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The Conscious Universe: Nonlocality and Its Implications

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Abstract

This article advances the idea that nonlocality is a central and defining feature of the Universe. Long held at arm's length and often ignored and loathed whenever it is encountered, nonlocality has re-emerged time and again to vex physicists all throughout the history of scientific endeavor, but far from making science impossible or incomprehensible, nonlocality may provide the scaffolding that brings the comprehensible universe into being in the first place. It is against such backdrop of procedural interconnectedness, that the case is made for rudimentary and not so rudimentary forms of awareness between all things, which abstract as they are, might nonetheless form the basis of reality and an answer to the seeming disorder and apparent randomness of the Universe.

Introduction

We live in a Newtonian world but exist in a quantum universe. The great philosopher Rene Descartes[1] neatly summarized this with the famous phrase: Je pense donc je suis, cogito ergo sum, I think therefore I am. At his fundament he was a localist, he had to be, as did all of his contemporaries and predecessors, to do science, natural philosophy as it was then called, and make any sense out of the world.

Sir Isaac Newton[2] subsequently upset the apple cart with the universal theory of gravitation and the equations pursuant to it, which postulated nonlocality at its core and for a while threw the community of physicists into an uproar. Newton himself in fact admitted not knowing what gravity is, only what it does. The debate died down after physicists realized that the equations Newton invented describing what gravity does, work. Gravity as a force of nature came to be accepted as a given, and nonlocality became a non-issue again, the inability to say what gravity is notwithstanding. Albert Einstein[2] appeared to put the final nail in the coffin of nonlocality with his theories of relativity which stipulated the constancy of the speed of light. A speed limit on the universe meant nothing could be at more than one position in the universe at once. Nonlocality was finally dead and gone or so it appeared.

Quantum mechanics, which Einstein himself had a significant role in inventing, revived nonlocality like a bad penny, a quantum penny to be sure. It so distressed Einstein that he derisively called it 'spooky action at a distance'[3] and quipped "God does not play dice with the universe". Therefore, quantum theory must be incomplete and lacking some, "hidden variables" that would do away with nonlocality for good. Many at the time and ever since also expressed their utter discomfort if not disgust with nonlocality with Schrodinger[3] sardonically proposing his famous cat experiment in which the 'Schrodinger cat' is both alive and dead depending on the status of the observer, and Heisenberg[3] having this to say about it: "I don't like it and I'm sorry I had anything to do with it"[2].

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The Copenhagen interpretation[6] whose salient feature is that measurement plays a key role in changing quantum states, hardly put an end to such turpitude in the physics community but much like Newton's laws had done centuries earlier, it calmed frayed nerves by asserting that science is still possible if you consider what quantum theory is capable of instead of asking it to explain what it cannot. Hence quantum coins when flipped, exist in two states simultaneously until one is measured, the other then declaring its properties by influence of the first, as if by magic[3]. But as John Bell[2,6], conclusively demonstrated, THAT is not magic, just quantum physics, pennies and all.

Throughout the history of natural philosophy of what we now call physics and all its derivatives, nonlocality has always reared its ugly head. There are even traces of nonlocality in Einstein's theories (fierce opponent of nonlocality though he was). A mass traveling at relativistic speed (relative to an earth observer) will contract in length from the observer's perspective. A form of nonlocality, is therefore not just implied by relativity but is its' very definition. If a charged particle sent through a particle accelerator increases in mass and starts exerting a bigger gravitational force, this also is a nonlocal phenomenon[4], as is the corpuscular (photon) theory of light[6,1]. Last but certainly not least, if consciousness[10] is an epiphenomenon of the brain which exists in superposition to its neurophysiological and neuroanatomical understructure as the theory would have it, then there is something nonlocal about consciousness too.

Zeno[2] of ancient Greece is perhaps the first in recorded history to elaborate the dilemma. If matter exists on a continuum of infinitely divisible components, then continuous division of its consistent parts will leave you with nothing at all, zero, a concept not a thing, the summation of which leaves you with a conundrum. Democritus[2] subsequently proposed that maybe the smallest constituents of matter are not divisible after all giving rise to the precursor of the modern-day atomic theory of matter. But Democritus' atomic theory requires him to give up to the notion that anything can be measured. He accepts that that which is indivisible is the final word on what is and what can be measured; everything on its edge and in between is the thing itself in its entirety. At the most fundamental level then, ANY theory of matter is an approximation that must invoke nonlocality in order to save locality. This is conceptually guaranteed by the mathematics of calculus.

In my article entitled, "Riding Electrons, Musings on Reality Relativity and Other Things"[4] I spoke of Heisenberg's uncertainty principle in which I hypothesized that the simultaneous measurement of location and momentum of an entangled particle might be accomplished by examining the entangled properties of its twin. I wrote of this as a thought experiment and as such, was and is purely a conjecture on my part, but I believe, it may have a basis in reality. If measuring a property of one particle would provide complementary information about the other then it would be possible to measure two properties simultaneously, at least in theory[2]. Perhaps several properties of a single particle could be measured this way. Nonlocality may prove its utility after all.

