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A More “Universal” Atomic Model

Charles A. Laster

An excerpt from my Book, Simply Logic and Reason
http://www.simplylogicandreason.com/
A more detailed discussion can be found in my book.

Abstract

The author exploits areas of common ground to arrive at an atomic model, compatible with quantum mechanics, which can be treated in a classical manner, to a point. If we are to ever arrive at a unified field theory, exploration of the common ground between the fields of physics may yield clues.

Classical physics and QM have grown so far apart that some suggest that "Classical physics is some kind of Limiting case of quantum physics" (p. 11 [1]). We have spent so much time pointing out how different they are, we have forgotten how much they have in common.

Do we even need a classical model for the atomic and sub-atomic world considering the success of quantum mechanics? QM already has a number of promising lines of research in the hunt for a unified field theory.

A classical viewpoint offers a more intuitive model. Why do we need an intuitive model? These are Peter Milonni’s thoughts on the subject: "At the opposite extreme one can take a stand "against interpretation." and argue that none of these effects require us to think in terms of vacuum fields, or source fields, and that for the purpose of calculation all we need to know about is Schrödinger equation and the other tenets of quantum theory. Such an approach, though perfectly rational,...but also contrary to the way physics has for the most part developed - intuitively and with physical images...most physicists would agree on the value of a single concept that provides intuitive explanations...that the quantum vacuum is just as valuable when we broaden our perspective to include relativistic effects"(p. 295 [2]).

An intuitive model could be very useful in teaching QM. “Quantum effects like “Barrier Penetration” can be expressed in an intuitive model that students could grasp easily. Both quantum and classical waves are the same in the respect that they both can penetrate a material in which they can not propagate” (p. 21 [3]). There are models and theories out there that are sound quantum mechanics but can also be examined from a classical perspective. Effects normally thought of as quantum effects, like the Casmir effect, can be seen in the everyday world; for example, when two ships are close together at sea [4].

A semi-classical atomic model created by exploiting these points of common ground is explored, and while not a mature theory, has produced some promising results. It predicts a mass of 1.533 MeV for the Up quark and 4.599 MeV for the Down quark. It solves a large part of the matter-antimatter imbalance and offers a promising line of research into the rest of the charge parity question.

The electron of the atomic model: How to Incorporate the Vacuum into a Semi-Classical Electron Model

The vacuum energy is fundamental to quantum theory. When one examines most electron models, some aspect of the vacuum is included. The vacuum is a quantum concept, so how then can we model it in a semi-classical manner? There are links between the vacuum and relativity, so if a classical link can be found, we might have a hope of creating a more universal electron model.

The vacuum is also fundamental to electromagnetic theory where the vacuum is also treated as a medium. In quantum theory, you can view the vacuum energy as being composed of virtual particles. Virtual particles have mass and exist for only a very short time. They are created out of the vacuum as particle antiparticle pairs, which annihilate each other and return to a pure energy state.

In relativity, even pure energy has mass, so it is this pure energy state that is the best way to incorporate the vacuum energy into a classical model. This is not the first time this approach has been used. As early as 1934, Georges Lemaitre interpreted the cosmological constant as being due to the vacuum energy using a perfect-fluid equation of state. His paper later became known as “The Big Bang Theory.” A classical approximation to arrive at the vacuum energy can be done with general relativity. It is called the “Lambda vacuum solution” and is an exact solution to Einstein’s field equation. The cosmological constant is used as the stress-energy tensor. It is Georges Lemaitre that found the best solution to this problem. He modeled the vacuum energy as a perfect fluid. His work also shows that this pure energy state was the early state of the universe and that before, there was a source field or any discrete particles.

Classically, pure energy behaves like a perfect fluid. It has zero-viscosity, is completely elastic and compressible, and has no inertia. This can be used in the electron and other aspects of an atomic model to incorporate the vacuum into a more classical model.

