Quantum key distribution in a free-space link in the Sapienza Campus

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A fundamental requirement for the future quantum internet is the ability to establish reliable communication links that enable multiple pairs of users to exchange quantum information over metropolitan distances. Free-space optical channels represent a promising solution for connecting remote nodes [1,2,3]. However, atmospheric turbulence introduces wavefront distortions and beam wandering, leading to fluctuations in coupling efficiency. For this reason, the development of robust stabilization platform capable of mitigating these effects is important. In this work, we present recent progress on a 270 m free-space quantum communication link implemented between two buildings of the Physics Department at the Sapienza University campus. The platform is designed to test and validate key technological components required for future quantum networks, including single-photon sources based on quantum dot (QD) technology and beam stabilization techniques. We report in particular the recent advances carried out in the link, that include upgrades of its functionality, where sources with different characteristics can be used to perform transmission of quantum information.

These results demonstrate the potential of free-space links integrated with QD-based photon sources as a scalable platform for quantum networking applications. The developed setup provides a versatile environment to investigate multi-node communication scenarios.

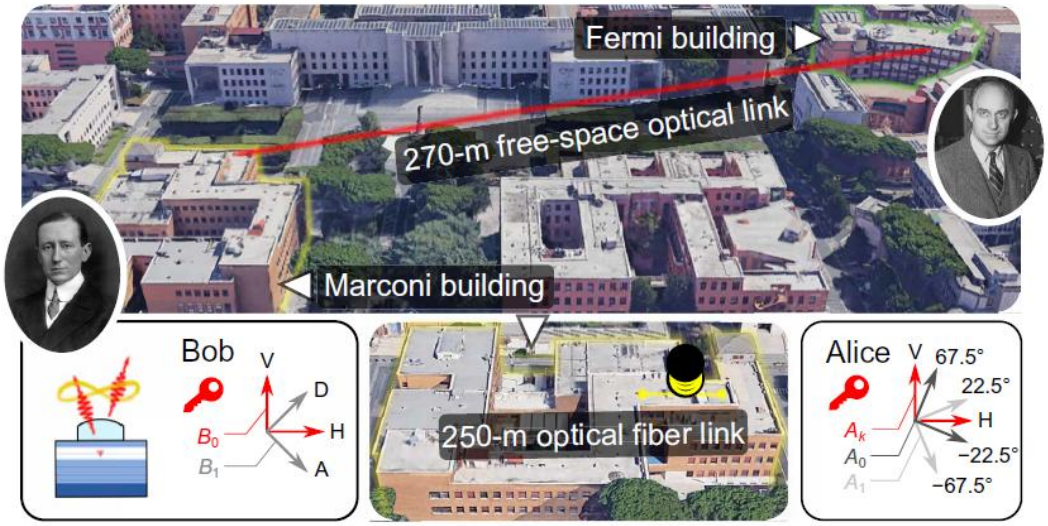

Fig. 1: Scheme of the operating free-space link within the Sapienza Campus.

References

[1] F. Basso Basset et al., Quantum key distribution with entangled photons generated on demand by a quantum dot. Sci.Adv. 7, eabe6379 (2021).

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[3] Carvacho G, et al. Quantum violation of local causality in an urban network using hybrid photonic technologies.