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How special are black holes? Correspondence with objects saturating unitarity bounds in generic theories

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Black holes are considered exceptional due to their time evolution and information processing. However, these properties are generic for objects, the so-called saturons, that attain the maximal entropy permitted by unitarity. We discuss the correspondence between black holes and saturons within a renormalizable SU(N) invariant theory.
The spectrum contains a tower of bubbles representing bound states of SU(N) Goldstones. We argue that a saturated bound state exhibits a striking resemblance with a black hole despite the absence of gravity. The Bekenstein-Hawking formula gives the saturon entropy. Semiclassically, saturons possess an information horizon. They evaporate at a thermal rate with a temperature proportional to their inverse radius. The information retrieval time is equal to Page's time. Additionally, we examine the memory burden effect, which states that the quantum information contained within a system stabilizes it. We discuss the fundamental and observational implications of the black hole–saturon correspondence.

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