The Uncertainty Principle

Before we can proceed with incorporating the vacuum energy of a quantum electron into a semi-classical electron model, we have another issue to address, which limits the kinds of classical electron concepts we can use due to the uncertainty principle. In 1926, Schrödinger developed a mathematical atomic model with the electrons as three-dimensional waveforms instead of a point particle. It was this model that made him realize that using waveforms to describe particles has a drawback. It becomes mathematically impossible to obtain precise values for both the position and momentum of a particle at the same time. This became known as the "Uncertainty Principle," as formulated by Heisenberg that same year.

As long as we use a three-dimensional waveform for the electron, we will be in agreement with the uncertainty principle. This also means that later we will have to keep the quantum numbers for the electrons in the atom. So, while it is a semi-classical model, it brings us a step closer to a unified theory.

Which Quantum Electron Model to Modify

Finding a quantum electron model to modify was no easy task. A semi-classical electron in harmony with quantum theory is difficult enough and to include relativistic effects will make it more so. Peter W. Milonni states in his book, The Quantum Vacuum: "The relativistic theory of an extended charged particle has evidently not been developed. Such a theory would be very complicated ecause the assumption of a rigid charge distribution as earlier is inconsistent with special relativity" (p. 168 [2]).

Point particle electron models suffer from the preacceleration problem. A classical shell model does not have this but suffers from being rigid. Lorentz's 1892 Theory of the Electron suffered from its rigid structure and could not follow the Fitzgerald-Lorentz contraction (p. 3-4 [5]).

Arthur Yaghjian modified Lorentz's electron to correct this, but he had to give it bare mass, where as Lorentz's version did not. He looked at the electron as being a charged insulator, and general expressions are derived that account for the binding forces that were postulated by Poincare which are needed to hold the charge distribution together [6].

A spherical standing wave has both a point particle component and an extended, non-rigid spherical component, resolving the problems mentioned. It would meet the above requirements and give a classical representation of wave/particle duality. Adding the vacuum or zero-point energy helps with another problem of electron models: persistence.

Stochastic Electrodynamics Theory used this approach [7]. When Yaghjian added bare mass to Lorentz's electron to fix the Fitzgerald-Lorentz contraction problem, it also helped with persistence [6].

Treating the vacuum energy in its pure energy state should also help the semi-classical electron with its persistence problems.

Electron Model and Modifications

Milo Wolff's equation for the electron is used because it meets the above criteria, accounts for both electron and positron production, and can be converted to a semi-classical electron with ease.

His electron was based on QED. He solved the problem with infinite mass in QED by having the electron emit scalar waves, just like a classical atom would radiate energy. These scalar waves then become the waves of the source field for other nearby particles.

This process where each electron receives a de Broglie wavelength from another was the original experimental basis of quantum theory. However, he removed the bare mass of the QED electron, which many felt made it too dependent on source waves to account for electron persistence. The vacuum energy is added back in classically by treating the vacuum as a perfect liquid filling the standing wave of the electron, accounting for ½ the energy of the electron.

From a classical viewpoint, we can apply Huygens's principle of wave propagation. This shows that 1/2 of the energy emitted by the Out wave will return to the center as the new In wave; the rest will continue away from the particle as a scalar wave like in Milo's model. Factor in the vacuum energy, and the semi-classical version radiates energy at ¼ the rate of Milo's version while requiring only ¼ the energy input, greatly aiding persistence.

The process of In and Out scalar waves of the standing waveform also explains the source of oscillations that create the frequency of waves required by Quantum theory, given in the equation f = m c2 / h.

This frequency is determined by mass, which allows us a connection to relativistic effects of mass to increase or decrease as it can be considered the "internal" clock of a particle.

These spherical waves, just like the waves in scattering experiments of a free particle beam, need not imply that the wave has the same intensity in all directions in any but the most ideal of conditions. Just as in QM, the intensity of the wave in a particular direction is connected to the probability that a particle will be scattered/emitted in that direction (p. 42-43 [3]).

There is also a relativistic effect on the vacuum modeled as a perfect fluid. Due to rotation about the axis of the electron, the distribution of energy within the electron standing wave will not be uniform. This might explain why “ring” models of the electron have been tried with some success.

As for the emitted scalar waves themselves, they can be treated as radiation pressure in a classical model. Since EM radiation exerts radiation pressure in the direction of propagation, it must have momentum as well and can be treated separately from the electron that radiated it in a classical treatment.

