Space,
Elastic and Impeding

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Space, Elastic and Impeding:
Two Qualities of Space Define Energy Which Defines Elementary Particles and Their Interactions

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Preface

An alternative title for this book is Einstein's Dream In A Heisenberg Brain. I must say immediately, that I possess nothing near the genius of Dirac or Feynman. One way to look at me is like a fly on a wall, something to be ignored. What do ***I*** know; I'm just a technician. But, another way is just as valid since I am not entrenched in the dogma of convention. It ***is*** possible for me to have a fresh and clean perspective of physics, seemingly unable to prove things formally, but able to sense things intuitively. I believe Heisenberg was intuitive and heuristic in his perceptions of correctness and validity in physics. He, after all, produced the first accepted formulation of quantum mechanics. Science was ripe and ready for his matrix formulation, building on it and running with its precepts.

The following formulations, due to Dirac and Feynman, proved to be more formalized, respected, and accepted than Heisenberg's. Science built on and ran with those too. But the direction that we have come is questionable. We weigh virtual particles, vector bosons, and inherent indeterminancy ***way*** too much. We put too much faith in them as valid models of reality. We are sorely ready for another Heisenberg and reformulation of quantum mechanics, more in jive with reality.

The history of physics has come full circle: from determinism to indeterminism and back. Einstein and de Broglie inspired me. And I must say again, that I come no where near the genius of those men. There seems to be two components of progress in science: inspiration and determination. If I possess any 'genius', it is the combination of those qualities.

So I must give thanks to my 'mentors': Einstein, de Broglie, and Heisenberg for inspiring me, for goading me, for pushing me into this position. God has blessed me as the vessel for their dreams and perhaps now, I have the skills and perspectives to prove them right.

This task is both blessing and burden. ***The logic and machinery of conventional quantum mechanics are impeccable, but the foundational assumptions are dubious at best.*** Physics has taken the road of conservative trepidation. It was as if a person was walking on thin ice, terrified and unsure of where to step next. They mapped the cracks and thin ice sure enough, but seemed to forget: Spring arrives.

The waves of the future crash onto the present, undeniable and inexorable. How we adapt, the choices we make, the things in which we put our faith - those will determine the ultimate fate of humankind. Adapt .. choose .. believe, but do them wisely.

Change is certain. We must employ consistent and integrative efforts in order to achieve positive lasting change. And, it is our obligation to minimize uncertainty, with respect to ***all*** relevant variables. Maximize lasting improvement while minimizing uncertainty in all its forms; that is our mission and duty. Let us proceed.

Chapter 1: The Uncertainty Principle, Its Misapplication And Misunderstanding

There are two ways to go about this: at an intuitive superficial level or at a deeper and more 'valid' level. We will do both, saving the latter for later. If we consider the two quantum principles: uncertainty and exclusion, which is deeper? Which is more core to quantum mechanics?

I believe the fermion exclusion principle, discovered by Pauli, has more profound implications and is more telling in terms of natural laws. The basis for the principle is the fact that two objects cannot occupy the same space, but this is the macroscopic analogy and there are subtleties to consider.

Precisely stating the principle, no two fermions can occupy the same ***state*** at the same time. Embedded in that statement, is the fact that fermions can have two spin states: ±1/2. This explains why, for instance, there are never more than two electrons per sub-orbital. They are at the same energy level, but with different spin states.

Though intuitive, this superficial treatment of exclusion belies the true nature of fermions. It is a fact, there are two kinds each of: protons and electrons. And, at this moment, I am not referring to antiparticles. The concept of chirality best introduces this. As it is defined: angular momentum vector co/anti-sense-aligned with velocity vector, but this is only an introduction to the idea.

We will defer our explanation of fermion spin and focus on photons. Perhaps the most important fundamental constant in our universe is the quantity $\hbar$. It describes the fundamental unit of angular momentum. We will not investigate the actual numerical value of $\hbar$; that is a cosmological consideration. But, we will discuss its ubiquity and centrality.

$\hbar$ is the magnitude of photon spin - ***all*** photon spin. All photons have spin $\pm\hbar$. This translates to left or right chiral (sometimes called helical, when describing photons); as our universe would have it, photons spin co-sense-aligned with their path of travel - or - anti-sense-aligned. The fact of these alignments is similar to the numerical value of $\hbar$; we will not discuss the cosmological significance. But, the consequences of that spin and alignment are far reaching. They allow us to understand uncertainty intuitively.

