The Persistent Failure of a Two Substance Paradigm

Peter CM Hahn
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Abstract

The assumption that matter and space are two separate entities (or substances) has resulted in the creation and development of two mutually exclusive theories of reality: quantum mechanics and relativity. The power of these two theories is undeniable, however they are incompatible and there are many questions which cannot be resolved. The belief that reality is comprised of two substances is the root cause of our continual failure to build a workable unified quantum theory of gravity (or theory of everything).

This dual substance world view has also led us to the unfortunate philosophical interpretation that we are separate entities (particles of matter) living *in* the universe rather than beings that are *part of* the universe as a whole, where all the parts are intrinsically connected.

This essay proposes an essential change in mindset that creates a pathway to a holistic, interconnected paradigm.

False Assumptions

The predictive success that quantum mechanics (QM) and relativity have achieved has resulted in physicists becoming overly dependent on mathematics. It is tempting to believe that our advancement in technology is a confirmation of the validity of our current models and that an actual physical model of reality is not necessary. The success of QM and relativity has caused many physicists to proceed without question. As long as there are equations, one needn't ask the question 'why', or what does reality actually look like on the Planck scale?

Although QM and relativity are the best theories we have, they are both based on the assumption that the physical universe is in fact comprised of two separate entities (or substances). Thinking that matter is the only substance in our universe and that the space in between matter is empty, is misleading. Space itself is full of electric and magnetic fields, gravitational fields, gravitational waves, EM waves and dark energy. Space also has curvature on the macro and cosmological scale, and granularity on the Planck scale. With all the properties with which space is endowed, one cannot help but conclude that space can be and should be considered a substance. The recent discovery of the Higgs particle is also thought to provide further validation that space is filled with a 'molasses like' field [1].

The assumption that the universe is comprised of two unique ingredients, space and matter, is the major reason why we have two theories in the first place, where neither one accurately describes all of reality. The fact that quantum mechanics describes all forces of nature in terms of particles further exacerbates the problem because each time we discover a new phenomena, or when observations don't agree with theory, we try to

invent new particles (i.e. dark matter). This practice of explaining everything in terms of particles prevents us from evolving to a more holistic view of the universe, which is essential for the development of a true 'theory of everything'.

Our Current Paradigm

Matter:

In order to learn chemistry and physics, young students are presented with an array of visual images that have been created over the last few decades. Unfortunately, over time, these images have been misinterpreted as actual views of reality. For example, Figure 1 shows the popular planetary atomic model that was initially developed by Ernest Rutherford and Niels Bohr. It gives students the impression that electrons are orbiting a compact nucleus comprised of neutrons and protons, like billiard balls in three dimensional space. Bohr later developed a more advanced model (Figure 2) that shows how orbiting electrons emit a photon when instantaneously dropping down to a smaller orbit. Figure 3 shows a more current quantum mechanical model where the exact positions of electrons are not known, but rather, described by mathematical probability clouds [2]. These three images, however, are simple graphical representations or metaphors, used to help students learn chemistry and physics and to later prepare them for the bizarre world of quantum mechanics. Unfortunately, because we lack an actual physical model, we have accepted these images as reality.

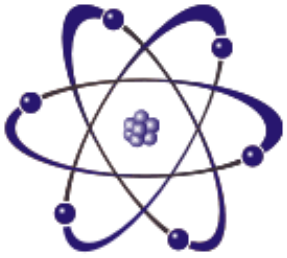

Figure 1
Rutherford-Bohr Model

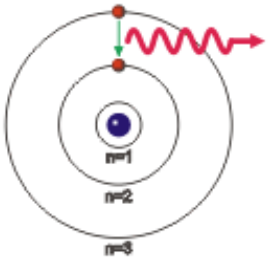

Figure 2
Bohr Model

Figure 3
Probability Cloud Model

Other diagrams have also been used to describe the interactions of subatomic particles. Figure 4 is a sample Feynman Diagram [3] that shows how two electrons interact by the exchange of a virtual photon. Although this is an extremely useful tool for the particle physicist, it gives the impression that the electric fields that permeate space can be explained in terms of particles. The fact that Feynman diagrams work does not constitute absolute proof that it is a true underlying description of reality. It is merely a graph. Should we not be skeptical of theories that use the word 'virtual'?

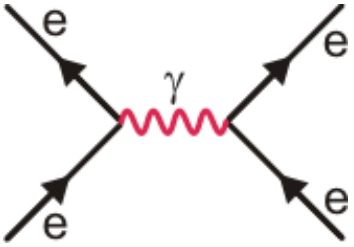

Figure 4
Feynman Diagram

One example of a working system based on false assumptions is the GPS navigation system, which assumes that our earth is at the center of the universe. It does not take into account that the earth is orbiting the sun at 18.5 miles/sec, nor that our entire Milky Way galaxy is rotating around its axis. Hence, the fact that the GPS system works is not absolute proof that we are indeed at the center of the universe. But GPS does work very well, so we continue to use it.

Space:

For centuries space was viewed as the emptiness that lies between particles of matter. Space was considered flat and featureless and time ticked by with equal intervals, regardless of where you were in the universe. The interaction of particles was analogous to billiard balls colliding on a flat pool table.

