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Thermodynamic ensembles for Schwarzschild-de Sitter BATOUL BANIHASHEMI, TED JACOBSON, University of Maryland — The entropy of a de Sitter horizon was derived long ago by Gibbons and Hawking via a gravitational partition function, but the foundation of their method is obscure because there is no boundary at which to define the ensemble. We introduce an artificial "York" boundary inside the cosmological horizon, with either canonical or microcanonical boundary conditions. Path integrals over spherically symmetric geometries (with a possible black hole in the center) then define either the partition function or the density of states. We explore the stability of these ensembles and investigate the viability of negative temperature for the cosmological horizon. The stationary point of the microcanonical path integral yields the expected Bekenstein-Hawking entropy of the cosmological horizon, and defines a positive temperature (but we have not found a way to test stability in this case). The canonical ensemble path integral at negative temperature is indeed dominated by the stationary point, but yields a negative entropy, indicating an underlying inconsistency in the analysis. The positive temperature ensemble yields the expected positive entropy, however the stationary point is a maximum, indicating an instability. Perhaps this points to decay of the cosmological constant.

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