QUANTIFYING QUANTUMNESS: THE ELUSIVE POWER AND LIMITS OF QUANTUM INFORMATION PROCESSING

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ABSTRACT

Quantum information science investigates how to perform computations by manipulating atoms and photons. A critical issue is that these quantum systems display very complex configurations, so it is hard to capture in simple quantitative laws their distinctive properties.

In this talk, I discuss exact quantum bounds on the conversion of physical resources, such as energy and time, into computational ones. A new quantum inequality, formally similar to the Heisenberg uncertainty relations, dictates that our ability to perform a quantum computation is never greater than the related experimental cost.

Finally, I elucidate how the result advances our understanding of the structure and dynamics of complex quantum systems, e.g., quantum computers, and how it paves the way to design principles for quantum information processing in realistic, noisy scenarios.

References:
D. Girolami and F. Anzà, Phys. Rev. Lett. 126 170502 (2021)
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