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Quantum dynamics in Krylov space: from tridiagonal matrices to quantum chaos

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The dynamics of quantum systems typically unfolds within a subspace of the state or operator space, known as the Krylov space. Krylov subspace methods provide a compact and computationally efficient description of quantum evolution and quantum chaos, which is particularly useful for describing nonequilibrium phenomena of many-body systems with a large Hilbert space. In this talk, I will explore the notion of Krylov complexity as a probe for operator growth and quantum chaos, scrambling, and quantum state evolution. Illustrative examples include quantum spin chains, Sachdev-Ye-Kitaev models, and random matrix theory. The talk is based on selected topics from the review article arXiv:2405.09628 (Physics Reports).

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