It's About Time

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Abstract

We develop a model for quantum theory that is fully retrocausal (that is, there is no forward causality), local, deterministic, and single-universe, referred to as the *Backyon* model. Backyons are proposed as fields propagating causality strictly backward through time from a single definite final boundary condition (the "eschaton"). What is proposed is a backward-causal universe, where the "initial condition" is actually in the future, pushing influence into the past, and in which time runs from a cosmic omega point back toward the Big Bang.

Keywords: causality, retrocausality, time asymmetry, Backyons, quantum mechanics, quantum theory, Bell's inequality, EPR, hidden variables, eschaton, Big Bang, cone of light, Einstein, Copenhagen model, dark matter, dark energy, determinism, locality, realism, measurement problem, Schrodinger, spooky action

Introduction to the model

A Backyonic (DeHaas, 2004, 2009) model is presented in which only future events ("cause") direct past events ("effect"); only retrocausality exists, and no forward causality exists. Though not demanded by such a model, the Backyonic model permits a local, single-universe, deterministic framework; this discussion will assume such a framework because of its ontological simplicity. With those conditions, there is a "final state," an end point (from our forward-time perspective), an "ultimate observer," an eschaton, such that the Backyon field

$\phi B(x,t)$

becomes $\phi B(x_\Omega, t_\Omega)$, which is a scalar field representing Alice's final state (the eschaton), and

$\phi B(x_\wedge, t_\wedge)$, where $\wedge > 0$, is the scalar field representing some future state for Alice, and

$\phi B(x_0, t_0)$ is the scalar field representing the present state for Alice, and

$\phi B(x_{-\wedge}, t_{-\wedge})$, where $\wedge \leq 0$, is the scalar field representing some past state for Alice, and

$\phi B(x_{\alpha}, t_{\alpha})$ is the scalar field representing the Big Bang.

Anthropomorphic confusion

It is naturally confusing from our forward-time human perspective to confuse discussion of "beginning," "final," and even words like "future" and "past." Of course, it depends on the perspective of the observer.

Assume two observers, Alice and Qix. Alice lives in positive time flow, t^{+}, as is the case with all humans. But Qix lives in negative time flow, t^{-}, as is the case with all Xarxians. For Alice, the present could be considered t_0, and an event in the "future" (from her perspective) would be, say, t_5; the final "end" boundary condition would be

T_{FINAL}, or t_{Ω}.

The "Big Bang" would be, for Alice,

$T_{BEGINNING}$, or t_{α}.

From Alice's perspective, Qix lives in a t^{-} timeframe. Of course, to Qix, it is just the opposite. For Qix, the Big Bang is t_{Ω}, and Alice's t_{Ω} becomes Qix's t_{α}. This author happens to live in Alice's timeframe, so for the sake of consistency, her perspective is used in this discussion.

The model

While quantum theory has developed dramatically over the last century, it still requires a leap of imagination to accommodate the weirdness of our universe. The various models in extant literature require one or more of the following: 1.) randomness, forward causality, "collapse" of the probabilities ("Copenhagen"); 2.) multiple universes; 3.) "pilot waves" or some form of forward and backward causality; 4.) non-locality or superluminal communication; and/or 5.) non-realism.

The Backyon model requires none of these, but rather requires that only retrocausality exists, without forward causality, wherein the assumption would be that events in the future determine events in the past, but no influence propagates from the past to the future.

Whereas in some models it is proposed that a quantum measurement causes "collapse" of the probability function, in the Backyonic model the measurement itself becomes a boundary condition at the time of measurement, which appears to be random but is deterministically fixed by future conditions.

In the Backyonic model, the apparent "collapse" in Copenhagen is re-interpreted as the discovery of future boundary conditions that retrocausally shape the system. The apparent "collapse" is simply the point x,t (in the spatial universe and time) in the Backyonic field

$\phi B(x,t)$

where the future boundary conditions become known, at which time a variety of probabilities for Alice resolve into the one objective state directed from future states (hence solving the "measurement problem").

While calculations of probability (for instance in the Copenhagen models) maintain their usefulness in the Backyonic model, they are accurate yet cumbersome, not unlike Aristotelian geocentric calculations of planetary motion.

The Backyon model is not presented as an entirely convenient theoretical model begging for data to support it. On the contrary, we begin by identifying the assumptions made in existing models; specifically, the assumption that is made by Bell and for Copenhagen is that causality moves forward through time. In its traditional form, Bell's inequality relies on that assumption; if reverse causality is allowed, Bell's inequality in its traditional form would no longer be meaningful. And experimental data of Aspect and others leads one to be satisfied with "spooky action at a distance."

