Paper ID: 39288
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24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Nano/Pico Platforms (6B)

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AMMEQ-1: A 3U CUBESAT SYSTEM DESIGN FOR TECHNOLOGY DEMONSTRATION OF QKD

Abstract

Quantum Key Distribution (QKD) addresses the vulnerabilities in current methods of encryption and traditional secure communication by using quantum properties for the generation of a cryptographic key used to encrypt messages. QKD ensures the highest security regardless of increasing computational power as external interference to the secure link disturbs the system entirely leaving behind a 'footstep' which is easily detected by key-holders. SPEQS-CS, launched in 2015, was developed by Centre for Quantum Technologies (CQT), Singapore as part of the GALASSIA cubesat and is the first quantum experiment payload in space. Furthermore, an earlier SPEQS-CS payload had survived the Antares explosion in 2014 and was fully functioning after retrieval from the debris.

The School of Aerospace, Mechanical and Mechatronics Engineering (AMME) at The University of Sydney is working with CQT, National University of Singapore to develop a 3U cubesat "AMMEQ-1" which tests various subsystems in support of the CQT SpooQySats programme which assesses how different APDs and lasers operate and endure when exposed to the harsh space environment. The testing of these components in space is a crucial step in any space-based single photon counting experiment and ultimately to the development of a quantum entangled photon source payload for QKD. The primary mission is to run the onboard experiment periodically to observe how it ages in the space environment in a low earth orbit.

Although there are no point-to-point communication payloads or requirements for the current mission, future QKD missions require very high pointing accuracy. The secondary mission is a technology demonstration of reaction wheels developed in-house at The University of Sydney and is intended to test the technology required for future QKD missions requiring high pointing accuracy for space to ground and space to space laser communication. In order to demonstrate optical communication, a pointing accuracy of at least 0.01 degrees or 36 arcseconds is required.

This study introduces the QKD applications in quantum cryptography and presents a viable solution in the form of a 3U cubesat. The mission objectives and requirements with the respective payloads are presented and the latter half of the study describes the overall system design of the cubesat and the components which make up the various subsystems.