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Quantum Thermodynamics of Precision: theory and experiment

Understanding and controlling microscopic quantum devices represents a major milestone. Their precision is related to the fluctuations of their measurable output, an aspect that becomes crucial at the nano-scale. Achieving a regime where the machine operates at a given precision inevitably comes at a cost in terms of thermodynamic resources, thus massively impacting the machines' performances.
Thermodynamic Uncertainty Relations (TURs) have represented a landmark first step in understanding this balance, as they express a trade-off between precision, quantified in terms of the noise-to-signal ratio of any thermodynamic quantity (e.g. work, heat, …), and the amount of associated irreversibility.
Here we present novel genuinely quantum TUR, obtained by combining techniques from quantum information theory and thermodynamics of geometry.
Moreover, such theoretical findings will be experimentally benchmarked both in a trapped-ion experiment and in an experiment with IBM using quantum and classical computers in concert.

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