Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Testing Quantum Devices: Practical Entanglement Verification in Bipartite Optical Systems HAUKE HASELER, TOBIAS MORODER, NORBERT LUTKENHAUS, Institute for Quantum Computing, INSTITUTE FOR QUANTUM COMPUTING COLLABORATION, UNIVERSITY OF ERLANGEN COLLABORATION — We present a method to test quantum behavior of quantum information processing devices, such as quantum memories, teleportation devices, channels and quantum key distribution protocols. The test of quantum behavior can be phrased as the verification of effective entanglement. Necessary separability criteria are formulated in terms of a matrix of expectation values in conjunction with the partial transposition map. Our method is designed to reduce the resources for entanglement verification. A particular protocol based on coherent states and homodyne detection is used to illustrate the method. A possible test for the quantum nature of memories using two non- orthogonal signal states arises naturally. Furthermore, closer inspection of the measurement process in terms of the Stokes operators reveals a security threat for quantum key distribution involving phase reference beams.

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Date submitted: 27 Nov 2007 Electronic form version 1.4