Effects of the decorrelation and the noise on the coincidence detection in a optical system with entangled photons

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The experimental setup to observe decorrelation phenomenon is similar to the setup for the two-photon measurement with a partial coherence. The two-photon source is a 2W laser beam passing through a BBO crystal and a 50/50 beam splitter. The two output beams are delayed by a quarter-wave plate and a polarizer, respectively.

The two beams are then recombined and directed to two avalanche photodiodes (APDs) with a 50/50 beam splitter. The APDs are biased at about 500V and have a bandwidth of 10MHz. The output signals from the APDs are amplified and fed to a fast digital oscilloscope (Tektronix TDS 610C) with a bandwidth of 1GHz.

The experimental results show that the probability of coincidence is reduced by about 10% due to the decorrelation phenomenon. The noise level is also increased by about 5dB.

These results indicate that the decorrelation and the noise caused by the two-photon source can significantly affect the coincidence detection in an optical system with entangled photons. Therefore, it is necessary to take into account these factors when designing such systems.
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Figure 1. 광자쌍의 동시계수 측정을 위한 실험장치도.

그림 2. 두 검출기 $D_1, D_2$에 광자쌍과 잡음이 섞여서 입사할 때 단일계수의 변화에 따른 동시계수.
(a)는 검출기 $D_1$에만 잡음이 입사할 때이고, (b)는 $D_1$과 $D_2$에 모두 잡음이 입사할 때이다.