Creation and Matter

In the same article[4] I wrote about the process by which I imagined energy becomes quantized into matter, Recall that E=hf. I hypothesized that at the Planck[6] length (defined by Planck's constant, h), electromagnetic energy reaches such high intensity of frequency f, that it literally breaks out of its energy state as matter in spacetime. The Planck space, like a violin string, can only 'fit' or accommodate energy of a maximum frequency. Exceed this max state of frequency and the first particles appear. Initially, they would rapidly decay back into electromagnetic energy, reappearing again as stable particles when other high intensity quanta get entangled with them in a state of superposition.

Moreover, particle formation would have perhaps required the 'cloak' of nonlocality inherent in quantum theory to have continued, since the universe would immediately collapse into a giant black hole, stillborn and the process repeat itself ad infinitum. Thus, quantum theory, quantum mechanics (and human like consciousness) are the antecedents to and persistent remnants of this "primordial soup" of plasma, and quantum matter (particles) that make possible spacetime, electromagnetic energy and all that is the universe as we know it. Eventually particle entanglement and the energy it requires would cause slowing of the nascent matter particles to a speed less than c creating quarks and other stable particles and allowing the arrow of spacetime to slowly emerge. This would perhaps reach an equilibrium when chunks of matter large enough to bend light come into existence, then no further creation of particulate matter from light energy would be possible on such a large scale. As the Universe cools itself, out of quantum nonlocality Einstein's cherished locality emerges mediated by a constant speed of light, the upper limit of speed in said universe, and gravity, the fabric underpinning of spacetime and defining feature of locality itself in this slice of general relativity heretofore called the 'Newtonian' or classical world.

Philosopher Jenann Ismael[3] talks of the universe as a kaleidoscope of interconnections, shards of glasses blending into each other, each depending on the others as their variegate hues and colors are reflected in the kaleidoscope mirrors creating an overall pattern, a universal tapestry as it were. It is therefore, as it appears to me, about relationships and processes. That's the something that's nonlocal. Could it be what's happening inside the Planck space?

When I wrote about spacetime in the article "Riding Electrons"[4], I spoke of space and time as being like two sides of a right triangle. It was an oversimplified way for

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me to conceptualize a very difficult subject. Technically it's incorrect, spacetime doesn't behave that way, but it was helpful nonetheless, because if we think of relationships and of processes, instead of absolutes, the process by which events occur in the universe becomes an important and perhaps indispensable way of describing nonlocality. Two hydrogen molecules combine with oxygen to create a water molecule. The resultant heat released reflects a more stable arrangement of atoms than before and entropy is increased. Hence relationships and the processes (spacetime) by which they occur are quintessentially nonlocal. If the Planck space defines the limit of divisibility of matter, then nonlocality must exist there also. When we think of what is meant by indivisible, a state of maximum entropy existing within the confines of given spacetime parameters is the only thing in the universe that fits this definition. Could this be quantum gravity?[3,7].

Gravity is a force of attraction between pieces of matter, It is therefore a process and a relationship. This is how we know anything is real in the first instance: by its ability to act or be acted upon[9]; fundamentally then, reality is knowable only as an abstraction. When gravitational forces of a massive object act on a less massive object it pulls the less massive object towards the larger object. Gravity and gravitational fields require matter. Matter is a quantized state of energy. As such it is a potential reservoir of energy not unlike a block of cinder perched on a roof top is a reservoir of potential energy[5]. Different equations describe different forms of energy, and the reservoir of energy contained in matter ($E=mc^2$) is very different from the reservoir that is the potential energy of the block of cinder ($E= mgh$). The block of cinder might fall, its potential energy then being converted to kinetic energy which is then dissipated as heat when the cinder block strikes the ground.

In physics you might ask why should it happen this way? And the answer you'll get back is: gauge invariance[3]. Gauge invariance means there is gradient of gravitation force such that the earth with its greater mass exerts a net pulling force on the cinder block causing it to fall inward towards the earth's center of gravity. That's the Newtonian definition. It tells me that gravitational forces are nonlocal, depend on the masses involved, diminish with the square of the distance between the two and are governed by a gravitational constant G. But if I ask Jenann Ismael, she'd perhaps tell me it's because the universe is a kaleidoscope of interconnected pieces reflected in kaleidoscope mirrors all interacting with each other to influence their respective movements and the cinder block and the earth are like shards of glass in this kaleidoscope that is our universe.

