

Emergence of Fermi's Golden Rule in a Quantum Many-body System

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Ultracold fermions in optical box traps are a fascinating platform for studying nonequilibrium many-body dynamics in highly controllable settings [1-5]. In this talk, I will present two such studies: (i) By tuning the power and pulse duration of an rf, we map the generic dynamical response of a strongly interacting Fermi gas coupled to a probing field, from the universal early-time quadratic regime to the onset and breakdown of Fermi's Golden Rule, and into coherent many-body Rabi dynamics [6]. (ii) We established a surprising link between the long-time properties of a thermalized driven state and the short-time weak-drive response of a spin coupled to a bath. This relation, which we coin 'the Kubo-Thermalization correspondence', formally connects macroscopic observables even though they can be very challenging to calculate independently, and is largely independent of the nature of the thermal bath [7].

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- [2] Ji et al, Phys. Rev. Lett. 132, 153402 (2024)
- [3] Vivanco et al, Nat. Phys. 21, 564-569 (2025)
- [4] Huang et al, Phys. Rev. X 15, 011074 (2025)
- [5] Schumacher et al, Nat. Comm. 17, 174 (2026)
- [6] Chen et al, arXiv:2502.14867 (Nature Phys. in press, 2026)
- [7] Huang et al, arXiv:2605.06666