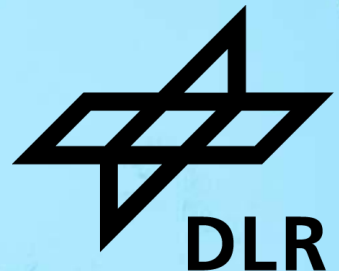


SPECTRO-TEMPORAL STUDY OF PHOTON PAIRS FROM A LITHIUM NIOBATE WAVEGUIDE RESONATOR

Stefan Kazmaier & Kaisa Laiho

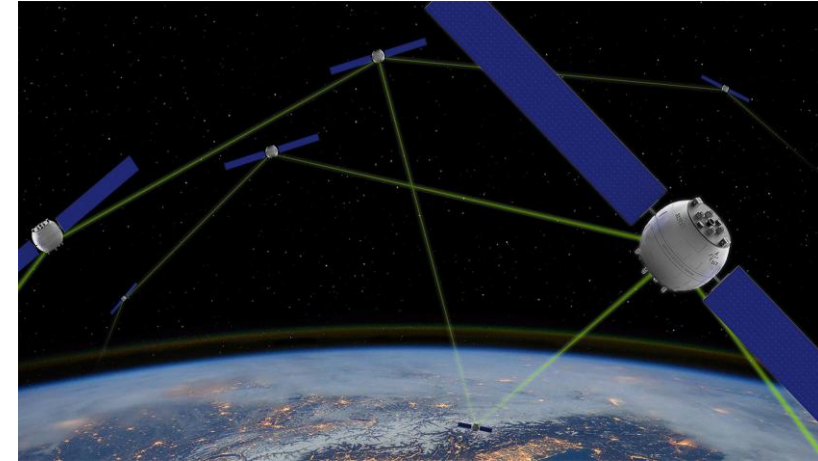
German Aerospace Center (DLR), Institut of Quantum Technologies, Ulm, Germany

02.03.2026 DPG Spring Meeting

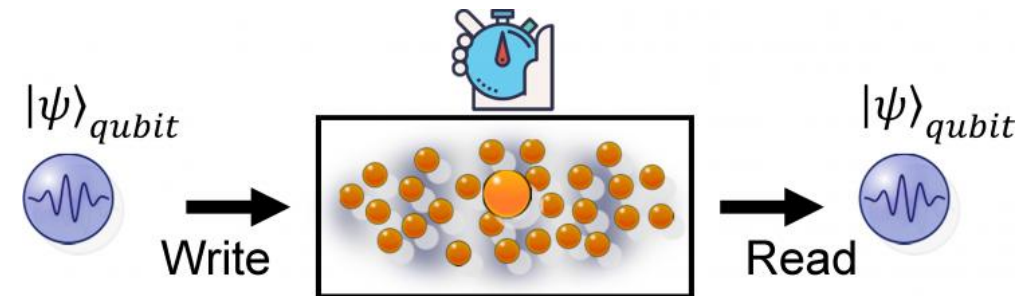
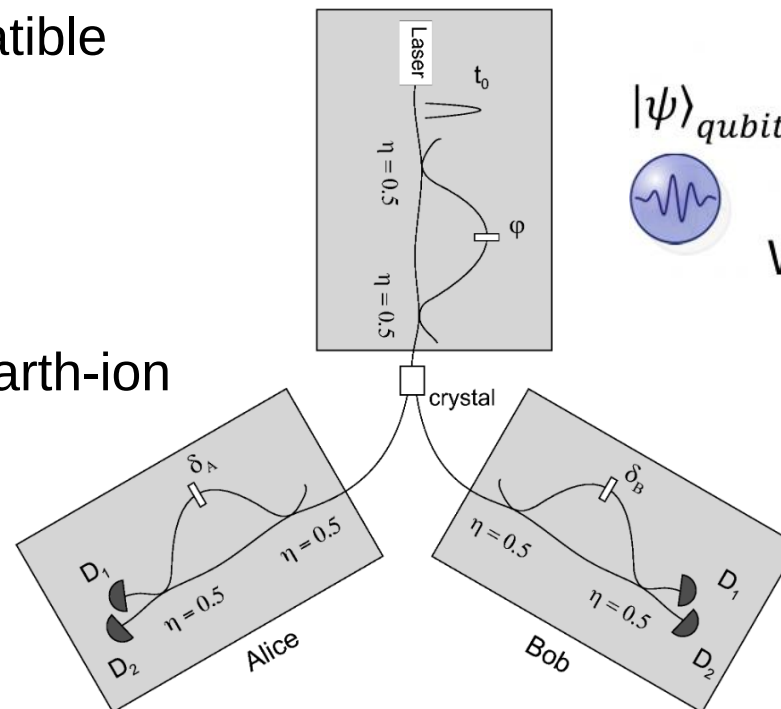
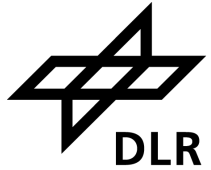


Future Vision

- Quantum Communication in Space
- Time-Bin Entanglement
 - Efficient synchronization
 - Robust against polarization drifts
- Narrow Bandwidth
 - Quantum Memory Compatible
 - Low Dispersion
- Telecom wavelengths
 - Low Attenuation
 - Compatibility with Rare-earth-ion doped crystals at hand



