Particles as Wave-Collapse Equilibrium Points

Terry Bollinger
2022-09-10.21:20 EDT Sat [Updated 2022-09-11.17.40 EDT Sun]
https://www.youtube.com/watch?v=QHa1vbwVaNU&lc=Ugx2YiNF9fjRyRPcFaF4AaABAg

A Comment on the Sabine Hossenfelder post:
The Multiverse: Science, Religion, or Pseudoscience?
https://youtu.be/QHa1vbwVaNU

Sabina, thank you for a superb presentation. Two quick (no kidding!) observations on math and measurement:

12:12 **MATH** *"The big problem with multiverse ideas is that physicists mistake mathematics for reality."* The most pernicious math danger is that classical continuum math assumes that infinite information densities cost nothing in the physical world. For nearly a century, computer and communication creators have run well-funded and ferociously results-oriented experiments pushing the limits of information physics. The results tell us that bits are not simple abstractions but machines for storing a particularly rigid form of information and that the physical world never supports infinite bit densities.

14:22 **MEASUREMENT** *"But if you don't update the wave function upon measurement, then that just doesn't describe what we observe."* Shocker: all forms of acceleration, even incredibly minute accelerations, cause wave collapse and thus update the wave function. As Feynman noted in his lecture on the two-slit electron self-interference experiment [1], the degree of this collapse is mathematically well-quantified since it cannot exceed the wavelength of the momentum unit causing acceleration.

Let's think this one through. If in laboratory experiments acceleration always causes wave collapse up to, but never exceeding, the spatial wavelength of the total momentum transferred by the acceleration event, then wave collapse cannot be a rare event. For example, if two atoms bond chemically, they also collapse each other's xyz location waves every time they accelerate each other's positions (think orbits). That's good since their wave locations in xyz space would otherwise expand until the probability of staying bonded vanishes.

The Wave-Collapse Equilibrium (WCE) Model of Particles

Wave collapse via mutual acceleration thus is literally how the atoms *stay* bonded and avoid drifting off into separate quantum realms. Exchanges of momentum at spatial frequencies comparable to their sizes enable them to stay bonded and possess sufficient structure to support chemistry. For less tightly bound conduction electrons that fail to receive atomic-scale momentum packets regularly, the idea of drifting off due to the expansion of their wave functions is not an abstraction. It is how they conduct current. It is also how you are reading this text since the photons passing through the lenses of your eyes exchange just enough momentum to "see" the human-scale shape of those lenses but not enough momentum to localize and scatter their wave functions. We call the latter case of scattering-level momentum exchanges a white surface.

Unless you are modeling specific quantum phenomena in condensed matter physics, it's easy to overlook these incredibly rapid, fine-grained, no-conscious-observers-needed wave collapse processes. We tend to do that because these processes allow compact wave functions to hold their shapes at modest energies and thus look and behave like particles. Once you begin thinking of a wave function that maintains its shape as a particle, it's hard to return to the wave view. The particle approximation is one of physics' most significant gifts to biology since it enables a straightforward and computationally efficient way to estimate what happens next in a world where such predictions make survival possible.

However, ignoring this wave-collapse equilibrium (WCE) perspective is unwise when attempting to build comprehensive models of reality. Continual mutual measurement via same-space-scale momentum exchanges is the fabric of classical reality and the source of our approximation of quantum waves as particles. Atoms reside at a size and temperature sweet spot where their masses generate a mix of similar-scale momentum frequencies. Exchanges of these momenta, in turn, keep them well-localized relative to each other. Another wave collapse equilibrium sweet spot exists at the much higher energies and far smaller sizes of atomic nuclei, and yet another for the binding of quarks inside protons, neutrons, and other particles. The disparity of the energy scales isolates these sweet spots from each and lets different levels of quantum behavior exist simultaneously in one system, with the Mössbauer effect as one example. The increasing disparity between spatial momentum frequencies and object sizes in chemistry is also why the quantum world begins to fade as molecules grow more massive and more classical in behavior.

