

Entanglement-based Free Space Quantum Cryptography in Full Daylight

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Abstract

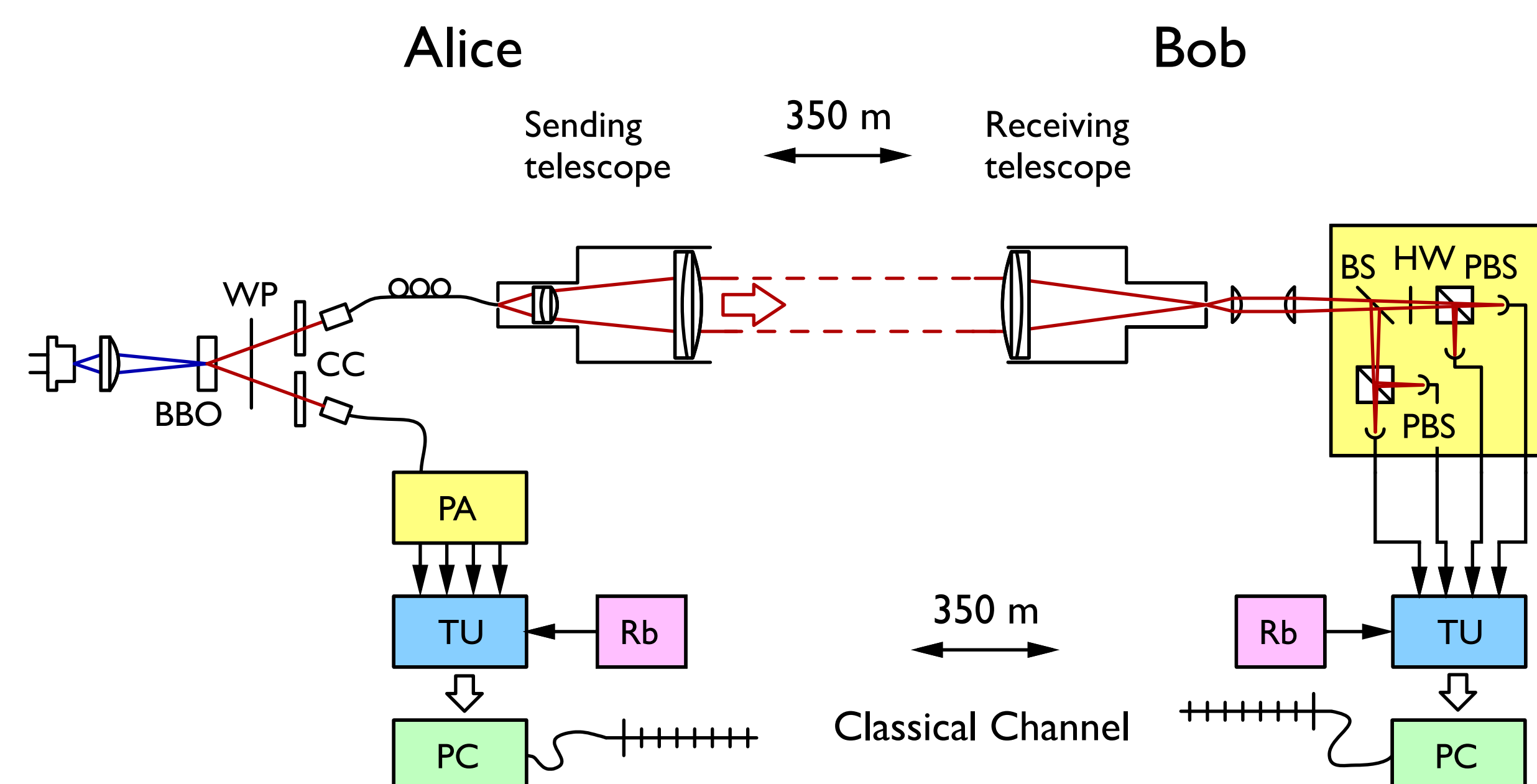
Free space quantum key distribution experiments have the advantage of ad-hoc setup, that they can be build up in a short period of time as long as there is line of sight.