The Semi-Classical Atomic Model: Atomic Orbital Model

Having covered how to convert Milo’s QED electron to a semi-classical version, we can proceed to incorporate it into the current atomic model. The Atomic Orbital Model, sometimes referred to as the Wave Mechanics Model, is the currently accepted model of the atom. The nucleus has electrons found in orbitals around it.

Definition of “Orbital” from Webster’s Dictionary: orbital Function: noun Etymology: orbital, adjective Date: 1932: a mathematically described region around a nucleus in an atom or molecule that may contain zero, one, or two electrons. The orbitals of our semi-classical model are no different.

Because of this, most of the time this model is represented in the form of “the electron cloud.” This probability distribution can be virtually reproduced from the semi-classical atomic model we are building if we plot a probability distribution of the point particle component of the electron waveform.

In QM, the electrons of the Atomic Orbital Model are more accurately described as standing waves surrounding the nucleus. De Broglie noticed this back with the atomic model by Bohr. The angular momentum of the electron is an integer multiple of $\hbar$ which can be interpreted as an electron that is a standing wave, which is in an orbit defined by this requirement. A whole number of wavelengths must fit along the circumference of the electron orbit. This is exactly how QM describes the Atomic Orbital Model.

Our electron is a spherical standing wave that can be treated in a semi-classical manner. Classically, we can graph an orbital composed of a whole number of wavelengths for each of the orbital energy levels of a Bohr’s atom.

As our electron conforms to the uncertainty principle, this orbital is still a mathematically described region around a nucleus in an atom or molecule that may contain zero, one, or two electrons. It just represents a region of higher probability.

Any semi-classical model of the atom should be viewed as an ideal stable state the atom seldom achieves for more than a moment if ever.

The real world is never an ideal steady state, even classically; electrons would be changing orbits or getting knocked out of one for a number of reasons. This means elliptical orbits must also be accounted for. Now, if we plot a probability distribution of the point particle component of our electron, we have the electron cloud recreated.

This semi-classical model is functionally equivalent to the quantum Atomic Orbital Model. Quantum numbers must still be used to track individual electrons. All we have done is provide a visual representation of the quantum model from a semi-classical viewpoint. We have created a semi-classical electron and atomic model in harmony with QM; this was no easy task, but other than an educational aid, it is not of much use.

So let's examine if it can help solve any of the problems with a classical atomic model.

Classical Problems

If our electron was treated in a quantum manner, then there is no problem dealing with the source waves and persistence. When treating it in a classical manner, however, we have to show this process to account for persistence.

Because our electron is basically a harmonic oscillator emitting scalar waves, we can model the electrons as coupled harmonic oscillators. This way, we can show classically that the source waves from one electron provides the energy needed for other electrons nearby.

This method can also be used in the study of atomic bonding from a semi-classical standpoint.

That also means that classically, we now have another force at work in the atom. There would be some attraction from this exchange of scalar waves. In larger atoms, this would tend to contract the size of the atom slightly.

As an electron in a higher energy orbit literally has more energy by relativity, that electron now has more mass. Because the electron has slightly more mass by quantum theory, it has a slightly higher frequency, and therefore a smaller standing wave. This would also serve to contract the size of larger atoms.

The Photon

There was another problem with a classical approach to Bohr's atom. It had problems with the conservation of energy and momentum. BKS theory was an attempt by Bohr to correct this. He could not and gave up on an intuitive model.

Born and Jordan sent a letter to Bohr in 1925 outlining a proposal to correct the failure of their BKS theory. The proposal combined the emission of a wave with the emission of a light quantum during a quantum jump to give a space-time model of radiation (p.105-106 [9)]. Our electron emits a scalar wave, so this approach deserves a closer look.

"Classically, of course, a dipole in the vacuum is not acted upon by any "external" field: ...In quantum theory, however, there is always an "external" field, namely, the source-free or vacuum field...the free field is the only field in existence at t = 0" (p.52 [2]). In the electron wave equation we used, t = 0 coincides with the existence of our point particle component of the electron. It's the zero-point energy of the particle, which is its minimum total energy of a particle in quantum mechanics (p. 20-21 [3]).