The standard uncertainty relation expressed by $\Delta x \Delta p \geq \hbar/2$ can be derived from 'first principles' in about two pages of text. Is it coincidental $\hbar/2$ is the same value as the magnitude of fermion spin? Or 1/2 photon spin? Again, we will consider these questions later. What we wish to address presently is photon interaction with an electron.

This can happen in two ways: the photoelectric effect or Compton scattering. In either case, momentum is transferred from photon to electron. Let us consider the case where a photon is entirely absorbed by an electron; the momentum is entirely transferred, E/c. The question is: does chirality of the photon affect momentum transferred? Let us take the naive approach and assume there is a connection.

This naive approach explains uncertainty quite nicely. Uncertainty in position-momentum arises from uncertainty in chirality causing momentum transferred to be $\pm\hbar$. Admittedly, this approach is superficial and easily criticized. A deeper explanation of uncertainty will be presented after the following paragraph.

The gravitational uncertainty principle expressed by $\Delta x \geq \hbar/\Delta p + L_p^2\Delta p/\hbar$ implies $\Delta x \geq 2L_p$, where L_p is the Planck length. This is not necessarily a consequence of superstring theory or spacetime foam, but can be derived within general relativity. The interpretation of the relation follows. "If the photon momentum and Δp are chosen to be very small, then the electron position is imprecise because the long photon wavelength gives poor resolution. If the photon momentum and Δp are chosen to be very large, then the gravitational field of the photon makes the electron position very imprecise." The authors, Adler and Santiago, go on to discuss minimum position uncertainty. (It will be seen later, that their conclusions are correct, that gravitational interaction does play a role in uncertainty, but their understanding of minimum uncertainty is incorrect.)

The following alternative explanation of uncertainty is based first on the fact that like fields interact. The only assumption required is that energy in e-m field oscillates with energy in gravitational field. The general form of the oscillation can be described by $E = E_e + E_c = E\sin^2\theta + E\cos^2\theta$, where E_e is energy in e-m field, E_c energy in curvature of spacetime, and θ internal phase. The concept was inspired by considering the Poynting vector, the power flow*, within a photon over time. Neglecting relativistic effects, ***position-momentum uncertainty is caused by uncertainty in phase*** since gravitational interaction is mediated by ***phase coincidence*** of curvatures through the physical domain of interaction. Explicit models, including relativistic effects, will be detailed later. These same models explain tunneling and the nature of Bremsstrahlung radiation. *Power flow is defined to be the cross product of two vectors, representing electric and magnetic field intensity. If we consider a transverse electromagnetic wave, one representation of a photon - and be careful of helicity, the magnitude of power flow is proportional to $\sin^2\theta$, so the model is imprecise. The integral of $\sin^2\theta$ is of the form $\theta - \sin\theta\cos\theta$, representing the accumulation of flow. This accumulation is the energy in field/curvature at any instant. So, the precise form of energy content should involve a function of $\theta - \sin\theta\cos\theta$.

The objectives here are: to create an alternative to conventional probabilistic quantum mechanics from a semi-classical point of view, with a minimum of required assumptions, and sufficient sophistication to explain the richness of results found in various relevant gedanken and actual experiments. The goal is ***not*** to reformulate the machinery of quantum mechanics; that would be a futile effort since most is linear algebra - essentially perfect in form. It is the ***assumptions*** we attack and strive to replace: inherent indeterminancy with internal oscillation, virtual particles with field/curvature, and vector bosons - the same.

The motivations for this approach are many: proton decay, multiple dimensions, renormalization, the Higgs mechanism/boson, spacetime foam, and differing definitions of uncertainty. Proton decay is a consequence of grand unified theories; none has been detected. Multiple dimensions are required by string theory which are elegant, but many question their connection with reality. Both Feynman and Dirac, among others, were dissatisfied with renormalization, an essential part of quantum electrodynamics. The Higgs boson has not been detected - just as the limits of allowable detection are eliminating spacetime foam. "Hence, if future experiments show that spacetime fluctuates at a level smaller than our prediction.., we will know that our current understanding of semiclassical gravity and black hole physics may need a considerable revision." wrote Jack Ng. He is a fervent supporter of spacetime foam, but recognizes the possibility that it may not even exist.

I consider frame-dragging, a prediction from relativity, to be a minor adjustment in the theory. If it turns out to be wrong, no great loss - relativity need not be dismantled nor discarded. But, as Jack Ng acknowledges, quantum foam and black holes are inextricably interlinked; eliminate one and the existence of the other comes into serious question. It can be seen that a fundamental assumption of probabilistic quantum mechanics, if proved wrong, could collapse the entire structure like a house of cards.