This is the first experimental demonstration of an entanglement based free space QKD system that runs continuously over a full day cycle. We show that with careful filtering and clock synchronization algorithms, a secure key can be produced at all times.

Advantages of entanglement based QKD

- An EPR-source as a single photon source
- No need for random numbers, such as in BB84
 - passive choice of measurement basis by a beamsplitter
- Dimensionality of Hilbert space needs to be known for security
 - Violation of Bell's inequality could be a measure for the knowledge of an eavesdropper

Experimental Configuration



Realization on NUS-Campus

Alice



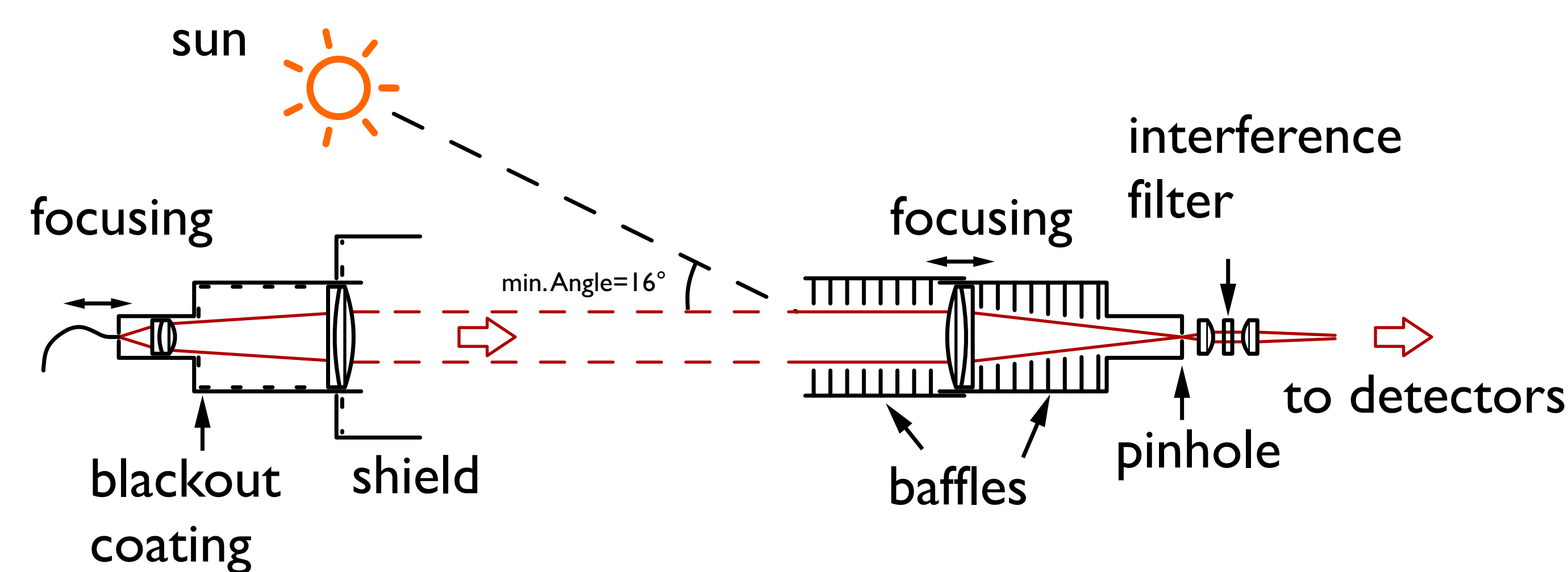
Bob



Problems in daylight

- Destruction of detectors
- Saturation of detectors
- Accidental clicks
- Fluctuations of ~30dB