DLR (rendering), ESA/NASA (image of the Earth)

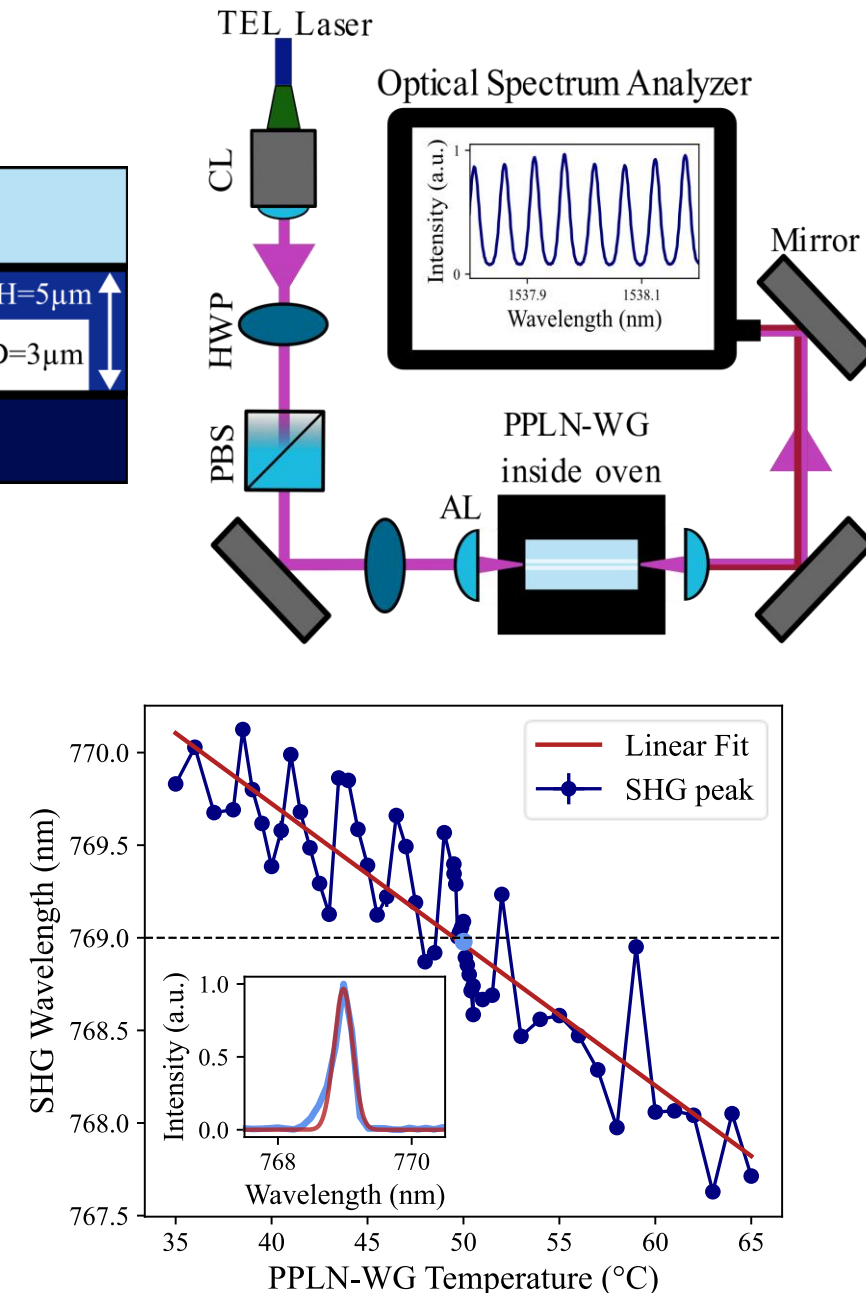
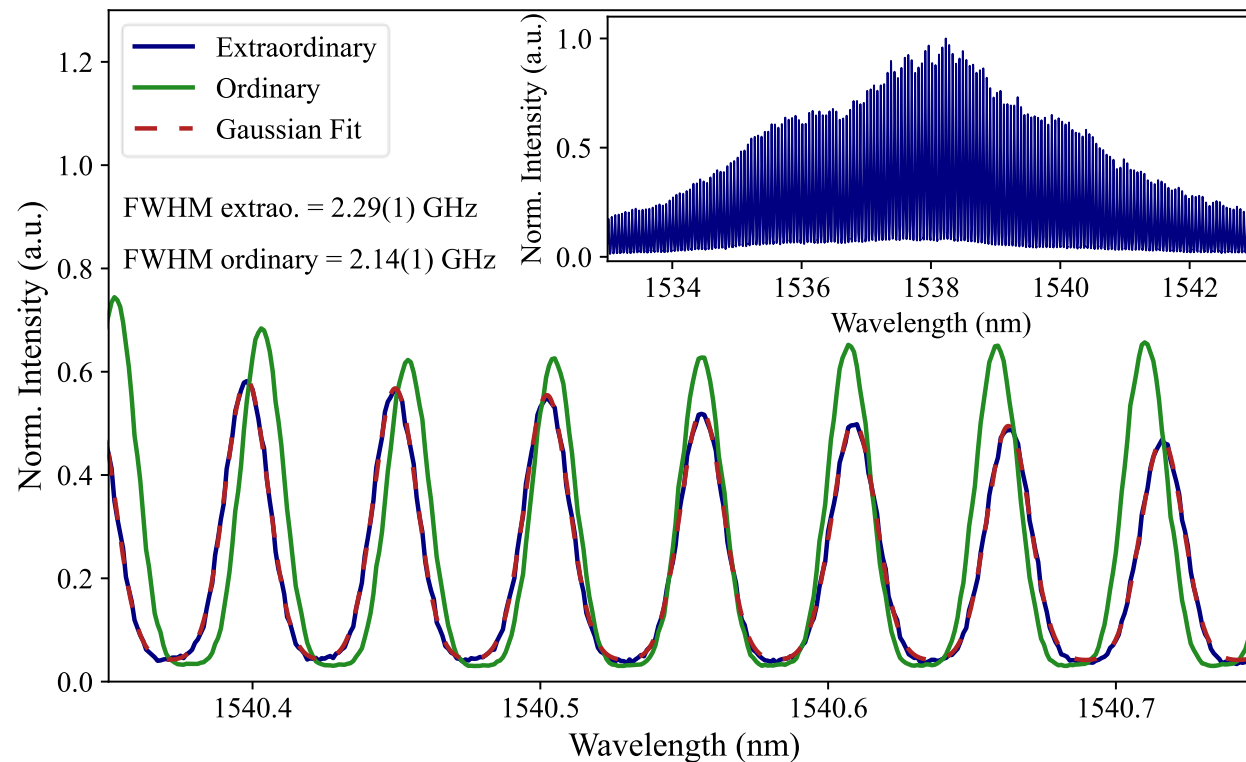
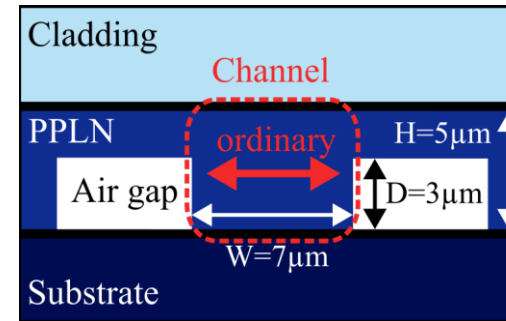