Thus, the assumptions and spooky data of Quantum Mechanics (QM) are the starting point in developing the Backyon model. As Gauss, Lobachevsky, and Bolyai discarded the assumptions of Euclidean geometry, or as Einstein discarded the assumption of the constancy of time, the author began by discarding the assumption of forward causality. The wonderment of non-Euclidean geometry, time dilation, or the Backyon model is the realization that these models are simply

a rest stop in the quest for truth.

In the Backyon model, the Backyon field $\phi B(x,t)$ guides the quantum system at earlier times, determining measurement outcomes. Key features aligning backyons with Einstein's hidden variables include:

- Determinism; the Backyon field fully specifies all measurement outcomes, such as in a Bell test; the Backyon field dictates the outcomes, making the model deterministic.
- Locality; Backyons, which propagate at or below the speed of light, ensure that their influence respects relativistic causality. Correlations between distant measurements (e.g. Alice and Bob in a Bell test) are established locally at the entanglement preparation event via Backyons converging from the future, avoiding non-local interactions.
- Physical realism; the Backyon field $\phi B(x,t)$ provides a complete description of the system's state, assigning definite values to measurement outcomes, fulfilling EPR's criterion that every element of physical reality has a counterpart in the theory.

Thus, Backyons can be seen as the hidden variables Einstein sought, fulfilling his technical requirements for a local, deterministic completion of QM in a retrocausal framework, resolving the EPR paradox.

Because there is only one global history beginning with the Big Bang and ending with a single final boundary, the eschaton, probability equations and their apparent collapse arise only as ignorance of the exact details of the Backyon fields and their effects.

Classical outcomes on macroscopic systems emerge because the future constraints on large-scale systems are overwhelmingly regular and consistent.

The key aspect of locality in the Backyon model arises from the author's assumption that the cone of light for the eschaton envelops the cone of light for the quantum experiments, and also envelops entangled particles. For instance (see fig. 1), at time t_Ω (that is, in the eschaton), two photons A and B which are measurable particles have Backyon fields $\phi B(x_{\Omega A}, t_{\Omega A})$ and $\phi B(x_{\Omega B}, t_{\Omega B})$ which begin their journey backward through time. Those fields are still associated with A and B at time t_5, a time in Alice's future, but x_{5A} and x_{5B} are inside the cone of light for the eschaton but outside the cones of light for each other and perhaps even for Alice, but they are local to Qix! And A and B at x_{5A} and x_{5B} themselves are passing on Backyon fields $\phi B(x_{5A}, t_{5A})$ and $\phi B(x_{5B}, t_{5B})$ to the past.

Let t_0 be the time of entanglement in Alice's experiment. The Backyon fields are still associated with A and B at t_0 , which Alice perceives as her "present." From Qix's perspective, they have been particles all along, but Alice just knows that they are entangled, thinking they could be measured either for their particle or their wave properties. Little does Alice know that her experiment, including Alice and her restaurant, comprise a larger system with future constraints such that upon measurement, it is not that the probability function collapses, but rather Alice simply "will" measure A and/or B for their particle properties. Furthermore, there is a sense in which Alice at t_0 actually then passes on $\phi B(x_{0A}, t_{0A})$ and $\phi B(x_{0B}, t_{0B})$ to the past, and in that sense, Alice plays a role in causing A and B to be particles all the way back to their origin. And so at t_{-5} (that is, a point in Alice's past), Alice caused A and B to be particles and not waves. It is all part of Qix's plan.

Is the Backyon Model preferable over Copenhagen and other models

To merit consideration for replacing the Copenhagen model of QM, a model should:

- Have simpler ontology with better conceptual clarity
- Be scientifically possible
- Sufficiently reproduce all the empirical predictions of standard QM
- Resolve foundational puzzles such as wavefunction collapse or the "measurement problem"
- Allow for future work as clearly, or more clearly, than Copenhagen
- Have the possibility of being understood intuitively as "true"

A simpler ontology

While retrocausality (with no forward causality) is difficult to comprehend, it is simpler than trying to comprehend spooky action at a distance, or the measurement problem, or the double slit experiments. And the difficulty is akin to the difficulty of grasping a non-Euclidean universe, or the dilation of time with speed. In fact, from Qix's perspective, it is trivially clear conceptually.

Scientifically possible

The author is not aware of any reason why the Backyon model would be scientifically impossible. In fact, weird outcomes like the double slit experiment, entanglement, etc. seem more impossible if we are limited to forward causality.

Sufficiently reproduce all the empirical predictions of standard QM

All of the empirical predictions of standard QM are expected in the Backyon model. As stated above, probability equations and their apparent collapse arise only as ignorance of the exact details of the Backyon fields and their effects. Classical outcomes on macroscopic systems emerge because the future constraints on large-scale systems are overwhelmingly regular and consistent.

The Backyon model does not require any level of consciousness, and does not even require measurement – future constraints apply to the entire system of any possible quantum experiment; those constraints even apply to the entire system long before any such experiment is conceived.

