Measurement-device-independent Quantum Key Distribution with directly modulated lasers

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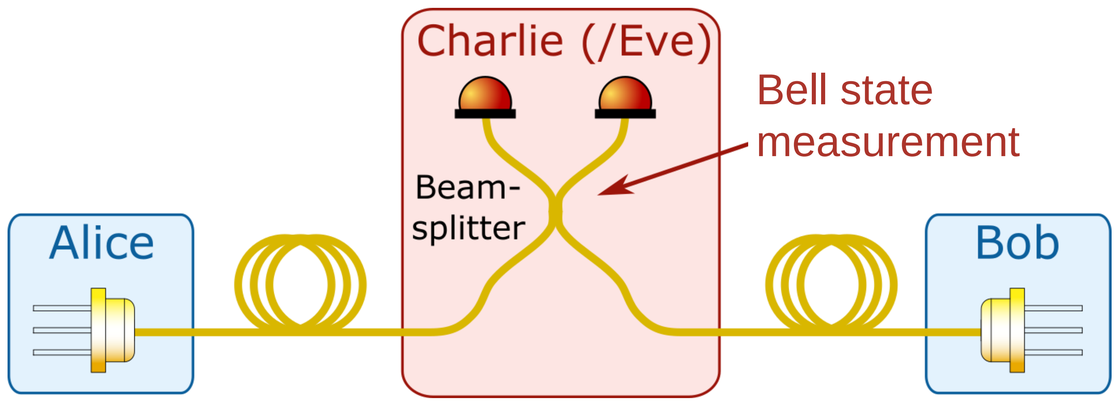
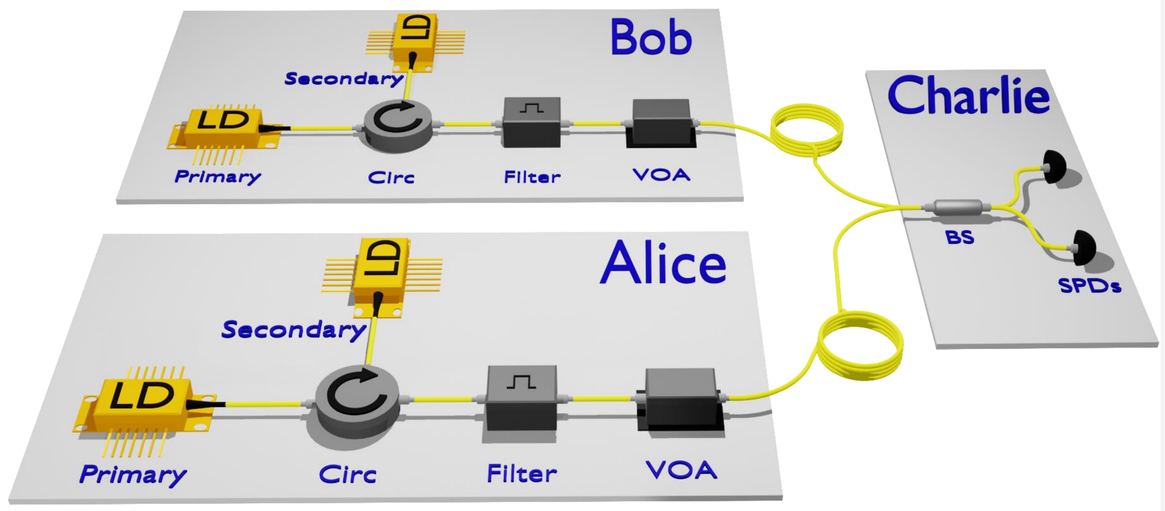
Measurement-device-independent Quantum Key Distribution (MDI-QKD)



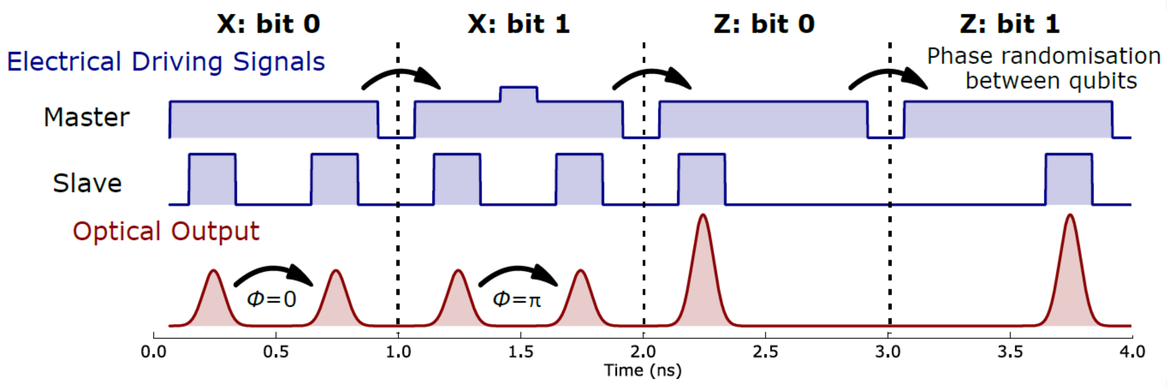
- Imperfections in real-world QKD systems can create security loopholes.
- In MDI-QKD, the users (Alice and Bob) send their signals to Charlie, who interferes them.
- The measurement results only reveal the correlation between Alice and Bob's bits, but not the bit values, this allows MDI-QKD to remove all detector loopholes.

