



Shaping Spectral Entanglement

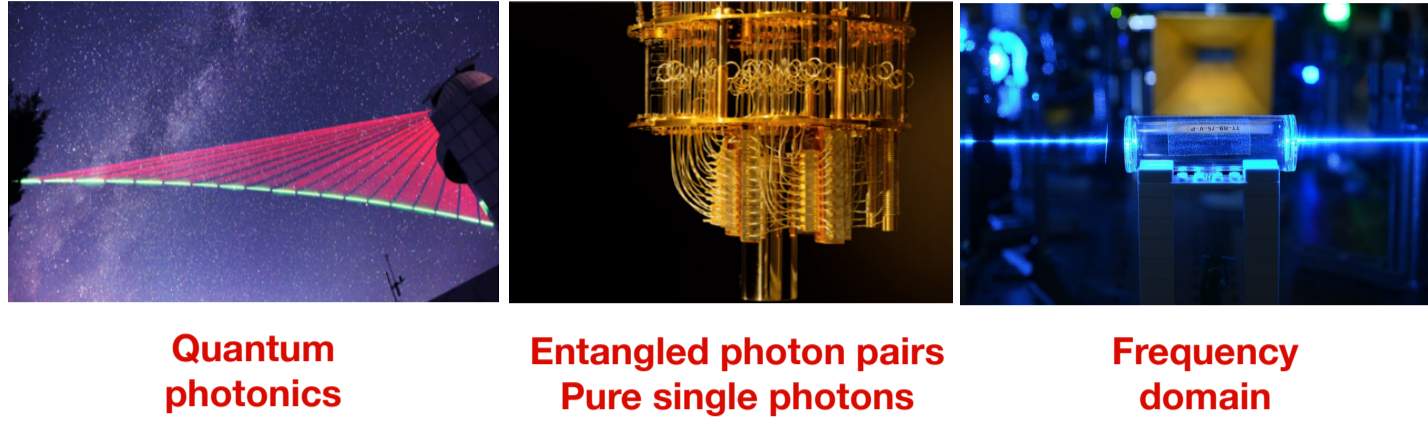
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Motivation

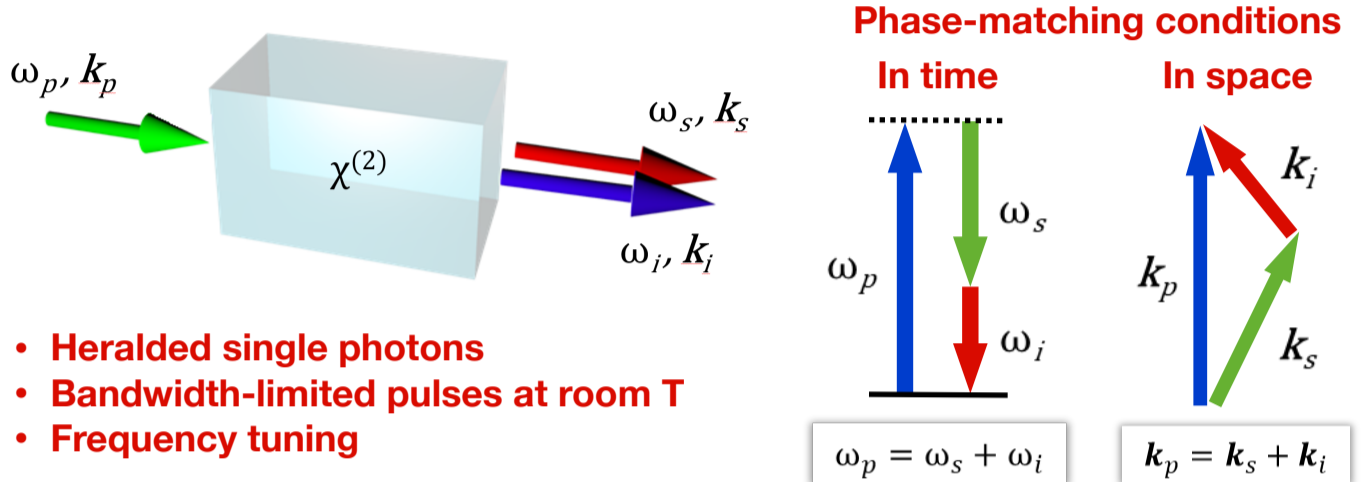


Quantum photonics

Entangled photon pairs
Pure single photons

Frequency domain

Spontaneous Parametric Down-Conversion



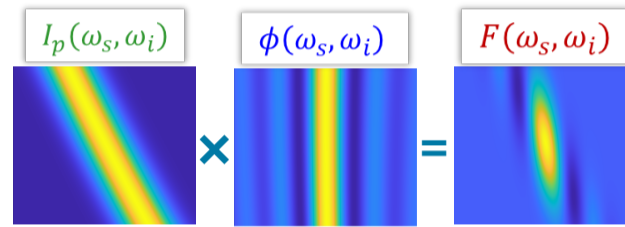
- Heralded single photons
- Bandwidth-limited pulses at room T
- Frequency tuning

