

Chain Fountains and the Nature of Centrifugal Forces

Terry Bollinger

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(I love puppies. Don't you love puppies? And kittens, too!)

A Comment on the [ElectroBOOM](#) (Mehdi Sadaghdar) YouTube post:

Chain Fountain Dispute (Jul 22, 2021)

<https://youtu.be/hx2LEqTQT4E>

2023-05-02 Centrifugal Force Update: In a 2021-08-15 comment on *Chain Fountain Dispute* I said: "Regarding one amusing way to understand why the chain fountain manages to defy gravity, here's the title of a paper I'm writing for my tarxiv.org/tao website: 'On Mould's Accidental Implementation of the Goddard Antigravity Engine.' Yes, Virginia, centrifugal forces *are* real in practice, no matter how much the Royal Academy may fume about 'silly' engineers using this mathematically very-well-defined pseudo force as a handy way to summarize the effects of linear momentum in systems under tension."

I never finished that paper, but the reason why is interesting: Attempting to assess all of the issues involved morphed into a much faster-paced and far more interactive self-publication effort, Apabistia Notes [\[1\]](#), that over the past few months has led me to a nicely productive but delightfully upside-down view of physics and, especially, real maths. It is a view in which space, time, length, and duration become emergent properties that apply fully only at unreachable, infinitely energetic limits.

(Incidentally, you can blame emergent lengths and durations in no small part on Derek Muller's video on why the speed of light can only be measured in loops [\[2\]](#). It's worse than that since it's not just the speed of light c that stays fixed only in loops, but the concept of stable, fully isotropic length and duration units. These, too, cannot exist without completed loops. Ironically, these loop needs come directly from special relativity, which is why Einstein was so excruciatingly careful to define the speed of light using only loops. The negotiation achieved by loop completion allows otherwise unscaled lengths and units to take on the solidarity we think of as space, time, matter, and history.)

The importance of the centrifugal pseudo force is that it sits at the center of this upside-down negotiation process of length and time. Without multiple scales of bound rotation, the universe flies off into unscaled and unscalable quantum chaos at every level of existence.

Here's a much more concrete example of what I mean by upside down: If the universe contained nothing but two flywheels linked by a drive shaft, would the wheels experience exhibit outward tension, that is, the centrifugal pseudo force, when the drive is activated?

Mach's Principle says no. This concept, much beloved by Einstein, says that the reason a spinning wheel feels this force while the universe does not is a matter of relative scale. Mach linked the *entire* outside universe as if it was a single unit whose mass is so much larger than that of the wheel that the universe always "wins" in their mutual effort to produce an outward force. The wheel *does* induce a similar force in the surrounding

universe, but one vanishingly small in comparison. In Mach's view — and Einstein's, for much of his career — the centrifugal pseudo force cannot exist without the weight of an entire vast universe residing all around it, some of it at unimaginable distances.

More than any other idea, it was this Mach-inspired idea that spacetime binds the entire universe together into an essentially rigid structure, one capable of affecting local spins *immediately*, that persuaded Einstein to return to a much more aether-like stance in his General Theory of relativity [3], that is, to believing Minkowski's spacetime is a substance. Both then and now, folks familiar with Einstein's reversal are uncomfortable discussing it.

Nonetheless, and somewhat surprisingly, Einstein's aether reversal has had an incredible impact on physics theory since then. In particular, it undermines at all scales the utter and complete blankness of space in special relativity. In its place, spacetime became a fabric again — a malleable substance with an existence independent of matter. Spacetime became *fundamental* in a way that appealed powerfully to mathematical frameworks of the 1700s and 1800s. These largely differential frameworks analyzed higher dimensional space and shapes with exquisite and often infinite levels of precision and detail. In his later years, Einstein proposed that particles are nothing more than clever knots of this malleable spacetime fabric. He and Rosen invented the Einstein-Rosen bridges not to provide travel Marvel heroes a shortcut across lightyears of distance but to construct ghostly *neutrinos*, the simplest and most ghostly type of matter particles. Taking the older Einstein to a modern movie that invokes modern Einstein-Rosen bridges might put him at risk of a heart attack, either outright or from laughing too hard.