Again, the math is not in question. But, assumptions dictate perspective and interpretation. I admit that I may be wrong about deterministic quantum mechanics and its associated assumptions. Could the founders of the standard model say the same thing? I admit, many of my propositions are mere speculation at this point - such as the explanation for quantum interference. I propose, for that issue, a spatially extended model for fermions and photons, specifically - their gravitational fields. I propose a soliton-like three-dimensional wave, self-interfering through an appropriately arranged double-slit arrangement. The details of such a model, I believe, can be worked out, given sufficient time, determination, and inspiration. (It may be - that the oscillatory nature of the e-m field is enough to explain self-interference. We will have to wait for the results of the numerical simulation, to be presented below.)

Two people, to my knowledge, made such efforts: Einstein and de Broglie. De Broglie gave up much too soon and Einstein was, perhaps, too entrenched in his own set of assumptions and perspectives - to ‘see the light’. Perhaps he was too close to the problem. In any case, I believe we gave up much too early on determinism with respect to quantum mechanics. *This book is an effort toward one of two things: vindicating determinism - or - laying it to rest, for good.*

Let us make small sure steps exclusively toward one - or the other.

Chapter 2: Uncertainty Continued

The misunderstanding of uncertainty has derailed scientific progress to such an extent that it must be pursued like a mad dog, frothing at the mouth. A heuristic description follows. Let us list the left-hand-sides of the relations again:

$$\Delta E \Delta t$$
$$\Delta x \Delta p$$

The traditional interpretation of uncertainty is: try to decrease one part, the other part increases proportionately. Naive, I respect it. I also respect attempts at a deeper understanding like Adler and Santiago's approach mentioned above. They shed light, even being misguided. But, propositions like quantum foam, in part - there to explain uncertainty, are dangerously misleading.

There are two sources of uncertainty in each relation, one for each component: the uncertainty in energy is there because energy ***varies in form*** within a photon/fermion, time is there because that oscillation is completely dependent on the *internal period* of that photon/fermion, position is there because the photon/fermion has ***time varying spatial extent*** (for fermions: not the primary radius, but the secondary radius associated with the expansion of space) related to semi-classical radius (we will consider the options, on how to look at this, later), and momentum is there because mass/curvature also varies with the internal period (out of phase with e-m field).

The mere fact that uncertainty in position dictates uncertainty in position-momentum, because a photon/fermion has spatial extent, does not address the heart of the matter. The fact a fermion has a ***relativistic radius*** of exact extent - does. *Trying to localize that fermion better than its spatial extent* (in other words, minimize position uncertainty, smaller than its radius) *is almost meaningless* (or equivalently, trying to minimize uncertainty in time, shorter than its period). It's like trying to describe a partial wave; it makes no sense without explaining in context of the full wave. Similarly, a fermion has a ***relativistic period***, exactly determined by its speed:

$$\Delta E \Delta t \quad T = T_0/\gamma$$

$$\Delta x \Delta p \quad r = r_0 \gamma$$

Relativistic-period is rest-period divided by gamma, the relativistic factor, γ = sqrt(1-(v/c)^2) (in literature, gamma is traditionally the inverse of what I have defined; it does not matter, as long as we are consistent). Relativistic-radius is rest-radius multiplied by gamma. (At this point, the uncertainty relations may be rewritten: $\Delta x \geq r$, $\Delta t \geq T$. Continuing this reasoning, we may construct a new uncertainty relation called position-time uncertainty: $\Delta x \Delta t \geq rT = r_0 T_0 = \lambda_0^2/2\pi c = cT_0^2/2\pi$. The components are orthogonal, but I question the validity of trying to increase precision in one component at the expense of the other. However, if we calculate the minimums for electrons and protons, they are ~10^{-33} ms and ~10^{-39} ms, respectively. This is in stark contrast with Adler and Santiago's results. More thought is required on this matter.) As with the actual numerical value of $\hbar$, the fact our universe dictates the actual form of these equations - is beyond the scope of this book. (Cosmology is fascinating. The equation $\lambda = (c - v^2/c)T$ encodes a ***tremendous*** amount of information about our universe. The relationship between space and time - and special relativistic effects - are all there. Similar equations can be arranged for fundamental properties of fermions, which are beautiful in their simplicity, but that discussion can be delayed.) There is a deeper perspective of the equations however:

$$\Delta E \Delta t \quad T = T_0/\gamma \quad t\gamma$$
$$\Delta x \Delta p \quad r = r_0 \gamma \quad x/\gamma$$

Period seems to lengthen as speed increases; radius seems to contract, but something else is going on. Einstein proved, indeed, that special relativistic effects are geometric in origin: the effects are dependent on the observer's reference frame, relative to the observed. But, the effects are no less real, with measurable consequences, than anything else. The insight here is that, actually: ***local time contracts; local space expands; particles are invariant***.

