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Realistic loophole-free Bell test with atom-photon entanglement COLIN TEO, Centre for Quantum Technologies, MATEUS ARAÚJO, MARCO QUINTINO, Departamento de Fisica, Universidade Federal de Minas Gerais, JIŘÍ MINÁŘ, DANIEL CAVALCANTI, Centre for Quantum Technologies, VALERIO SCARANI, Centre for Quantum Technologies; Department of Physics, National University of Singapore, MARCELO TERRA CUNHA, Departamento de Matematica, Universidade Federal de Minas Gerais, MARCELO SANTOS, Departamento de Fisica, Universidade Federal de Minas Gerais — The establishment of nonlocal correlations, guaranteed through the violation of a Bell inequality, is not only important from a fundamental point of view, but constitutes the basis for device-independent quantum information technologies. Although several nonlocality tests have been performed so far, all of them suffered from either the locality or the detection loopholes. Recent studies have suggested that the use of atom-photon entanglement can lead to Bell inequality violations with moderate transmission and detection efficiencies. In this paper we propose an experimental setup realizing a simple atom-photon entangled state that, under realistic experimental parameters available to date, achieves a significant violation of the Clauser-Horn-Shimony-Holt Bell inequality. Most importantly, the violation remains when considering typical detection efficiencies and losses due to required propagation distances.

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