Experimental Setup



- With optical injection locking, the pulses generated by the primary laser are injected into the secondary laser.
- Each primary pulse (1 ns) seeds two secondary pulses (500 ps).
- Stimulated emission in the secondary laser is seeded by the injected photons, thus, the **secondary pulses inherit the phase of the primary pulses.**

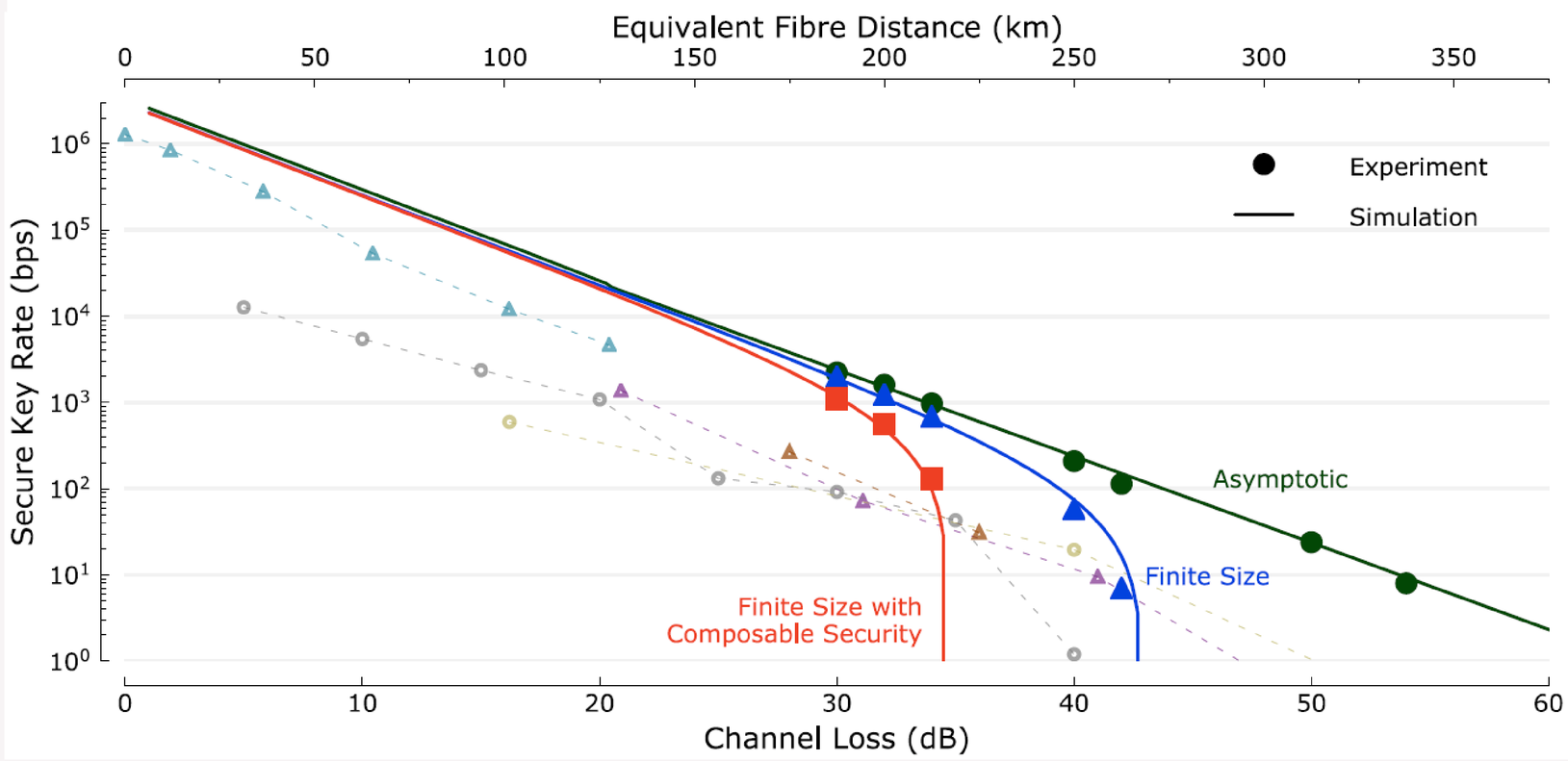
Bit encoding with directly modulated lasers



- **Z-basis**: modulate the electrical driving signal of the **secondary** laser, selectively switching the laser on in the desired time bin.

- **X-basis**: modulate the electrical driving signal of the **primary** laser, the perturbation signal changes the phase evolution of the primary pulses, which imposes a phase difference on the secondary pulses through **laser seeding**.

Secure key rates



- QBERs as low as **0.55%** are recorded in the Z basis and as low as **26.6%** in the X basis, showing the practicality of the technique.
- Our design improves the state-of-the-art key rates by about an order of magnitude, up to 8 bps at 54 dB (equivalent to 340 km fiber)

References:
[1] R. I. Woodward, Y. S. Lo *et al*. npj Quantum Inf 7, 58 (2021)
[2] Z. L. Yuan *et al*., Phys. Rev. X 6, 031044 (2016).
[3] H-K. Lo, M. Curty & B. Qi, PRL **108**, 130503 (2012)

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