University of Geneva, Quantum Memories

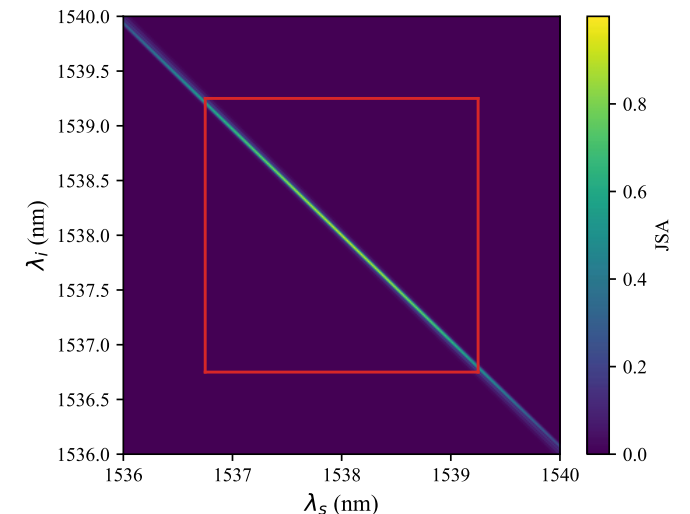
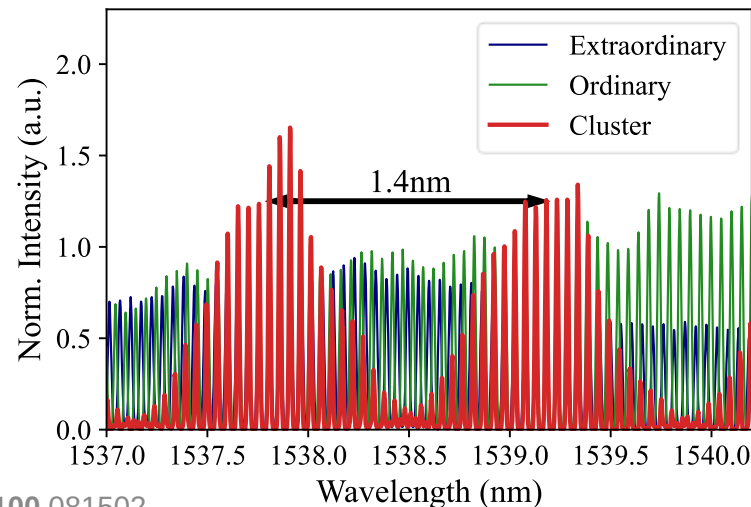
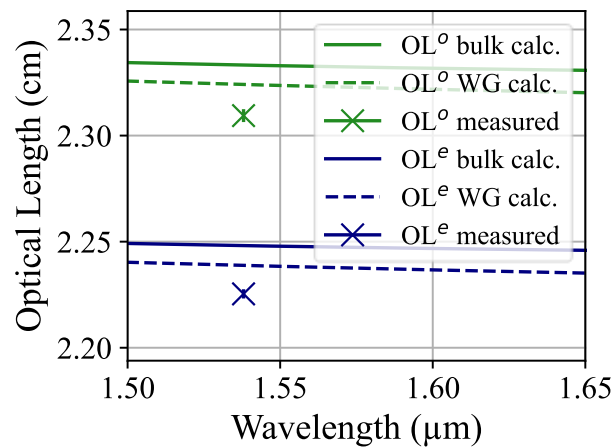
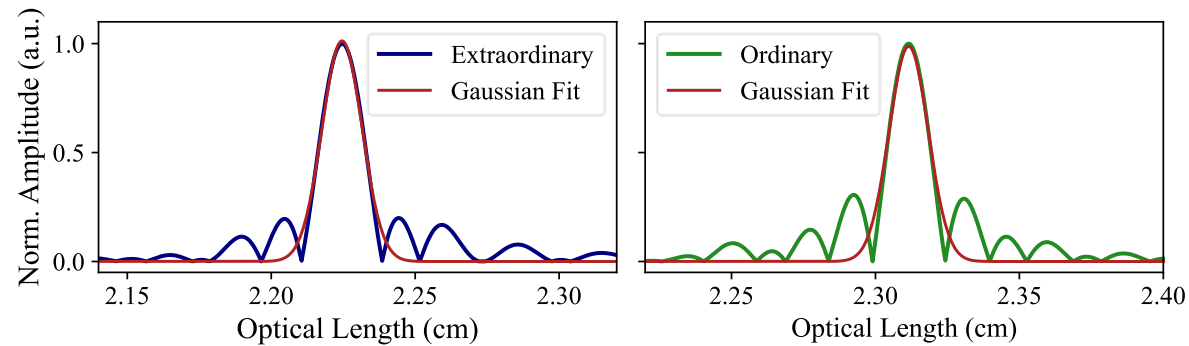
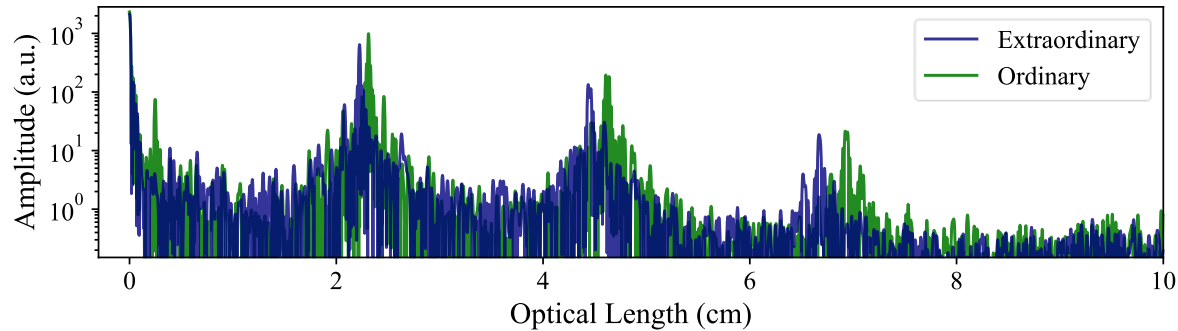
Our goal:
Narrow-bandwidth photon-pair
source at telecom wavelengths

Our Approach – Quantum Light Source

- Commercial PPLN-WG Type-II SPDC
- Pulsed pump (fs) 769nm $\rightarrow$ 1538nm
- FPI HR coating R=97% 1cm long



