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A GLOBAL QUANTUM NETWORK USING CONTINUOUS VARIABLE QUANTUM KEY DISTRIBUTION

Abstract

A future global quantum network provides unprecedented leaps in rapid computation, accurate and precise metrology, and secure communications by utilising quantum technologies. With the developments in access to space, such a network is more realisable by using satellites and the plethora of ground stations across the globe.

To enhance such a network, Gaussian modulated continuous variable quantum key distribution (GM-CVQKD) could be employed. This quantum cryptographic method shares secret keys between different parties to encrypt information where an eavesdropper can be inferred through fundamental quantum mechanics, thus providing unconditional security in communications. GM-CVQKD, with its proven security, uses the continuous amplitude and phase quadratures of light to encode the secret key. In addition, it uses technologies that are more cost-effective and compatible with existing telecommunication networks, enabling the faster development of a global quantum network.

In this work, the feasibility of GM-CVQKD in the context of a global quantum network is studied by investigating its performance in realistic communication channel conditions and available links: inter-satellite, satellite-to-ground, fibre, underwater. In combination with real ground station locations such as the NASA Deep Space Network, the secret key rate and link capacity have been used as metrics for simulating national and inter-continental secret key distribution via the available links and realistic parameters.

The practicality of GM-CVQKD in a global quantum network is also explored by studying routing, scheduling, and implementation of a universal quantum network architecture that would combine existing national QKD networks; all of which would contribute to the realisation of the grand goal of a global quantum network.