

Violation of Bell inequalities in larger Hilbert spaces: robustness and challenges

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We explore the challenges posed by the violation of Bell-like inequalities by d -dimensional systems exposed to imperfect state-preparation and measurement settings. We address, in particular, the limit of high-dimensional systems, naturally arising when exploring the quantum-to-classical transition. We show that, although suitable Bell inequalities can be violated, in principle, for any dimension of given subsystems, it is in practice increasingly challenging to detect such violations, even if the system is prepared in a maximally entangled state. We characterize the effects of random perturbations on the state or on the measurement settings, also quantifying the efforts needed to certify the possible violations in case of complete ignorance on the system state at hand.

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- [H2020](#) [5]
- [QIPC](#) [6]
- [RySQ](#) [7]
- [03.10.+m Entanglement measures](#) [8]
- [Result](#) [9]
- [SIQS](#) [10]
- [02.30.Bi Bell inequalities](#) [11]

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