

A Fibre-Integrated SPDC PPLN Source of Polarisation-Entangled Photons

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Following [1], we report a fibre-integrated, broadband-degenerate Sagnac source of polarisation-entangled photon pairs based on a 40 mm Zn-indiffused PPLN waveguide. The entire SPDC spectrum (~ 90 nm FWHM) is symmetrically distributed to both output arms via a 50:50 fibre coupler, enabling degenerate operation. We characterise the source using visibility measurements, Bell-CHSH tests, and quantum state tomography (QST). To obtain physically meaningful fidelities, we apply local-unitary (LU) constrained optimisation to remove fibre-induced SU(2) rotations. This approach reveals an intrinsic Bell-state fidelity of $\sim 84\%$ in the broadband regime and a CHSH S-parameter of 2.69 ± 0.04 when filtered with 1560 ± 6 nm bandpasses. Broadband visibilities of 86.3%, 93.2%, 87.2% and 86.4% were recorded in H, V, D, A bases, improving to 87.5%, 95.3%, 98.0% and 97.8% respectively in the filtered regime. The QST results confirm high intrinsic coherence despite broadband operation, supporting applications in quantum networking.

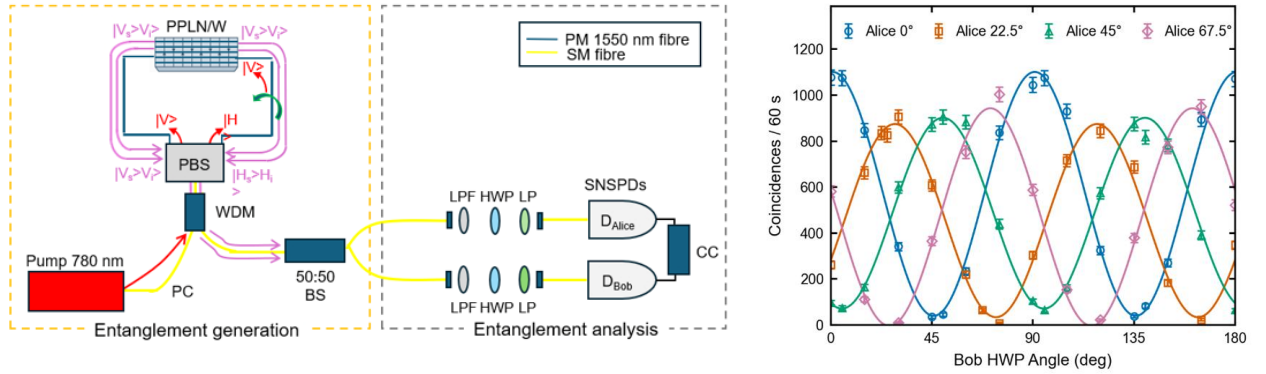


Fig. 1: Left: Experimental setup. PC: Fibred polarisation controllers, WDM: Wavelength-division-multiplexer, PPLN/W: PPLN waveguide, BS: 50:50 Beamsplitter, LPF: 1100 nm Longpass filter (broadband) /Bandpass filter 1560 ± 6 nm (narrowband), CC: Coincidence counter. Purple arrows indicate the down-converted pairs. **Right:** Coincidence counts in the filtered regime (1560 ± 6 nm bandpasses).

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References

[1] Yadav VK, Venkataraman V, Ghosh J. High-brightness fiber-coupled source of polarization-entangled photon pairs spanning the telecom C- and L-bands. *Optics & Laser Technology*. 2024;175:110774.