

Everett's Many Worlds Are Nothing Like Radio Channels

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<https://youtu.be/kknkNpYt3Rs&lc=UgyC0nFK-UBT2gnIUTZ4AaABAq>

A Comment on the [Closer To Truth](#) YouTube post:

Michio Kaku on Quantum Supremacy | Closer To Truth Chats (May 5, 2023)

<https://youtu.be/kknkNpYt3Rs?t=28m23s>

28:23 Kaku "... in a room ... there are radio waves [from] all over the world ... but your radio is only tuned to one frequency... Now replace these radio waves with electron waves... of dinosaurs, pirates, atoms of all sorts of things... Why can't you touch them? ... Because, just like in radio, ... your electrons do not vibrate in unison with them."

Imaginary Worlds Are Fun! (But Also Crispy)

Michio Kaku, using pirates and dinosaurs makes this one of the more entertaining many-worlds explanations I've seen. It reminded me of my early teen years when I entertained friends with stories of how different dimensionalities — e.g., Flatland, though I didn't know that name then — might intersect invisibly with our own 3D space, allowing all sorts of marvelous things to exist next to us without us seeing or touching them.

Given the Fourier relations of quantum mechanics, I readily understand the temptation, even to Nobel Laureates, of explaining astronomically subtle distinctions between adjacent Everett composite system states by replacing them with a blindingly obvious and utterly non-physical radio-carrier-wave model. It's non-physical, not just because Everett never proposed such an idea, but because even for the low energies of ordinary FM radio broadcasts, the density of carrier waves needed to represent even a "small" multiverse in such a room would instantly vaporize its residents. It would be akin to labeling ants by applying a distinctive mountain to each of their backs.

Everett's Ultra-Expansive Vision of Wave Collapse

So what mechanism *did* Everett propose to separate his universe states?

Contrary to the widespread belief that Everett "eliminated" wave collapse by focusing only on the smooth evolution of the Schrödinger wave function of the universe, his thesis did the opposite: It focused almost entirely on the *importance* of observation — nominally human observation — in the creation of new, unique ("orthonormal"; think electron spin-up and spin-down) states of the *entire* universe.

Importantly, Everett's vision of how quantum observation works is far *more* impactful, not less, than the localized wave collapses of the Copenhagen interpretation. If he had not broadened the impact of every observation from local to the entirety of the universe, he would have had no way to untangle his smoothly developing Schrödinger wave into separate universes that retained most of the details and structure of the original universe. Without these highly structured internal states, his smoothly developing Schrödinger wave quickly turns into slushy, structureless noise, for the same reason that well-structured sounds eventually degenerate into structureless heat.

A Multi-Solipsist Universe

The reason Everett went to all this trouble is interesting: His goal was to create what amounted to a multi-participant version of solipsism. That's the philosophy that the person reading this text is the only sentience in the universe, and the rest of us — including me, the author — are, at best, simulations. Everett emphatically was *not* a solipsist. However, he was of the widespread Wheeler-inspired school of thought that only a *conscious* observer could cause wave collapse. Everett also wanted observers as the ultimate causes of wave collapse, but he wanted *many* such observers can exist at once. His way of doing this was to *assume* — incorrectly, as it turns out (read on) — that every observation can “instantly” create an entirely orthogonal universe state.

It is only the *sum* of Everett's infinitely many infinitely detailed states that gives the smoothly evolving Schrödinger wave function so often called out as why his approach is his version of observer wave transformation is superior to the localized Copenhagen version of observation restructuring. Ironically, the resulting smooth Schrödinger wave function of the universe is not particularly useful since it quickly develops into a slushy mess of thermal-like wave noise. It is *only* Everett's belief in entirely orthogonal, exquisitely structured, per-observer composite states of the universe that allows the reinterpretation of this noise as an interwoven sum of independent universe states.

The Finite-Energy Wave Problem

There's another problem with noisy waves: All Schrödinger waves in labs have *finite*, energy-dependent levels of detail. That means that to encode sufficient detailed noise into the wave function to hold indefinitely many unique universe states *simultaneously*, one must propose that a universe-sized Schrödinger wave function is infinitely energetic. That, too, is a problem since such a universe immediately collapses by gravity.

The Ultimate Leveraged Buyout

With that background, Everett postulated that every observer-observation pair creates a tiny local difference in the universe's wave function. When this local difference attaches to the wave function of the *entire* universe, it creates a *fully isolated* version (state) of the entire universe's wave function. (We'll return to that “fully isolated” point later.)

The temptation for invoking a radio analogy arises because this *local* observer-observed pair alters the state of the entire universe via a Fourier transform — that is, by altering the details of the wave function that represents the entire universe. Radio signals come through separately because their carrier waves differ enough to ensure that your radio “vibrates” only at the desired frequency. If the frequencies are too similar, you hear two stations simultaneously.

When folks say that different Everett universe-states exist at different “frequencies,” *that* is the difference they are invoking: The unbelievably tiny frequency difference created by re-encoding the entire universe based on one particle change at one local observer location. This new state then slices off some astronomically minute slice of the *entire*

energy of the universe. The new state is extraordinarily similar to other states, and the sum of all such states becomes the Everett multiverse.

Can you see how there might be, in radio terms, a problem with stations interfering?

It's time to look at that issue more closely. Ditching the arbitrarily imposed and enormously higher-energy carrier-wave nonsense, let's look more carefully at what "extraordinarily similar" means in Everett's *actual* strategy for creating multiverses.

Magic Ten-Lightyear Mushrooms

Imagine an electron wave function one meter across — difficult, but not impossible. Someone at the edge of the wave function observes it and then finds the electron either close by or a meter away. That's an example of the situation that, in Everett's view, creates a new state of the *entire* universe.

