# Yarn Theory

Terry Bollinger
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**Terry Bollinger** (2022-05-01.05:15 EDT Sun):

Colleen, Tracey, I do like the sound of it: **Yarn Theory**, where everything is a Yarn, and most of the cosmos is hidden Black Yarn plus Black Yarn Energy... oh shoot, never mind, that's just string theory with dye!

[But first, a sidenote on Big Amazing Physics Announcements:]

> On verification of this latest "amazing new physics" finding: Big, highly publicized announcements like this one [in early 2022 on how a tiny variance in the W-boson mass measurements may "break" the Standard Mode], which tend to come about once a year in the spring, tend to do just what you suggested: Fire up a flurry of competition among large, nationally funded facilities that then look very carefully at whatever 0.1% difference was reported and finally conclude *"Nah... it was data noise after all..."*
>
> Federal funding of Big Science is, to say the least, a perplexing perennial process of people, press, and politics. Things get especially weird when a formerly highly productive vein of new discoveries seems fully tapped out, yet you still have all that expensive mining equipment and personnel searching for some shiny new crystal to show off to the boss and the public. In such situations, the slightest variations in gray in the dull bedrock begin looking Very Promising Indeed! to everyone involved.

[Now back to Yarn Theory:]

**Colleen** (06:20 EDT): So, practitioners of Big Science are proficient at spinning big yarns.

**Terry Bollinger** (10:02 EDT):

Colleen, seriously, that is pretty much what a huge chunk of theoretical physics has become over the last few decades: Telling big yarns that have no connection with anything in any laboratory but instead have some mythical flavor to them that makes them emotionally attractive to a broad audience:

Yarn theory.

I think most of the folks who engage in Yarn Theory are entirely sincere about it and truly think they are doing physics. They see an idea that has some godlike, mythical potential, and they genuinely think, "Wow, that is so weird and fascinating that it just has to be true!"

Then they present the idea to others and the positive reactions they get reinforce the loop. When hundreds of thousands or even millions of folks go Oooo! and Aaaah! at your idea, it gets harder to convince yourself that maybe it was wrong even after lab results contradict it.

It gets worse when universities start building research programs around your idea, students devote their entire academic careers to your idea, and folks in the federal government risk their careers funding your idea. Imagine going to all those folks a few years later and telling all the folks who bet their lives on you amazing insight that wow, so sorry, it turns out my idea was kind of a pile of crap?

Ah, the hazards of yarn theory!

There are more insidious versions of yarn theory than being flat-out wrong, however. What if you win the day so thoroughly that your idea becomes entrenched below the conscious level in the minds of every person in that field, or perhaps even in society as a whole? That kind of sublimation of the reasoning process can happen with humans, and is one of the areas where we differ profoundly from machine intelligences. When it happens, the danger is that folks can no longer perceive, let alone revisit, critical lower branches of the analysis tree that may prove fundamental to the final resolution.

Here's a specific example: The Hilbert formalist position is that the xyz and Hilbert spaces of physics and quantum physics are pre-existent, infinitely precise, and fully independent of the nasty imprecision of mundane material particles.

Stated that way, it almost sounds like a religious faith premise, doesn't it? That kind of reductionism is part of how human brains handle massive amounts of information.

Clearly, such faith assumptions are not always wrong since the physical world has plenty of predictable structure in how it works. That's why our brains have such shortcuts built into them. But it also means that in science, and even more so in math, one must be incredibly careful about what is accepted as a true statement. Axioms, even in mathematics, must be examined and often reexamined over time with excruciating care for whether they are truly self-consistent. It is not an accident that General Relativity became possible only after the geometric axioms that assumed flat Euclidean space were explicitly examined and, in time, abandoned.

In mathematical science, the Hilbert formalism school won out in debates well over a century ago, and did so with such completeness that most people have never heard the name of the other side of the debate. Derek Muller at Veritasium has a well-done video on this powerfully impactful event. The other side of that particular mathematical debate had and still has a truly awful name: the intuitionists.

Even for mathematics, that was an especially sexist era. I suspect the label of "intuitionists" contributed to their failure by making them sound wishy-washy and soft, while "formalists" sounded all precise and manly.

Using modern resource-aware computer terminology, a more descriptive name for intuitionists is "**big O realists**" or just "**realists**." That's because the fundamental

principle of the intuitionist approach, at least as I interpret it, is that the real-world, real-time, finite-resource nature of all actual calculations must, in some fashion, be respected by the axioms of mathematics.

Conversely, a better label for Hilbert formalists is "**big O mystics**" or just "**mystics**." This is because, for all practical purposes, they don't believe big O analysis has any relevance whatsoever to mathematics. For a sincere formalist, both infinitesimals and infinities are equally as real and as cheap to use as the counting numbers. Consequently, formalists believe any reference to the finite nature of physics, particularly when talking about manifolds and continuous spaces, is an anathema that undermines the power of mathematics.

That is, of course, absolutely true! That is, if you pay no attention to the big O measure of your formal structures, you also implicitly and unavoidably create an assumed godlike computer capable of instantaneously completing any task of any size anywhere in spacetime.

For example, the computational cost of infinite differentiability -- and there absolutely is one -- becomes irrelevant to mathematics and, by implication, to any physics that relies on the lovely smoothness of infinite differentiability. That's extraordinarily relevant to quantum mechanics since both distribution functions in general, and the Dirac delta function in particular, rely upon exactly this big O mysticism trick when they splice one-over-infinity function points to a flat plane to create bump functions.

The entrenchment of formalism before and during the emergence of quantum theory was simultaneously enabling and devastating. Big O mysticism took the persistent early 1900s experimental observations that the universe loses detail below certain spatial scales not as evidence that mysticism might be wrong but as a challenge of how to make such blurriness infinitely precise anyway. Much superposition summing of infinities of infinitely precise states in infinitely small portions ensued, with profound consequences to this day.

The point is that if the world we can access experimentally never works in quite that way. Thus the infinitely smooth, infinitely differentiable path of big O mysticism, like the assumption of Cartesian flatness before it, is a hypothesis that must be tested experimentally and not simply assumed as a basis of faith.

The unforgiving nature of quantum uncertainty argues powerfully against this, despite the construction of many clever and truly delightful constructs, e.g., renormalization, to address the proliferation of infinities.

Many-world multiverses, string theory, and even Sabine's past casual use of Planck foam (sorry, Sabine) all stem from the deep assumption that it is perfectly fine to impose absolute spatial precision on top of any calculation.

Other more subtle impacts, often partially corrected by layering other mathematical techniques on top of them, creep in through the Dirac delta function. While distribution theory does do a much more rigorous job of defining the Dirac delta, its common description as the product of an infinite magnitude by an infinitesimal width almost perfectly captures the essence of the big O mysticism view of spacetime.

Lately, I've been calling the Dirac delta the tetraethyl lead of quantum physics. Like tetraethyl, it's incredibly powerful and useful for its intended purpose. However, it's also profoundly infinity-toxic to everything it touches, especially at the finer levels of detail.

Incidentally, if you've ever heard distribution theory "proves" the Dirac delta is mathematically consistent, no, it does not. That is because the distribution theory itself is deeply flawed by its habit of splicing one-over-infinity function points together to create mystical (meaning big O indifferent) smoothness at that point. Our human eyes don't have the resolution to notice this when looking at the resulting graph, so we instead say "eh, whatever" and give it a pass.

So yeah, yarn theory is not just a hypothetical. For large chunks of physics, it's kind of the world is right now: Too many yarns, way too few episodes of serious self-examination.

A house of yarn.