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Resolving the Microstructure of Degenerating Superstrata

One of the proposed resolutions of the information paradox is that black holes are described by ensembles of horizonless fuzzballs. Suitably coherent superpositions of such objects can be described within supergravity. Explicit examples are superstrata: smooth and horizonless microstates of the supersymmetric D1-D5-P black hole, which have a well defined dual description in terms of pure states of the D1-D5 CFT. However, in a particular limit of their parameter space, these geometries seemingly develop a horizon and this contradicts the main idea of the fuzzball proposal. In this talk I will describe a resolution to this contradiction. I will briefly introduce superstrata and describe the limit in which they form a finitely-sized horizon. The appearance of the horizon is a consequence of neglecting certain degrees of freedom in the construction of these geometries. One can avoid the horizon formation by working in a different duality frame and show that the neglected degrees of freedom are crucial in the limit where superstrata degenerate. As an example, I will present a solution which has the same asymptotic charges and SO(4) rotational symmetry as the F1-NS5-P black hole, but has a vanishing horizon area. The formation of a large horizon is prevented by additional D0-D4 brane charge densities which are localised on the NS5-brane. I will then argue that this provides evidence that a horizon does not form in the degenerate limit of superstrata. Finally, I will discuss progress in the construction of microstate geometries in the new duality frame. I will present the relevant six-dimensional BPS equations and show that these can be organised in several layers of linear differential equations. In addition, one can look for the uplifts to higher-dimensional supergravities. Finally, I will present possible explicit horizonless solutions and discuss future directions.

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