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Progress towards a loophole-free test of nonlocality¹ KEVIN MCCUSKER, BRADLEY CHRISTENSEN, PAUL KWIAT, University of Illinois at Urbana-Champaign, JOSEPH ALTEPETER, Northwestern University — We report on our progress towards a loophole-free test of nonlocality using spontaneous parametric downconversion (SPDC). While the timing loophole can be easily closed in such a system by moving the detectors far apart [1], closing the detector loophole is significantly more difficult. In the standard Bell entangled states with the maximal violation of the CHSH inequality [2], an overall efficiency of 83% is required. This limit can be lowered to 67% by using non-maximally entangled states (although sensitivity to noise is greatly increased) [3]. We are carefully engineering our source to achieve maximal heralding efficiency, by optimizing both the spatial and spectral filtering, while keeping noise low using high-extinction-ratio polarizing beamsplitters. Combined with high-efficiency detectors, either optimized visible-light photon counters [4] or transition-edge sensors [5], closure of the detection loophole is within reach.

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