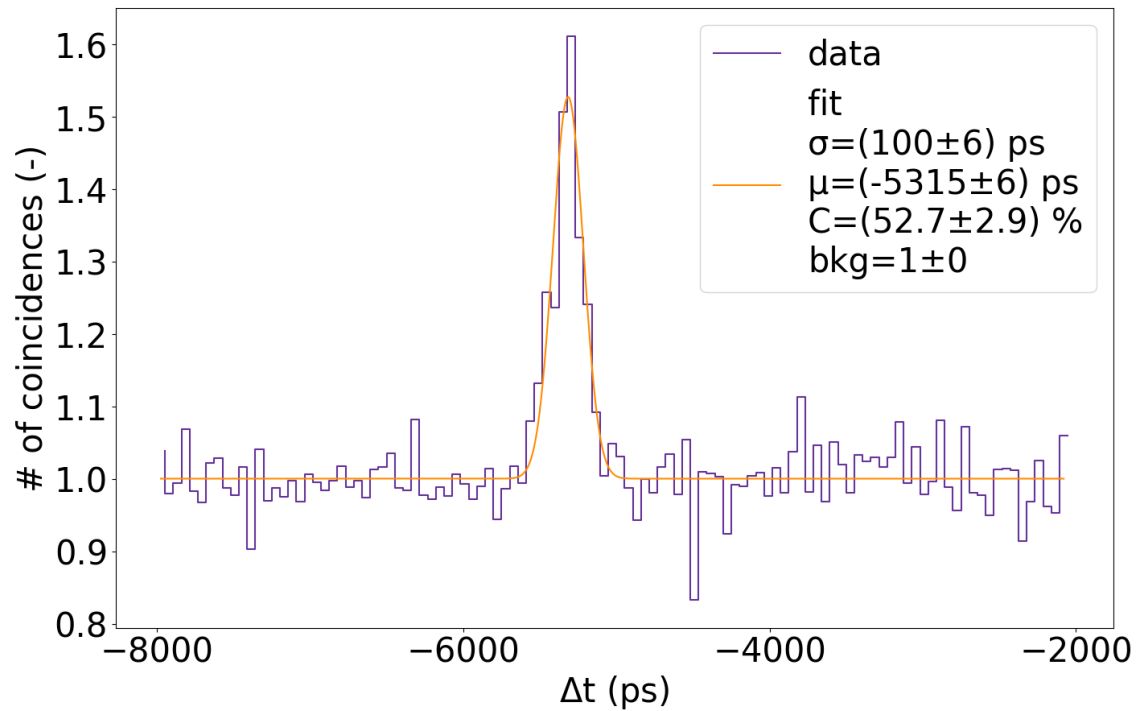


HBT peak: Ne vs LED

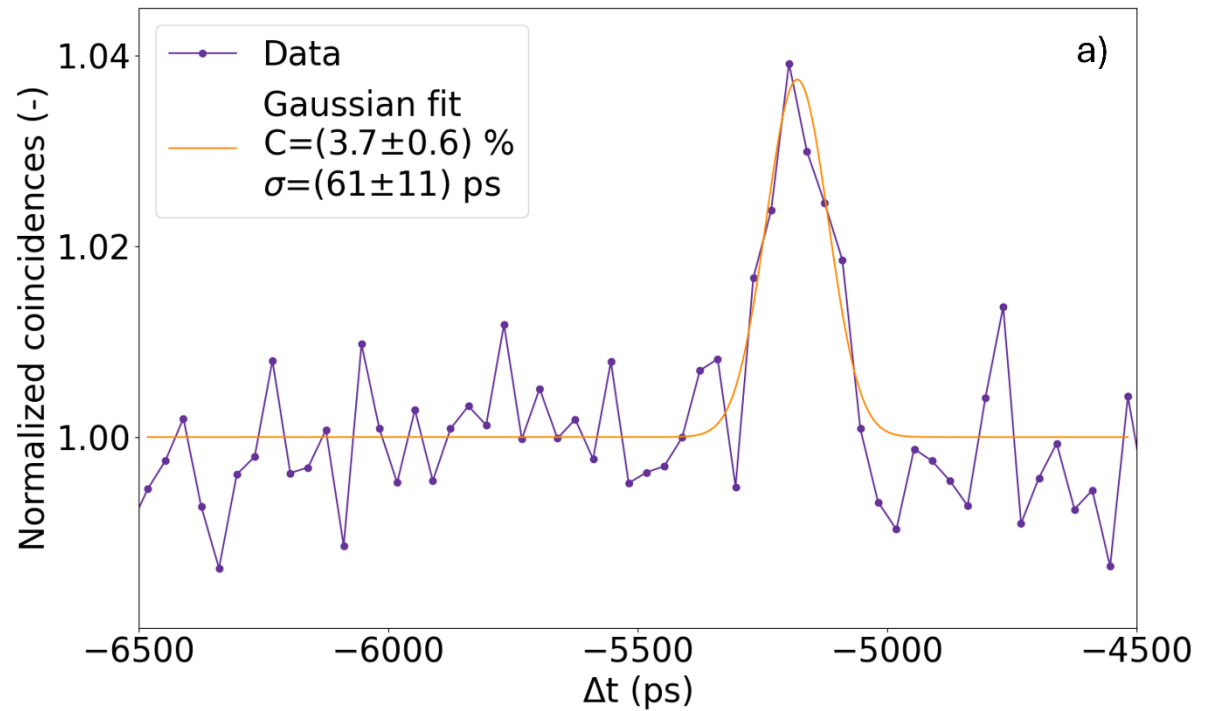
