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QUANTUM OPTICAL GROUND STATION OF TII FOR SPACE APPLICATIONS

Abstract

Optical ground stations (OGSs) represent a transformative advancement in satellite communication technology, employing laser-based systems for high-capacity data transmission. Unlike traditional radio frequency (RF) systems, OGSs utilize wavelengths in the visible and near infrared spectrum to enable both classical and quantum communication, offering substantially greater bandwidth and enhanced data rates necessary for modern applications, including Earth observation, climate monitoring, and global connectivity on the classical level, and information-theoretic secure communications in the quantum domain. Additionally, OGSs allow for the efficient transfer of large data volumes over extensive distances with reduced latency, establishing them as critical infrastructure for future satellite communication networks and inter-satellite connectivity. This paper analyses the architecture, operational principles, and key benefits of OGSs, such as minimized signal attenuation and enhanced security. Particular focus is given to the Abu Dhabi Quantum Optical Ground Station (ADQOGS), developed by the Technology Innovation Institute, which integrates a flexible quantum acquisition and tracking system designed to support various upcoming space-based QKD missions. This facility is pivotal for advancing the future global quantum communication network. The layout, specifications, and prospective projects related to ADQOGS are detailed, emphasizing its capacity to support space-focused initiatives.