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Vladimir Egorov
ITMO University, Russia

Maintaining security against photon-number-splitting attacks in subcarrier wave quantum communication systems

Subcarrier wave (SCW) approach to quantum communication systems demonstrates many promising capabilities for establishing multiuser quantum networks. In this type of systems the quantum signal is obtained at spectral sidebands in course of phase modulation of light at the central frequency emitted by the source. All current SCW experiments use laser radiation for generating the light at central frequency, and its subsequent modulation and attenuation for creating the sidebands. Therefore, the photon number statistics in the quantum channel is described by the Poisson distribution, and countermeasures against photon-number-splitting (PNS) attack are in order. Differences in SCW architecture from other types of quantum communication systems require developing special techniques for maintaining security against PNS. For the widely-employed decoy states method, one must ensure that the eavesdropper cannot identify the decoys by monitoring the fluctuations of intensity of light at the central frequency. To solve this problem, we propose a novel experimental scheme of the SCW transmitter module. The "strong reference" protocol especially proposed as an alternative to the decoy method in SCW, establishes certain bounds on the filtering subsystem in the receiver module. We calculate the optimal parameters of the source, detector and filter in the system in order to find an effective trade-off between them. Finally, we developed a novel method of maintaining security against PNS by analyzing the counting statistics using a photon-number-resolving detector. We compare the system architectures from engineering point of view and calculate key generation rates for these protocols, defining optimal solutions for different channel losses.

Biography

Vladimir Egorov has completed his PhD studies in Optics at ITMO University in 2015. He has published more than 15 papers in peer reviewed journals. His research interests include quantum communications and networking, nanophotonics and plasmonics.

viegorov@corp.ifmo.ru