
Summary: Collapsing shells form horizons, and when the curvature is small classical general relativity is believed to describe this process arbitrarily well. On the other hand, quantum information theory based (fuzzball/firewall) arguments suggest the existence of some structure at the black hole horizon. This structure can only form if classical general relativity stops being the correct description of the collapsing shell before it reaches the horizon size. We present strong evidence that classical general relativity can indeed break down prematurely, by explicitly computing the quantum tunneling amplitude of a collapsing shell of branes into smooth horizonless microstate geometries. We show that the amplitude for tunneling into microstate geometries with a large number of topologically non-trivial cycles is parametrically larger than $e^{-S_{BH}}$, which indicates that the shell can tunnel into a horizonless configuration long before the horizon has any chance to form. We also use this technology to investigate the tunneling of M2 branes into LLM bubbling geometries.

MSC: 83C57

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References:


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