Optical Path Length Difference



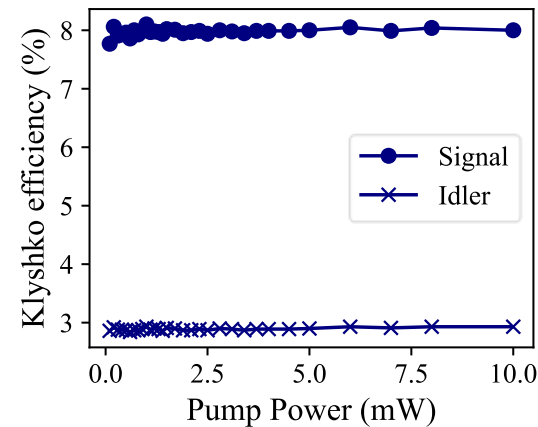
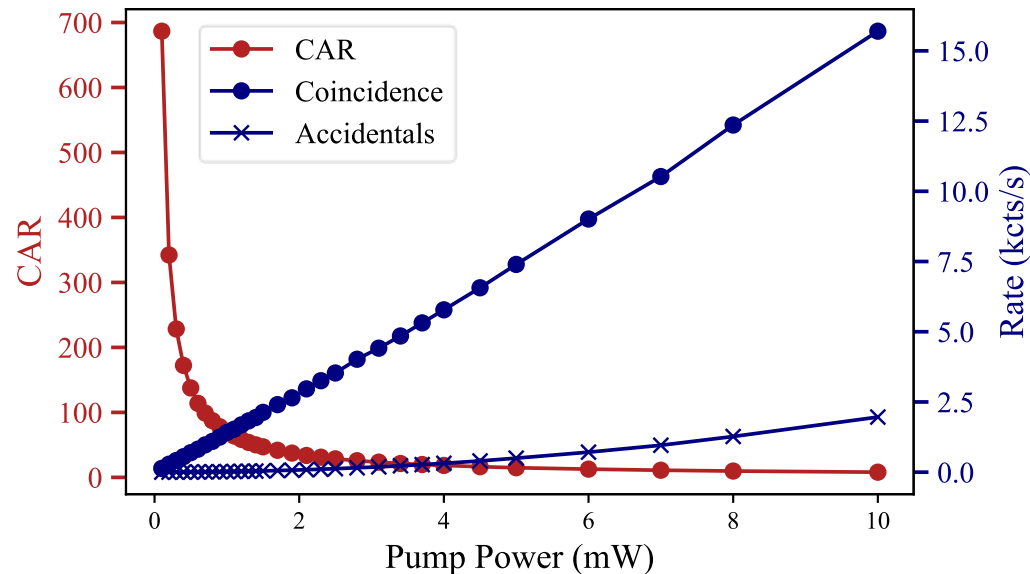
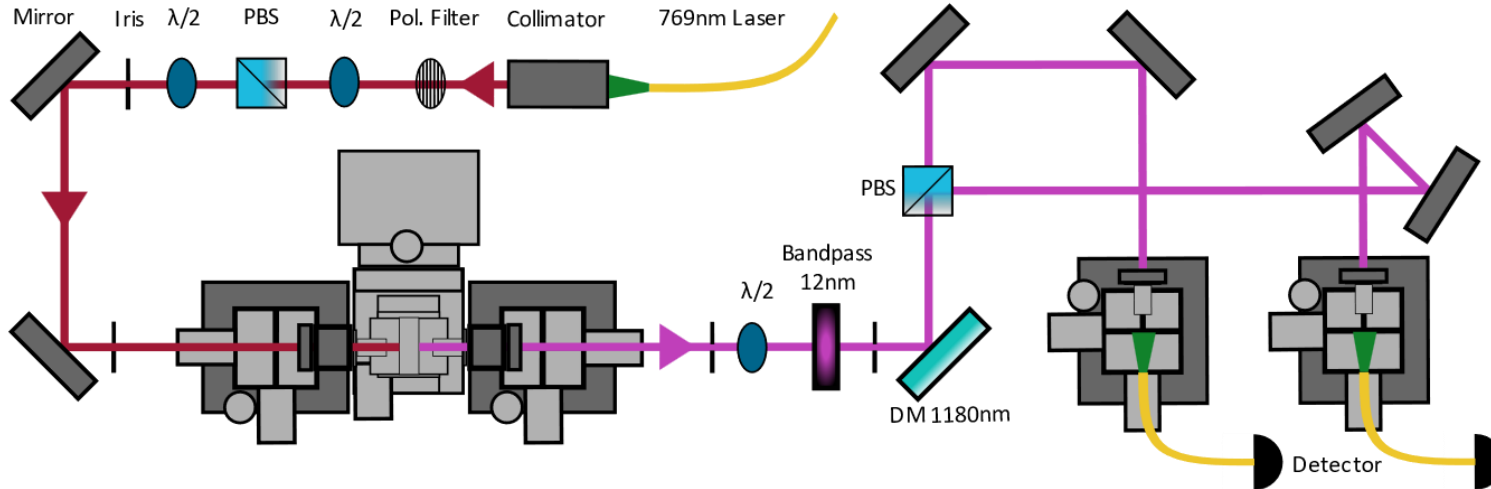
Predictions from transmission measurements

- Differential group delay
 - 1.4(1) ps
- Cluster spacing ^[2]
 - 178(12) GHz / 2.8(2) nm