Pixels 51 and 218



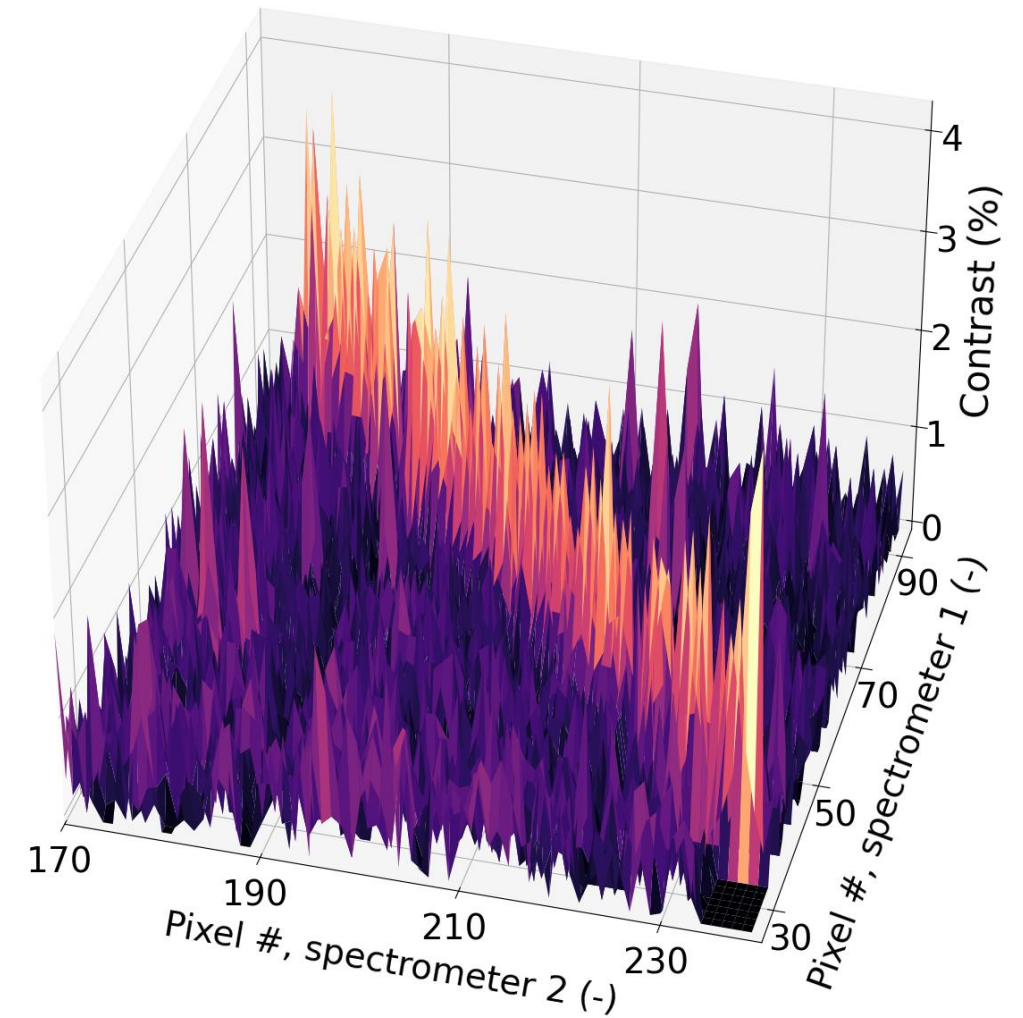
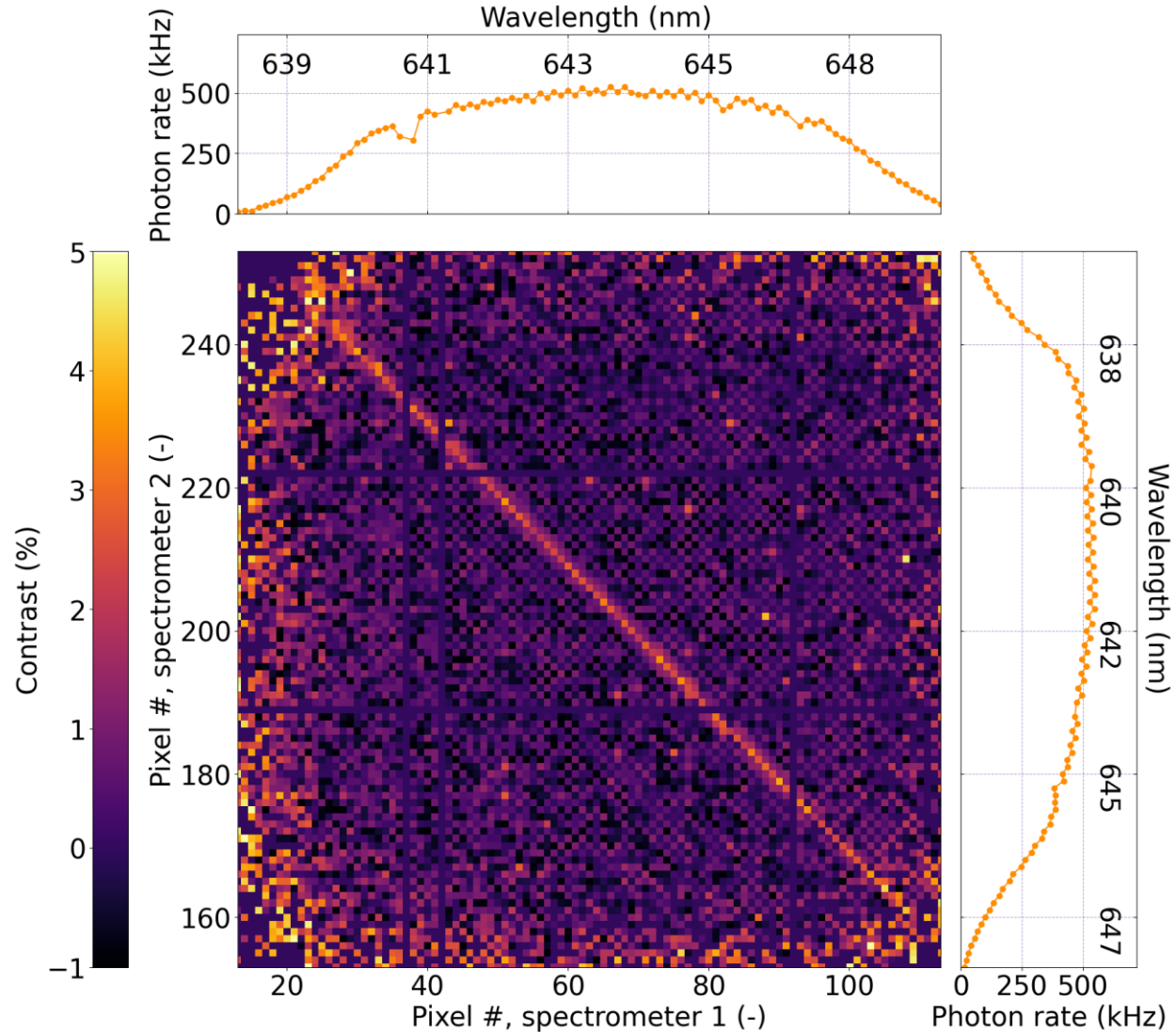
Ne 640 nm lines