Next, picture the state of the universe as one of those Pinscreen pads that captures the shape of whatever presses against it. Observing the electron results in a single meter-wide pin clicking into either an up or down position. That pin, and that pin *only*, is the difference that keeps the two Pinscreens "unique" in quantum superposition space.

To give you some feel for the size of this universal state Pinscreen compared to a one-meter-wide up-or-down observation pin, shrinking the universe-spanning Pinscreen from one meter per pin to one *atom* per pin gives a Pinscreen about 10 lightyears across.

Since the massive-overkill FM wave analogy has nothing to do with Everett's thesis proposal, what is the *actual* distinction he used to distinguish between two possible outcomes of an observation?

It's that *one* pin: a single atomic column in two sheets 10 lightyears across. Everything else is *identical* on both Pinscreens. But at that one point, there's a mismatch that keeps the sheets pushed apart from each other. It's akin to having a pair of mushroom caps, both 10 lightyears across, that stay separated *only* because of a single atomically thin stem pushing them apart. That's a far more accurate image of how delicately and subtly the states are isolated. The sheets must also be rigid in a way not comprehensible to material physics. And finally, the two sheets must *instantly* separate if they are to become entirely separate states — you can't have annoying speed-of-light delays.

Slow to Build, Quick to Collapse

You might think, well, at least the "instant" part is OK. These are *quantum* wave functions, and photon wave functions millions of light years across collapse instantly when telescopes look at distant galaxies. So, "instant" is not a problem. Right?

Ah... no. Ask anyone in quantum security how long it takes for entangled states to spread far enough from each other to become usable for security. The answer, part of commercial hardware, is easy: The speed of light. Break that assumption, and you get no entanglement and no encryption.

That *has* to be the case. Otherwise, you could use entanglement to transmit data faster than light speed. It's widespread, though I genuinely don't understand why, for folks to *assume* that the formation of an entangled wave function is just as "instantaneous" as collapse. However, the two phenomena are entirely different. The event that *spreads* the entanglement is the Schrödinger wave equation, which, in its 3D embedding, spreads no faster than the speed of light. It is only the event that *collapses* the wave once it forms that appears "instantaneous" to observers.

What this means for Everett's idea is not complicated: According to physics *as observed in labs*, you must wait half of 93 billion years for the impact of observation to reach all edges of the observable universe before you get a new, entirely orthogonal universe state. That's give-or-take an eternity since that universe keeps expanding as this goes on.

Uniqueness Gets Harder for Waves

Ironically, translating all of this into the wave domain makes the situation *worse*, not better. That's because, in the wave domain, the infinite or almost-infinite *repetition* of slightly different waveforms keeps them unique or orthonormal. The number of wave repetitions needed to keep two waveforms isolated grows as the shapes of the waveforms grow more similar. To keep the waveforms of 93 billion lightyear mushrooms with one-meter stems fully independent, you'll need to repeat that enormous waveform so many times that you might just as well call the number infinity.

Waiting just half of 93 billion years thus is not nearly enough since that only creates *one* iteration of the waveform of the newly created universe state. To keep it entirely separated from the rest of the universe, you must repeat that process an essentially infinite number of additional iterations to spread the new waveform far enough in wave space to keep it distinct from the rest of the universe.

The bottom line is simple: Everett's idea is not a plausible way to create multiverses.

Classical Maths Are the Deeper Issue

A critical closing note: The math behind the Everett approach is *classical* math. That is, it is math based on the assumption that perfect points, lengths, angles, and orthogonality of even infinite numbers of dimensions are all *fundamental* concepts that need no further explanation. Special relativity and quantum mechanics have not supported such thinking for over a century. However, because these maths arose in the 1700s and 1800s and are emotionally appealing to human analytical styles, they got grandfathered in and applied as if they were *more* fundamental than the classical physics that inspired them.

The observable universe doesn't use classical maths. However, one of the essential features of the deeper maths is their robust support for the *emergence* of the classical approximation, that is, of locally "real" xyz spaces. These enable information persistence and, through that remarkable continuity, history, and life. The robustness of this support for classical maths makes them useful for a broad range of physics problems, especially human-scale problems. Classical maths can even be bent and stretched (renormalization, anyone?) enough to support calculations in the special relativity and quantum mechanics domains, though often at the cost of high energies to extend the local xyz model's range.

The Siren's Song of Classical Math

The deftness with which the deeper unit-creating maths enable classical approximation is also the source of the overwhelmingly powerful temptation to *assume* that the local-only xyzt approximation of a single frame observer is "just as true" when taken to a wide range of infinite limits. For comparison, a well-designed computer simulation of physics can *look* as though it extends to infinity, but this is always a finite-resource emulation that loses accuracy if pushed too hard. While the physical universe uses a radically different style of computation in which concepts such as isotropic length and angles are costly and require significant complexity, the message is similar: For both computer simulations and deep physics, what we perceive as unlimited options and resources, such xyz space itself, is never anything more than a clever simulation that creates the *illusions* of boundless expanses.

However, when examined in detail, both computer simulations and the deeper physics of the universe always have subtle limits due to the shared constraints of finite energy, speed, and information capacities. Such open-ended concepts as boundless space and infinite numbers of dimensions thus are the very types of concepts we should be the *most* cautious about generalizing into "obviously" correct axiom sets. Hilbert spaces and Block spheres are both physics maths that, while effective, fail dramatically on this simple point of caution.

The siren to which Everett fell victim is that just because the classical-first maths used to express quantum mechanics *look* as if they could support infinite resolution between similar indefinitely large composite systems states, that does *not* mean the pre-classical universe contains anything remotely similar to such concepts. We need better maths.