The Other Impending Singularity

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A Comment on the Parth G YouTube post:
The Simple Assumptions That Gave us ENTROPY (and the End of the Universe) (May 16, 2023)
https://youtu.be/tPt12EAKZeY

@alanziryan4625, regarding superstrings, my comments below are unlikely to help much in your primary interest in finding a good visual tutorial intro to superstring theory. Still, the history and origins of superstring theory in 1960s accelerator physics form a story that gives important context and is interesting in its own right. That story is below.

If your goal is a grasp of the basics of superstring theory, the best starting point is not the mind-bogglingly complex body of 60 years of math that we now call superstring theory but the original, well-documented, and experimentally rock-solid *string* theory of the late 1960s. (Note the absence of the "super" prefix!)

Accelerator folks in the 1960s discovered that if you "vibrated" (excited) particles like protons, neutrons, and other particles collectively known as *hadrons* (heavy particles), you ended up increasing their masses in an extraordinarily regular way. Folks got quite excited when they noticed these mass increases used a quantized version of the same equations as the vibrating strings of musical instruments. From this, many speculated that the *interiors* of protons and neutrons were "pure math" rather than xyz space and that this underlying math had the same mathematical structure as vibrating strings. This pure-math hypothesis was known, a bit cryptically, as S-matrix, for "scattering matrix." This matrix gives the probability of generating new particles when two entities collide.

A few folks introduced the *super* string hypothesis into this pure-math S-matrix environment. The idea was simple: Just as the interiors of protons and neutrons seemed to be composed of pure string vibration math, there might be a similar but deeper layer of pure math responsible for all the other non-hadron, point-like particles in the Standard Model, such as electrons and photons. These particles would then seem point-like only due to the minimal size of the new "super (small)" strings. So how much smaller than proton strings are they? About 20 orders of magnitude. For comparison, if you expanded a proton to the size of an earth, one of these superstrings would be as long as about 150 ordinary protons end to end. That's *small!*

(Ironically, the postulate that no test would ever prove or disprove the existence of superstrings proved not *quite* to be true. Just a few years ago, extreme-gamma analysis by the HAWC group proved superstrings are too large and clunky to implement the degree of spacetime smoothness required for the most extreme forms of cosmic gamma radiation. The superstring theory community, shocked by this damning body of new evidence showing their mathematics cannot represent the physical universe, immediately held a community-wide press conference admitting their error… just kidding, they ignored it. Working for that many decades without paying attention to *any* kind of experimental data becomes an entrenched habit even when directly relevant data *does* arrive.)

Getting back to superstring origins, in the 1970s, the idea that electrons and photons might also have a string-vibration-like representation similar to hadronic strings sounded very promising at the time. However, the more important driver for the superstring hypothesis was a desire to resurrect and re-implement a discredited 1930s idea by W. Pauli and M. Fierz called the *graviton.*

But why would they focus on a *disproven* idea? While the answer is not "42," it turns out that it *is* "2." That's the number of spin units added in accelerators every time they excited a hadronic state into its next higher iteration, and, coincidentally, it was also the number of spin units hypothesized for the hypothetical Pauli-Fierz gravitons. That sounds like a bad joke when stated this way, but in that period, the simple phrase "2 spin units" in both descriptions convinced many folks that gravitons *must* be real despite earlier failures. They wanted to make gravitons real, so they set the size for the new string-like vibrations at 20 orders of magnitude smaller to match Pauli-Fierz graviton scales.

If the main reason to propose a new level of *super* strings was to represent gravitons, what were these gravitons, and why did folks want (and still want) them so much?

A Pauli-Fierz graviton is a photon-like particle designed specifically by Pauli and Fierz to mimic the behavior of Einstein's gravity — not implement it, but mimic it. Is that not the sentence you expected? Please read on. I said "mimic" because the first thing Pauli and Fierz did in their papers was *require* the space on which their gravitons moved to be flat. The "duh" obvious problem is that the moment you insist on this entirely arbitrarily flattening of spacetime, you, in effect, kick Albert and General Relativity out the window and replace him with a quantum-by-definition, graviton-mediated mimic of actual gravity. Remove the arbitrary flat-space constraint to see why this is a pseudo-gravity force. When you curve the space, the true Einstein gravity returns, and the graviton version becomes a redundant gravity mimic riding on top of it.

Gravitons thus never were, and still are not, related to Einstein's actual topological gravity. Not surprisingly, the Pauli-Fierz idea quickly led to inconsistent mathematics and was mostly abandoned a few years later. This earlier well-justified abandonment of gravitons is one reason I find the intense refocus on them since the 1970s deeply baffling: Gravitons, *by design,* cannot answer the question of what Einstein's curved-space gravity is.