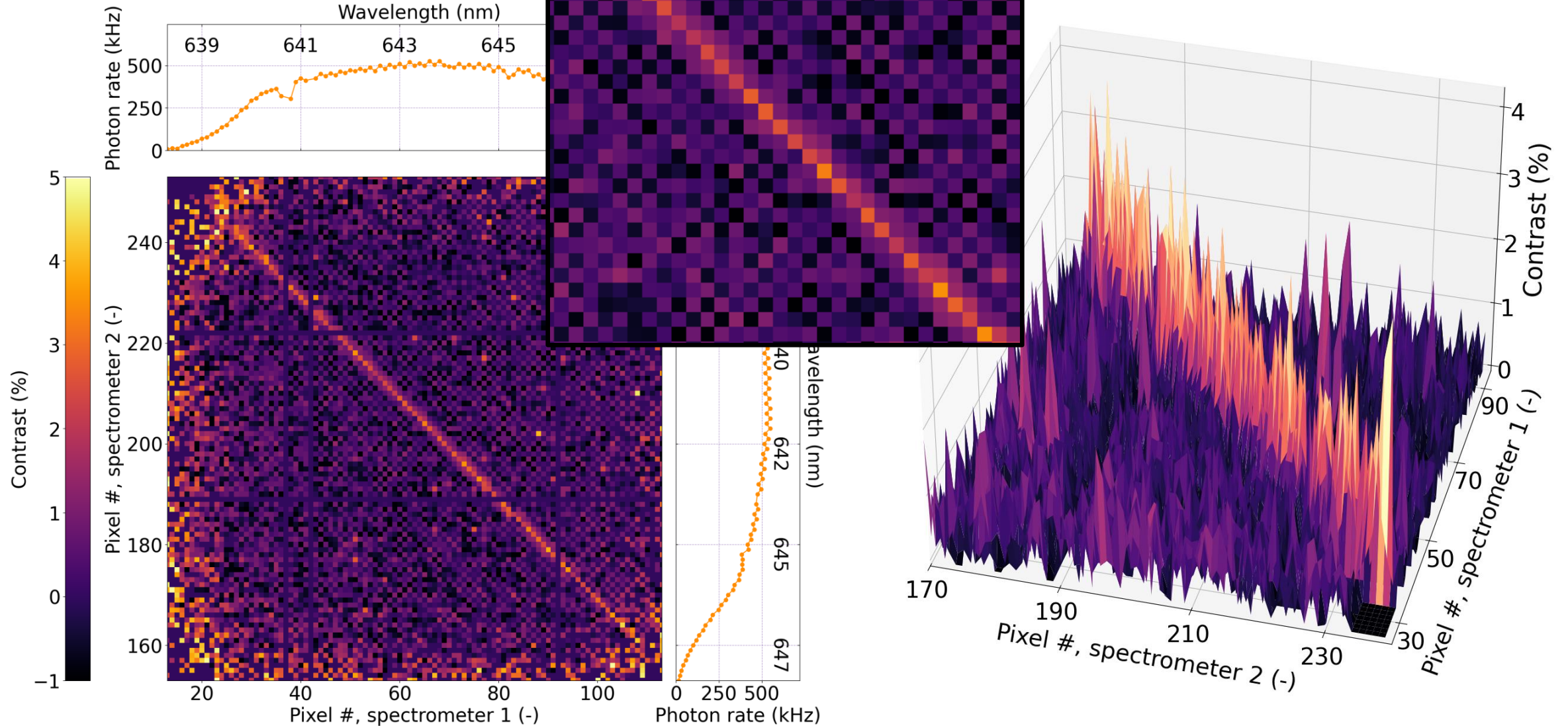
LED



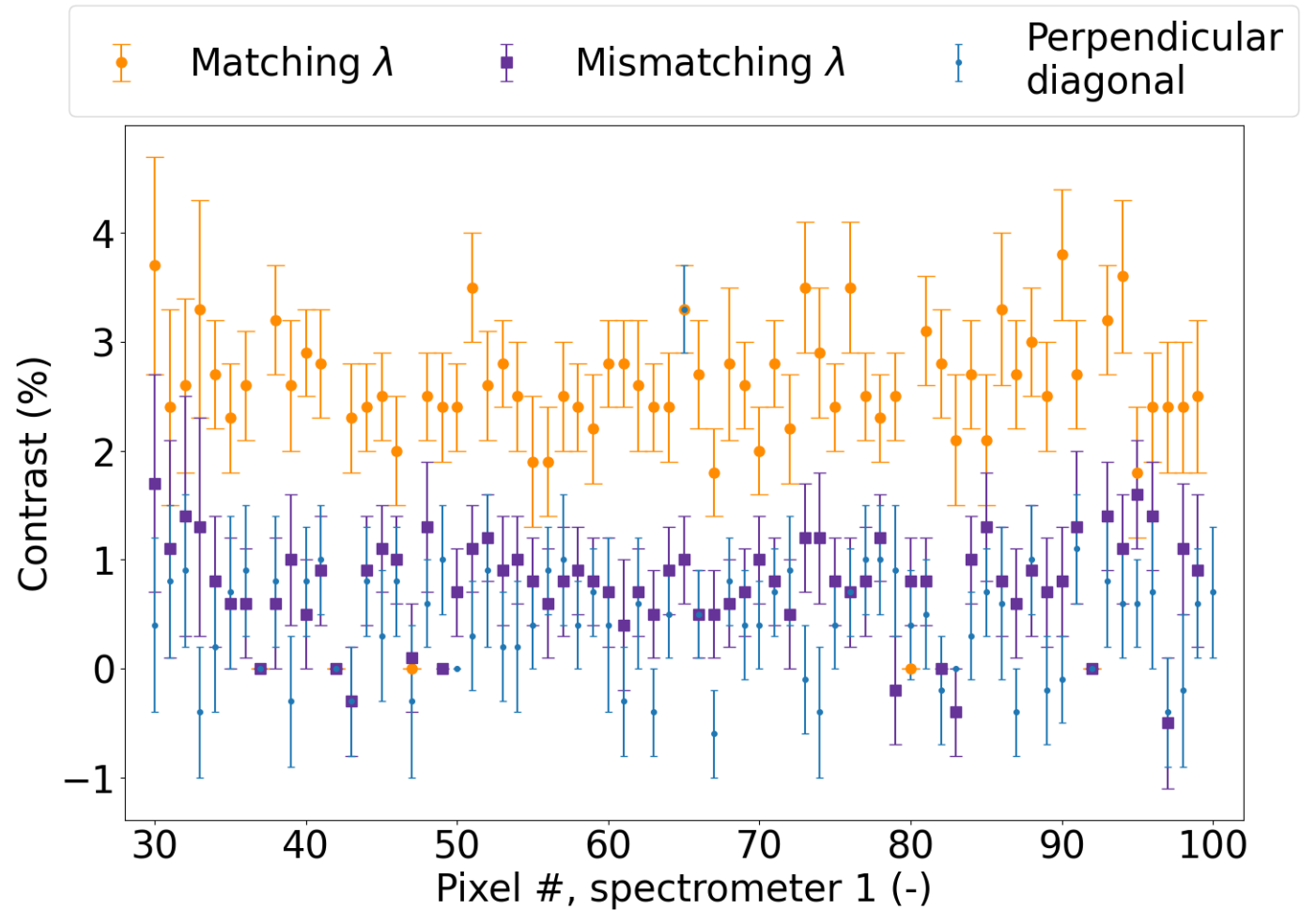