General relativity turned that flat pool table into a stretched sheet of rubber (see Figure 5). This model can be compared to a game of golf. After being hit by the putter, the ball has to traverse a warped landscape. While rolling along, the golf ball's trajectory is affected by the curvature of the green. The path of the ball is affected even further if there are variations in the density of the grass (thereby causing the golfer to miss his putt).

Using a pothole-ridden stretched sheet of rubber to explain gravity is a useful tool, but not an accurate picture of reality. For one thing, there really are no two dimensional rubber sheets in empty space, and gravity itself, in this model, is required to pull the objects in a downward direction. Therefore, gravity is being used to explain gravity! (A strange model indeed.) Since that is the best explanation currently available, and because it works, it is the model that is used. The problem is that the model works so well that we have forgotten that it is merely a three dimensional graphical representation. Like figures 1 to 4, it should not be interpreted as reality.

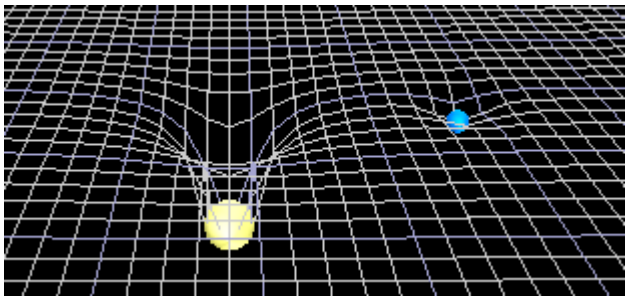

Figure 5
Rubber Sheet Analogy

To make matters worse, quantum mechanics make the particles blurry so particles are described using probability or wave mathematics [4]. Therefore, matter is not actually a 'thing' anymore, but merely probabilities of an outcome. (Another bizarre model.)

This is our current paradigm or dogma that has been built over the years. We have developed a permanent mindset that everything can be explained in terms of particles and that space is a sheet of stretched rubber. This world view leaves far too many questions unanswered and phenomena unexplained to qualify as a theory of everything.

Crazy Conundrums

Students are taught the two separate entities assumption in introductory physics and chemistry. We are told that there is a substance called matter and there is some 'thing' between that matter. This thing has been given a variety of names over the years such as space, space-time continuum, vacuum and aether.

The mindset that reality is comprised of two unique substances, with one travelling through the other, has created a multitude of conundrums and paradoxes. Although QM and relativity have provided us with mathematical solutions and predictions, neither can give satisfactory answers to questions such as the following:

- Why is gravitational mass and inertial mass equivalent?
- Why are there two unique (completely different) causes of time dilation? Moving through space causes time to slow down (as described by special relativity); and standing still on the surface of a large chunk of matter causes time to slow down (as described by general relativity). Furthermore, why is the time dilation on the surface of the earth equal to the time dilation of a rocket traveling at speed equal to the earth's escape velocity? Is this pure coincidence?
- Why can't we solve the wave-particle duality conundrum where particles behave like waves and waves behave like particles? The duality of light has had brilliant minds baffled for centuries.
- If particles can be waves and waves can be particles, why does the Pauli exclusion principle [5] apply to fermions but not to bosons?
- If virtual photons are used to explain the electric and magnetic force, how do electrons 'know' which direction to fire the photon? This is analogous to two blindfolded astronaut football players exchanging a football in outer space. They need to determine where the other astronaut is, what direction they are going and how fast they are traveling relative to each other. Then an instant calculation

has to be made so one can throw the football in such a way as to reach the other player. A complex scenario, to say the least!

- If an electron is a fundamental particle and absorbs a photon, is it still a fundamental particle? Should it not be more than fundamental while it's storing a photon?
- What is the mechanism that ensures that electrons stay in their proper orbits?
- How is it possible for point particles (i.e. quarks and electrons) to have spin or angular momentum?
- What is the purpose of antimatter? And why does matter and antimatter annihilate each other on contact?
- What happened to all the antimatter moments after the big bang?
- What is the underlying mechanism that explains quantum entanglement?
- How does matter couple to and curve space-time? Do particles have little hooks that pull on the surrounding space to distort it?
- How can space, which is viewed as nothing, be granular?
- Why is time granular?

Quantum mechanics has been described as weird and unintuitive [6] resulting in many bizarre interpretations [7]. All of these unanswered questions are strong indicators that our assumptions and or models are seriously flawed and that we are in desperate need of a completely new view of reality.

The reductionist approach of quantum mechanics, whereby particle physicists continuously separate reality into smaller and smaller individual components, has been useful to a degree, but this methodology causes us to forget about how interconnected and whole the universe really is. We have used this reductionist method for centuries, causing us to view reality as a collection of discrete, fragmented objects.

A One Substance Paradigm: A New View of Reality

A proper theory of everything should be a theory with the fewest axioms and assumptions and with no conundrums or paradoxes. It should also be a theory that approaches reality with a connected and holistic view.