While I don't think this was always true, most folks interested in physics these days tend to assume the opposite: gravitons *necessarily* "merge" general relativity and quantum mechanics and, thus, are the key to unifying all of physics. Alas, they are not, which makes this a sad hope indeed. Regardless of that popularity, gravitons, by definition, neither explain Einstein's curved-space gravity nor connect to it meaningfully. But then, the superstring idea gave the old gravitons a new life, so perhaps this skewed focus on a non-existent, not-explanatory pseudo-gravity force is not totally strange. It's a necessary hitchhiker on the supergravity hypothesis.

So what are the statuses of hadronic strings and superstrings these days?

The reason you've probably never heard of hadronic string theory is simple but ironic. The strings doing the vibrating turned out to be *completely real* and composed of what we now call the strong force. Unlike the electromagnetic and gravitational forces, the strong force stretches and snaps like a bungee cord. With quarks necessarily attached at either end, these strong-force strings rotate and vibrate "just like" vastly large strings in musical instruments. In both cases, the source of the string-like math was, well… strings, just of very different sizes. There was never a shred of "pure math" inside protons and neutrons, just the universe's smallest and most energy-intense real strings.

The superstring theorists never got the memo. They continued as if *pure math* was the only thing needed for superstrings, despite the quark and strong force theories having made that hypothesis untenable. The correct path would have been to propose a *new* force, one remarkably similar to the strong force but 20 (!) orders of magnitude more powerful. They should also have proposed two or three entirely new particles to carry the charges of this new force and use it to bind themselves together. Finally, despite the enormous energies involved, they had to do this in a way that left almost no net mass. In the case of photons and several other particles, they had to leave no mass at all.

That level of more hands-on physics theorizing was too much for the almost entirely math-focused community that quickly emerged around superstrings. To my knowledge, no one in superstring theory circles even bothered to try. They kept asserting it was all pure, beautiful math and adding more. And more. And *more.*

In 60 years, these pure-math superstring ideas never generated *one* lab-testable idea, though they did generate enormous numbers of unverifiable equations. And, of course, there's the sad but overlooked point that the HAWC space-is-smoother-than-superstrings data showed the entire superstring concept to be incompatible with special relativity.

That is also one of the most surprising features of superstring fascination: It's necessarily an *aether theory* that violates special relativity. To be fair, all current variants of field theory are also frame-bound aether theories, but that's a different problem. What's surprising is how one proposes to fill *all of space* with an incredible number of tiny, insanely energetic vibrating "somethings" and *not* notice that this also creates a frame-dependent aether. That's what an aether *is:* a space filled with lots of little "somethings," such as atoms or fields, that hold energy and carry waves. Einstein's theory of special relativity, taken at face value and without qualifications, remains one of the best-proven theories in history. Folks should take it more seriously, especially when proposing theories about the deeper nature of space and time.

Also, when reading about superstrings, you may encounter confusing claims that a mathematician "invented" them decades after their well-documented origin in the 1970s. This event was a promising math-only twist that, at the time, seemed at the time to breathe new life into pure-math superstring speculations. Alas, after decades of noisy papers later, the idea only ended up making the entire area vaguer, broader, and, remarkably, *less* predictive of actual physics.

That latter point about too much noise is why I've made no effort to "explain" all of the dimensions, curves, branes, and such of superstring theory. Very good observational (HAWC) data says they don't exist, so it's best not to take non-physical and deeply noisy paper literature seriously. Beautiful noise is, after all, still just noise in sheep's clothing.

In sharp contrast, the hadronic strings were and continue to be entirely real. However, in isolation, such proton-scale strong force strings have no more to do with gravity than the pseudo-gravity particles Pauli and Fierz first proposed almost a century ago. Gravity is *topological,* even if "topological" is, itself, a statement needing deeper analysis and linkage to particle physics, quantum physics, and the underlying nature of space and time.

A final note: Folks talk about an AI "singularity" a lot these days. Permit me to observe that another singularity is approaching quickly, and it's likely to be a doozy: The abrupt collapse of a wide range of "noisy," energy-indifferent, points-are-real math models in physics. Condensed matter and energy physics should do fine, but a *lot* of math and most physics theory in its current forms won't. The Real Math Singularity is all about shedding noise-generated complexity, not loss of prediction, and it revolves around the need for a deeper understanding of how all space and time emerge from matter, as opposed to the decades-long physics point of faith that it's the other way around.