Certifying ergotropy under partial information

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Abstract: We introduce a general certification framework that lower bounds ergotropy using only the expectation values of a limited set of arbitrary observables.

Ergotropy, the maximum work extractable from a quantum system, is a central resource in quantum physics. Computing ergotropy is well established when the system state is fully known, but its estimation under partial information remains an open problem. Here we introduce a general certification framework that lower bounds ergotropy using only the expectation values of a limited set of arbitrary observables. The method naturally applies in the finite-statistics regime, yielding confidence-certified bounds that explicitly incorporate shot noise. We benchmark our approach on both synthetic data and experimental measurements from an IBM quantum processor. This establishes a robust and experimentally accessible tool for certifying extractable work in realistic quantum settings.

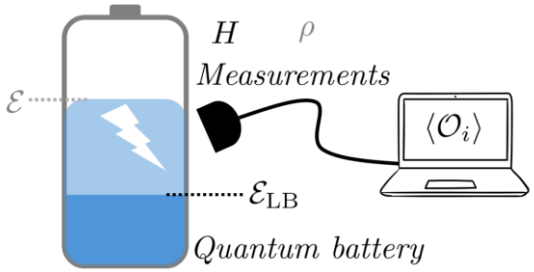

Fig. 1 Schematic illustrating the problem under consideration. We assume the Hamiltonian of the system is fully characterized and we want to find a lower bound for the unknown ergotropy under partial information on the true state. This is obtained through an informationally incomplete set of measurements, defined by a set of expectation values.

References

[1] Egle Pagliaro, Leonardo Zambrano, Mir Alimuddin, Alioscia Hamma, Antonio Acín, Donato Farina, "Certifying ergotropy under partial information", arXiv preprint arXiv.2603.18828 (2026)

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