Actively-Stabilised Variable-Asymmetry Mach-Zehnder Interferometer for QKD Device Characterisation

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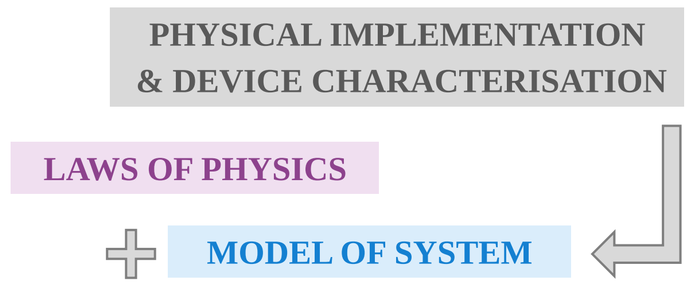
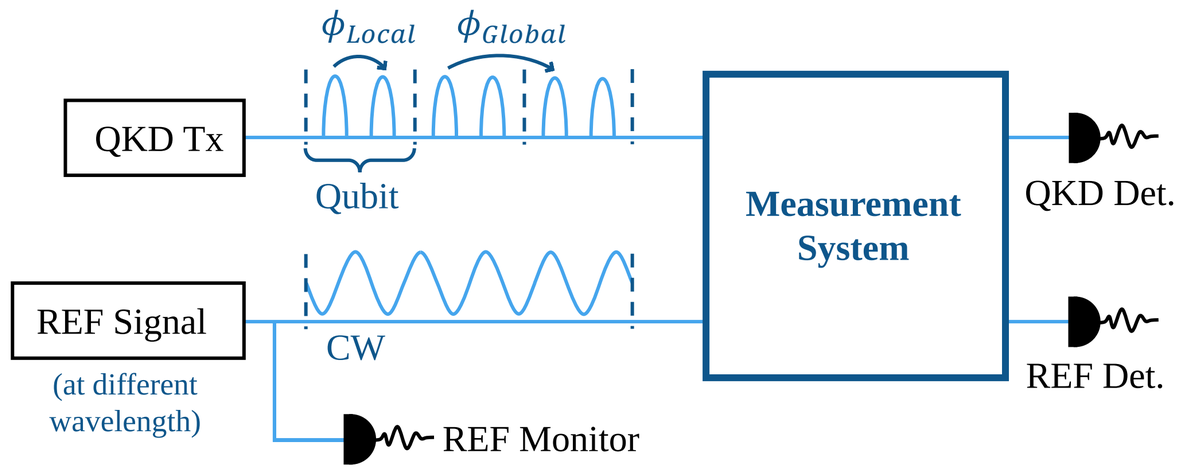
QKD Device Characterisation

- Security of QKD protocols requires that the hardware be characterised to quantify the information leakage to an eavesdropper and assess the system implementation security [1-5]
- Prevalence of phase-encoding (ϕ_{Local}) and phase-based security conditions (ϕ_{Global}) requires characterisation of phase relationships in the QKD signal
- A measurement system to characterise the phase properties of QKD hardware modules has been constructed



