

Polarization Entanglement Based Quantum Key Distribution Over 100 km Deployed Quantum Network

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Quantum Key Distribution (QKD) is among the most advanced technologies exploiting quantum physics and allows for the generation of cryptographic keys with unconditional security. In this work, we report the implementation and characterization of a QKD system distributing polarization-entangled photon pairs between two users separated by 100 km of deployed optical fiber (see Fig. 1). This real field experiment demonstrates stable long-distance secret key rates (SKR) over 300 bps, and investigates several techniques aimed at improving the practicality and robustness of entanglement-based quantum communication.

Polarization-entangled photon pairs are generated by spontaneous parametric down-conversion in two cascaded non-linear crystals in a fibered Sagnac interferometer [1] located 50 km away from each measurement station. To identify each event in both stations and maximize correlations, we use a synchronization method and a polarization basis calibration/stabilization relying exclusively on the intrinsic correlations of the entangled photon pairs, eliminating the need for classical timing or polarization reference signal.



Fig. 1: QKD network with the source (Inria), Bob (GéoAzur) and Alice (Université Côte d'Azur).

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References

[1] T. Troisi, Y. Pelet, R. Dalidet, G. Sauder, O. Alibart, S. Tanzilli, and A. Martin, e-print arXiv:2602.08863 (2026).