Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

A robust Bell inequality without two-outcome measurements WILLIAM PLICK, ROBERT FICKLER, RADEK LAPKIEWICZ, SVEN RAMELOW, Institute for Quantum Optics and Quantum Information — We present a novel Bell inequality that does not require dichotomic (two-outcome) measurements. It is based on an inequality originally derived by Wigner in 1969, extending it such that no assumptions other than local-realism, fair-sampling, and freedom-of-choice are necessary. It is most useful in situations where there is no direct access to true two-outcome (dichotomic) measurements, like photonic quantum experiments where spatial degrees-of-freedoms are analyzed with spatial light modulators (SLMs), as well as many other experimental scenarios. The only other class of inequalities (CH-type) that has this feature requires coincidence and singles rates to be of the same order of magnitude for violation, ours does not. It thereby enables the stringent verification of entanglement and rejection of local-realism, without any assumptions about the underlying Hilbert-space, such as dimensionality – in the most difficult experimental conditions. We also experimentally violate this inequality in a novel setup: entangled states of very high orbital angular momentum. This constitutes a rejection of the hypothesis of local realism (under reasonable assumptions) with the highest quanta to date.

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Date submitted: 07 Nov 2013 Electronic form version 1.4