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Experimental violation of a Bell-Leggett-Garg inequality using weak measurements, Part II: The Violation T.C. WHITE, UC Santa Barbara, J. MUTUS, Google Santa Barbara, J. DRESSEL, UC, Riverside, J. KELLY, UC Santa Barbara, R. BARENDS, Google, Santa Barbara, A. MEGRANT, UC Santa Barbara, E. JEFFREY, D. SANK, Google, Santa Barbara, B. CAMPBELL, UC Santa Barbara, Y. CHEN, Google, Santa Barbara, Z. CHEN, B. CHIARO, A. DUNSWORTH, UC Santa Barbara, A. FOWLER, Google, Santa Barbara, I.-C. HOI, C. NEILL, P.J.J. O'MALLEY, UC Santa Barbara, P. ROUSHAN, Google, Santa Barbara, C. QUINTANA, A. VAINSENCHER, J. WENNER, UC Santa Barbara, A.N. KOROTKOV, UC Riverside, A.N. CLELAND, UC Santa Barbara, J.M. MARTINIS, University of California and Google, Santa Barbara — We experimentally demonstrate the violation of a hybrid Bell-Leggett-Garg inequality that avoids both the disjoint sampling and fair sampling loopholes that are common to traditional Bell inequalities. Our algorithm uses sequential weak measurements of a Bell state that are implemented with four superconducting Xmon qubits. In this second of two talks, we present experimental detail on the measurement of the CHSH correlator and the analysis of error mechanisms. We find that the dependence of the correlations on the measurement strength shows excellent agreement with theoretical predictions, but the magnitude of the correlator varies greatly with system fidelity. For sufficiently weak and high fidelity measurements, we achieve a violation that is many standard deviations above the classical limit.

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