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Conclusive quantum steering with superconducting transition edge sensors MARCELO P. DE ALMEIDA, DEVIN H. SMITH, GEO GILLETT, CYRIL BRANCIARD, ALESSANDRO FEDRIZZI, TILL J. WEINHOLD, School of Mathematics and Physics, University of Queensland, 4072 Brisbane, QLD, Australia, ADRIANA LITA, BRICE CALKINS, THOMAS GERTIS, SAE WOO NAM, National Institute of Standards and Technology, 325 Broadway, Boulder CO 80305, USA, ANDREW G. WHITE, School of Mathematics and Physics, University of Queensland, 4072 Brisbane, QLD, Australia — Quantum steering allows two parties to verify shared entanglement even if one measurement device is untrusted. A conclusive demonstration of steering through the violation of a steering inequality is of considerable fundamental interest and opens up applications in quantum communication. To date all experimental tests with single photon states have relied on post-selection, allowing untrusted devices to cheat by hiding unfavorable events in losses. Here we close this "detection loophole" by combining a highly efficient source of entangled photon pairs with superconducting transition edge sensors. We achieve an unprecedented $\sim$62% conditional detection efficiency of entangled photons and violate a steering inequality with the minimal number of measurement settings by 48 standard deviations. Our results provide a clear path to practical applications of steering and to a photonic loophole-free Bell test.

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