- Predict photon pair bandwidth ^[2]
 - 320(20) GHz / 2.5(2) nm

[1] Stefan Kazmaier and Kaisa Laiho 2025 *Phys. Scr.* **100** 081502

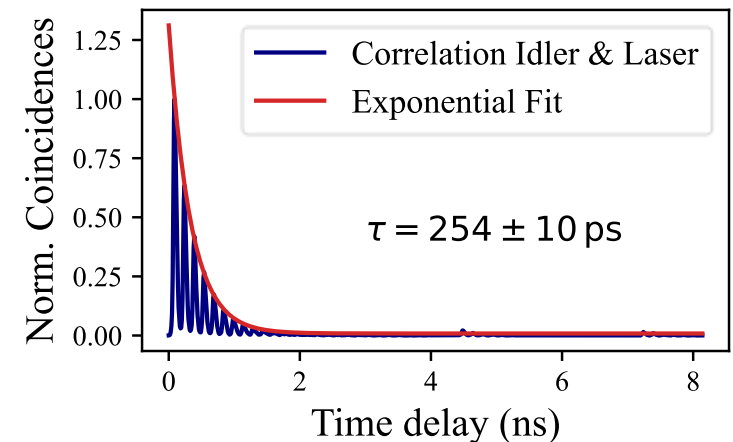
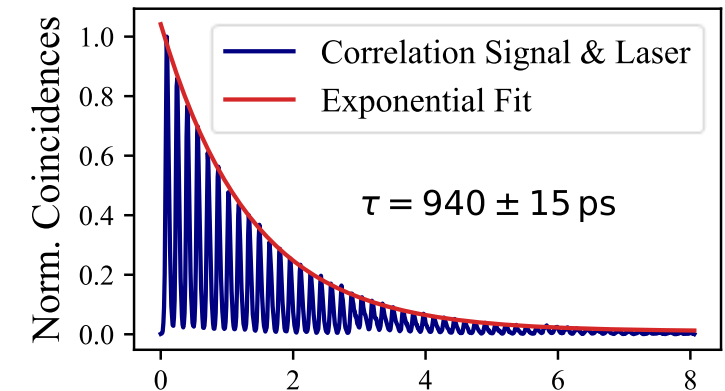
[2] Kai-Hong Luo *et al* 2015 *New J. Phys.* **17** 073039