Ways to suppress the sunlight in a daylight experiment

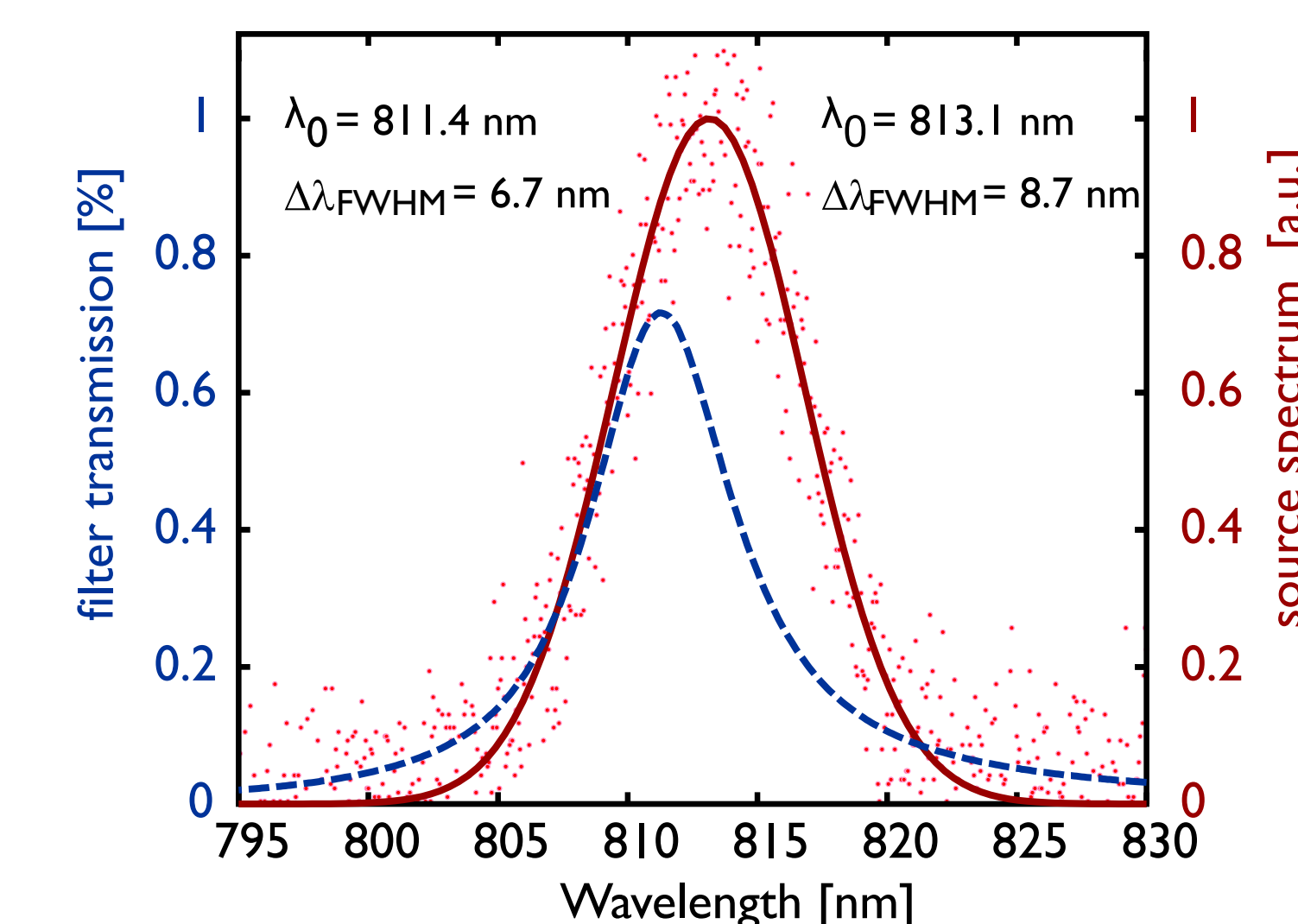


Suppression

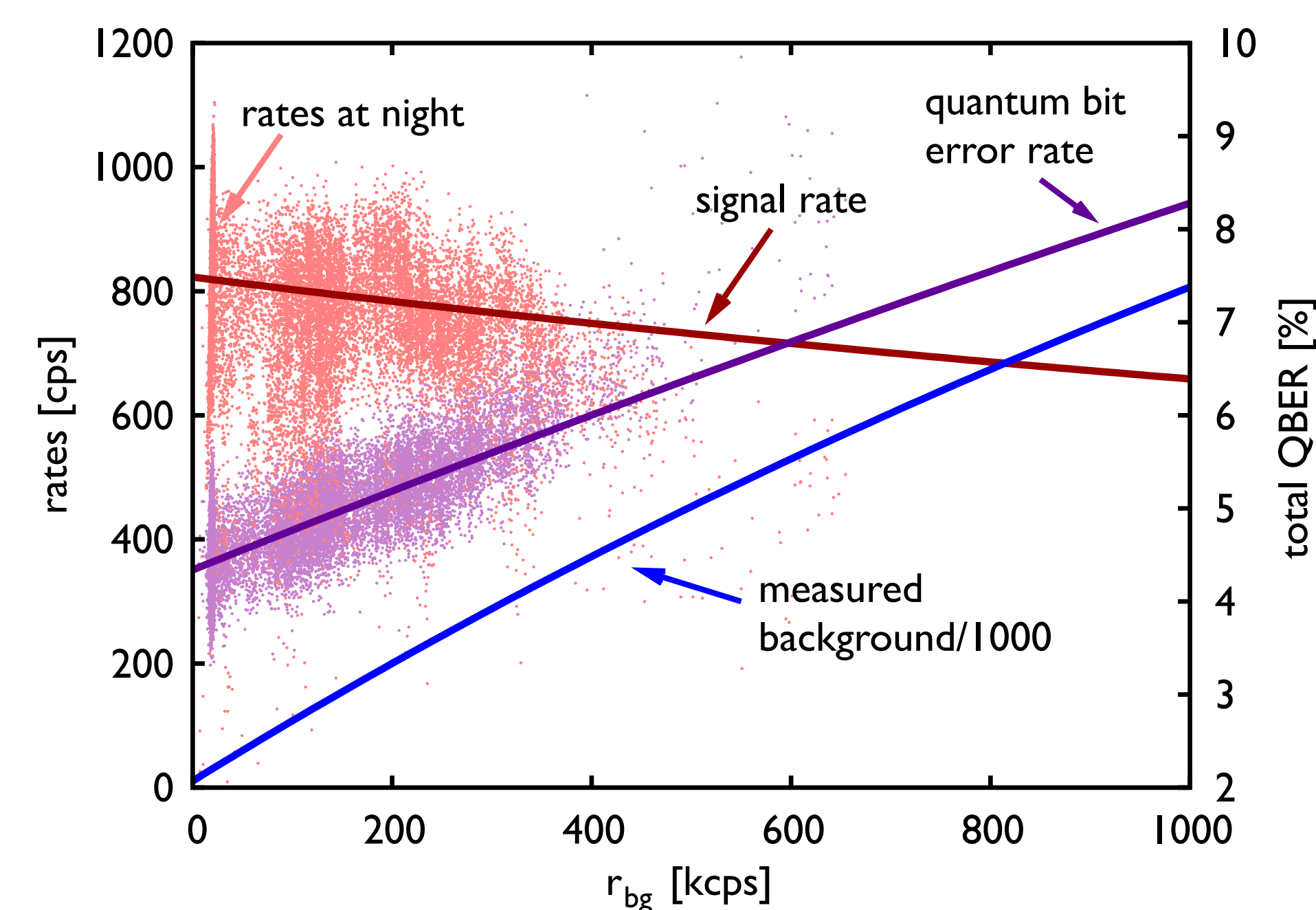
- Spectral: 1 nm width
- Timing: $\Delta t = 1$ ns
- Spatial: 100 μ rad, FOV = 10 cm
- Baffles: 3-4 dB
- Shielding: 10-12 dB

After these filtering steps it is possible to synchronize the experimental setup during daylight conditions