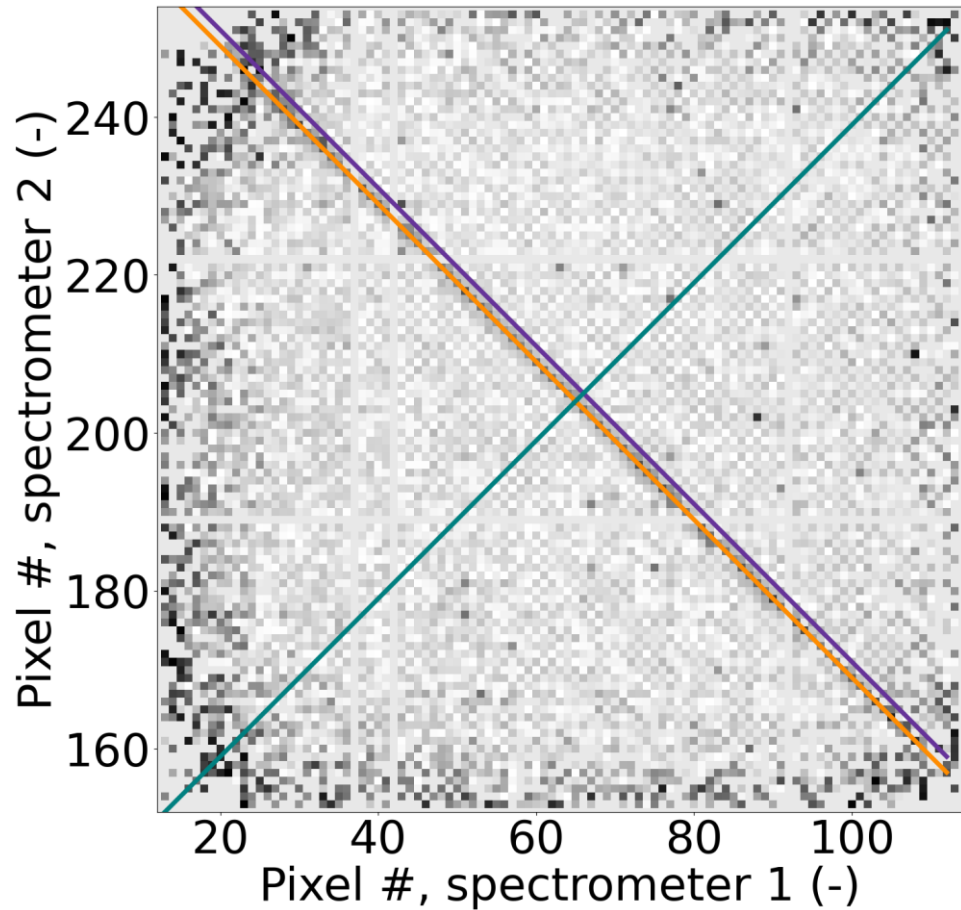
Hundreds of HBT peaks