Professionals will balk at the adjective 'local', but it is important not to get confused at this point in the presentation. Local refers the point in spacetime, the particle exists, with the extent determined by its radius and period. That logic sounds circular, but if we define a particle at rest to be at rest - associated with the observer's reference frame, the confusion disappears. If the reader feels bogged down in assumptions, if they ask: "What's the point!?", I ask they have some patience. This theory took years to evolve, within a self-consistent framework. If I presented details - as they precipitated, things would be worse.

There are tests for the theory; a theory cannot be offered without tests of its validity. One such experiment is what I call Plate-Torque: a circularly polarized beam of photons exerts a measurable torque on a plate - the beam is directed at. How much that plate moves - is exactly determined by its mass and applied torque: T = ma*. This is obviously an expression of Newton's Second Law: torque equals mass times angular acceleration. The utility here is that I predict a measurable difference in acceleration, due to gravitationally induced relativistic effects, between here on Earth's surface and deep space. *The correct form of this equation follows the argument: $\mathbf{p} = m\mathbf{v}$, momentum equals mass times velocity, ⇔ $p' = mv' + m'v$ ⇔ $\mathbf{F} = m\mathbf{a} + m'\mathbf{v}$, where $m' = m_0v/(c^2(1-(v/c)^2)^{3/2})$. The second term is negligible for non-relativistic systems. The movement of the plate is clearly non-relativistic, even though we are looking for a relativistic effect! (The formula T = ma is strictly not correct. From mechanics, T = Ia, where I is the moment of inertia. For a disk, $I = .5mr^2$, axially.)

The point is: ***consistency between special relativistic effects and those of gravity***: length contraction, time dilation, and mass increase. Time dilation has been proven to be consistent between special relativity and gravitation. This means: the effect is real and measurable - and - consistent with local energy density.

Another test I call Gravitational Enhancement: this experiment determines the extent of spatial curvature augmentation for a rotating massive body, due to relativistic effects. A spinning massive body, like Earth, has an oblate gravitational field - corresponding to its oblate shape. This can be calculated and subtracted out, from the measurements. What is left are: regional variations in gravitation -

anomalies - and gravitational enhancement. The cause of the anomalies is unknown - perhaps density variations in Earth's composition. The gravitational enhancement I predict is due to the rotating mass near the equator which should produce a measurable increase in gravitational field - colinear with direction of motion. Since motion is tangential to rotation, the cumulative effect is a slab coplanar with the equator. Gravity Probe B will begin the science phase of its mission very soon. The precision of its instrumentation should allow measurement of oblateness, anomalies, and enhancement. I wait in eager anticipation for the results. The point is progress, whether I'm right or wrong. For the record, I also predict no detection of frame-dragging. That effect, and its associated assumption, is not consistent with my theory.

Space is like a frictionless track with only one degree of freedom: length. You can stretch it, but you cannot bend or twist it. Those are my assumptions, but no evidence supports going outside the gravity-relativity framework. Whether space can be compressed is another question entirely. That would correspond to negative-energy in curvature. I concede that it may be possible, but conceptually undesirable. (This issue will resurface later when we consider oscillatory energy and its relationship to kinetic energy, if any.)

This intricate diversion into relativity may seem distracting, but is required for full treatment of uncertainty - as is the following description of energy oscillation within fermions/photons. The details of the terms change between them (between fermions and photons), but the form remains. To introduce them, recall the two expressions for kinetic energy: low energy approximation and exact:

$$(1/2)mv^2 \qquad E_0(\gamma^{-1}-1)$$

After simplification, setting $c = 1 = m$, the functions can be seen to coincide for $0 < v < .1$. This shows the true genius of Einstein. $E_t = E_0 + E_k = E_0 + E_0(\gamma^{-1}-1) = E_0/\gamma$ = relativistic energy. So, total energy equals relativistic energy. The divergence of the functions for $.1 < v < 1$ simply means the low energy approximation loses its valid domain of application. If early physicists knew about relativistic effects, they would have revised the expression for kinetic energy earlier.