In quantum models, the photon is a virtual particle. "In a process in which a photon is annihilated (absorbed), we can think of the photon as making a transition into the vacuum state. Similarly, when a photon is created (emitted), it is occasionally useful to imagine that the photon has made a transition out of the vacuum state" (p.48 [2]).

At t = 0 in our semi-classical electron, the point particle component is formed by the wave energy and the vacuum energy of the particle. It is the point of energy exchange between wave energy and vacuum energy needed to maintain balance between the two in and out electrons.

Our semi-classical electron model is limited in how fast it can dump excess energy by wave action alone. When an electron jumps to a lower energy state, it must dump a lot of energy quickly. Therefore, our electron model must emit a photon in such cases, and if an electron can emit a photon, it can absorb one. The photon is visually represented as making a transition into or out of the vacuum state.

In classical relativistic physics, the photon is a fluctuating waveform that has mass, much like a standing wave, It is also easy to model using our electron with the photon coming out from the point particle component in the same manner and continuing away from the electron in phase with the scalar waves. In other words, the fluctuating waveform of the photon is between two scalar waves moving at the speed of light away from the particle.

Conversely, the photon then is a stationary wave, of a given frequency, relative to the advancing scalar field. Thus, it is in accord with relativity as the photons energy being contained in it frequency.

So, a semi-classical approach can solve some of the problems with a purely classical model. If this was all it was good for, it is still of little use outside the classroom.

The Nucleus: Electron Capture and Beta Decay

In the nuclear process known as “Electron Capture,” an unstable atom can take in an electron from the lowest orbit, into the nucleus. It combines with a Proton, turning it into a Neutron, and releasing a Neutrino. In one form of Beta decay, $\beta-$ decay, we see the opposite. A Neutron changes into a Proton, while emitting an Electron and an Antineutrino.

It is the other form of Beta decay that is interesting. In $\beta+$ decay, Energy must be added to a Proton to convert it into a Neutron, releasing a Positron and a Neutrino. A positron spotted without its companion electron, how very odd. But no Electron or Positron has ever been found in the nucleus of the atom. No quark has ever been seen outside a nucleus.

In classical physics, when a wave enters a region of different density, the wavelength of the wave is altered. So, a standing wave would have its amplitude decrease, increasing its frequency and mass when entering a region of higher density. Conversely, a standing wave will increase in amplitude, reducing its frequency and mass when entering a region of less density. The nucleons have a much higher energy density than the surrounding atom.

In a semi-classical model of the nucleus, then, the Up and Down Quarks are Positrons and Electrons with reduced amplitude and increased mass due to the high energy density of the Nucleons. Upon leaving the region of the Nucleus, they regain their former amplitude and mass.

Is there any evidence to support this? Classically, the proton is 1/3 the size of the electron/positron. By coincidence, the fractional charges of quarks are integer multiples of 1/3, known as the “quantum of charge”, and there are 3 quarks per nucleon. So, we should be able to calculate this easily.

So, in a classical model, what would an electron/positron mass be if it were the size of a proton? At 1/3 the size, or 3 times the frequency if you prefer, we would have to multiply the mass of the electron by 3. In the equation required by quantum theory, f = mc2/h, which governs all particles, c2/h is a constant, so a particle that had 3 times the mass would have a frequency 3 times higher.

The mass of the electron/positron is 0.511 MeV. If it were the 1/3 that size, the size of the proton, it would have a mass of 1.533 MeV. The observed mass of the Up is normally given as 1.9 MeV.

With a predicted mass of 1.533, and an observed mass of 1.9 MeV, it would seem the positively charged Up quark is a Positron at reduced amplitude due to high energy density of the Nucleons in a semi-classical model.

The down quark is more massive than the up quark. This makes sense. If the up and down quarks were the same amplitude, they would wipe each other out, just like in pair production. Because they are not at the same amplitude, the two waves are no longer mirror images of each other. Therefore, they can coexist only at significantly different amplitudes. When we reduced the size of the electron/positron to 1/3 its original size, the magnitude of the charge was reduced by 1/3. The Up quark has a 2/3 positive charge, which make it the positron. Then the down quark with a negative charge of 1/3 should be the electron.