$$|\psi\rangle \sim |0\rangle + \eta \iint F(\omega_s, \omega_i) |\omega_s\rangle |\omega_i\rangle d\omega_s d\omega_i$$

Joint spectral amplitude (JSA)

$$F(\omega_s, \omega_i) = I_p(\omega_s, \omega_i) \phi(\omega_s, \omega_i)$$

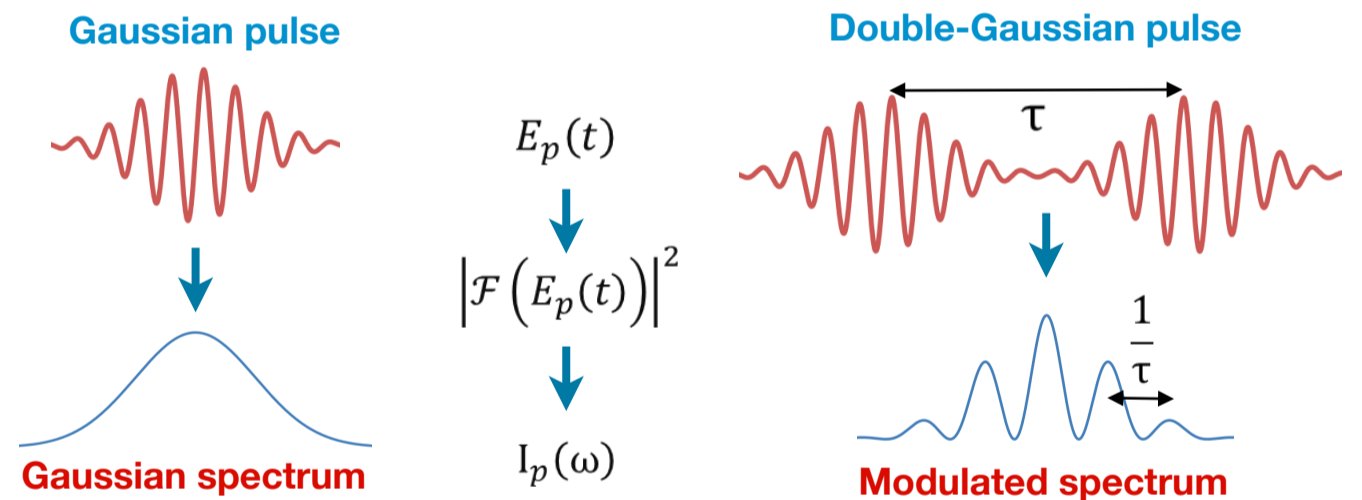
Pump function Phase-matching function



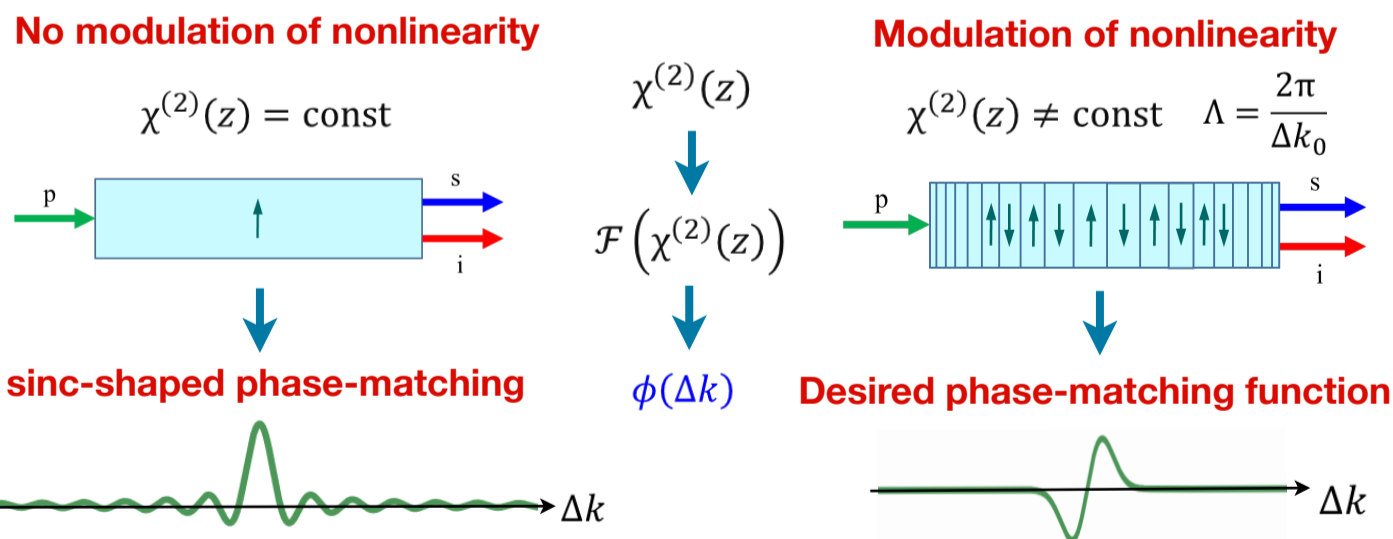
Joint spectral intensity (JSI)