The accepted form of exact kinetic energy and associated relativistic scaling factor, however, belie the underlying oscillatory nature of elementary particles; they are deceptively simple:

$$E_0(\gamma^{-1}-1) \quad \gamma$$

Note the form of kinetic energy: it is a function of rest energy and scaling factor. The scaling factor itself is used to determine relativistic effects:

$$m = m_0/\gamma \quad T = T_0/\gamma \quad r = r_0\gamma$$

These are stated in conventional terms - mass increases, time slows down, length reduces - only to avoid confusion. Now we are ready to introduce a formal description of energy oscillation within a fermion:

$E_0 = E_0(1)$
$\quad = E_0(\sin^2\omega t + \cos^2\omega t)$
$\quad = E_0\sin^2\omega t + E_0\cos^2\omega t$
$\quad \approx e^2(Z_0\omega_0)(\sin^2\omega t) + m_0(c^2)(\cos^2\omega t)$ (and, dividing by gamma implies)
$E \approx e^2(Z_0\omega_0/\gamma)(\sin^2\omega t) + m(c^2)(\cos^2\omega t)$
$\quad \approx e^2(Z_0\omega_0/\gamma)(\sin^2\omega t) + m_0(c^2)(\cos^2\omega t)/\gamma$

Most readers can follow until the third line. The association of mass with $\cos\theta$ and charge with $\sin\theta$ is completely arbitrary and only done for ease of understanding. Supposing there is some form of internal oscillation within fermions, one must construct a model. This is the simplest model I can generate. Another simple model was created for comparison without trigonometric exponents, but required more scaling constants and was less elegant. It seemed to perform better with conventional exact kinetic energy, but again - was inelegant. After understanding the scaling constants built into the above model, its performance seemed adequate to move forward. The assignments were arbitrary, as stated, but the groupings are critical. First, $E_0 = \hbar\omega_0$. Next, the derivation of $\hbar \approx e^2Z_0$ can be done with dimensional analysis. And, of course, $E_0 = m_0c^2$. The meaning of omega is relativistic angular frequency, $\omega = \omega_0\gamma$. Note as speed goes up, angular frequency goes down. The 'heartbeat' of the particle slows. This corresponds to a longer period, so the model is consistent. (Charge is relativistic invariant. That is why gamma was associated with ω_0 above. It is the only parameter in that first term that can be operated on. This will be investigated further, later.) As stated, the groupings are critical for understanding: the first parameters are those being operated on, the second set are merely scaling terms - for unit conversion, and the third factor, modifying energy in mass, literally jumps at the eyes - begging for attention. It reminded me instantly of the relativistic scaling factor and exact kinetic energy:

$$(\cos^2\omega t)/\gamma$$

Here we have an oscillatory term containing relativistic frequency and energy factor. Comparing a simplified version with conventional exact kinetic energy, shows the function behaves well at low resolution, over many periods. As expected, the granular nature of the function appears under high resolution, or few periods. Two other problems crop up: time averages and the seeming inconsistency between relativistic parameters. Let us deal with the latter first:

$$c = \omega_0 r_0 = (\omega/\gamma)(r/\gamma)$$
$$= \nu_0 \lambda_0$$
$$= (1/T_0) \lambda_0$$
$$= (1/T\gamma)\lambda/\gamma$$

Some fundamental identities will help: $r = \lambda/2\pi$ and $\omega = 2\pi\nu$. Further, the assumption that rest parameters relate identically to c requires no great leap of faith. The ‘trick’ is to realize that as radius decreases, so does wavelength. But, that does not necessarily imply a shortening of period, as we know! Again, this structure embedded in our universe - cannot be explained in this book; we leave that for divine inspiration.

Professionals may balk again at this point exclaiming “Too speculative!”, but the assumptions I have put forth so far are the minimal set, in my estimation, for implementing a deterministic view. Truly, the more I learn of the conventional and accepted standpoint, the more I admire the sophistication and maturity of the mathematics employed to describe it. Again, I have no issue with the math; it is the underlying assumptions I object to. Although it did not come from PQM, frame-dragging and its associated degrees of freedom on the ways to distort space - is a good example.