We need to reduce the magnitude of the charge by 1/3 again from the value for the Up quark of 2/3 charge. If the ratio holds true, a particle 1/3 the size of the up quark should have the right charge. So, the particle we are looking for will be 1/9 the size of the electron, which is 1/3 the size of the Up quark.

So, the predicted mass of the Down quark is 4.599 MeV. The observed mass of the Down quark is 4.8 MeV. The Down quark is the Electron at reduced amplitude due to high energy density in the Nucleons in a semi-classical model.

If quarks are indeed electrons and positrons at reduced amplitude that would help to solve “The Charge Parity Violation and the Matter-Anti-matter Imbalance.” One of the great-unsolved questions in theoretical physics is, “where did all the antimatter go?” Matter/antimatter pairs have opposite charge, and they tend to wipe each other out of existence shortly after forming. If Up quarks are indeed positrons, then a large part of this problem is solved, and shortly we will see how our old friend persistence plays a role.

How did positrons get trapped in the nucleus in the first place?

The Charge Parity Violation and the Matter-Antimatter Imbalance

The Big Bang should have produced equal amounts of matter and antimatter. Therefore, the matter and antimatter should have wiped each other out of existence, leaving an empty universe devoid of matter. We must go back in time to just before pair production starts.

When pair production first starts, there is no source field of scalar waves to replenish the energy radiated by particles, so the first particles to appear will be very short lived, even if they don't wipe each other out. But for the short time they do exist, they are emitting scalar waves, slowly building up the source field for future particles.

Even if the electron/positron were the only waveforms we look at, an enormous number of particles over a wide range of masses would be found at first due to variations in energy density. As the energy density of the universe became more uniform, so would the mass of the particles.

All these little matter/antimatter explosions from pair production have another effect. The energy density is no longer uniform, even on a small scale. Some regions will become more rarefied while others more dense.

The source field is now to the point where particles could exist for awhile, if they were not busy killing each other, that is. Then, pair production occurs near the border of a rarefied region and a dense one. One of the two particles slips into the denser region, and its amplitude is reduced. Let's make it a positron.

The particle must cross this border through the process of "barrier penetration" just the same as in the nucleons during beta decay and electron capture. This is because the border has an interesting effect on classical waves. Most important are its effects on the scalar waves that make up the source field for particles.

As we see from the study of classical waves, when a wave passes from one density to another, both Transmission and Reflection of the wave's energy will occur at the boundary. The greater the difference in density the greater the difference between reflected and transmitted wave energy.

Wave intensity is greatly affected by the density. This can best be expressed with the equation for wave intensity. I = 2pi2 f2 A2 vd where I is intensity in watts/cm2, f is frequency, A is amplitude, v is wave velocity, and d is density.

The First Quasi-Atom

Now, the pair is still attracted to each other because of charge. The lighter particle, let's make it an electron, will try to orbit the heavier one. The source field is not yet strong enough or consistent enough to ensure survival. So, many of these particles will not last for long, but the conditions for survival are no longer the same for the pair. It all comes down to the source field waves, which keeps slowly building over time.

The electron is dependent on the source waves from other particles for persistence. The positron at the center is more dependent on its own reflected wave energy from the boundary layer between the regions of density. More importantly, there is now a difference in the ratio of charged particles between these two regions.

Both particles are "bleeding to death" at different rates. However, if two of these quasi-atoms were close together, they could merge into a more stable structure. The two massive but smaller positrons could help each other survive if their regions of higher energy density were to overlap so wave energy could be directly exchanged.

Attractive forces from scalar wave activity, modeled as coupled harmonic oscillators, cannot overcome the repulsion due to charge, unless an electron comes between them, that is. When one of the orbiting electrons comes between them, then they enter the region of higher energy density. In other words: electron capture.

Two positrons and one electron reduced in size create a Photon. With one electron left over to orbit it, we have the hydrogen atom. With electron/positron pairs in a wide range of masses, this is a gross oversimplification.

