

Observations around Quantum Mechanics 8_1_2024

Big Bang and the actual state of the universe; not information; entropic time is wrong; not discrete computation; 1-d topologies; QBism reconsidered; not Boltzmann brains; A-theories; the Big Bang and A-theories; not Boltzmann brains again.

The Big Bang and the current state of the universe; the entropic explanation of time is wrong; argument for A-theories; QBism reconsidered; everything is not information; everything is not discreet computation; observation about 1-d topologies; no Boltzmann brains; longer discussion about the Big Bang and the actual state of the universe; longer discussion about Boltzmann brains

1. There are two ways to approach the Big Bang and the current state of the universe.

1. Given state X at the Big Bang, and given the laws of physics, what is the probability that the universe would have evolved into its current state Y? What is the probability distribution for the various states the universe could have evolved into?

2. Give the current state of the actual universe Y', and given the laws of physics, what is the probability that the state of the universe at the Big Bang was X'? What is the probability distribution of the various states the universe could have started out in?

3. One can ask if you go back and forth are there any accumulation states? But while going back and forth is mathematically definable and interesting it doesn't seem to correspond to anything physical.

4. The same questions can be done with the Big Bang vs. the Standard Model (and its free parameters), and vice versa, and the current state of the actual universe vs. the Standard Model, and vice versa. But this is speculative and does not *necessarily* correspond to what's going on.

5. (1) and (2) above straighten out all this talk about fine-tuning, a multiverse, the inverse gambler's fallacy, and other stuff. Even Hawking was confused by this.

6. In addition, it is often argued that if the constants of nature were .1 off (for example), life (*as we anthropomorphically know it*) would be impossible. First, if the constants were only .01 off there would be 10 universes consistent with life as we know it. And if the constants were only .001 off there would be 100 universes consistent with life as we know it. And if the constants were only .0001 off there would be 1000 universes consistent with life as we know it. Etc... Second, there are probably many (probably an infinite number) of ways to instantiate a (physical) substrate that has (mental) conscious experience like ours. Third, this doesn't even get into the various possibilities given the extensive discussions about Dualism vs. Panpsychism, etc.

7. (1), (2), and (3) use a B-theory of time. What is the case if you use an A-theory of time? See **Section 9** below.

2. Everything is not Information

Information is a pleasing generalization of physics. But to get an electron, we would have to precisely describe everything about it—superpositions, 'locations', 'spin', etc. So the information hypothesis doesn't get us anywhere, since we have to specify everything anyway. Except possibly the proposal that *at bottom* everything is information. But this information has to be embodied. So again it's not at all

clear that the proposal actually gets us anywhere. If it is supposed not embodied because it is information then embodiment becomes relative to the information, so the objection that it doesn't get us anywhere goes through.

3. The entropic explanation of time is wrong. For starters, we could assume that we have a cubic meter of a gas in some state. Now, there is an entropic gradient. But, starting from that state, the macroscopic state is constructed from possible microscopic states. And the actual microscopic state (whichever one it may be) evolves into the future into one microscopic state according to Newtonian (or quantum) time-reversible laws. But, by the same token, the actual microscopic state is also a result of the actual single previous time-reversible microscopic state. And it is very clear that the actual microscopic state leads to one state in the immediate future, and ALSO that there was one microscopic state in the immediate past that led to it. Thus, there are an equivalent number of microscopic states into the future as into the past. Coarse-graining does not affect these numbers in any way. The entropy is a statistical artifact of the mathematical (indeed epistemic) technique of course-gaining, which is a mathematical not a physical operation. Thus the very clear conclusion is that entropy does not give time or an arrow of time: there are just as many states into the past as there are into the future, so there is no reason to 'go into' or 'choose' one versus the other as more probable. Again, the course-graining is not a *physical* operation, so does not affect the physics of which direction time goes in, which would be ambivalent.

One of the other problems with the entropic explanation for time and its arrow is that life (e.g. humans thinking, making decisions, and adding memories) would seem to involve a *decrease* in entropy. But, if that is the case, then humans should be going *backward* in time. Other parts of the universe would be going forward in time. Even if we took objectively going 'backward' as our 'forward' we couldn't explain e.g. adding memories. And other parts of the universe would appear to go backward in time relative to us, which they do not.

