Quantum Key Distribution (QKD) Using Imperfect Quantum-Dot Single-Photon Sources

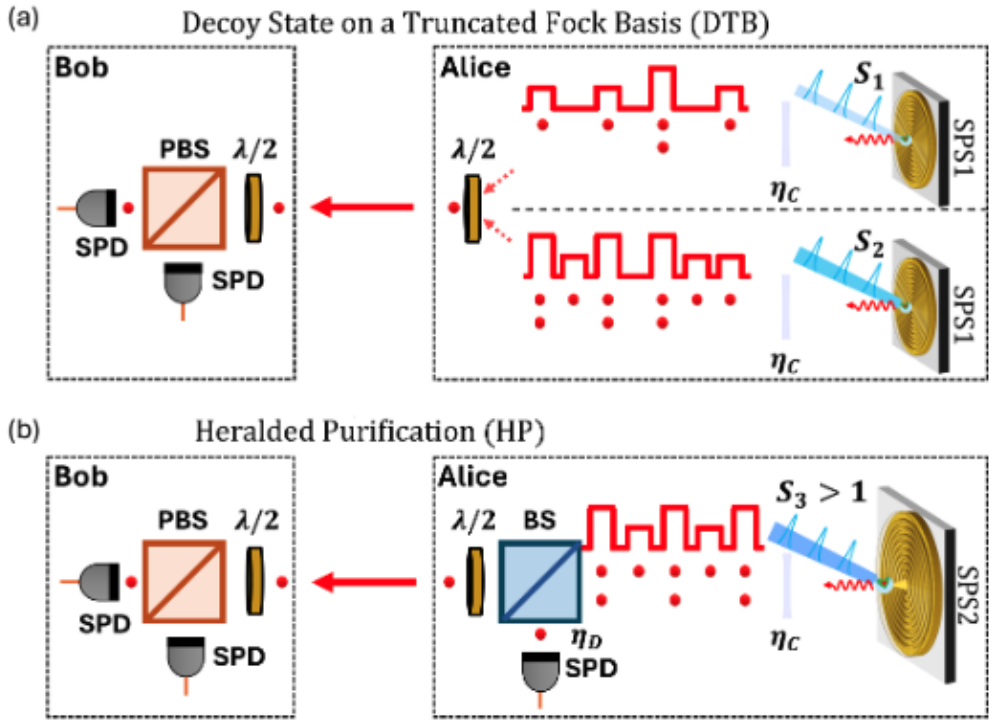

Figure: Concept of two QKD protocols based on a high rate, high collection efficiency SPS with imperfect purity.

Scientific Achievement

Demonstrated two simple-to-implement QKD protocols that allow practical, far-from-ideal sub-Poissonian photon sources to outperform state-of-the-art weak coherent states (WCS).

Significance and Impact

This study showed single-photon purity is not required for superior QKD.

Research Details

- Engineered photon statistics of a biexciton-exciton cascade in room-temperature single-photon sources based on giant colloidal quantum dots coupled to nanoantennas.
- Used truncated decoy-state protocol or a heralded-purification protocol to increase the maximal allowed channel loss for secure-key creation — exceeding even that of ideal WCS by more than 3 dB.

Bloom, Y.; Ordan, Y.; Levin, T.; Sulimany, K.; Bowes, E. G.; Hollingsworth, J. A.; Rapaport, R. Decoy-State and Purification Protocols for Superior Quantum Key Distribution with Imperfect Quantum-Dot-Based Single-Photon Sources: Theory and Experiment. *PRX Quantum.* 2025.

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