Resolve foundational puzzles such as wavefunction collapse or the "measurement problem"

In addition to reproducing empirical predictions of standard QM, the Backyonic model actually resolves some foundational problems. That which is "spooky" is now understandable. According to the Copenhagen model, an object like a photon has multiple possible states, and it is only when a measurement is made that the wave function collapses, and one of its possible states emerges as the actual state (100% probability), and all the other possible states disappear (0% probability). Schrodinger's cat is both dead and alive until you open the box and look in.

The apparent collapse of probability functions in the Backyonic model occurs because the Backyonic scalar fields provide future constraints not only on the photons, electrons, etc. of an experiment, but also on the entire experiment, and even events leading up to the experiment. It could be said that even the birth of the experimenter was subject to those future constraints.

There is extensive discussion in the literature about the influence of consciousness in the Copenhagen model. In the Backyon model, consciousness is the result of Backyonic fields, not the cause of collapse of probability wave functions.

The act of measuring a system is considered self-reflectively as being a subset of the data attempted to be measured. In Escher-like fashion, this leads to an enigma:

what is the ultimate measurement? When we analyze data, the analysis itself becomes part of the data, and the whole thing spirals into a recursive do-loop with no END statement. This "measurement problem" persists so long as we view it from our perspective. So there must be another perspective, and that is the perspective of Qix, not Alice. What appears to be "collapse" from Alice's perspective is the creation of a more complex system from Qix's perspective, a perspective which includes the entire system, including Alice and her tools, even her thoughts.

And figuratively, Qix is running the experiment that causes it all. The very act of measuring is part of the plan, if the plan is made in reversed time.

The Backyonic model is disturbing in that it raises questions about free will. I have contended with this question for over 20 years, and I have resolved that in the Backyonic model, I have no "true" free will; every state in which I exist is determined by the Backyonic fields. However, in my ignorance of the outcomes of my actions, I "feel" like I have free will. And in fact, I have come to understand that my passions, my desires, my choices all exist because they are determined, and I have come to embrace the fact that my passions, desires, and choices are actually part of Qix's plan! I find this actually to inspire, rather than stifle my own initiatives.

Allow for future work as clearly, or more clearly, than Copenhagen

"Unlike relativity, [Quantum Mechanic's] final version, the so-called Copenhagen interpretation, was contested even by some of the creators of the revolution. The questioning has not ceased." (Segre, 2007). The founding fathers of the Copenhagen model have all attested to its absurdity. What future work is there?

What if Backyons, like some would say about positrons, travel in a negative time direction, but have mass that produces gravity in the positive time world? What if they contribute to both dark matter and dark energy? Perhaps there is some interference pattern or other wave effect in the Backyonic fields that can be detected by us?

It seems that future work is allowed even more clearly than it is for Copenhagen.

Have the possibility of being understood intuitively as "true"

Copenhagen is difficult to accept as "true" because it is intuitively impossible to grasp. Even when its complexity is understood and expressed by wave functions, etc., the thing that actually must happen is outside of our understanding.

There are other examples of theories that have become more complex through the history of science. Trying to prove Euclid's 5th postulate, for example, led to the understanding that we don't live in a Euclidean universe; and we have come to understand that. The constancy of time assumed by Galileo has been replaced by Einstein's development of time dilation; and we have come to understand that.

But Copenhagen remains quite contrary to sensible understanding.

The Backyon model requires a surrender of the assumption that causality moves forward through time; it requires a surrender of actual (but not perceived) free will. But it is simple and understandable, even believable in contrast to Copenhagen.

And if it proves to be the simplest explanation, perhaps it is true.

Time will tell…

(Figure 1 below)

References

DeHaas, Ronald, 2004; Toward a Deterministic One-Universe Quantum Model; https://rjdehaas.com/time/index.php

DeHaas, Ronald, 2009; On Assumptions in Quantum Theory; https://rjdehaas.com/time/quantum.php; also see www.backyon.com.

Segre, Gino, 2007; Faust in Copenhagen; Viking Press

Figure 1. Alice lives in a T^+ world while Qix lives in a T^- world. The Eschaton (the "ultimate observer") emits Backyonic scalar fields backward through time, which become the causation influencer for everything in Alice's world. Because Qix's cone of light includes all of Alice's world, all interactions in Alice's experiment are local, even though they may be outside Alice's cone of light. At t_{-5} quanta A and B are actually particles, unknown to Alice; Alice believes they have a 50% chance each of being a particle or a wave. When she runs her experiment (the "present," or t_0 for Alice) to entangle A and B, she is unaware that the Backyonic scalar fields are actually causing not only particles A and B to come together, but are also causing everything about her experiment, including Alice and her restaurant. At time t_5 A and B are still particles (even if B has somehow found a way to escape Alice's cone of light), ready to be "measured" as such.