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Black hole thermodynamics, tower of states, and the emergent string conjecture

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Asymptotically massless towers of species are ubiquitous in the string landscape when infinite-distance limits are approached. Due to the remarkable properties of string dualities, they always comprise Kaluza-Klein states or higher-spin excitations of weakly coupled, asymptotically tensionless critical strings. The connection between towers of light species and small black holes warrants seeking a bottom-up rationale for this dichotomoy, dubbed emergent string conjecture. We will explore bottom-up constraints on towers of light species motivated purely from the consistency of the corresponding thermodynamic picture for small black holes. These constraints shed light on the allowed towers in quantum gravity providing evidence for the emergent string scenario with no reference to a specific ultraviolet completion.

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