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String Theory in Greater Paris

Rencontres Théoriciennes

"Supergravité, théorie des cordes et théorie M"

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Echoes of chaos from string theory black holes

The strongly coupled D1-D5 conformal field theory is a microscopic model of black holes which is expected to have chaotic dynamics. We study the weak coupling limit of the theory where it is integrable rather than chaotic. In this limit, the operators creating microstates of the lowest mass black hole are known exactly. We consider the time-ordered two-point function of light probes in these microstates, normalized by the same two-point function in vacuum. These correlators display a universal early-time decay followed by late-time sporadic behavior. To find a prescription for temporal coarse-graining of these late fluctuations we appeal to random matrix theory, where we show that a progressive time-average smooths the spectral form factor (a proxy for the 2-point function) in a typical draw of a random matrix. This coarse-grained quantity reproduces the matrix ensemble average to a good approximation. Employing this coarse-graining in the D1-D5 system, we find that the early-time decay is followed by a dip, a ramp and a plateau, in remarkable qualitative agreement with recent studies of the Sachdev-Ye-Kitaev (SYK) model. We study the timescales involved, comment on similarities and differences between our integrable model and the chaotic SYK model, and suggest ways to extend our results away from the integrable limit.

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