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The matter with TT-bar + Lambda_2

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We start by highlighting the convergence of several concrete research threads (among many) illuminating basic statistical mechanical properties of dS. In this line of development, the solvable TT-bar(+Λ2) deformation recently provided an explicit microstate count for the dS3 cosmic horizon, reproducing the refined Gibbons-Hawking entropy computed in https://arxiv.org/abs/2009.12464 along with the correct emergent radial bulk geometry (https://arxiv.org/abs/2110.14670, https://arxiv.org/pdf/2106.10227.pdf). This includes a holographic realization of the first law sign derived in https://arxiv.org/pdf/2208.11706.pdf, https://arxiv.org/pdf/2203.00700.pdf via the Brown-York energy, the appropriate notion of temperature suggested in https://arxiv.org/abs/2206.01083, and the states entering into the flat entanglement spectrum derived for the global dS ground state in https://arxiv.org/abs/1804.08623 (which itself may admit a TT-bar type formulation as in https://arxiv.org/pdf/2204.00591.pdf) .
To build from this, we develop the correspondence toward incorporating the (subleading) effects of local bulk matter fields. On the gravity side, the deformation brings in the boundary to just outside a black hole horizon, where it is indistinguishable from the dS cosmic horizon, enabling a continuous passage to a bounded patch of dS. In string/M theory, the relationship between AdS/CFT and dS involves uplifts that change the internal topology, e.g. replacing an internal sphere S with an internal hyperbolic space H (and incorporating varying warp and conformal factors as derived in detail in https://arxiv.org/abs/2104.13380). We qualitatively connect these two approaches, noting that the differences in the extra dimensions between AdS black hole and dS solutions are washed out by internal averaging in the presence of a timelike boundary skirting the horizon. Returning to the bottom up, we add contributions to the differential equation describing the deformation to capture local bulk gauge and scalar fields (cf https://arxiv.org/pdf/1807.11401.pdf), including both charged black holes and time-dependent propagation of local fields. Finally, we comment on potential implications for the von Neumann algebra of the static patch in the presence of both matter and a finite Newton's constant, bridging the type I fun above and the type II result (at infinitesimal G_Newton) of https://arxiv.org/pdf/2206.10780.pdf.

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