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CONCEPTS FOR UTILIZATION OF QUANTUM COMMUNICATIONS AND QUANTUM KEY DISTRIBUTION

Abstract

As secure space communications becomes more desirable, quantum based communications systems have the potential to become a high performing option. NASA/GSFC with its partner institutions is pursuing a variety of technology thrusts to enable the practical application of quantum communications in future NASA missions. This paper will discuss some of those technology areas. We will discuss methods being developed by GSFC and University of Kansas for securing and auto-synchronizing communication over free-space optics using quantum key distribution and chaotic systems. In such a scenario, the security of the system would stem from the sensitivity to initial conditions. Furthermore, specific windows of single chaotic runs can be harvested to be used with encoder/decoder in a cyclic manner. Not only would the security of such a system be unique, the initial conditions can be transmitted via a quantum key distribution to add another layer of security to the system. We will discuss work being performed by GSFC and Michigan State University in analysis and development of solid-state quantum communications materials and devices. These will be necessary for devices capable of processing and routing quantum information on-board a spacecraft. In recent years, advancements in the understanding of quantum properties has led to a wide range of promising applications. One such application is orbital angular momentum (OAM) being leveraged for secure optical communications. The utilization of OAM properties can be done via highly precise function values that can then be modulated using different constellations. GSFC and University of Wyoming are developing plans for such encoders and decoders to be designed specifically for applications such as space communications. We will also discuss work and potential forward

work with other partners. Opportunities for demonstration exists in a variety of possible venues from balloons to CubeSats. We will discuss the potential for a low cost, high altitude balloon to balloon quantum communications demonstration to be carried out under the University of Wyoming Space Grant that can further show its distinctive advantages in relation to secure optical communications.