Quantum key distribution with single photons from semiconductor quantum dots

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Quantum key distribution (QKD) enables the transmission of information that is secure against general attacks by eavesdroppers. The use of on-demand quantum light sources in QKD protocols is expected to help improve security and maximum tolerable loss. Semiconductor quantum dots (QDs) are a promising building block for quantum communication applications because of the deterministic emission of single photons with high brightness and low multiphoton contribution. In a recent work we have reported on the first intercity QKD experiment using a bright deterministic single photon source. A BB84 protocol based on static polarisation encoding has been realised using the high-rate single photons in the telecommunication C-band emitted from a semiconductor QD embedded in a circular Bragg grating structure [1]. Here we present the high-speed modulation of the polarisation states of telecom C-band single photons. A sequence of 32-bit digital pseudo-random numbers is repeatedly encoded into the polarisation via the phase-modulator involved Sagnac-Loop interferometer. An ultra-low quantum bit error rate ~1% at a fast clock rate of 76 MHz is identified using such a configuration. In the end, real-time active polarization compensation and software-based synchronization are demonstrated to ensure a long-term QDs-based QKD experiment.

Short Bio:

Dr. Jingzhong Yang completed his PhD study at Leibniz University of Hannover (LUH) in the field of semiconductor quantum optics in 2022. The objective of his study was to develop the semiconductor light sources for the photonic-enabled quantum communication, and his dissertation was recognised as the 3rd place of Quantum Futur Award 2023 by Federal Ministry of Education and Research (BMBF), Germany. Currently, he continues his research as subgroup leader in LUH to explore the semiconductor light sources for the establishment of future quantum networks.