Entanglement multiplexing through a multicore fiber

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In our work, we explore a new paradigm and experimentally demonstrate multiplexing of quantum signals by space-division multiplexing of quantum signals over a multicore fiber [1]. To this end, we generate polarization-entanglement photon pairs at telecommunication wavelengths and distribute several pairs simultaneously and independently through a 19-path multicore fiber. Exploiting quantum correlations ind different degrees of freedom of the generated photon pairs, we are able to deterministically couple and transmit entangled photons pairs through dedicated cores of the multicore fiber; see Fig. 1. Furthermore, we show the long-term stability of our experiment over 24 hours, demonstrating its technological readiness.

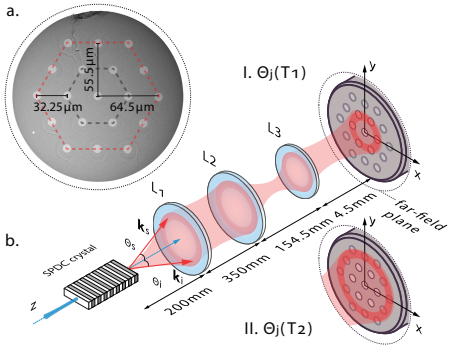

Fig. 1: Schematics of the experimental setup. Multiple polarization-entangled photon pairs are coupled to the multicore fiber.

Our results provide a major contribution to the field of quantum communication by introducing quantum space-division multiplexing. This new paradigm allows to overcome rate limits in quantum communication, and will therefore play an essential roll in advancing quantum communication links. Furthermore, the presented scheme opens the door for many extensions, including multi-user communication networks, multiplexing in multiple degrees of freedom, and high-dimensional quantum communication.

References

[1] E. Ortega *et al.*, PRX Quantum **2**, 040356 (2021).

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