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Experimentally Robust Self-testing for Bipartite and Tripartite Entangled States WEN-HAO ZHANG, GENG CHEN, CHUAN-FENG LI, GUANGCAN GUO, University of Science and Technology of China — Self-testing is a method with which a classical user can certify the state and measurements of quantum systems in a device-independent way. In particular, self-testing of entangled states is of great importance in quantum information processing. An understandable example is that the maximal violation of the Clauser-Horne-Shimony-Holt inequality necessarily implies that the bipartite system shares a singlet. One essential question in self-testing is that, when one observes a nonmaximum violation, how far is the tested state from the target state (which maximally violates a certain Bell inequality)? The answer to this question describes the robustness of the used self-testing criterion, which is highly important in a practical sense. Recently, J. Kaniewski derived two analytic self-testing bounds for bipartite and tripartite systems. In this Letter, we experimentally investigate these two bounds with high-quality two-qubit and three-qubit entanglement sources. The results show that these bounds are valid for various entangled states that we prepared. Thereby, a proof-of-concept demonstration of robust self-testing is achieved, which improves on the previous results significantly.

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