Before the patience of the reader wears thin, let us deal with the problem of time-averages. If $m_0(c^2)(\cos^2\omega t)/\gamma$ represents the continuously varying portion of energy residing in mass at any one moment, what is the time-average, and how does that relate to what we measure? First I must reemphasize that the term may superficially describe energy in mass, but the deeper perspective is energy in curvature of spacetime. Gamma represents the special relativistic factor, enhancing curvature. $\cos^2\omega t$ represents the oscillatory nature of energy form, including its own relativistic factor. The reason gamma appears twice in the function should be clear: one for overall effect, to be consistent with relativistic mass/energy, and two - for consistency with relativistic effects on internal frequency. $\cos^2\omega t$ varies from zero to one, symmetrically. The average of that factor is 1/2. That makes the time-average of a particle at rest appear to have $(1/2)m_0$. (No, this is incorrect. After some reflection, I realized this is a non-issue. The problem arises when we cling to the notion of mass. If we time average line five above, relating relativistic energy to its components, we get $E = .5\hbar\omega_0/\gamma + .5m_0c^2/\gamma = E$. I will not delete the following argument, so you can glimpse my train of thought. (Honestly, that last statement seems like rationalization, but the spirit is justified, as you can read at the end of the book.)) The only solutions are: use a different scaling factor for relativistic-oscillatory enhancement of mass, change models to something scalable, or discard energy oscillation. The last option would end this book. In the interests of optimism and diversity in perspective, let us consider its alternative and continue. If energy does not oscillate within a particle, it must manifest in dual-form. No oscillation means: a static electric field with static flux permeating surrounding space - total flux equals charge, a static magnetic field representable by magnetic moment, and static curvature measured as mass. If we deny the existence of virtual particles, we must explain the apparent energy content of all three quantities in semi-classical terms. This can be done, for an electron, in closed form - that takes on an apparent geometric origin with dependency on alpha, the fine structure constant. Incidentally, or not, an electron orbits a nucleus at Bohr radius, in equilibrium with electrostatic attraction and orbital speed, at αc. Many 'coincidences' can be discovered, such as the freedom for elliptical orbits. But, in my research, I discovered the 'dead end' of this classical approach: one being - magnetic moment. If you create a model for electron magnetic moment, you would expect something similar for protons, perhaps augmented to account for greater mass. But, the semi-classical static model for proton magnetic moment has nothing in common with that of electron magnetic moment. Another dead-end is the inability of the static approach to explain the weak nuclear force. Perhaps my insights are too limited; perhaps my understanding not deep enough, but in the quest for symmetry and parallels, I have abandoned the semi-classical static model of elementary particles.

Next, testing one alternative model of oscillation does not constitute good science and rejecting it based on inelegance - is weak and I admit - narrow minded. The only legitimate excuse I have is: in the interest of time. I estimate that a fully developed theory of energy oscillation within gravitational-relativity would take me ten years of part-time effort. This is too long for my preferences. Even though it sounds lame, I would rather present a half-baked idea than miss my chance due to some unfortunate accident. At some point in writing, I must decide to publish.

The final available choice is selecting a scaling factor for relativistic-oscillatory mass. The precedent is available: exact kinetic energy is different from the relativistic scaling factor. There is nothing prohibiting me from using an augmented scaling factor operating on mass. The assignment is arbitrary and ad hoc, but performed in faith - a valid rationale will surface in due time. The other, more major, issue concerns kinetic energy and the new scaling factor. Most physicists would dismiss this entire theory based on one seeming inconsistency: if mass oscillates, then so does kinetic energy, and therefore velocity. The particle should pulsate along its line of flight between some speed and the speed of light. Although intriguing, this logic is faulty. A moving particle is like a photon: a propagating oscillating wave of energy. True, a particle has charge and a spin that does not have to orient the way photons behave, but they are more alike than different, in terms of oscillating energy. So, if you find yourself confused about oscillating mass, recall that mass is nothing more than what we measure - from the deeper underlying mechanism of curvature. Energy oscillates, whether in photon or fermion, between curvature of spacetime and electromagnetic field. Reexamine exact kinetic energy: $E_0(\gamma^{-1}-1)$. It is a function of rest energy and speed; it ***is*** relativistic energy E_0/γ - E_0, the portion between them. (We call E_0/γ 'relativistic energy', but a better name for it is 'total energy'.) So, it is not inconsistent to speak about enhanced oscillating curvature. The enhancement is relativistic energy = kinetic energy = energy due to movement.

