

Irreversibility and the arrow of time in a quenched quantum system

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Irreversibility is one of the most intriguing concepts in physics. While microscopic physical laws are perfectly reversible, macroscopic average behavior has a preferred direction of time. According to the second law of thermodynamics, this arrow of time is associated with a positive mean entropy production. Using a nuclear magnetic resonance setup, we measured the nonequilibrium entropy produced in an isolated spin-1/2 system following fast quenches of an external magnetic field. We experimentally demonstrated that it is equal to the entropic distance, expressed by the Kullback-Leibler divergence, between a microscopic process and its time reversal.

- [1] T. B. Batalhao, A. M. Souza, R. S. Sarthour, I. S. Oliveira, M. Paternostro, E. Lutz, and R. M. Serra, Phys. Rev. Lett. 115, 190601 (2015).