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Ruder Boskovic Institute, Bijenicka 54, 10000 Zagreb, Croatia

CEMS Seminar series
Tuesday, 11.10. at 11^{00}h, Blue Hall, Bldg. III

"Gravitational Decoherence with Entanglement: the Space Quest Mission"

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Abstract. General relativity and quantum mechanics predict phenomena on very different scales. Several models predict a decoherence like effect due to gravity [1]. A recent advance [2] based on the event formalism predicts a nonlinear quantum effect that can only be observed using entangled systems. We present a detailed mission proposal to measure this gravitational decoherence using an Optical Ground Station (OGS) and the International Space Station (ISS). Using time-energy entangled photon pairs form a Spontaneous Parametric Down Conversion source, [2] shows that the gravitational decoherence effect will result in a loss of correlation in the arrival times of the photons from a pair. Our experimentally feasible scheme utilizes the NightPod and the 400mm telephoto lens already on board the ISS. Using proof of principle experiments on a 144 km free-space optical link as well as calculations, we study the effect of losses, background noise, pointing errors, orbital motion and atmospheric effects. Further, our experimental scheme is ideal for ground to space quantum communication and testing other aspects of fundamental quantum mechanics, like Bell tests [3], over unprecedented length scales which are inaccessible on the ground. Ultimately leading to a global quantum network and unconditionally secure communication.

References

[1] Anastopoulos C and Hu B L 2013 Class. Quantum Grav. 30 165007.
[2] Ralph, T. C. and Pienaar, J. Entanglement decoherence in a gravitational well according to the event formalism. New J. Phys. 16, 085008 (2014).
[3] Scheidl, T., Wille, E. and Ursin, R. Quantum optics experiments using the International Space Station: A proposal. New J. Phys. 15, 1–11 (2013).

Biography. Siddarth Joshi has been working in experimental quantum optics for the last 8 years on a variety of topics like Bell tests, Quantum bit commitment, quantum metrology, QKD and single photon detectors. He has worked with Christian Kurtsiefer in Singapore, John Rarity in Bristol and is now working with Rupert Ursin at IQOQI-Vienna. Currently he is, coordinating the ESA topical team for the Space Quest mission, studying afterpulsing in detectors, working towards device independent QKD, performing clock synchronization experiments and building sub-Shot noise quantum enhanced imaging devices.

Host: Dr. Mario Stipčević (Mario.Stipcevic@irb.hr), CEMS Photonics and Quantum optics