Multimode Photon Pair Characterization

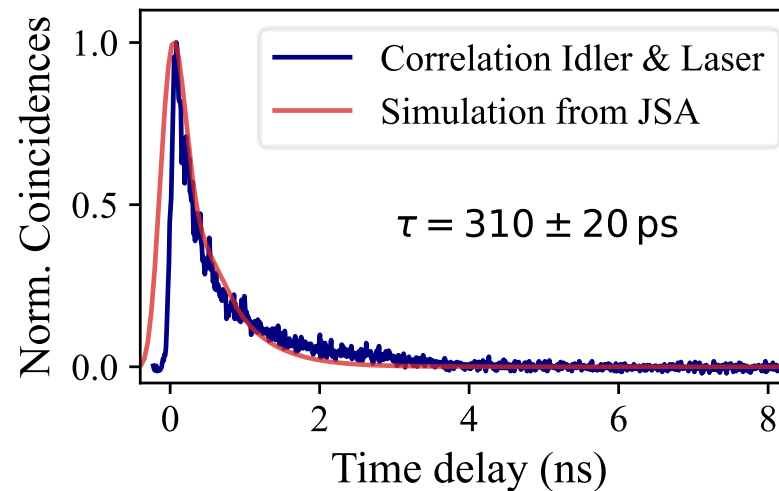
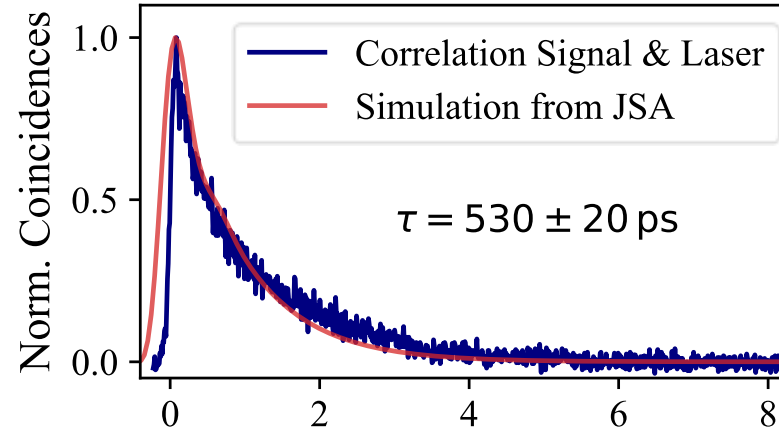
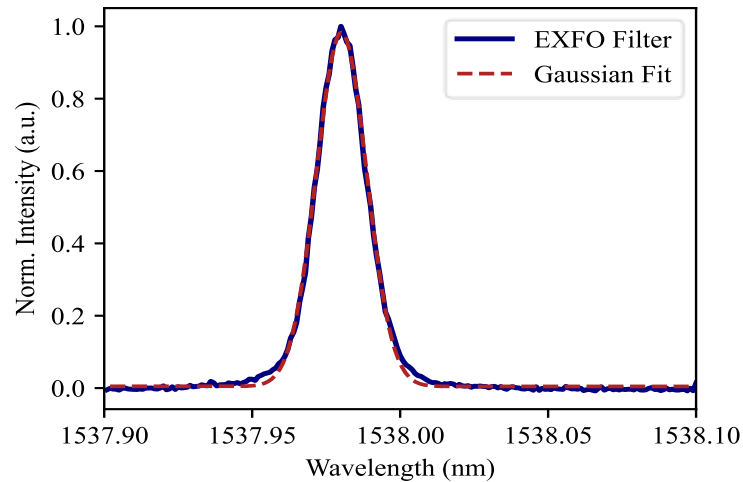


