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Fundamental bounds and performance tests for the storage or transmission of quantum light NORBERT LUTKENHAUS, HAUKE HASELER, NATHAN KILLORAN, University of Waterloo — In advanced quantum communication protocols, we require the ability to store light in a way which preserves the imprinted quantum information, a task which cannot be done with classical protocols. We propose benchmarks based on the idea that a quantum communication experiment is successful only if it operates in a quantum regime, that is, it outperforms any classical transmission strategy. Current criteria suffer from a gap between theory, which typically prescribes testing using a continuous distribution of test states, and experiment, which can test only a finite set of states. Our benchmark approach avoids this. One of our new benchmarks is based on weak coherent states with just three phase settings and homodyne detection. This benchmark has optimal strength reaching that of the continuous set of test states and avoids the need of costly tomographic reconstruction of the output states. As further simplification, for phase- randomized lasers, one coherent test state is sufficient to implement our test. As an extension, we consider the problem of quantitative performance, providing estimates for quantum throughput of the tested devices.

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