Abstract

Quantum information is based on the laws of quantum mechanics to solve the issues related to information theory. Any communication system based on the principles of the quantum information technology deploys microscopic information carriers which have comparatively less signal to noise ratio. From the technology point of view, the construction and real field implementation of such systems would be complex and challenging as one cannot neglect noise in practical applications. To make such systems reliable and efficient, the designer needs expertise in the fields of quantum electronics, communication theory, semiconductors, optoelectronics, photonics in addition to quantum optics.

This doctoral thesis is the analysis of various quantum cryptography protocols under various noisy models in addition to quantum-based satellite communication under atmospheric turbulence. The research includes the calculation of fidelity, mutual information, key generation rate, quantum bit error ratio (QBER), entropy and engineering the communication distance.

The noisy conditions between the transmitter and receiver are crucial and unavoidable for real field applications. For this reason, we have to deal with such situations in the case of remote state preparation and various other quantum cryptography protocols. Along with this, another challenging task is atmospheric turbulence which degrades the performance of quantum-based satellite communication. The factors to deal with under such turbulence phenomena are maintaining proper synchronization between the sender and receiver, alignment of the optical instruments and remotely controlling all these complex setups for low earth orbit (LEO), medium earth orbits (MEO) and between inter-satellite communication for tracking the laser beam in case of uplink and downlink scenarios to maintain the optimum and accurate use of the whole setup.