Multiverse Implications of WCE

The concept of wave-collapse equilibria sheds light on a deeper problem with multiverse concepts: They assume uncollapsed universal wave functions as self-evident mathematical generalizations of the quantum wave functions seen in laboratories. They are not. Due to their classical continuum mathematics heritage, universal wave ideas subtly but invariably invoke assumptions that, at least for wave functions, information that storage is free and has no real-world implications. Once one assumes that such infinitely smooth universe-spanning wave functions *necessarily* underly physical reality, the resulting density of states makes the theoretical emergence of one or more variants of multiverses almost inevitable. The situation is akin to the operator of a small-town radio station discovering that, for reasons unknown, her low-energy signal has suddenly acquired the ability to broadcast the entire world's collective data signal. In physics, the vacuum density problem is the most explicit example of the dangers of such subtle mathematical assumptions.

Even Schrödinger, while attempting with his cat to show the inherent flaws of infinitely elaborated smooth wave functions, inadvertently invoked this class of wave functions by assuming that the particle's emission must remain quantum. However, particle emission is an acceleration event that becomes irreversible once it leaves the high-energy sweet-spot environment of the nuclear matter. The correct answer to Schrödinger's thought problem is that the wave function collapses when the particle leaves the nucleus.

Apart from the information density problem, the ubiquitous nature of wave collapse in WCE means creating large-volume, high-mass, high-complexity complex wave functions is virtually impossible. If wave collapses are nothing more than minute accelerations via momentum — and experimentally, such exchanges *always* result in wave collapses —

then at no point in the history of the universe, including at its origin, did a sufficiently low-frequency momentum exchange environment exist for such a universal wave function to emerge or have meaning.

Far from being fundamental at the astronomy level, experimental evidence suggests wave functions are among the most fragile imaginable of large constructs. Only by removing wave functions from all momentum transfers for vast periods can they expand their scope, which, like all waves, is limited by the speed of light. Thus while intergalactic photon wavefunctions can occupy volumes up to a fraction of the entire universe, they do so only at a terrible price in terms of spacetime isolation.

But What About Standard Model Particles?

The wave-collapse equilibria model matches the dynamics of quantum-scale “bola systems” in which a force bonds and mutually accelerates two or more massive entities. These include nucleons of bound quarks, atomic nuclei of bound nucleons, atoms nuclei bound to electrons, and molecules of bound atoms. However, it seems irrelevant to Standard Model entities such as the electrons and quarks that lack discernable internal structure and thus any opportunities for mutual accelerations.

One possibility beyond this note’s scope is that subtler forms of wave collapse stay hidden in our classically comfortable xyzt mapping of the deeper, more rigorously relativistic Poincaré spacetime of special relativity. Mass, time, and quantum frequency would play roles, as would the notably xyz-incompatible half-spin characteristic of all fermions.

Force Strength and the Edges of Physics

For classical reality, the strength of the most potent binding force determines the level of details that can persist over time. Since the winner in this category is the strong force, quark-gluon plasmas may already be pushing the limits of detail. Lacking any sufficiently potent force, neither superstrings nor no Planck foam would have meaning in such a universe. The vigorous exploration of the strong forces of the CERN Large Hadron Collider (LHC) thus may already be exploring the limits of self-collapsing structures capable of persisting in time. Whatever they find thus may have relevance even for structures as extreme as black holes.

(And yes… I did say something about “brief,” didn’t I? Oops!)

-----
[1] Feynman Lectures I 37-6 - Watching the electrons
https://www.feynmanlectures.caltech.edu/I_37.html#Ch37-S6-p11

Terry Bollinger
2022-09-10.21.20 EDT Sat [Updated 2022-09-11.17.40 EDT Sun]
PDF: https://sarxiv.org/apa.2022-09-10.2120.pdf
All Notes: https://sarxiv.org/apa