Three Foundational Flaws in AdS-CFT

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A Comment on the Quanta Magazine YouTube post:
Can a New Law of Physics Explain a Black Hole Paradox? (Jun 6, 2023)
https://youtu.be/yLOHdW7dLug

This article is a massive re-promotion, complete with lots of lovely photos, of a video from three years ago [1]. More importantly, despite AdS/CFT enjoying massive academic popularity for decades, its roots are riddled with "trust me, I'm *very* smart" assertions more typical of theological discussion than hypothesize-and-test scientific methods. Three particularly dubious premises of AdS/CFT include:

(1) Reliance on the 1939 Pauli-Fierz concept of spin-2 bosons — now called "gravitons" — that implemented a quantum-by-definition gravity-like pseudo force [2]. Any use of "graviton" bosons, both then and now, does not attempt to explain or even understand Einstein's curved-space gravity, which reoccurs if the flat space in which this pseudo force resides is curved. You then end up with *two* gravity-like forces: Einstein's actual and original curved-space gravity and the quantum-by-definition Pauli-Fierz force.

(2) Use of the hyperclassical 1970s "superstring" aether hypothesis that provably violates Einstein's special relativity [3] by filling space with an 1800s aether of tiny particles that amount to extreme generalizations of the inherently string-like "orbitals" of the strong force. The "super" string hypothesis was made shortly before the development of strong and quark theories, and so never bothered to define the new force and new particles needed. The missing piece should have attempted to create new forces and new particles modeled on string-like strong force orbitals, only for aether particles 20 orders smaller and more energetic than the entirely real strong force bonds in protons and neutrons.

(3) Remarkably, the foundations of the entire AdS/CFT "holographic" projected universe date back to a single extremely speculative 1993 sentence by the highly respected Gerard 't Hooft: "One Boolean variable per Planckian [black hole] surface element should suffice." [4] Computer technology expanded rapidly in the 1990s, and physicists such as 't Hooft, who almost certainly did not fully understand such technologies, tended to make unfounded assumptions about how "simple" bits must be since they "only" have two values. Physicists in the 1990s flatly overlooked that bit storage devices are complex and *inherently* heuristic. Even the famous example of spin ½ particles as examples of simple bits ignores the need to attach particle spins to large *classical* devices before their "up" and "down" states become usable as bits — and even then, *only* approximately, since small-mass definitions of up and down are themselves quantum.

The final point is that without AdS/CFT context, the definition of "pseudorandomness" in this 2020 presentation lacks any clear distinction from more conventional definitions of randomness in classical and quantum physics. For example, given the weakness of the underlying assumptions of AdS/CFT — the above three examples are just a start — it makes no scientific sense to assume there is any discernable probability that the interior of a black hole has various properties.

[1] Adam Bouland, *Computational pseudorandomness, the wormhole growth paradox, & constraints on AdS/CFT,* YouTube, Jun 4, 2020. https://youtu.be/PmkEaPX2ON0.

[2] M. Fierz and W. E. Pauli, *On Relativistic Wave Equations for Particles of Arbitrary Spin in an Electromagnetic Field,* Proceedings of the Royal Society of London. Series A. Mathematical and Physical Sciences **173**, 211 (1939), https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.1939.0140. This summary sentence near the end of the paper describes what their quantum-by-definition spin-2 bosons, "gravitons," nominally provide. Note, however, that their "graviton" concept fell apart mathematically in the 1940s and has never been made self-consistent: "In the particular case of spin 2, rest-mass zero, the equations agree in the force-free case with Einstein's equations for gravitational waves in general relativity in first approximation."

[3] A. Albert et al., *Constraints on Lorentz Invariance Violation from HAWC Observations of Gamma Rays Above 100 TeV,* Physical Review Letters **124**, 131101 (2020), https://arxiv.org/abs/1911.08070. From the abstract: "HAWC finds evidence of 100 TeV photon emission from at least four astrophysical sources. These observations exclude, for the strongest of the limits set, the LIV energy scale to 2.2×10^{31} eV, over 1800 times the Planck energy." The Planck energy is the scale of the "super" strings of the pre-quark superstring hypothesis, which these days is often just called "string theory." The paper points out that *experimentally observed* 100 TeV gamma rays require space to be about 2000 times smoother than a superstring aether can provide. Einstein's non-aether special relativity theory thus beats superstring theory by at least three orders of magnitude regarding how well it describes experimentally observable reality.

[4] G. 't Hooft, Dimensional Reduction in Quantum Gravity, arXiv Preprint Gr-Qc/9310026 (1993), https://arxiv.org/abs/gr-qc/9310026. Page 6, middle of paragraph 2: "One Boolean variable per Planckian [black hole] surface element should suffice."