Measurement System

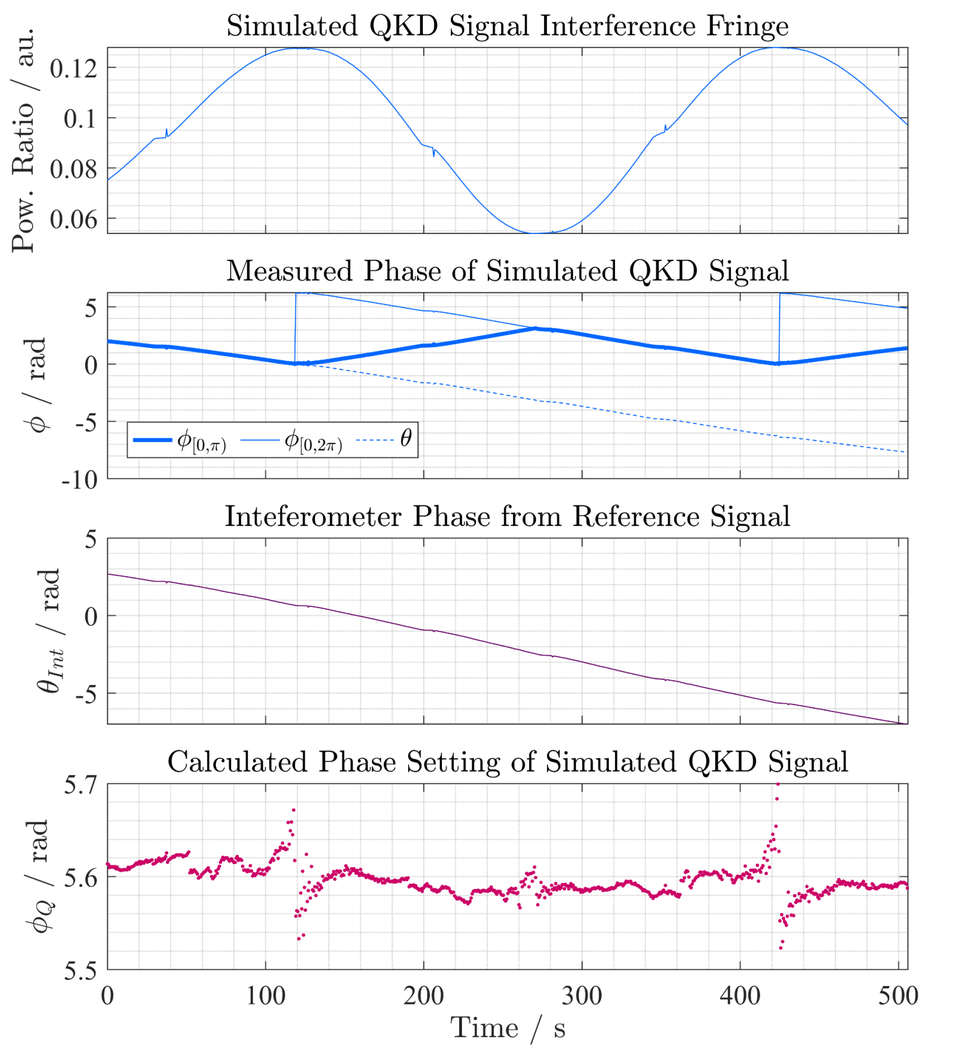
- Asymmetric Mach-Zehnder interferometer; actively stabilised using feedback from a reference laser; interferometer can be locked at any phase setting
- Interferometer asymmetry can be extended arbitrarily and varied on the submicron and wavelength-scale
- The device is designed for operation in the C-band, is transportable and can be used to characterise devices in situ



Preliminary Testing: Bright Simulated QKD Signal

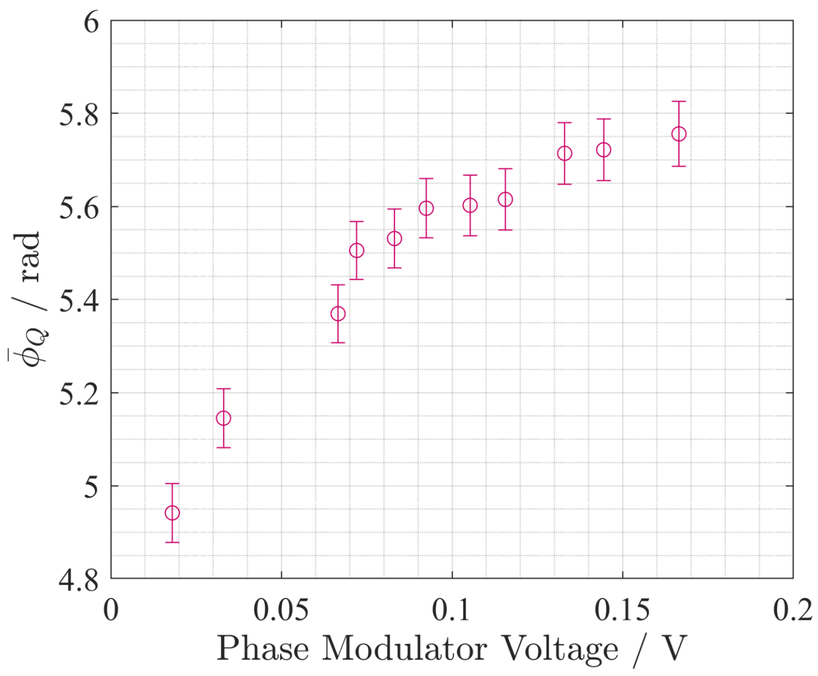
- Simulate bright phase-modulated QKD signal pulses
- Send pulses into measurement system and perform a phase sweep of the interferometer for each phase setting
- Calculate the phase difference between the pulse pairs

Phase Unwrap (One Modulator Setting)



Mean value of ϕ_Q: $\bar{\phi}_Q = 5.60 \pm 0.02$ rad

QKD Signal Phase (Many Modulator Settings)



$\bar{\phi}_Q$ for many phase modulator settings. Error bars result from uncertainties in reference signal.

References

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