4. Everything is not Discrete Computation (and The Ruliad)

As of this writing the Ruliad is the latest incarnation of the proposal that everything is a discreet computation. This was proposed a while ago, is naive, and is wrong. If anything, it is most likely that updating quantum states is *neither* discrete nor continuous in the traditional senses.

Additionally, several proposals that quantum mechanics could be based on the computer game of Life have been proposed (t' Hooft, Wolfram, others). (This might be equivalent to the proposal above.) One problem is they can't get Bell inequality violations. But 1. one could propose a different or generalization of Life where there are non-local influences to begin with, i.e. the update rule for a square involves the state of squares 2, 3, 4 ... squares away. But this is already non-local itself so it doesn't solve the non-locality problem. 2. One could try updating the state of a square using the state of squares a given number of steps behind (or perhaps yet to come). This might be retrocausality, which was critiqued in another paper in this series.

Further, letting the size of the squares go to 0, one wants to have probability distributions. But then it isn't really the game of Life. Ultimately, it would seem to turn into the Wigner probability distribution, which we know would have to have 'negative probabilities', so is not a viable interpretation.

5. Observation about 1 dimensional Topologies

1-dimensional topologies are relevant to interpretations of quantum mechanics. The crucial mathematical property of 1-d topologies is compactness (every cover has a finite subcover). But why? Because this math is an abstraction (or generalization) of how we (anthropomorphically) see/apprehend things. And our eyes have a finite resolution, so we always perceive a finite cover. (And both include the fact that we can look in different ways (change the subcover) of a supposed line/curve.) Time is different.

6. QBism reconsidered.

1. QBism is anti-realist. The universe is real. So the value in an anti-realist interpretation of quantum mechanics is that it might be a stepping stone to a realist interpretation.

2. At first it seems QBism faces insurmountable problems, because the idea is agents update their beliefs according to Bayesianism. But a 4 year old doesn't stop living in a quantum universe just because they don't compute Bayesian probabilities.

3. However, there might be something more subtle to it. If an agent updates their beliefs in a Bayesian way then, it is assumed (not derived), in some way we could get what looks like the Born rule. However, from several directions there is reason to suspect that the universe is *at bottom* a sea of consciousness. This comes from some philosophical directions (like panpsychism) as well as some intrasubjectively verified experienced spiritual directions, such as the case of the empirical information acquired in appropriate meditation.

So if this is true, then the whole universe, or at least parts of it relative to each other, might be updating its subjective states or experiences in a Bayesian way, which might look to us like the Born rule. I don't know—this would require a lot of fleshing out. One problem with this is that the Born rule has complex numbers and Bayesianism doesn't. Also it seems the Born rule could be derived using various sets of certain assumptions, at least one set of which might encompass or supersede Bayesian updating to begin with (given its other assumptions). QBism is an avenue to be explored supposing that the universe is at bottom a sea (both unfragmented and fragmented) of consciousness. That is also an argument for exploring A-theories of time.

7. Boltzmann Brains

Boltzmann Brains are vanishingly unlikely. It is an interesting Gedankenexperiment. But it is 'radical skepticism', like the Gedankenexperiment that we are each a brain-in-a-vat. So it is of limited interest. There is a longer discussion of Boltzmann brains in **section 10**.

8. Argument for A-theories

This is an argument against an argument against A-theories. There is a mistake in regarding the A-series, as relative to a person (or, in the PF interpretation, a quantum system), and therefore 'not interesting' because a person is already embedded along a B-series, so the ontological privilege of 'now' of the A-series is illusory, since each point along the B-series has one.

The problem is one is only thinking in all this. If one (perhaps meditates and) detaches one's awareness from all of the thoughts above, one can then also observe (by the awareness) one's actual experience of time, without getting confused as to what's what. You can then do an experiment: what is your actual

experience? When one does this one can see that the thoughts above give you a B-series, and your actual experience gives you an A-series (that is self-evidently not a function of the B-series).

