# Crosstalk-Suppressed Photon Pair Generation in a Self-Similar Waveguide Array

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Improving the integration density of quantum light sources on an integrated photonics platform is essential for realizing large-scale quantum optical circuits. However, reducing the spacing between adjacent nonlinear optical waveguides to achieve high integration density induces optical crosstalk due to evanescent coupling between neighboring waveguides, causing the independence of individual photon sources to degrade.

In this study, we attempt to eliminate the crosstalk by employing a self-similar waveguide array. The structure, in which the propagation constants of the waveguides are modulated in a self-similar manner, was proposed for suppressing inter-waveguide crosstalk of optical field in the linear regime [1]. Our device is based on a 32-core silicon waveguide array (Fig. 1). Waveguide core widths are modulated in the range of 450–500 nm to modulate propagation constants in the self-similar way. The spacing between adjacent waveguides is as small as 300 nm, thus the waveguide array has a half-wavelength pitch. The length of the waveguide array is 1.5 mm. In the experiment, pump pulses with a center wavelength of 1549 nm, a duration of 5.2 ps, and a repetition rate of 40 MHz were launched into a waveguide core in the TE polarization. Signal (1540 nm) and idler (1558 nm) photons were generated via spontaneous four-wave mixing and detected using superconducting nanowire single-photon detectors. Photon pair generation was evaluated through coincidence-count measurements.

Figure 2 shows the coincidence count rate measured at each waveguide when the pump light was injected into waveguide 16 with an on-chip peak power of 3.9 W. A clear photon pair generation was observed only from waveguide 16, while the coincidence count rate from other waveguides are negligible. The maximum photon-pair crosstalk was −33 dB, demonstrating that the self-similar waveguide array is useful to increase the integration density of quantum light sources.

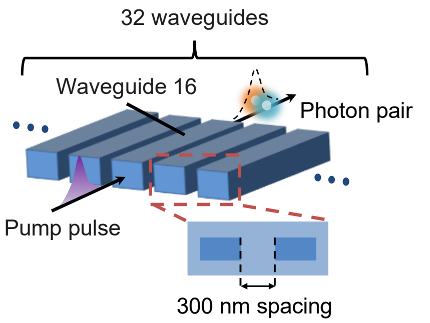


**Fig. 1:** *Photon pair generation in a self-similar silicon waveguide array.*

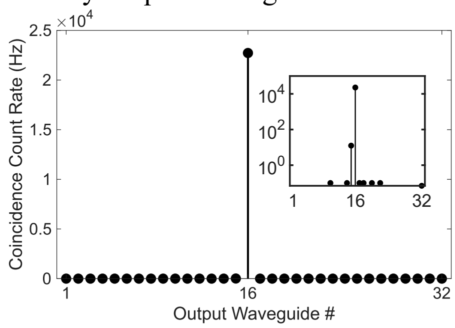


**Fig. 2:** *Coincidence count rate from each waveguide cores when the pump light is injected into waveguide 16. Inset: Logarithmic-scale plot of the same data.*

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## References

[1] J. Guglielmon and M. C. Rechtsman, Phys. Rev. A 99, 063807 (2019).