

# On Krylov complexity in open systems: an approach via bi-Lanczos algorithm

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**ABSTRACT:** Continuing the previous initiatives [1, 2], we pursue the exploration of operator growth and Krylov complexity in dissipative open quantum systems. In this paper, we resort to the bi-Lanczos algorithm generating two bi-orthogonal Krylov spaces, which individually generate non-orthogonal subspaces. Unlike the previously studied Arnoldi iteration, this algorithm renders the Lindbladian into a purely tridiagonal form, thus opening up a possibility to study a wide class of dissipative integrable and chaotic systems by computing Krylov complexity at late times. Our study relies on two specific systems, the dissipative transverse-field Ising model (TFIM) and the dissipative interacting XXZ chain. We find that, for the weak coupling, initial Lanczos coefficients can efficiently distinguish integrable and chaotic evolution before the dissipative effect sets in, which results in more fluctuations in higher Lanczos coefficients. This results in the equal saturation of late-time complexity for both integrable and chaotic cases, making the notion of late-time chaos dubious.

# Computational Complexity Study On Krylov Integration

**M Walker**



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accounting in a summary fashion for the state of the fields which they cover as determined by contributing developments at various times and in many places Considering the sustained growth of mathematics itself as well as the intensive use of an ever increasing number of its branches in diversified applied contexts the availability of such surveys in selected areas is believed to fill a real need The present articles are therefore aimed not so much at research specialists actively contributing to the subjects discussed as they are aimed at a broader mathematically literate audience looking for contemporary information on the important problems and results in these disciplines whether it be for use in classroom and seminar or for the sake of possible application to problems in other fields of science and engineering or simply for reasons of personal interest The selection of the areas surveyed as well as their coverage was further guided by giving first consideration to developments of whose current state no comprehensive picture could be obtained by going only to the readily accessible literature in familiar languages It is a unique distinction of the mathematical community to have never been taken in by the myth now generally shattered that Russian science merely followed the lead of the West at a respectful distance Mathematicians remained aware of the vigorous development during the postwar years of research in their field also in the Communist countries and they knew of the steady stream of important results which they produced

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