Centre for High Energy Physics

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Wigner negativity, Random matrices and Gravity (Onkar Parikar)

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Abstract:

For any state in a D-dimensional Hilbert space with a choice of an ordered basis, one can define a discrete version of the Wigner function —a quasi-probability distribution which represents the state on a discrete phase space. The Wigner function can, in general, take on negative values, and the amount of negativity in the Wigner function of a state can be interpreted as a measure of the "non-classicality" of the state from several points of view. In this talk, we will study the growth of Wigner negativity for a generic initial state under time evolution with chaotic Hamiltonians. We first give a perturbative argument to show that a certain special choice of basis – called the Krylov basis – minimizes the early time growth of Wigner negativity in the large D limit. Using tools from random matrix theory, we then show that for a generic choice of basis, the Wigner negativity becomes exponentially large in an O(1) amount of time evolution. On the other hand, in the Krylov basis, the negativity grows gradually (i.e., as a power law) for an exponential amount of time, before saturating close to its maximum value. We take this as evidence that the Krylov basis is ideally suited for a dual, semi-classical effective description of chaotic quantum dynamics at large D. We propose that this effective description is akin to the dual gravitational description in the AdS/CFT correspondence.