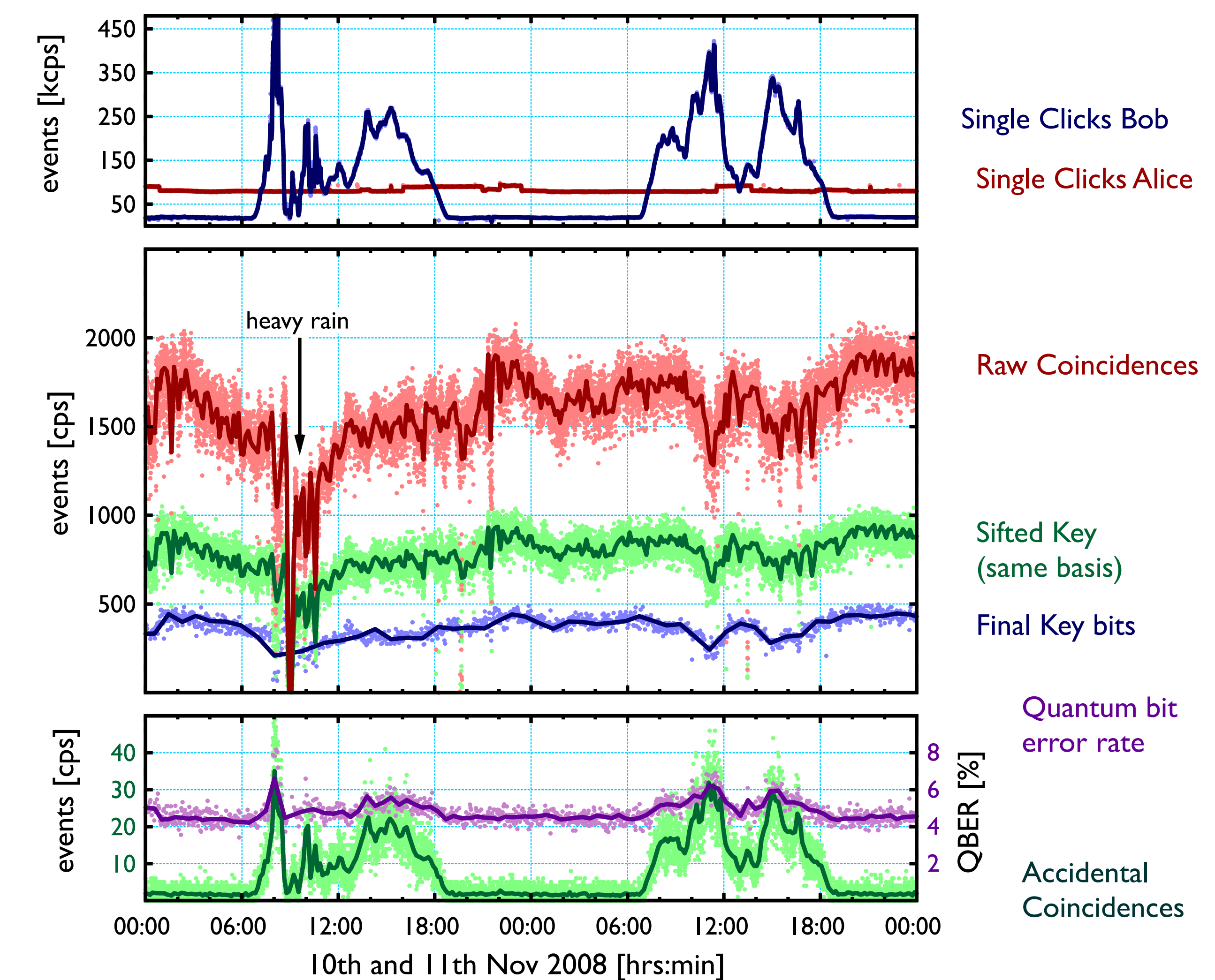
Spectral filtering



Rates for 48 hours (summary)



Rates for 48 hours of continuous operation



Publication

- *Daylight operation of a free space, entanglement-based quantum key distribution system*, M.P. Peloso, I. Gerhardt, C. Ho, A. Lamas-Linares, C. Kurtsiefer, New Journal of Physics, 11, 045007, (2009)

Summary & Outlook

- Entanglement based QKD in full daylight, continuous 4 days run without interruption
- Synchronization works at ambient conditions
- Noise Suppression
 - Spectral
 - Temporal
 - Spatial
- Future: Brighter and spectrally narrower sources

Correlation matrix

Daylight Correlation				
	H	-45°	V	+45°
H	599	22791	34032	18409
-45°	18647	2894	17512	44841
V	29062	16422	2125	25246
+45°	14635	40558	22280	1498