However, hopefully it is sufficient enough to demonstrate how atoms could came to exist in an intuitive semi-classical model and also shows that approach to physics can be used to model complex subjects that before were considered outside its realm. Lastly, it gives us the basic information needed to finish the model of the atom that was started.

The Nucleus and Quark Confinement

The quarks can be considered harmonic oscillators just like the electron. For them to couple with each other for efficient energy exchange, the wavelength of each should have a harmonic relationship with the other ½ spin particles around them and with the sphere defining their region of confinement.

This method of treating particles as harmonic oscillators is commonly used in QM as well. "The force binding an electron in an atom is the Coulomb attraction of the nucleus, and the Coulomb interaction between two charged particles is represented by a central potential, varying as 1/r.

The three-dimensional simple harmonic oscillator potential is also central. In quantum mechanics…according to one model describing the quark structure of the nucleon, each of the three quarks is bound to each of the other two through a three-dimensional simple harmonic oscillator potential" (p. 148 [3]).

But to explain quark confinement is not enough. In the MIT bag model, the nucleons are treated as bags containing freely moving quarks. Quark confinement implies that there will not be any quark currents through the bag. The Casimir energy is associated with the bag confinement (p.355-360 [2]).

Connections between the Casimir force and the Bag model have been discussed since 1980, but the zero-point energy was in the Bag model from its beginning (p.61 [10]). In the Anti-de Sitter Bag Model, quark confinement in gauge theory is achieved by describing nucleons as strongly curved universes.

Aspects of both of these quantum models are seen in our semi-classical model. There is both refection and transmission of scalar wave energy at the boundary between regions of different density. This boundary is the “Bag” defining the region of confinement. The MIT version implies no energy is conducted through the bag, but does not forbid it.

In a stable nucleon, the net sum of energy through the bag is zero. One side has more reflected scalar wave energy, the other less, but for the energy of the nucleon to remain stable, the net sum of loss and gain through the bag must equal zero. This could also explain why large atoms become unstable and radioactive decay. Some nucleons would be shielded from the scalar waves of orbiting electrons by other nucleons or the gain and loss of energy does not equal out.

The Anti-de Sitter approach makes sense from the classical view, as well. Due to greater dependence on reflected wave energy, they are completely dependent on each other for their existence, in a very small area. The largest waveform, the Up quark, has just enough room for its extended wave, no more, and no less.

So, let us take a closer look at this boundary. If we model the scalar waves as radiation pressure, the waves from the quarks are continually trying to expand the region of dense energy, reducing the overall density, leading to its death.

The scalar waves of any intensity come mainly from the orbiting electrons. They are constantly applying an inward pressure on the nucleus. So, the electrons help to contain the higher energy density of the nucleus, and keep it there.

In the quasi-atoms we talked about, this “Bag” of confinement would not have been as well defined, until scalar wave activity helped make it so. When modeling this “Bag” over time, it would appear that the nucleon would not always be at the full classical size. As each standing wave is only at full amplitude for a brief moment and three standing waves are involved, the size of the composite particle varies slightly from the full classical size. The time difference between the states is so short, it would be very hard to detect.

Lastly, one possible effect of confinement must be addressed: the fractional charge of the quarks and how it happens. The Hall effect can be used in both a quantum and classical model. The recent discoveries of the Fractional Quantum Hall effect opens up possibilities.

If quark charge can be linked to the Fractional Quantum Hall effect, it should also be able to have a classical solution in this model. So, it is hoped that this model will continue to be of use to students in the future.

Well, that sums up the basics of a semi-classical model for the atom and the sub-atomic view. A semi-classical model will never give the precise results like QM due to the uncertainty principle, and in many cases, cannot give a result at all.

What a semi-classical model can do is provide a visual and intuitive representation of complex processes and sometimes give an approximate answer.

But, it can always be treated in a quantum manner to obtain a result. While far from a robust tool, it does have some value.

The Very Large scale: General and Special Relativity

Einstein’s landmark works are in perfect accord with this model, although it may take a minute to show this. I will defer to Einstein himself on this matter. I have already made reference to his lecture of 1920 [11]. You must remember that the Ether theory did not die easy, if it ever did. While I have tried to show that the Vacuum Energy and the Ether are functionally equivalent, this was not so obvious at the time. QM would not even confirm the existence of the vacuum energy until over a decade after Einstein gave this speech.

