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Author: Mr. Andras Kiss
University of West Hungary, Hungary

Dr. Laszlo Bacsardi
Budapest University of Technology and Economics, Hungary

ENTANGLED-BASED QUANTUM INFORMATION TRANSFER ON EARTH-SATELLITE CHANNEL

Abstract

The quantum computers can effect several fields of the current information technology. In digital communication, the data encryption and the distribution of keys used for the encryption rely on computationally secure cryptosystems, which means that cracking the encryption with current technology would take astronomical time. With the arrival of quantum computers, this security will not be enough, the current cryptosystems will be breakable in short time with existing quantum algorithms (e.g., Shor's algorithm). The era of quantum computing is a step closer since the world's first quantum communications satellite has been launched by China in Aug 2016. They plan to use entanglement – a mysterious phenomenon of quantum mechanics – to perform quantum information transfer. Their network consists of a satellite and two ground stations. Although there were different successful free-space experiment in the past by different international teams worldwide, their mission is the most ambitious so far. In our work, we started to analyze the properties of the Earth-satellite quantum communication by simulating a global, satellite based quantum key distribution (QKD) network. We have proposed an entanglement-based QKD satellite network using mirrors to increase the coverage. Our network consist of three satellites and two ground stations. The entangled photons are generated on a satellite named generator, and are forwarded to the two ground stations using two mirror satellites. By this way, we can enhance the coverage of the system. For this network, we have calculated the maximum distance allowed between the satellites to minimize the atmospheric distortion of the transferred quantum states. Since the readout operation (named as measurement) of an entangled state is not a trivial step due to the problem of measurement basis, simulations were made to determine the rotation of the basis states which has to be corrected by the ground stations for the received photons. Considering the different optical properties of the atmosphere, we analyzed the effectiveness of an entangled-based protocol in such a network including transmittance of the channel and cost of the operation.