We complete this chapter considering a model of gravitational interaction, inspired somewhat by Adler and Santiago. Let us imagine a photon encountering an electron. Let us embrace, for this example, the oscillatory-relativistic model presented thus far:

$p_e = mv = (\cos^2(\omega_e t + \theta_e)/\gamma)m_0 v = k_e m_0 v$

$p_\gamma = m_\gamma c = \cos^2(\omega_\gamma t + \theta_\gamma)E_\gamma/c = k_\gamma E_\gamma/c$

$p_i = p_e$

$p_f \approx k_e m_0 v + k_e k_\gamma E_\gamma/c$, assuming spatial coincidence.

p_e is electron linear momentum. The subscripts simply denote relativistic angular frequency and ***unknown*** initial phase, unique to the electron. p_γ is photon linear momentum. The gamma subscript simply refers to mass-equivalent and energy contained. This subscript has nothing to do with relativistic scaling factor. The symbol γ has two common uses in physics: relativistic scaling factor and generic symbol of a high-energy photon, a gamma ray. The other subscripts are associated with the unique angular frequency and ***unknown*** initial phase, of the photon. p_i is the initial momentum, before encounter. p_f is the final momentum, after encounter. It should be clear that the ***only*** unknowns, that can dictate uncertainty, are the initial phases. Therefore, the parameters that ***define*** uncertainty are: *unknown initial phases*. As stated previously, this treatment is based on the fact: like fields interact. The same analysis can be performed for electromagnetic interaction.

Chapter 3: Spin, An Introduction

There has been much fanfare and celebration in the discussion of spin for elementary particles. The conventional position is similar to its perspective of quantum mechanics: if you think you understand spin, you probably don't. As discovered by Pauli, spin is a spinor: a matrix-like object, defining fermion angular momentum. As an aside, it is useful to briefly discuss the difference between the words: discovery and invention, in science. Discovery implies a natural feature of the universe, waiting for human perception. Invention implies a tool developed for control or ease of understanding. Invention, by itself, does not imply discovery of a universal natural feature. It is appropriate to say "Planck discovered $\hbar$", but not exactly appropriate to say "Pauli discovered spinors". Pauli ***invented*** spinors; the 'jury is still out' on whether his spinor model of spin is truly appropriate for our universe.

Pauli was a genius. I cannot deny that. His model for spin fit conventional probabilistic quantum mechanics nicely, consistently. The admiration in the community has not diminished with time. His name ranks with Heisenberg and Dirac. But, like those great men, Pauli was immersed in the Copenhagen perspective. *When a theoretical physicist approaches a problem, it is first their assumptions - that provide a basis for solution.* Most times implicit, *it is the assumptions that frame a problem.*

A brief diversion into heuristics is in order. I have been trained in the language of systems science, a holistic engineering field linking concepts from many: electrical, mechanical, ecology, and meteorology, to name a few. Differential equations and linear algebra are the primary tools employed by systems analysts. Another area I received training in: statistics and probability, with its deep foundation in mathematics. I have learned in logic, perhaps the most important theorem in mathematics, Godel's Incompleteness Theorem: briefly, logic cannot assert its own consistency. This is ***not*** to say: we must abandon logic. I raise it to illustrate logic's *limitations*.

This makes a point clear: *the solution to unification may come from outside physics*. I suggest: electrical engineering - specifically, using the impedance of space, as a unifying concept. Physicists will balk yet again: the number, 377 ohms, is meaningless or contrived at best. But, it is this quality of space and the twist-and-fold topology of elementary particles - that inspired the rest. That topology will be explored later. First, we must finish our digression into heuristics.

To continue 'setting the stage', I must point out that I have not studied formal quantum mechanics until now. Many will stop reading now, closing this book, never to return. I beg your patience, however. There are two serendipitous consequences associated with my delay: 'clean mind' and adequate preparation. I needed the time to develop my formulation of quantum mechanics unclouded and uncontaminated by the Copenhagen perspective. I also needed the time to prepare for my thorough understanding of it. The tools employed by systems science and statistics are the same for quantum mechanics, albeit with somewhat annoying notational differences. To be able to extract the salient features inherent in the ***tools*** versus the ***models***, is my current task. In other words: *what properties are consequences of the math employed - and - what properties are consequences of underlying assumptions?*

Both physics and engineering are 'guilty' of taking whatever math they feel appropriate for their needs. In this sense, physics and engineering can be called 'applied math'. To be fair, the selection is not arbitrary. In most cases, there is a precedent, or insight, or compelling argument linking reality with the tools employed. But, let us be absolutely clear about the differences I outline above. Take a specific example. A differential equation can be employed and solved, to describe a dynamical system, such as particle trajectory under forces and constraints. This is a tool borrowed from mathematics. The model is the ***specific form*** of differential equation, with associated stipulations and assumptions. The distinction may seem blurry to some and indeed, the features associated with one or the other may be difficult to extract, but with practice, the procedure ultimately allows traceability.

