Q→NU

Modulator free QKD

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SparQ Summer Internship logo

SMART Plan

Specific: 1. To **study** the operational principles and characteristics of directly-modulated QKD transmitters based on optical injection locking (interns will do).
2. Simulate modulator free QKD in Matlab and Simulink environment (Shashank), and
3. Compare its capabilities, limitations, and practical implications against traditional QKD employing external optical modulators for weak coherent pulse based Decoy-DPS QKD protocols.

SMART Plan

Measurable: Success will be measured through the **quantifiable results obtained from simulations** (e.g., simulated QBER, intensity fluctuations, visibility, or theoretical key rate estimations), alongside a **structured comparative analysis.**

SMART Plan

• **Attainable:** This objective is attainable for an internship through a focused **literature review (2 weeks)** coupled with the **development and execution of a targeted simulation model (4 weeks) and comparative analysis (2 weeks).**

SMART Plan

• **Relevant:** The project is highly relevant as it directly investigates and contrasts different approaches to building **practical QKD transmitters**, which is crucial for the development and deployment of future quantum networks.

SMART Plan

- **Timely:** The research fits within the current phase of QKD development focused on making the technology practical and ready for mass deployment in real-world networks.

- Deliverables - Simulation tool for the Modulator free QKD + comparative analysis report (modulator vs modulator free).

- Success criteria - Modulator free design and simulation of the Decoy-DPS QKD.

Weekly Plan

Here's a concise 8-week plan in one-liners:

1. Week 1: Literature review on Decoy-DPS QKD, optical injection locking, and external modulators.
2. Week 2: Continued with literature review + Set up simulation framework (Python/MATLAB) and define key parameters.
3. Week 3: Simulate directly-modulated laser dynamics (rate equations, injection locking effects).
4. Week 4: Analyze modulation response and extinction ratio in direct modulation (intensity modulation, phase modulation, both intensity and phase modulation).
5. Week 5: Model external modulator performance (extinction ratio, insertion loss).
6. Week 6: Compare QBER, key rates, and stability between both systems.
7. Week 7: Optimize parameters and refine simulations.
8. Week 8: Finalize comparative analysis report and simulation tool documentation.

Deliverables: Simulation tool + comparative report (modulator vs. modulator-free).