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Black holes in 3D dS

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In three-dimensional de Sitter space classical black holes do not exist, and the Schwarzschild-de Sitter solution instead describes a conical defect with a single cosmological horizon. We argue that the quantum backreaction of conformal fields can generate a black hole horizon, leading to a three-dimensional quantum de Sitter black hole. Its size can be as large as the cosmological horizon in a Nariai-type limit. We show explicitly how these solutions arise using braneworld holography, but also compare to a non-holographic, perturbative analysis of backreaction due to conformally coupled scalar fields in conical de Sitter space. We analyze the thermodynamics of this quantum black hole, revealing it behaves similarly to its classical four-dimensional counterpart, where the generalized entropy replaces the classical Bekenstein-Hawking entropy. We compute entropy deficits due to nucleating the three-dimensional black hole and revisit arguments for a possible matrix model description of dS spacetimes. Finally, we comment on the holographic dual description for dS spacetimes as seen from the braneworld perspective.

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