Floquet-Magnus theory and generic transient dynamics in periodically driven many-body quantum systems

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We explore the universal nature of relaxation in isolated many-body quantum systems subjected to global and strong periodic driving. In the thermodynamic limit, such systems are known to heat up to infinite temperature states in the long-time limit, which kills all the specific properties of the system.
In our work [1,2], instead of considering infinitely long-time scale, we aim to provide a general framework to understand the long but finite time behavior of a periodically driven system in the high-frequency regime. In our analysis, we focus on the Floquet-Magnus expansion that gives a formal expression of the effective Hamiltonian on the system. Although in general the full series expansion is not convergent in the thermodynamics limit, we give a clear relationship between the Floquet-Magnus expansion and the transient dynamics. More precisely, we rigorously show that a truncated version of the Floquet-Magnus expansion accurately describes the exact dynamics for a certain time-scale, which is at least exponentially long with respect to the frequency of the driving field. Our theory reveals an experimental timescale for which nontrivial dynamical phenomena can be reliably observed.
Based on the above result, we discuss the prethermalization phenomenon in an isolated quantum system under a high-frequency driving field.

[1] T. Kuwahara, T. Mori, and K. Saito, Ann. Phys. **367**, 96 (2016).

[2] T. Mori, T. Kuwahara, and K. Saito, Phys. Rev. Lett. **116**, 120401 (2016).