This is ‘non-trivial’ because, when one’s expands one’s capacity to take in experimental information in this way, the A-series is seen to be empirical, actual, and experimentally relevant. It is the opposite of merely definitional. So it is within the purview of science. One can retain the B-series, but there is an A-series too. This is an experimental result and so is a part of science. It is an experimental result like the mass of the Higgs particle measured at CERN, or of the pattern of observations in a double slit experiment.

To do the experiment one must be able to enter the relevant psychological states. This is often hard to learn to do. But it is the same way with, say, solving the Schrodinger equation—it is often hard to learn to do. So this is not new. As quantum mechanics requires mathematical technology, the time experiment requires introspective technology. The experimental outcome is intra-subjectively verifiable (and falsifiable). See reference [1]. It is thus a part of science. One can be led astray in introspection, but one can be led astray in solving the Schrodinger equation, too. See reference [1].

[1] Calculus of Qualia 2: Intersubjective and Intrasubjective Verification; Experimental Predictions; Expanding Science <https://philpapers.org/rec/MERCOQ-2>

8. Again, there are two ways to approach the Big Bang and the current state of the universe.

1. Given state X at the Big Bang, and given the laws of physics, what is the probability that the universe would have evolved into its current state Y? What is the probability distribution for the various states the universe could have evolved into?
2. Give the current state of the actual universe Y’, and given the laws of physics, what is the probability that the state of the universe at the Big Bang was X’? What is the probability distribution of the various states the universe could have started out in?
3. If you go back and forth are there any accumulation states? But does going back and forth correspond to anything physical?
4. The same questions can be given (both ways) with respect to the Big Bang and the actual state of the universe and the Standard Model.
5. These use a B-theory of time. What is the case if you use an A-theory of time?

Note a B-theory has B-series. An A-theory has both B-series and A-series. The B-series is a block-world that has earlier-states/(classes of) simultaneous-states/later-states. The A-series is future/present/past. So an A-theory can differentiate between ‘simultaneous’ (B-series) and a ‘present’ or ‘now’ (A-series), *which allows for a quantum theory that is consistent with the relativity of simultaneity*. In the A-theory below, *each* quantum system has an ontologically private A-series (which runs from future to present to past), which form fragments of reality, whose ‘present’ or ‘now’ extends throughout space, as is ubiquitous in our experience.

The answer below leverages an AI (Claude 3.5 Sonnet). It is an *initial* foray into answering the question but not the final word.



Edit

This is a profound and complex question that touches on fundamental issues in cosmology, probability theory, and the philosophy of time. Let's break it down and analyze it step by step, including the consideration of A-theory time in the Presentist Fragmentalism (PF) interpretation.

1. B-theory approach:

In the B-theory of time, all moments exist equally, and there's no objective "now" or flow of time. Under this view:

a) Forward probability (1):

- This is essentially asking about the evolution of the universe given initial conditions.
- It's deterministic if we assume perfect knowledge of initial conditions and laws.
- In practice, due to quantum indeterminacy and chaotic dynamics, we'd deal with probability distributions.
- The challenge is in defining a proper measure over possible universe states.

b) Backward probability (2):

- This is akin to the problem of retrodiction in physics.
- It's complicated by the second law of thermodynamics and information loss.
- There might be multiple initial states compatible with the current state.
- The principle of maximum entropy is often used to assign probabilities to past states.

c) Accumulation states:

- In a deterministic system, going back and forth would always return to the same states.
- With quantum indeterminacy, you might see a kind of "spreading" of probability distributions.
- Certain macrostates might act as attractors in this process.

2. A-theory approach (Presentist Fragmentalism):

The Presentist Fragmentalism interpretation, as I understand it from our previous discussions, posits that only the present moment exists (Presentism) but that there isn't a single, unified present (Fragmentalism). This radically changes our approach:

a) Nature of probability:

- In PF, probability might be more fundamental, not just a result of our ignorance.
- Each "fragment" might have its own probabilistic evolution.

b) Forward evolution:

- Instead of a single probability distribution, we might have multiple, fragment-specific evolutions.
- The "current state Y" would be a collection of fragment states, not a single unified state.

c) Backward inference:

- This becomes more problematic in PF, as past states don't "exist" in the same way.

