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Testing Quantum Randomness in Single-Photon Polarization Measurements DAVID BRANNING, MATTHEW BERMUDEZ, Trinity College — A binary sequence constructed from 17 million polarization measurements of single photons was subjected to a comprehensive set of tests for randomness. The polarization measurements were carried out using photon pairs from spontaneous parametric downconversion under low-intensity conditions similar to those of many optical quantum cryptography protocols. One member of each photon pair was used as a detection trigger, while the other was put into a superposition state of horizontal (H) and vertical (V) polarization, and then measured in the H-V basis. The resulting sequence of binary outcomes was subjected to a suite of fifteen tests developed at the National Institute of Standards and Technology (NIST) to assess the quality of algorithmic random-number generators. Several of these tests require many distinct sub-sequences of at least 1 million bits, with very low bias, in order to be meaningful. In this experiment the low bias of the collected sequence (0.04%) enabled all of the NIST tests to be applied directly to the polarization measurements themselves, without the use of numerical unbiasing procedures.

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