$$J(\omega_s, \omega_i) = |F(\omega_s, \omega_i)|^2$$

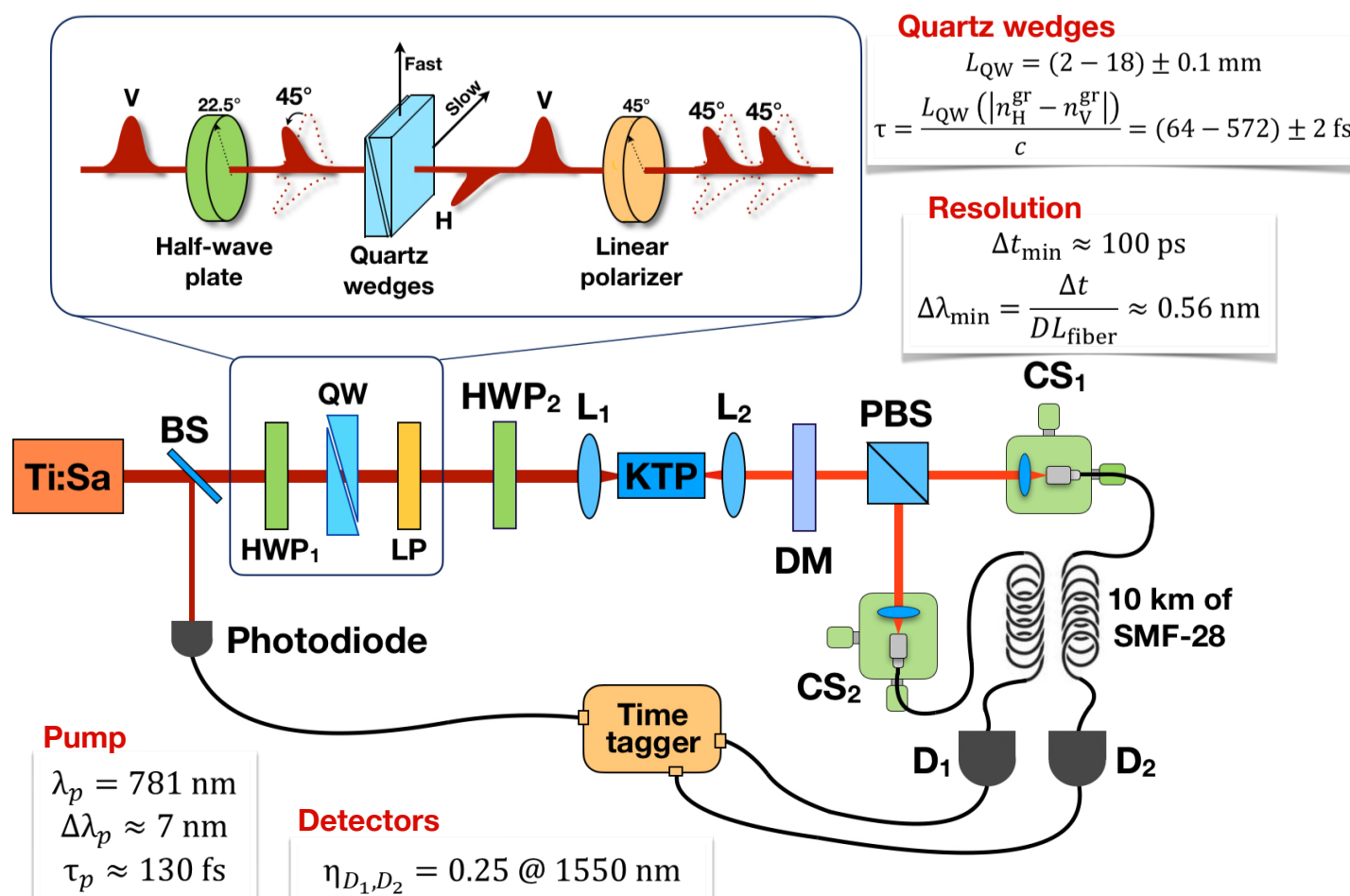
Pump Modulation



Domain-Engineered Nonlinear Crystals

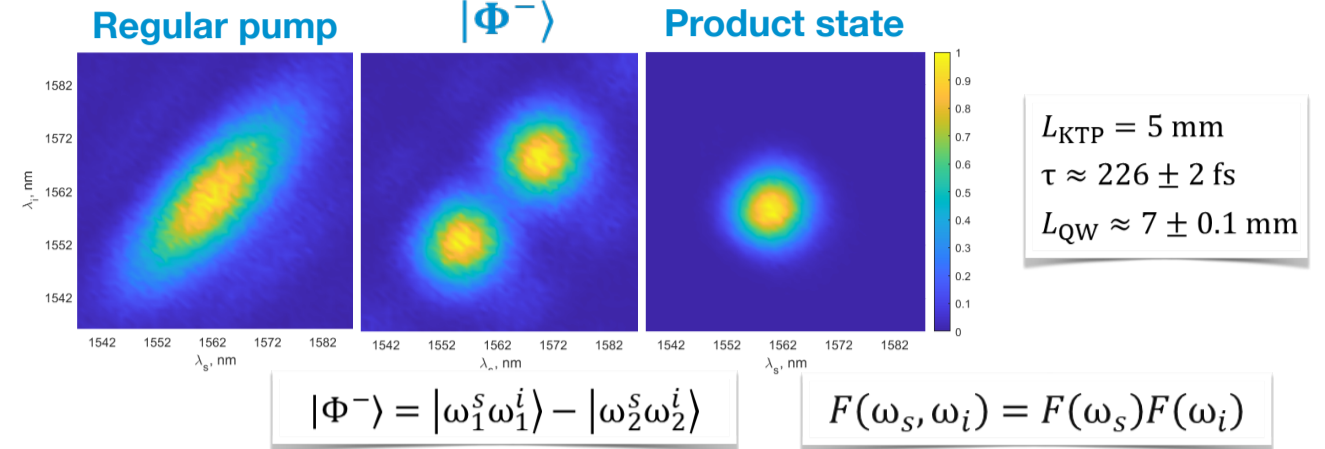


Experimental Layout

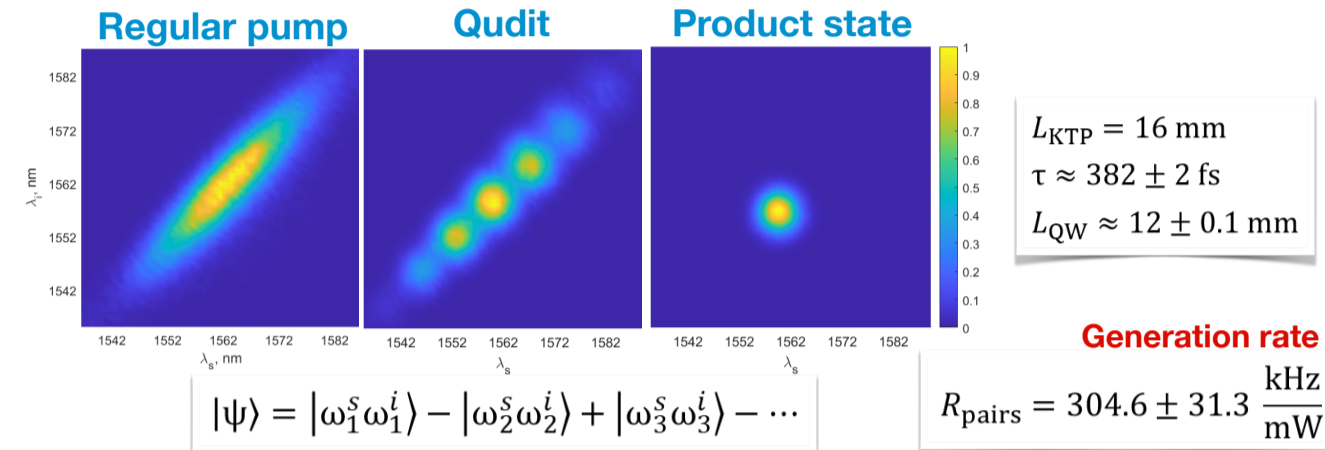


Results