Today, we think of Einstein and QM as killing the Ether theory once and for all. Einstein was smart enough to see that only the concept of the Ether as discrete, real particles in space was flawed.

“More careful reflection teaches us, however, that the special theory of relativity does not compel us to deny ether (vacuum). We may assume the existence of an ether (vacuum); only we must give up ascribing a definite state of motion to it…is justified by the results of the general theory of relativity” [11].

“The special theory of relativity forbids us to assume the ether (vacuum) to consist of particles observable through time, but the hypothesis of ether (vacuum) itself is not in conflict with the special theory of relativity” [11].

This speech was meant to show Ether supporters that this old view of the Ether was flawed. General and special relativity does not exclude a different view of the Ether that is not made up of small particles. QM realized that even when all matter was removed in empty space, the vacuum left behind still had energy; hence the name, vacuum energy. This vacuum energy also had physical properties of its own. Einstein was already on this track. .

“To deny the ether (vacuum) is ultimately to assume that empty space has no physical qualities whatever. The fundamental facts of mechanics do not harmonize with this view” [11].

“Space is physically empty. But therewith the conception of the ether (vacuum) has again acquired an intelligible content, although this content differs widely from that of the ether of the mechanical undulatory theory of light. The ether of the general theory of relativity is a medium which is itself devoid of all mechanical and kinematical qualities, but helps to determine mechanical events” [11].

The ether/vacuum is “devoid of all mechanical and kinematical qualities” like friction and inertia. Einstein then goes on to describe some of the other notable aspects of the ether/vacuum that are important here.

“What is fundamentally new in the ether (vacuum) of the general theory of relativity, as opposed to the ether of Lorentz in this, that the state of the former is at every place determined by connections with the matter and the state of the ether (vacuum) in neighboring places, which are amenable to law in the form of differential equations” [11].

Einstein is pointing out here that the density of the ether/vacuum is not the same everywhere as it was considered to be in the old ether model. Because pure energy has mass in relativity, it will be affected by gravity, and this can be calculated. This means that the vacuum density of space is not the same in all locations. Another important point is that the vacuum energy of free space must be a positive value or wave activity and natural forces would break down.

This also explains why gravity waves would be so hard to detect. While the energy density of matter is high, the energy density of free space is low. The density of the medium directly affects the intensity of the wave. Thus, gravity waves would have a very low intensity that makes them hard to detect but would regain their intensity and effect when encountering the high energy density of matter. Gravity waves are just the combined effect of all the scalar waves emitted into space by the particles that make up an object.

So, there is no problem with our model and either general or special relativity. Einstein saw this new view of the ether/vacuum as a relativistic outgrowth of the old view.

"Thus we may also say, I think, that the ether (vacuum) of the general theory of relativity is the outcome of the Lorentzian ether, through relativation" [11].

However, he was not yet sure what role the ether/vacuum played in particles themselves; QM had to solve that mystery.

"We do not know whether it has an essential share in the structure of the elementary particles constituting matter" [11].

He did realize that QM would set limits based on the uncertainty principle that would affect any future model.

"Further, in contemplating the immediate future of theoretical physics we ought not unconditionally to reject the possibility that the facts comprised in quantum theory may set bounds to the field theory beyond which it cannot pass" [11].

In this speech, he makes one last point that I must agree with, and it is why at the very start I said I do not have a unified field theory. We can unite QM, classical, and relativity with scalar wave activity, but as we saw in the short section on the photon, electromagnetic theory is not directly related to scalar activity.

"If we consider the gravitational field and the electromagnetic field from the standpoint of the ether hypothesis, we find a remarkable difference between the two…the electromagnetic seems to be only secondarily linked to the ether. From the present state of the theory it looks as…though nature might just as well have endowed the gravitational ether (vacuum) with the fields of quite another type, for example, with the fields of a scalar potential, instead of the electromagnetic type."

Indeed, nature seems to have endowed gravity and particles with scalar fields instead of the electromagnetic type. Unless this can be solved at some future date, if it even needs it, there will never be a unified field theory.

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