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String Theory in Greater Paris

Rencontres Théoriciennes

“Supergravité, théorie des cordes et théorie M”

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Slow scrambling in extremal BTZ and microstate geometries

Out-of-time-order correlators (OTOCs) that capture maximally chaotic properties of a black hole are determined by scattering processes near the horizon. This prompts the question to what extent OTOCs display chaotic behaviour in horizonless microstate geometries. This question is complicated by the fact that Lyapunov growth of OTOCs requires nonzero temperature, whereas constructions of microstate geometries have been mostly restricted to extremal black holes.

We compute OTOCs for a class of extremal black holes, namely maximally rotating BTZ black holes, and show that on average they display "slow scrambling", characterized by cubic (rather than exponential) growth. Superposed on this average power-law growth is a sawtooth pattern, whose steep parts correspond to brief periods of Lyapunov growth associated to the nonzero temperature of the right-moving degrees of freedom in a dual conformal field theory.

Next we study the extent to which these OTOCs are modified in certain "superstrata", horizonless microstate geometries corresponding to these black holes. Rather than an infinite throat ending on a horizon, these geometries have a very deep but finite throat ending in a cap. We find that the superstrata display the same slow scrambling as maximally rotating BTZ black holes, except that for large enough time intervals the growth of the OTOC is cut off by effects related to the cap region, some of which we evaluate explicitly.

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