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A Critique of the Fuzzball Program (Suvrat Raju, ICTS)

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We explore the viability of fuzzballs as candidate microstate geometries for the black hole, and their possible role in resolutions of the information paradox. We argue that if fuzzballs provide a description of black-hole microstates, then the typical fuzzball microstate can only differ significantly from the conventional black-hole geometry at a Planck-scale-distance from the horizon. However, precisely in this region quantum fluctuations in the fuzzball geometry become large and the fuzzball geometry becomes unreliable. We verify these expectations through a detailed calculation of quantum expectation values and quantum fluctuations in the two-charge fuzzball geometries. We then examine a subset of the solutions discovered in arXiv:1607.03908. We show, based on a calculation of a probe two-point function in this background, that these solutions, and others in their class, violate robust expectations about the gap in energies between successive energy eigenstates and also violate the eigenstate thermalization hypothesis. We conclude that while fuzzballs are interesting star-like solutions in string theory, they do not appear to be relevant for resolving the information paradox, and cannot be used to make valid inferences about black-hole interiors.

Summary