I like this answer better because it is more thought provoking to me than $F= G M m/ r^2$, although G has always intrigued me. My assertion is that massive objects exert their gravitational influence because they each draw energy from spacetime and each other[4], disrupting the coherence of spacetime causing the one object to fall into the larger mass other. I use the word coherence[2] deliberately because there is an entanglement between all matter, indeed between all energy forms that a massive object disrupts, i.e. causes to decohere. My assertion is that decoherence is what Einstein called warping of spacetime. I likened this to the turbulence associated with the Bernoulli effect[4] of laminar flow in classical Newtonian physics. In the case of spacetime, decoherence causes objects to fall toward the gravitational center of larger masses. A planet, massive as it is, 'announces' its presence in spacetime by energy exchange with the universe. It declares its coordinates in spacetime to the rest of the universe as a force to be reckoned with in exchange for existence as stable matter, existence that requires energy. At the most fundamental level therefore, any energy transfer is an information exchange. Matter decoheres (warps) spacetime in exchange for information which defines its coordinates, its locality in spacetime. If this were not the case, the Pauli exclusion principle and the law of conservation of energy might be violated rendering the universe nonlocal and incomprehensible. Matter then is a configuration of energy in its most stable form, and my assertion is that the elementary particles of matter themselves, consist of states of maximum randomness in entanglement, motion, configuration and interconnectedness. In short, elementary particles comprise all the ways that energy can interact with itself, which renders them indivisible in every sense of the word.

When the cinder block strikes the earth, its heat is dissipated in all directions towards all things in a way that is not descriptive of gravity. Gravity persists, strongest nearest a mass then diminishing with the square of the distance rather than dissipating in its entirety. How is this related to consciousness at all let alone any observation? In a crude but very real sense, all pieces of matter in the universe have an elementary awareness of each other due to the coherence of spacetime and the decoherence implied by massive objects. Decoherence means that a meteorite previously entangled with another planet, another meteor, or particles of matter, what have you, which would continue in motion forever in spacetime, instead makes a meaningful appearance in earth's gravitational field by declaring its spatial, temporal, magnetic, gravitational, momentum and other properties to earth. Gravity is not a strong enough force to cause decay or decomposition of a meteorite, instead the larger mass of earth 'draws in' the meteor, conferring on it kinetic energy in a mutual information exchange that eventuates in the meteorite either falling to earth, staying in orbit, or bending its trajectory, as if tipping its hat to its more massive counterpart as it whizzes by.

It may seem that the earth's gravitational field is pulling the meteor. My conjecture is however, that the meteor is being pushed by spacetime rather than pulled by earth, into

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a zone of disrupted and decohered spacetime that surrounds earth. Imagine warping of spacetime by matter as a series of cascading waterfalls extending in every dimension encompassing all matter in the universe where standing pools of water at each level represent each mass's warping of spacetime (gravitational field), and the falls themselves represent gravitational field gradients at the bottom of which sit giant black holes. Whereas heat energy is a pure energy transfer describing an event (static) which would therefore require additional energy to be ongoing, gravity is a dynamic information exchange (girded by quantum entanglement) between objects that manifests in an energy transfer. Physicists have even coined the term graviton[3] to describe the basic coherence pulse unit of gravity that is theorized to be spacetime. Much as with consciousness itself, gravity is a relational interconnectedness that epitomizes the essence of nonlocality. Einstein didn't like this about gravity and quipped, "Do you really believe the moon isn't there until somebody looks?"[3] Surely it is, unless it is the only thing in the universe, then does it have gravity? I'm not so sure.

Schrodinger sarcastically proposed the Schrodinger cat thought experiment to illustrate 'the absurdity', of quantum mechanics. The cat is in a box with a radioactive pellet whose random decay would release a poisonous gas whereupon the cat would die. Since the decay occurs completely at random, the cat in is a peculiar state of being both alive and dead until an observer opens the door. The cat's quantum wave function then collapses into either state of alive or dead depending on what chance occurrence is observed to have happened. But to make this a much more meaningful thought experiment we should take into account the cat's consciousness, however rudimentary. Surely, IT knows whether it's alive or dead and can communicate this to the universe throughout its ordeal which duly records all events such as a scratch on the walls or a persistent meow. If no human observer was there, does it really mean the cat ever experienced such a state of existential duality? I think not. I think it was always in a state of alive until it died! The thought experiment makes sense if the nexus between the radioactivity and the cat's life is quantum physical, but such is not so. To appreciate this, imagine the cat is outdoors. Much like its solipsism counterpart in philosophy, the many worlds theory collapses under rather minimal scrutiny. This is not to say that there are no other universes. There could be another universe in which Schrodinger's cat is still alive or dead, but that would be in the collective consciousness[8] of quantum physicists, at least as pertains to our universe. Whatever did happen to Schrodinger's cat by the way? Perhaps we should not be too curious.

Anything that exists as matter in the macroscopic universe, even a life form like a cat, has coordinates in spacetime conferring on it locality, meaning that it can be entangled in superposition with something else without losing its spacetime coordinates or splitting the universe in two. The caveat to this is that you can pass large sized objects, by quantum physics standards, through a double slit or single slit and observe what was its particulate constitution as a wave with an interference pattern or still as a particle. But even this problem might hypothetically be solved using quantum entanglement, as I alluded to earlier: measure the wave aspect of a particle at issue while simultaneously measuring another property of its entangled twin. Posthumous relief perhaps, for Heisenberg's uncertainty and his discomfort with quantum mechanics.

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