ICFO

SEMINAR: Universal quantum mechanical limit to dissipation

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November 10, 2026
12:00 to 13:00
Seminar Room

The question of approaching the reversible limit with finite ressources is one of the central problems in thermodynamics. In this work, we use the Planckian bound for thermalization to derive a universal non-trivial lower-bound to the entropy production of arbitrary physical processes. We show that quantum mechanics imposes that the dissipation incurred by any operation is larger than L^2 \tau_{\rm Pl}/\tau, where \tau_{\rm Pl} = \hbar/k_BT is the Planckian dissipation time, L is a Fisher information distance between the boundaries of the operation, and \tau is the duration of the protocol. This result holds true for all quantum mechanical systems where thermal states are fixed points of the evolution. Furthermore, this bound implies a stronger version of the second law of thermodynamics: the entropy production of any finite-time process cannot be brought arbitrarily close to zero unless it is in a critical state where its thermal Fisher information can be arbitrarily small. Finally, we can apply this bound to obtain a universal finite-time correction to Landauer's principle: erasing one bit of information requires to dissipate at least k_BT(ln(2) + \frac{\Gamma(3/4)^4}{\pi}\frac{\tau_{\rm Pl}}{\tau}) heat into the environment.

Hosted by: Antonio Acin