Towards Dual-band GHz-clocked Single-Photon Quantum Key Distribution

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In quantum cryptography, fundamental laws of physics are exploited to enhance the security of cryptographic primitives such as quantum key distribution (QKD). Recent advances showed that quantum dot (QD) -based single-photon sources (SPS) enable a performance-advantage compared to weak coherent pulses (WCP), both in implementations of QKD [1] and cryptographic primitives beyond QKD [2]. The clock rates of QD-based QKD implementations, however, are typically limited to values of about 80 MHz or below [3], while decoy-state based implementations use clock-rates in the GHz-regime [4].

Here, we report recent advances towards implementations of single-photon QKD operating at GHz clock speeds. Employing state-of-the-art cavity-enhanced QD single-photon sources emitting at 921 nm [3] and 1550 nm [4], respectively, we achieve system clock rates of 1.28 GHz and 2.50 GHz. Random polarization-state encoding for implementing the BB84 protocol is realized by a customized fiber-based electro-optic modulator (EOM) in single-pass configuration in combination with a fast arbitrary waveform generator (AWG) using the laser trigger as common clock for the QKD setup. We show that our current setup allows for sufficiently-low quantum bit error ratios below 6% in both wavelength bands. Finally, first preliminary results for the achieved raw key rates are presented.

Our results show up a clear path to unleashing the full potential of QD light sources.

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