In contrast to Mach's Principle, allow me to suggest the much smaller-scale Terry's Principle: There *is* no spacetime fabric. The only requirement for a spinning wheel to feel outward forces is *another* wheel with exactly canceling angular momentum.

Far from being some exotic effect dependent on distant stars, the outward force felt by both wheels is a rather mundane form of *energy excitation*. It is possible only because *the two wheels are quantum entangled*, with each spinning wheel "knowing" the existence of the other wheel. From that (initially) local-only quantum mechanical relationship, and in combination with binding forces (centripetal forces), both wheels create the nearly continual quantum-collapse tension we think of as the centrifugal force.

And that is why, in the previous sentence, I stopped calling centrifugal a pseudo force.

A tension induced by massive levels of quantum entanglement and collapse between two vast lumps of ordinary matter seems, to me at least, deserving of a bit more respect than calling it a "pseudo force."

Folks like to think of quantum entanglement as some astronomically delicate thing that only arises in the most delicate and minute situations. That delicacy does exist, but only at the quantized fringes of the astronomically more massive forms of entanglement that, in its milder forms, we call "classical" mechanics.

Another corollary of pairs of linear and angular momenta being quantum entanglements on massive scales is that we don't need to quantize gravity. That's because we *already* quantize gravity every time we set a delicate fringe entanglement between two large

lumps of classical matter, such as the two detectors receiving spins from correlated photons. There's no need for illusory Planck "spacetime" foam in this, thus no need for astronomical energy levels. It is instead the mundane, "ordinary" entanglements of linear and angular momentum pairs — primarily linear — that *are* the quantizations of the gravitational force between the objects. To prove the existence of quantum gravity, we must devise a few incredibly sensitive experiments designed to "see" such minute but quantized changes in the gravity pulls between two human-scale objects.

Getting back to the chain fountain that helped kick off my Apabistia Notes, what, if anything, does all of this say about chain fountains?

First, let's dispose of the idea that the beaker side "launches" anything. There's *no* energy source there, so can we please stop acting as if there is? I don't mind unraveling the very fabric of meters and seconds, but *energy* remains incredibly sacred. Lose that, and you lose *everything*.

What's going on is the creation of an asymmetric centrifugal loop with a standing wave at the top of the loop, the mass of the earth at the other end, and primarily linear sides undergoing almost no centrifugal forces. The centrifugal force — a classical effect with quantum underpinnings — wants to move outward at *all* points in the loop. Geometry moderates the forces on the sides, leaving only the standing wave at the top and the earth at the bottom to participate in the creation of the centrifugal force excitation. The top of the chain *pushes against the entire earth* as the chain's rotation creates paired outward pushes along its entire length. Just as the outward forces on those two spinning wheels connected by only a drive shaft are entirely real for each wheel, *even after disconnecting the wheels from each other*, the unbalanced centrifugal force of the chain fountain stays real even as the chain itself constantly renews itself.

The proper test is to rapidly rotate an incrementally lengthened chain loop inside a long tube that is open at both ends. Both ends, not surprisingly, should leave the tube. If you block one end, the other end should leave the tube about twice as fast.

[1] T. Bollinger, *Apabistia Notes* (2022-04-16 to Present). <https://sarxiv.org/apa>

[2] T. Bollinger, *On the Importance of Derek Muller's Asymmetric Light Speeds*, Apabistia Notes 2023-08-29.0030 (2022). <https://sarxiv.org/apa.2022-08-29.0030.pdf>

[3] A. Einstein, *Ether and Relativity Theory*, Leiden University 1920 Inaugural Lecture (1920). <https://www.spaceandmotion.com/Physics-Albert-Einstein-Leiden-1920.htm>