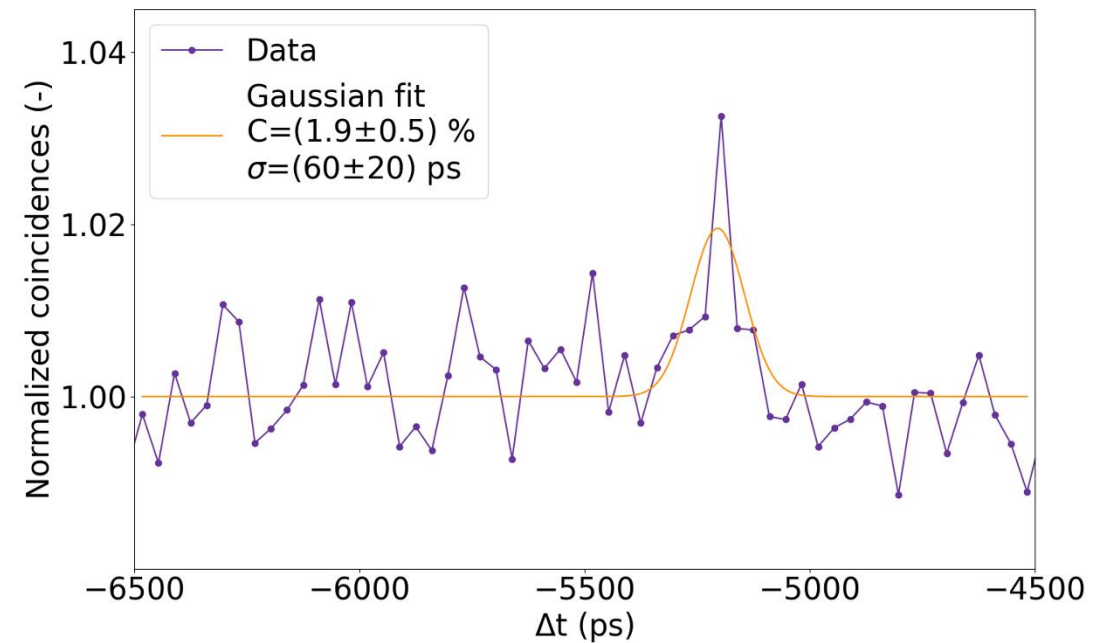
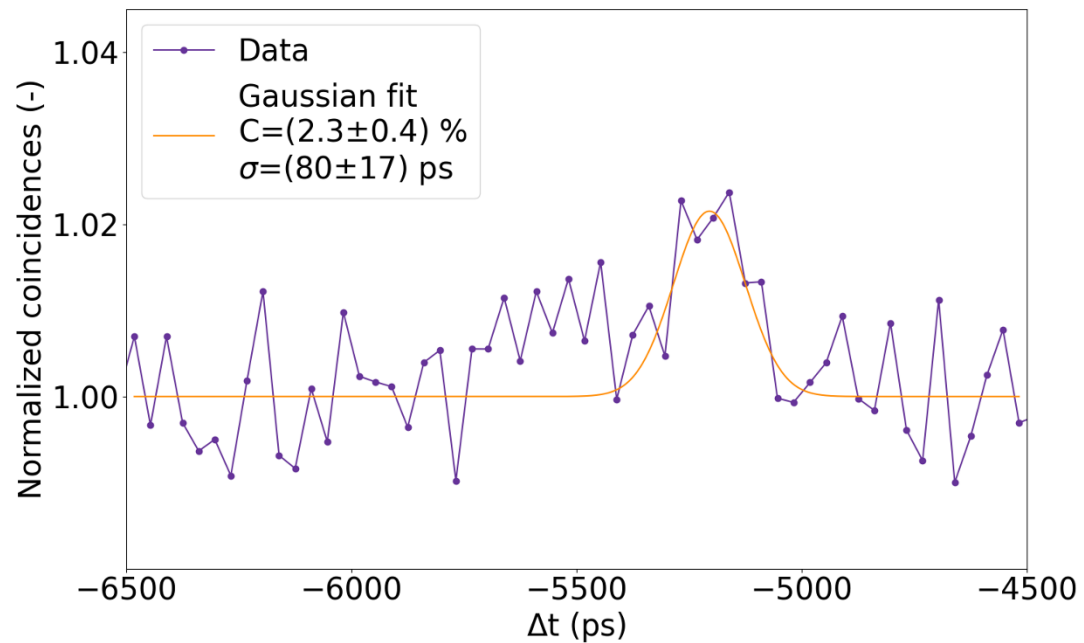