David Bohm [8] made an attempt to introduce us to a more holistic view of reality. He proposed that reality, at its most fundamental level, is an unbroken and undivided whole. What we perceive as events or particles is actually an unfolding of a deeper enfolded order. In other words, we view explicate orders of reality, not reality itself. Unfortunately, Bohm was unsuccessful in convincing the mainstream physics community the value of his holistic view, because the predictive powers of quantum mechanics and relativity seemed to make his wholeness concept unnecessary.

A connected and holistic view of reality was actually created as early as the 3rd century with the introduction of Indra's Net [9]. This model proposes that the entire universe is built out of a three dimensional net with its nodes looking like polished pearls. Each pearl reflects light from every other pearl. So any movement in one pearl will ultimately change the light reflected off all other pearls. This is similar to the rubber sheet metaphor used in general relativity, except that Indra's Net is three dimensional in nature.

The metaphor of Indra's Net can actually be used to describe the large scale structure of the universe, where galaxies and galaxy clusters form a three dimensional cosmic net or web (as shown in the simulation in Figure 6), and the galaxies are the pearls that bend light through gravitational lensing (as shown in the photograph in Figure 7).

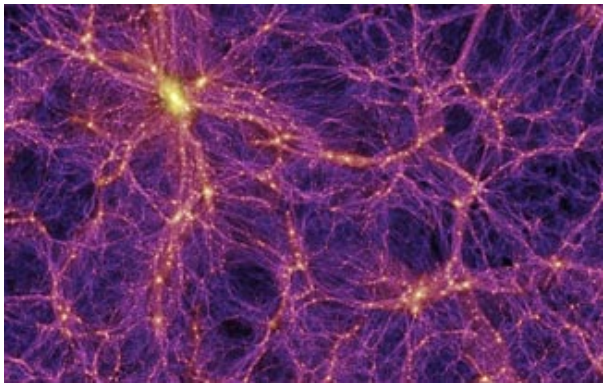

Figure 6
Cosmic Web
Credit: Millennium Simulation Project

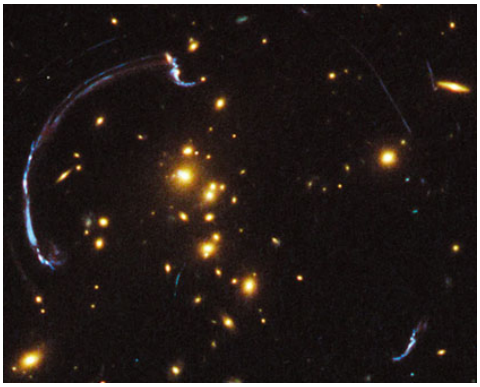

Figure 7
Gravitational Lensing
Credit: NASA Hubble Space Telescope

The three dimensional web-like structure depicted by Indra's Net can also be found in the human brain, where neurons are connected to a multitude of other neurons (Figure 8). To understand the functioning of the brain, one cannot look at a single neuron, but rather, must study the interconnectedness of *all* neurons.

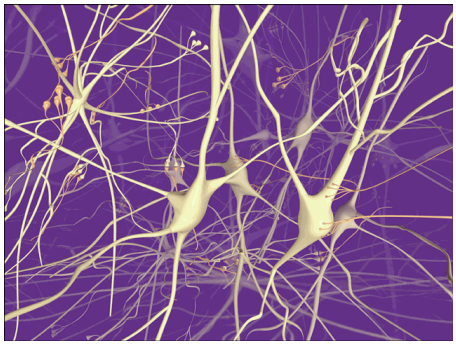

Figure 8
Neurons of the Brain
Credit: Christophe Morin

The metaphor of Indra's Net is also consistent with the teachings of many spiritual leaders and wisdom traditions all over the world, which have advocated an interconnected and holistic world view for centuries. Eckhart Tolle said it well in his book 'Stillness Speaks' with the statement, "But reality is one unified whole, in which all things are interwoven, where nothing exists in and by itself." [10].

Using Indra's Net as a model frees us from the fragmented view of reality provided by quantum mechanics and relativity, and could provide us with a holistic paradigm with which to explore current and new phenomena. One only has to define the properties of the net to make it a proper theory of everything. It can be stringy, springy, sticky,

bendable, foldable or stretchable. It can look like a sponge, 3D spider's web, or a lattice with kinks, knots or loops as particles. We can give it whatever properties it takes to make it work.

Conclusion

The belief that the universe is comprised of two unique entities (or substances) has resulted in the creation of two conflicting theories of reality: quantum mechanics and relativity. Many questions and paradoxes remain unresolved because of the incompatibility of these two theories. Unfortunately, our current models of particles and space prevent us from thinking in terms of wholeness and interconnectedness. These models are so engrained in our thinking and in our education systems, that we are unaware that a two substance paradigm is indeed an assumption.

A world view based on the assumption that the universe is comprised of an undivided single substance, would make a far better candidate for a theory of everything. Only one theory, describing the properties of one substance, would be necessary. The work of David Bohm and the metaphor of Indra's Net could provide us with a starting point for the development of a new holistic paradigm. Everything in the universe, including the viewer, become one interconnected whole; space and matter are viewed as one and the same. Perhaps, then, we can be freed from our current conundrums and paradoxes.

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