

Detecting incapacity

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Using unreliable or noisy components for reliable communication requires error correction. But which noise processes can support information transmission, and which are too destructive? For classical systems any channel whose output depends on its input has the capacity for communication, but the situation is substantially more complicated in the quantum setting. We find a generic test for incapacity based on any suitable forbidden transformation—a protocol for communication with a channel passing our test would also allow us to implement the associated forbidden transformation. Our approach includes both known quantum incapacity tests—positive partial transposition (PPT) and antidegradability (no cloning)—as special cases, putting them both on the same footing. We also find a physical principle explaining the nondistillability of PPT states: Any protocol for distilling entanglement from such a state would also give a protocol for implementing the forbidden time-reversal operation.

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