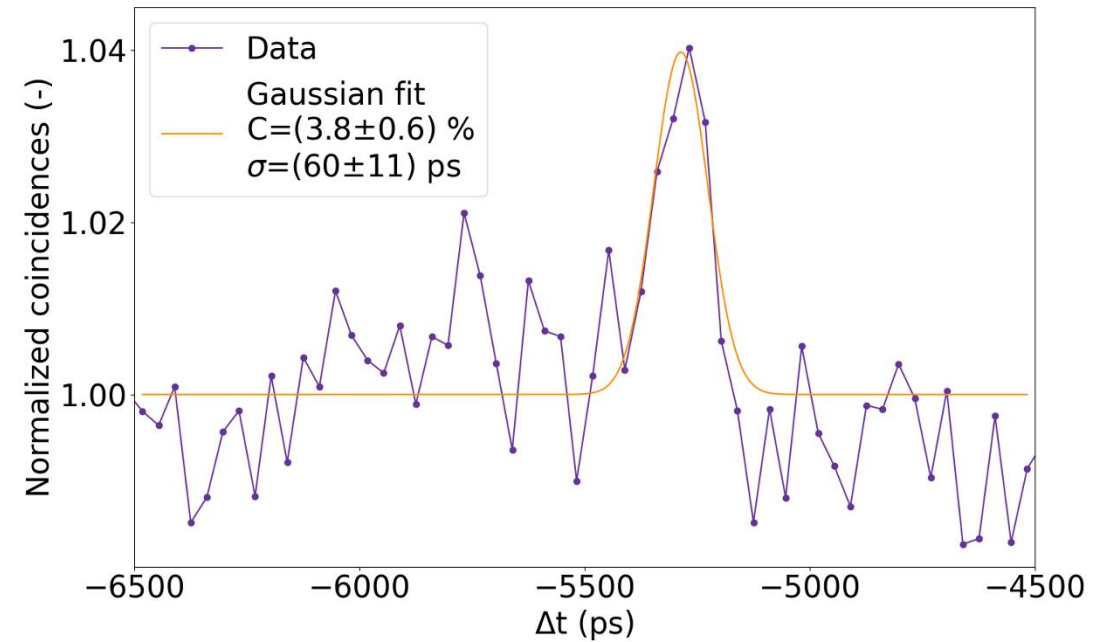
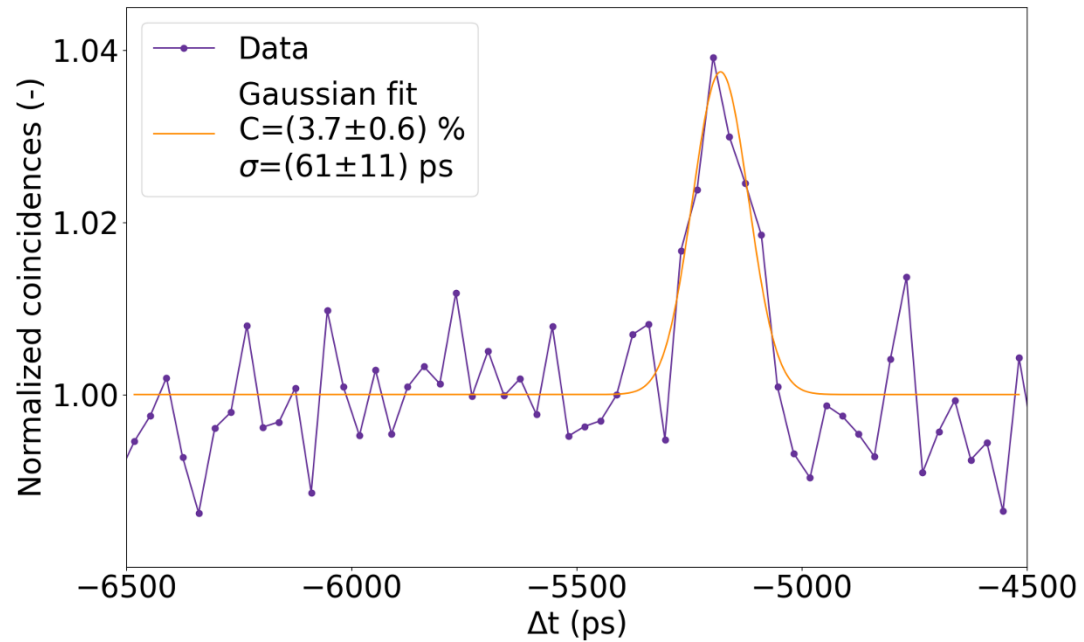


