Abstract Submitted
for the DAMOP19 Meeting of
The American Physical Society

Hyperentangled Time-bin and Polarization Quantum Key Distribution[1] JOSEPH CHAPMAN, Department of Physics, University of Illinois at Urbana-Champaign, CHARLES LIM, Department of Electrical and Computer Engineering and Centre for Quantum Technologies, National University of Singapore, PAUL KWIAT, Department of Physics, University of Illinois at Urbana-Champaign — Fiber-based quantum key distribution (QKD) networks are currently limited to metropolitan distances without quantum repeaters. To reach longer distances, satellite-based QKD links have been proposed to extend the network domain. We have developed a quantum communication system suitable for a satellite-to-ground link. With this system, using polarization entangled photons, we have executed the QKD protocol developed by Bennett, Brassard, and Mermin in 1992 (BBM92), achieving quantum bit error rates (QBER) below 2%. More importantly, we demonstrate low QBER execution of a higher dimensional hyperentanglement-based QKD protocol (HEQKD) using photons simultaneously entangled in polarization and time-bin. We verify the security of our protocol using a rigorous, modern finite-key analysis, and show it is suitable for a space-to-ground link, after incorporating a Doppler shift compensation scheme. Finally, we demonstrate a distinct advantage to using HEQKD over BBM92.

[1]J.C.C and P.G.K acknowledge support from NASA Grant No. NNX13AP35A, NASA Grant No. NNX16AM26G, and a DoD, Air Force Office of Scientific Research, National Defense Science and Engineering Graduate Fellowship (NDSEG). C.C.W.L. acknowledges support from NUS startup grant R-263-000-C78-133/731 and CQT fellow grant.

Joseph Chapman
Department of Physics, University of Illinois at Urbana-Champaign

Date submitted: 31 Jan 2019 Electronic form version 1.4