- We might need to reframe this in terms of consistency between fragments rather than tracing back a unified history.

d) Accumulation states:

- The concept of "going back and forth" is less clear in PF, as there's no single timeline to traverse.
- We might instead consider how fragments relate to each other and whether certain types of fragments are more "stable" or common.

e) Role of the A-series:

- The A-series properties (past, present, future) become crucial in understanding the evolution of fragments.
- We might need to consider how the "presentness" of each fragment influences its evolution.

f) Qualitative aspects:

- In line with the Calculus of Qualia, we might need to consider the qualitative, experiential aspects of each fragment.
- The evolution of the universe might involve not just physical states, but qualitative states (■) as well.

g) Hard Problem solutions:

- The transformative experiences [T] that bridge physical understanding and qualia might play a role in how fragments evolve or relate to each other.

h) Non-referential nature:

- The non-referential nature of qualia in CQ might influence how we conceive of "states" in PF.
- Each fragment's state might be partly defined by non-referential qualitative content.

In the PF interpretation, we might reformulate the questions as:

1. Given a collection of present fragments X, what is the distribution of possible future fragment collections Y?
2. Given our current experience of fragments Y', what can we infer about the distribution of past fragment collections X'?

These questions would need to be understood in terms of the A-series properties and the qualitative content of each fragment, not just their physical properties.

The PF approach, combined with insights from the Calculus of Qualia, suggests a much more dynamic, experiential view of cosmic evolution. Instead of a single probabilistic evolution of physical states, we're dealing with a complex interplay of fragments, each with its own qualitative and physical aspects, evolving in a way that respects the primacy of the present and the irreducibility of conscious experience.

This view presents significant challenges for traditional cosmological modeling, but it also opens up new avenues for integrating consciousness and qualitative experience into our understanding of cosmic evolution. It suggests that a complete understanding of the universe must account not just for physical states, but for the rich tapestry of conscious experiences that, in this view, are fundamental to the nature of reality.

Section 10

Again, Boltzmann Brains. We leverage an AI, Claude 1.5 Sonnet.

PM

What are reasons Boltzmann Brains are unlikely?

Edit

Boltzmann Brains are hypothetical self-aware entities that arise due to random fluctuations in a state of thermal equilibrium. While they're an interesting thought experiment, there are several reasons why many scientists and philosophers consider them unlikely:

1. Complexity and improbability: The spontaneous formation of a complex, self-aware entity is extremely improbable. The likelihood of particles randomly assembling into a functioning brain is vastly lower than other, simpler configurations.
2. Thermodynamic considerations: In a universe at thermal equilibrium, any Boltzmann Brain that formed would almost instantly dissolve back into randomness. The sustained existence of complex structures is thermodynamically unfavorable in such conditions.
3. Our observed universe: The universe we observe is far from thermal equilibrium and contains large-scale structures. This is inconsistent with the conditions required for Boltzmann Brains to be the dominant form of consciousness.
4. Evolutionary history: We have evidence of a long evolutionary history leading to human consciousness. This gradual development is more plausible than spontaneous emergence.
5. Consistency of memories and observations: Boltzmann Brains would likely have random, inconsistent memories and perceptions. Our coherent experiences and shared reality argue against us being Boltzmann Brains.
6. Occam's Razor: The existence of Boltzmann Brains requires many additional assumptions compared to conventional cosmology and biology. Simpler explanations are generally preferred.
7. Physical laws: Our understanding of physical laws and their consistency over time is difficult to reconcile with the random fluctuations that would produce Boltzmann Brains.
8. Information paradox: If Boltzmann Brains were common, most observers would have random, useless information rather than accurate knowledge about the universe. This conflicts with our ability to understand and predict natural phenomena.
9. Quantum fluctuations: In quantum mechanics, fluctuations tend to be small and short-lived. The emergence of a macroscopic, complex entity like a brain from such fluctuations is extremely unlikely.
10. Anthropic principle: The very fact that we can contemplate Boltzmann Brains suggests we're not them, as we possess consistent, long-term memories and the ability to reason about our existence.

While the concept of Boltzmann Brains raises interesting questions about consciousness, probability, and the nature of the universe, most scientists consider them a fascinating thought experiment rather than a likely reality.