Hundreds of HB



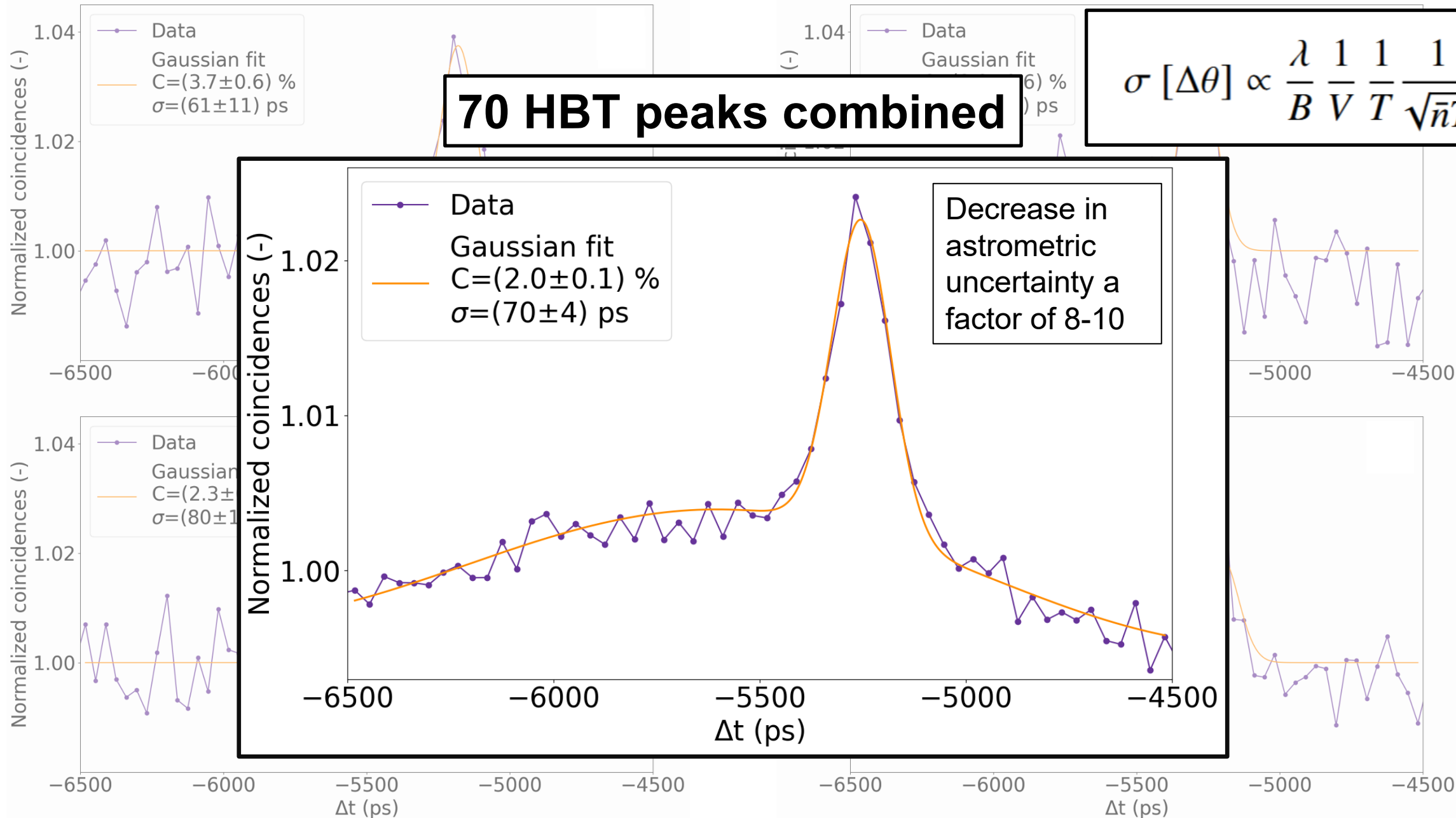
Contrasts from 3 diagonals



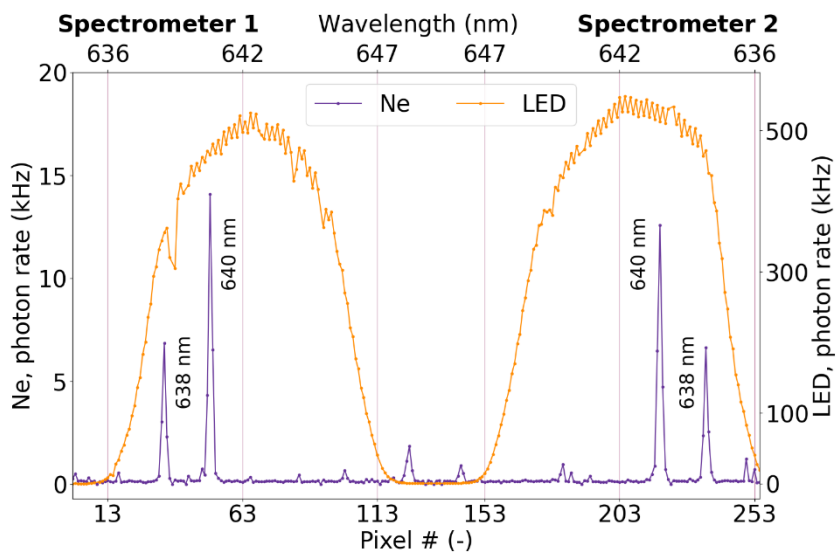


70 HBT peaks combined

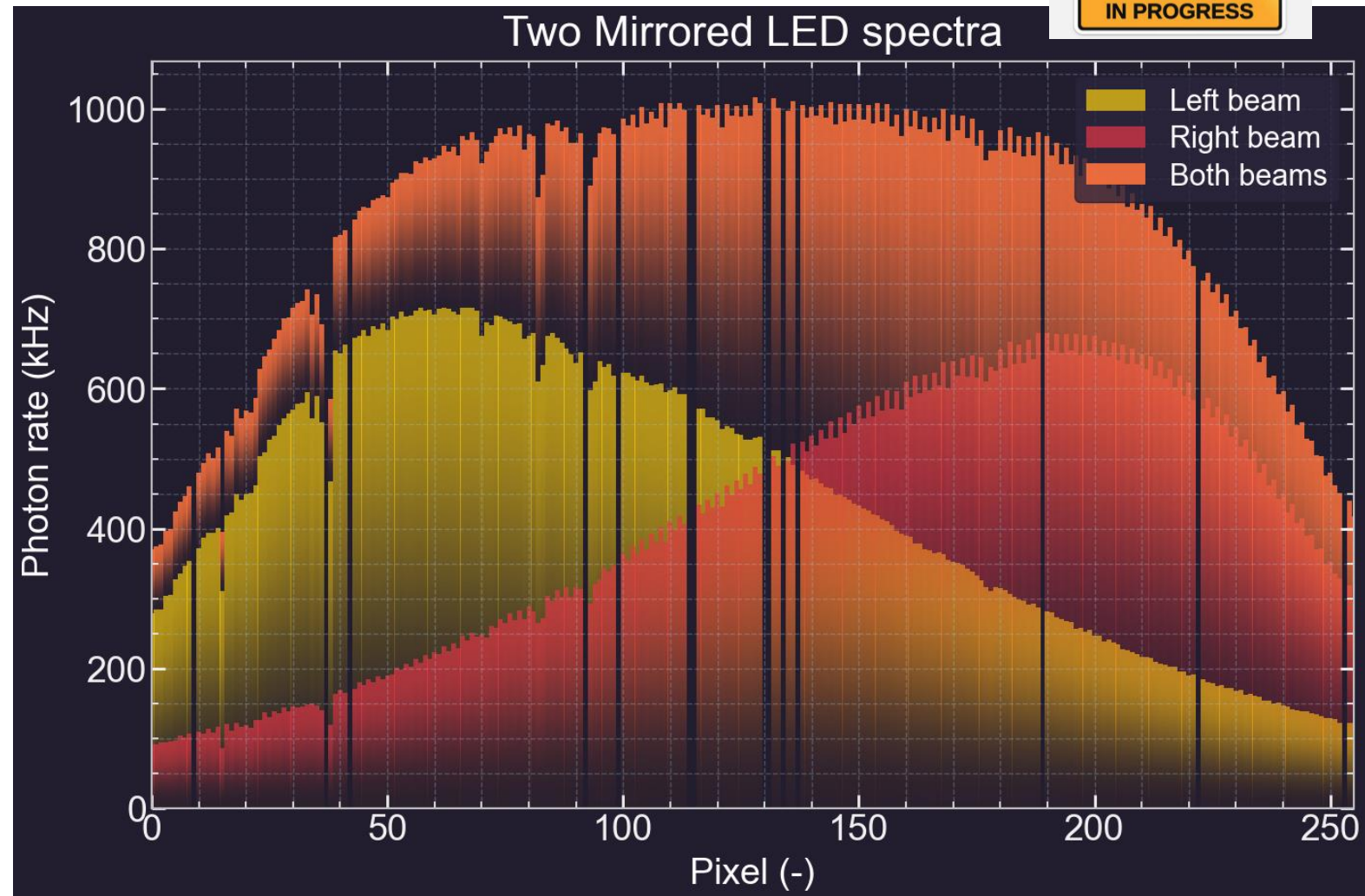
$$\sigma [\Delta\theta] \propto \frac{\lambda}{B} \frac{1}{V} \frac{1}{T} \frac{1}{\sqrt{nT}}.$$



Future plans: away with the filter!



10 nm => 28 nm
3x improvement



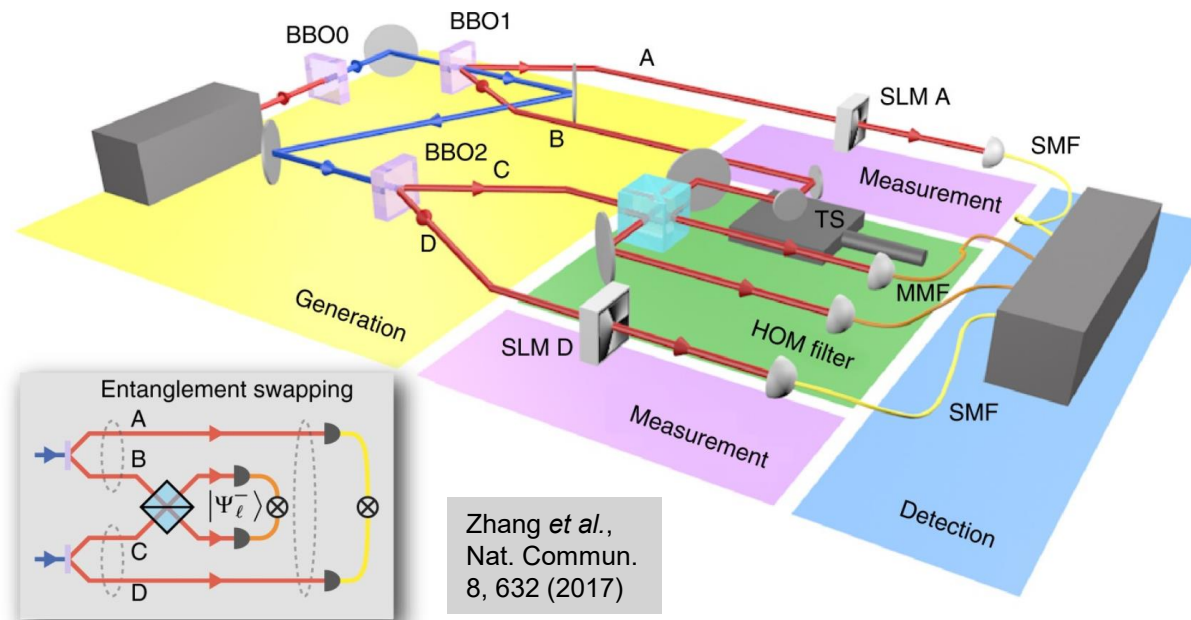
Future plans: go to a telescope

- Single-mode fiber – good for spectral resolution, bad for everything else (especially light collection)
- Testing MMFs – looking for middle ground



Another application

- Entanglement swapping



- 256 pixels => 128 Bell state measurements => ~2 orders of magnitude faster swap rate



Heisenberg-Gabor limit

$$\Delta E \Delta t \geq \frac{\hbar}{2}; \quad \Delta f \Delta t \geq \frac{1}{4\pi},$$



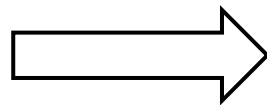
40 pm



40 ps

14.7x

Ways to improve



Echelle
spectrometer

Faster
detectors:
superSPAD,
SNSPD



Thank you for your attention!



CAPADS Web

