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A Strong Loophole-Free Test of Local Realism PETER BIERHORST, LYNDEN SHALM, MARTIN STEVENS, THOMAS GERRITS, SCOTT GLANCY, MICHAEL ALLMAN, KEVIN COAKLEY, SHELLEE DYER, CARSON HODGE, ADRIANA LITA, VARUN VERMA, RICHARD MIRIN, EMANUEL KNILL, SAE WOO NAM[1], National Institute of Standards and Technology, Boulder, CO — We discuss theoretical and statistical aspects of a recent loophole-free violation of local realism using entangled photon pairs. The experiment ensures that all relevant events in the Bell test are spacelike separated by placing the parties far enough apart and using fast random number generators and high-speed polarization measurements. A high-quality polarization-entangled source of photons, combined with high-efficiency, low-noise, single-photon detectors, allows us to make measurements without requiring any fair-sampling assumptions. We collected six data sets, and for each data set we used a hypothesis test to compute the maximum probability (the p-value) that our experiment, if it had been governed by local realism, would produce a violation as large or larger than we observed. The smallest p-value we observed is 5.9 X 10ˆ-9.

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