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QUBE-II – DEMONSTRATION OF QUANTUM KEY DISTRIBUTION (QKD) WITH A CUBESAT

Abstract

The digitization of our everyday lives is omnipresent. Secure data transmission is therefore of enormous importance in almost all areas of our society. The cryptographic processes for encrypting transmitted messages used today are based on algorithms relying on the limited computing power of today's computers. However, data intercepted today can be stored, decrypted and altered in the future with more powerful or even quantum computers, which are currently under development.

However, the use of quantum states as carriers of information makes physically secure communication possible. The laws of quantum mechanics guarantee that data cannot be intercepted or stored unnoticedly. The security against eavesdropping is based on fundamental laws of nature and therefore cannot be overcome even by future technologies. One approach for the global distribution of quantum keys is communication via satellite. This enables a greater range than fiber-optic links, which are currently limited to a few 100 kilometers due to losses along the line. The exchange of secret keys between several ground stations via satellite thus enables global, secure communication.

The QUBE-II group is working on the development of a novel miniature satellite capable of complete quantum key exchange. The platform for this is formed by low-cost miniature satellites, so-called CubeSats. New technologies for generating quantum keys on the CubeSat platform in combination with powerful optical communication systems will enable a fully functional system in a 3x2 cube form factor. Building on the predecessor project QUBE, miniaturized quantum components are being developed that can withstand the extreme temperature and radiation loads in space. These will then be integrated into a miniature satellite weighing about 10 kilograms. The research team will use the Optical Ground Station Oberpfaffenhofen near Munich as receiver station and upgrade it accordingly for reception of QUBE quantum states and implementation of the needed classical free-space optical communication links.

This paper provides insight into the structure of the QUBE-II project and lays out the challenges of a successful key exchange between CubeSat and ground station. Thereby, especially the future improvements and innovations compared to the predecessor project QUBE will be discussed.