Measuring with CAR = 50

- Coinc. Rate = 2 kHz
- Heralded $g^2(0) = 0.09(2)$

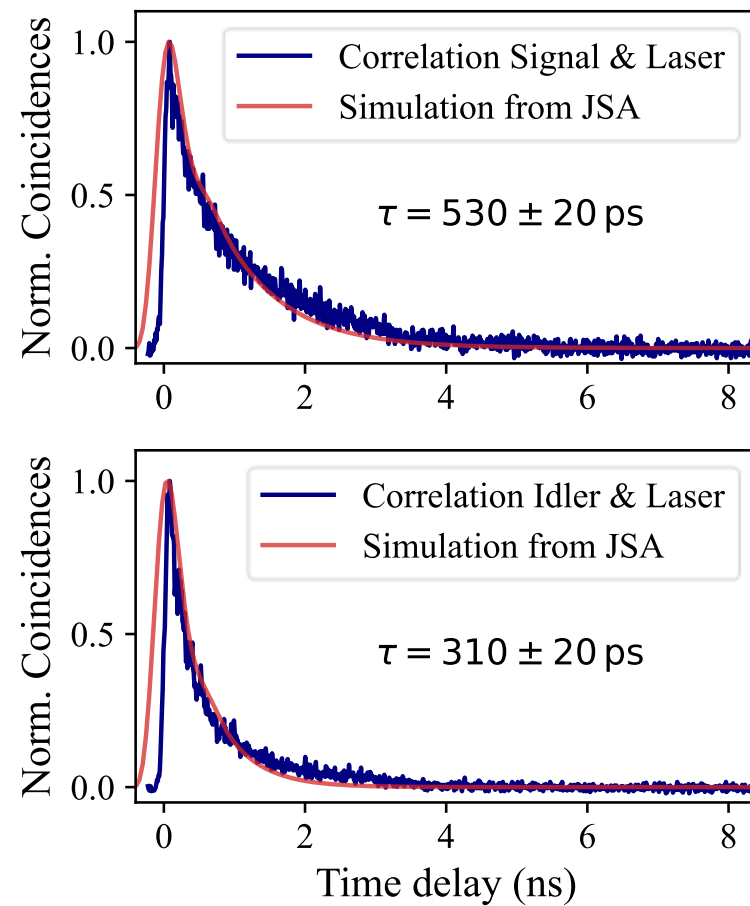
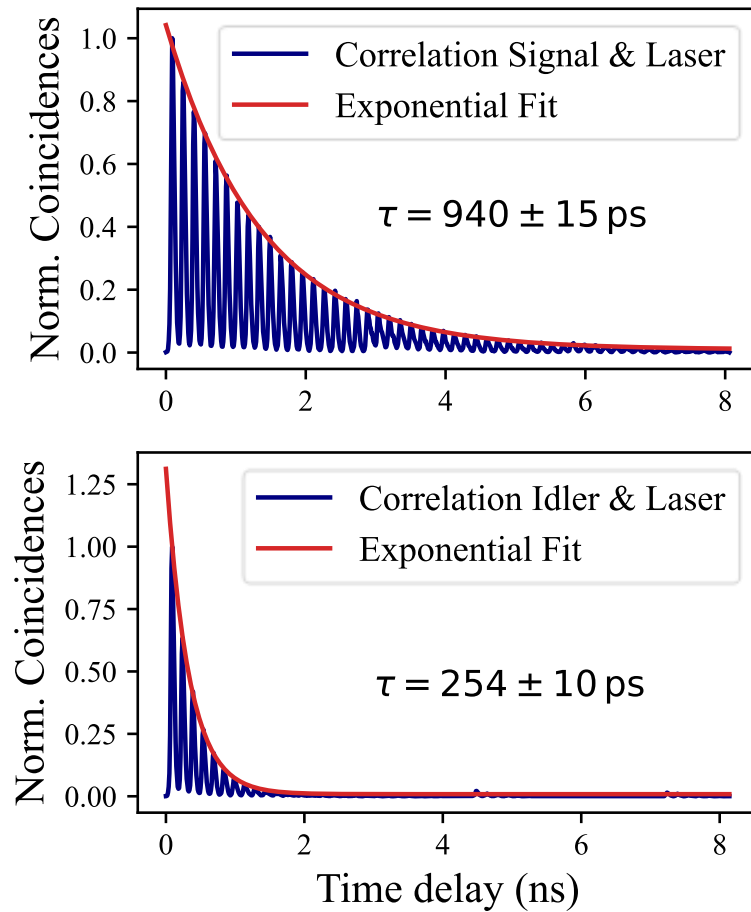


Time-Bin Characterization Single Mode



- Variable Bandpass filter
 - Filter one resonator-mode
 - FWHM ca. 2 GHz
- Half Time Single Mode
 - Signal: roughly half
 - Idler: slightly longer

