Random number generation using single photon emitters embedded in nanopillars

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Random number sequences have wide applications in science and technology [1,2]. A crucial application of random number generation is in the field of secure quantum communication [3], where photons act as qubits. Typically, such sequences can be generated by algorithmic methods via pseudorandom number generators. However, for a truly unpredictable random number sequence, inherent properties of a quantum system must be utilized [1]. Here, we implement a quantum random number generator (QRNG) based on single photon detection from a solid-state emitter (nitrogen vacancy – NV center in diamond) [4]. The principle is based on the inherent randomness of path selection by a photon incident on a symmetric beam splitter. The emitter is embedded in a nanopillar which helps in enhanced brightness of emission and knowing the precise location of these emitters. We investigate the photon statistics of emission by performing an anti-bunching measurement. This ensures the single photon nature of the emitted light for characterizing of the non-classicality of the source. Then, we experimentally demonstrate a real-time quantum random number generator at room-temperature for these NV centers. We perform von Neumann de-biasing to extract the random number sequence from the raw bit sequence and show a comparison of the random numbers generated for different emitters. The sequences pass the randomness tests with p-values >> 0.1, indicating high quality of randomness. Our results highlight the importance of true random number generation using single photon emitters.

References

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Figure

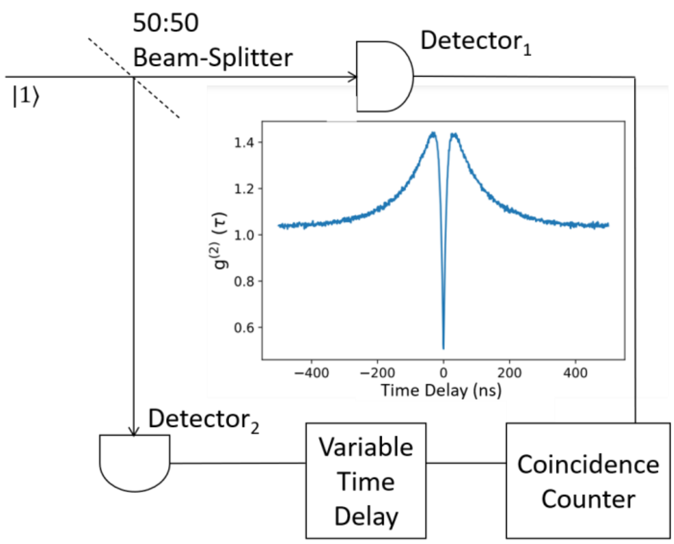

Figure 1: Experimental setup for random number generation and studying antibunching (inset: measured antibunching plot for NV center in nanopillar)