Frequency-bin Bell state



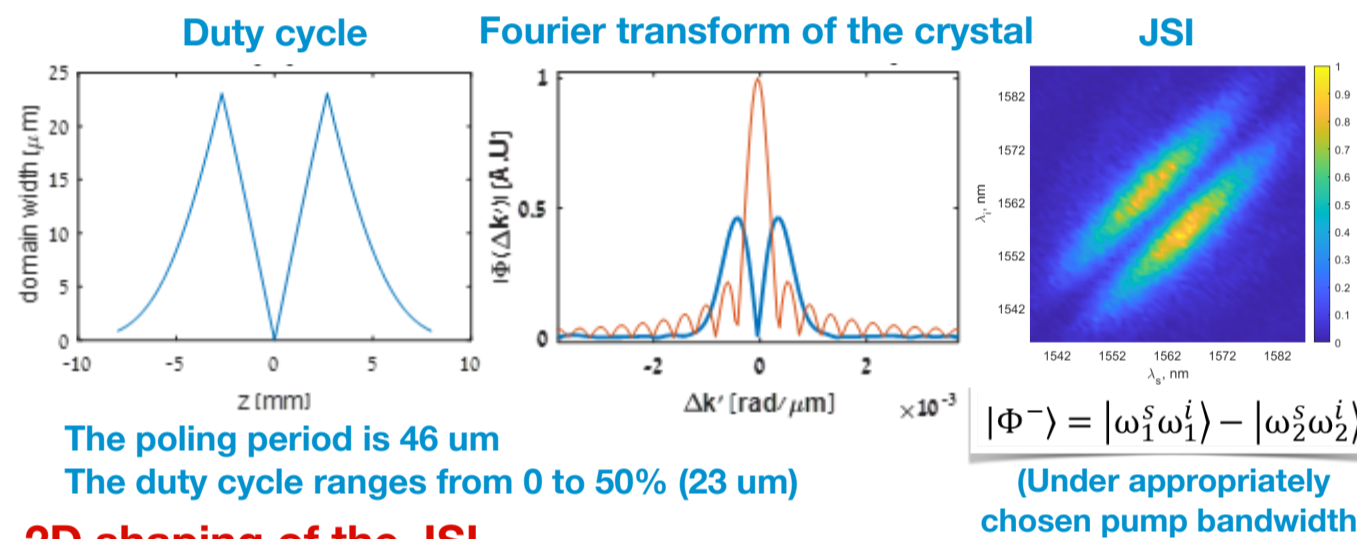
Entangled frequency-bin qudits



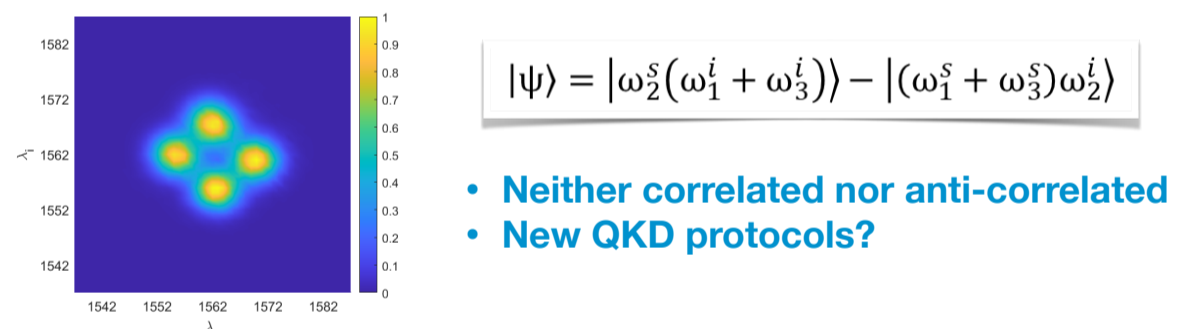
High-purity heralded single photons

$P = 0.996 \pm 0.003$

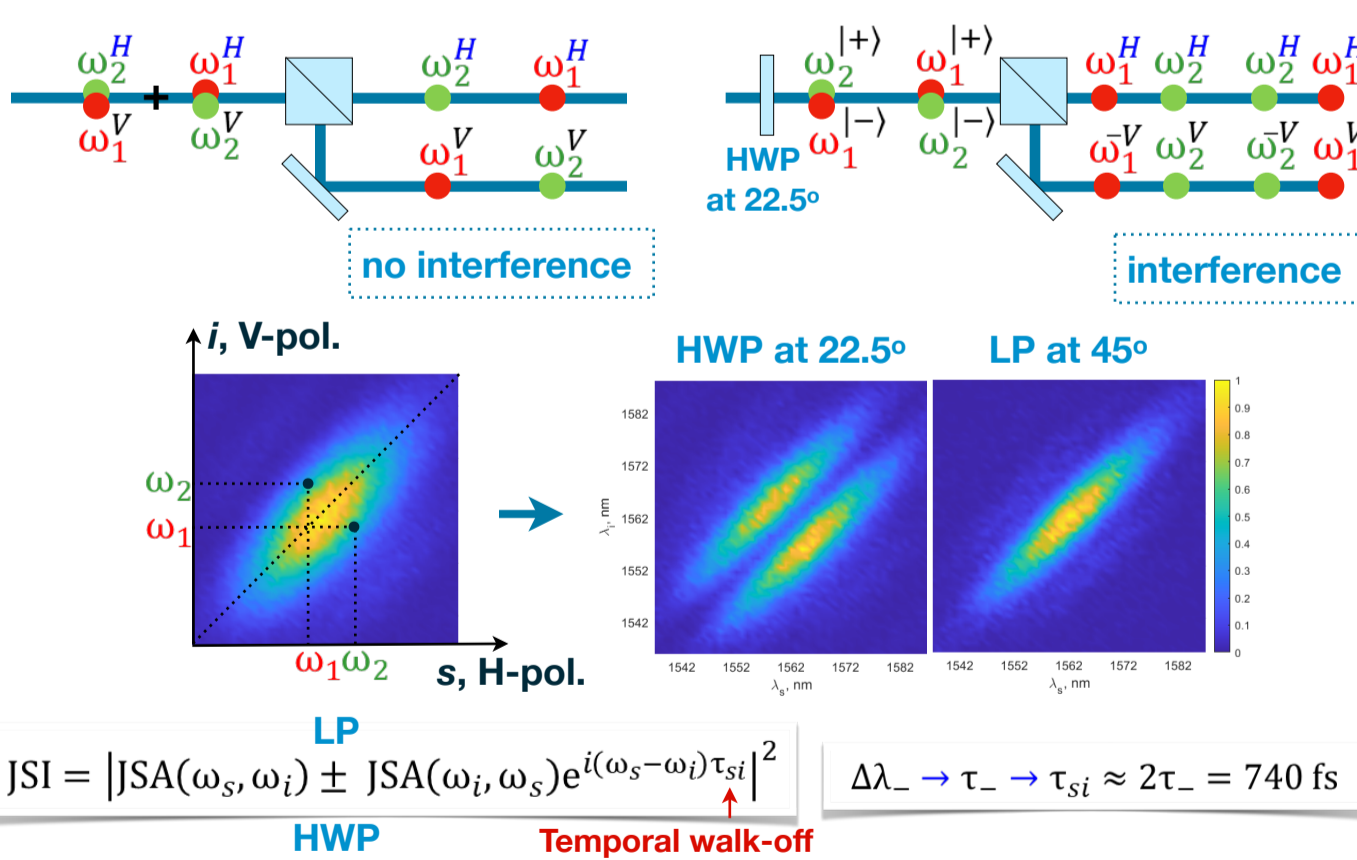
Frequency-bin Bell state (2)



2D shaping of the JSI



Modulation along ω_- axis without domain engineering



Summary

We experimentally demonstrated that utilizing • Pure heralded single photons domain-engineered KTP crystals along with the • Entangled frequency-bin qudits modulation of a broadband femtosecond pump • Frequency-bin Bell states allows one to generate a variety of two-photon • 2D JSI shaping and single-photon states with tailorable spectral • Telecom wavelengths properties. • Tunability

References

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