Spectral and Temporal properties



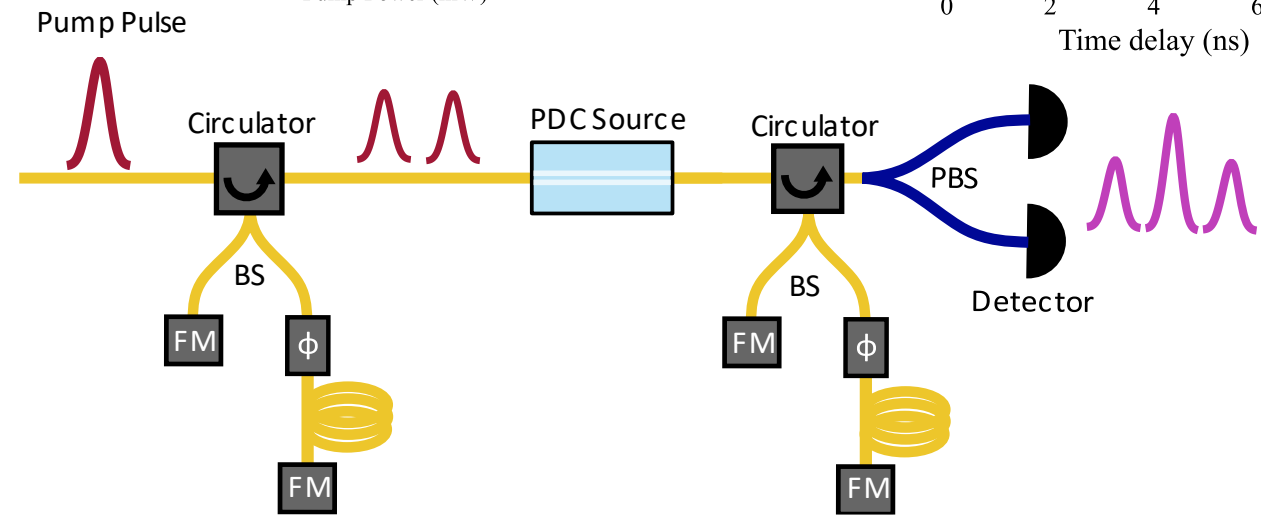
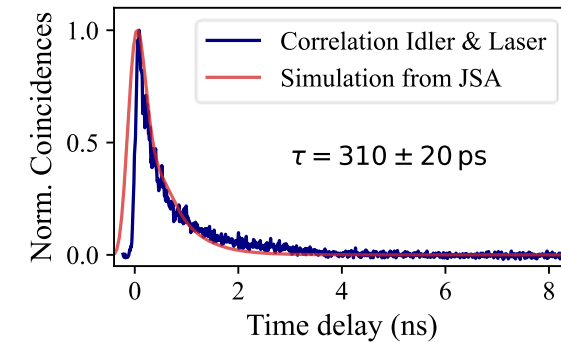
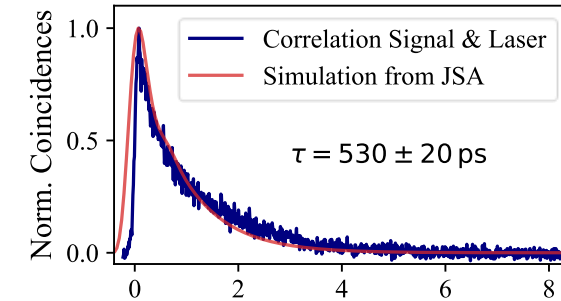
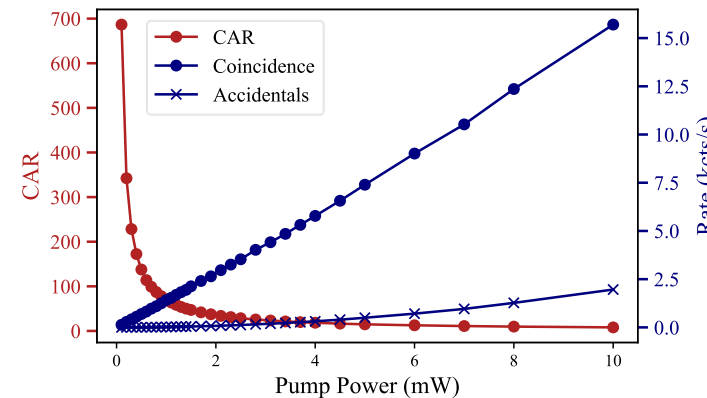
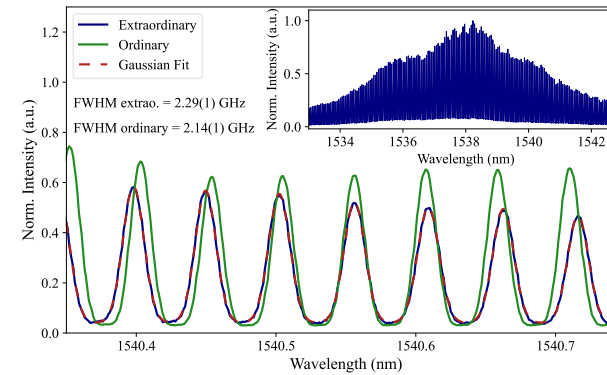
Empiric Time-Bandwidth Product
 $TBP = \tau * \Delta\nu$

Signal	Half Time (ns)	Bandwidth (GHz)	TBP
Multi Mode	0,942	2,14	2,02
Single Mode	0,535	2,14	1,14
Idler			
Multi Mode	0,254	2,29	0,58
Single Mode	0,318	2,29	0,73

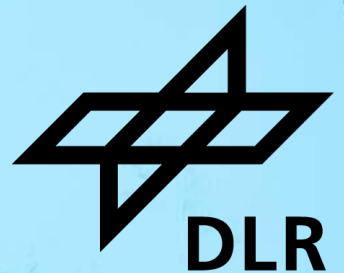
[1] B. Brecht and C. Silberhorn, "Characterizing entanglement in pulsed parametric down-conversion using chronocyclic Wigner functions" 2013 Phys. Rev. A

Conclusion & Outlook

- Narrowband pulsed PDC source
- Fabry Pérot Interferometer
 - FWHM $\approx 2.2\text{GHz}$; FSR $\approx 6.5\text{GHz}$
- Photon Pair generation
 - CAR >100
- Temporal properties
 - Multi-Mode & Single-Mode
- Towards Time-Bin Entanglement generation



Thank you for your Attention



Topic: **Spectro-Temporal Study of Photon Pairs from a Lithium Niobate Waveguide Resonator**

Date: 2026-03-02

Author: Stefan Kazmaier

Institute: Institut of Quantum Technologies

Image sources: All images “DLR (CC BY-NC-ND 3.0)” unless otherwise stated