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## Krylov complexity and the bulk Hilbert space of DSSYK

*Tuesday 4 February 2025 16:00 (1 hour)*

Within the framework of the AdS/CFT correspondence, the time dynamics of black holes in the bulk hints to the existence of boundary observables that evolve for very long time-scales. It was conjectured that quantum complexity has the correct features to be a candidate boundary observable. However, none of the proposed notions of quantum complexity yielded a precise bulk-boundary correspondence until recently. In this talk we will provide such a precise match by focusing on a particular notion of quantum complexity, known as Krylov complexity. We will begin with an overview of this boundary observable and of its properties for chaotic and integrable quantum systems. We will then focus on double-scaled SYK (DSSYK) and show how the so-called chord basis fits naturally within the Krylov construction. We will show that in the limit where DSSYK is dual to JT gravity, Krylov complexity of the infinite-temperature thermofield double state evolving in time on the boundary has a precise gravitational description in the bulk —making it the first microscopic instance of complexity to have a precise geometric description. Finally, we will discuss Krylov complexity for the time evolution of an operator in DSSYK. We will show that also in this case, in the limit associated with gravity, Krylov complexity has a well-defined geometric interpretation in the bulk.

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