

Talk: Quantum error correction for multiparameter metrology

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Content

Abstract: For single-parameter sensing, Greenberger-Horne-Zeilinger (GHZ) probes achieve optimal quantum-enhanced precision across the unknown parameter range, solely relying on parameter-independent separable measurement strategies for all values of the unknown parameter. However, in the multiparameter setting, a single GHZ probe not only fails to achieve quantum advantage but also the corresponding optimal measurement becomes complex and dependent on the unknown parameters. Here, we provide a recipe for multiparameter sensing with GHZ probes using quantum error correction techniques by treating all but one unknown parameters as noise, whose effects can be corrected. This strategy restores the core advantage of single parameter GHZ-based quantum sensing, namely reaching optimally quantum-enhanced precision for all unknown parameter values while keeping the measurements separable and fixed. Specifically, given one shielded ancilla qubit per GHZ probe, our protocol extracts optimal possible precision for any probe size. While this optimal precision is shot-noise limited for a single GHZ probe, we recover the Heisenberg scaling through use of multiple complementary GHZ probes.

Summary

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