

IAF HUMAN SPACEFLIGHT SYMPOSIUM (B3)
Utilization & Exploitation of Human Spaceflight Systems (3)

Author: Mr. Norbert M.K. Lemke
OH System AG - Munich, Germany, norbert.lemke@ohb.de

Dr. Bettina Heim
OH System AG - Munich, Germany, bettina.heim@ohb.de

Prof. Thomas Jennewein
University of Waterloo, Canada, thomas.jennewein@uwaterloo.ca

Dr. Elena Gubbini
OH System AG - Munich, Germany, elena.gubbini@ohb.de

Dr. Andreas Neuzner
OH System AG - Oberpfaffenhofen, Germany, andreas.neuzner@ohb.de

SPACEQUEST – CURRENT STATUS OF THE EXPERIMENT ON TESTING GRAVITATION
EFFECT ON QUANTUM ENTANGLEMENT ON THE ISS

Abstract

Space QUEST (QUantum Entanglement Space Test) is an ESA financed experiment on the investigation of gravitation effects on quantum entanglement, deploying a source of entangled photons on ground, a ground-to-space quantum communication link, as well as single photon detection on ground and on the ISS.

The main scientific goal is to resolve the conflict between the theories of Quantum Mechanics and General Relativity. A large number of models exist that attempt to combine quantum and general relativistic phenomena, and SpaceQUEST is an experiment that would allow to distinguish between some of these models by placing bounds on the extent of gravity induced de-coherence seen by a quantum entangled system. In addition the SpaceQUEST mission is fully capable to experimentally study quantum communication protocols.

The setup consists of two parts: A ground based part and a space based apparatus located in NASA's Window Observational Research Facility (WORF) within the ISS. Photons pairs, entangled in their emission-time degree of freedom as well as in their polarization degree of freedom, are generated in the optical ground station. One photon of each pair is launched towards the ISS via an optical quantum channel and detected by a polarization-resolved single-photon detector system. The other photon of the pairs is detected on ground, again polarization resolved. The project is currently in Phase B executed by OH System together with the University of Waterloo, and studies the development of the space segment (ISS instrument). An investigation of the overall system including the ground segment and end-to-end system performance is currently under discussion.

This paper presents the current status of the project and the way forward to implementation in Phases C/D/E.