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Title: Arrow of time and its reversal

Abstract:

Uncovering the origin of the “arrow of time” remains a fundamental scientific challenge. Within the framework of statistical physics, this problem was inextricably associated with the Second Law of Thermodynamics, which declares that entropy growth proceeds from the system’s entanglement with the environment. This poses a question whether it is possible to develop protocols for the local in time and space circumventing the irreversibility of time, and if so to practically implement these protocols. Here we show that, while in nature the complex conjugation needed for time reversal is exponentially improbable, one can design a quantum protocol that includes complex conjugation and thus reverses a given quantum state. Using this algorithm on an IBM quantum computer enables us to experimentally demonstrate a backward time dynamics for an electron scattered on a two-level impurity.