Consider the procedure for decoupling a system. Or, consider separation of variables. These are analogies for what I am referring to. The model for conventional probabilistic quantum mechanics is traceable to the fundamental assumption that $\psi\rangle$, the state vector - describing the behavior of a quantum system, is actually a set of ***probability density functions***, containing the information of the quantum system (strictly speaking, ψ^2 is a density function, but the spirit of the statement is correct). The typical justification for this approach are the results of double-slit experiments, evidencing quantum self-interference - even for a single photon or elementary particle!

Because there is no classical analogy and because the only available paradigm existed in statistics - at the time, in the development of quantum mechanics, it was only natural for physicists to extract the model and associated tools from statistics. They combined that with the tools of linear algebra and differential equations, based on the Lagrangian formalism, culminating in the Feynman path-integral formulation. This is the pinnacle of modern quantum mechanics, the frame for the crown-jewel.

But, there were three missing concepts that were overlooked by the community. The first concerns double-slit experiments. The fact - the separation between slits was always within an order of magnitude, near the wavelength of incident particles - was ignored. Because of that seemingly inexplicable self-interference, apparently encoding all possible states, internal oscillation was overlooked. And, because of that, the actual topology of fermions was never discovered.

So of course, the point in the history of physics, where models diverged from reality, was when we tried to ***explain*** self-interference. Ignoring and overlooking: apparatus dimensions relative to incident wavelength, internal oscillation, and internal topology - placed us on the path where we find ourselves today. *We have an elegant mathematical structure that describes the statistical behavior of quantum systems, without understanding the underlying* *mechanisms.* It's like looking at a river: we see ripples on the surface, but know nothing of currents underneath. Our observations and predictions are summary and superficial.

Heuristics is all about properly *framing problems*. ***Properly frame a problem - the solution presents itself***; choose an appropriate model for a system - the behavior becomes clear. *Perspective is everything.*

Returning to physics and spin, before we investigate topology, we must reexamine energy. Aside from the elastic quality of spacetime and impedance, there is nothing deeper than the following realization: ***there are only two kinds of energy in the universe, electromagnetic and gravitational***. Kinetic and potential are manifestations of the others. Because of the equivalence between gravitational energy and special relativistic effects, kinetic energy translates to gravitational energy. Pumping up kinetic, elevates relativistic, enhancing curvature. Potential refers to a spatial difference of something. That could be electric field, magnetic field, or curvature of spacetime. The next deeper realization is that: ***for each of the two kinds of energy, there is a corresponding quality of space, impedance and elasticity***, which allows energy content/expression in their respective form.

A hidden point reveals itself: time is elastic; it can store energy. This may boggle the mind of some, but wait for the next point. Perhaps the deepest realization of all, in this context, is that: ***what impedance and elasticity allow can be treated as different forms of curvature***.

This is where I become 'my worst enemy', following the logic of this discussion, and adopt the premise of multiple dimensions. Since spacetime requires four and each form of curvature requires one for each, a model of our universe, from the curvature perspective, possesses six dimensions. I am not betting my life on this proposition; I do not wager the entire theory. It is merely a logical conclusion of connected observations.

For those with the patience to endure 'tromping through the swamp' above, we finally investigate the topology of fermions. I did not initially propose the basis for this discovery. Auto-confinement or self-confinement of photons comprising elementary particles was proposed long before I was born. The 'stumbling block' impeding progress along that route has been the actual mechanism for auto-confinement. It has been developed, but in controversial journals. In any case, we will assume that near the beginning of our universe, elementary particles precipitated from the energetic 'photon soup' filling space before such particles existed. These are protons, electrons, and neutrinos. To visualize the process, envision mutual annihilation in reverse.

Whatever the process, the simplest topology, that explains the difference in spin between photons and fermions, is the twist-and-fold. This same topology incorporates chirality. Using wire models appropriately labeled, it is possible to visualize the various configurations. Grasping the wire model at electromagnetic minima, there are four ways to twist and fold it. But, two sets are identical. This produces two kinds of fermion from each kind of photon: left-chiral and right-chiral. Analogies abound. Perhaps one of the most interesting explains the two types of hydrogen: ortho and para. Another example concerns neutrinos. They are more confusing and intriguing because, so far, only left-chiral neutrinos and right-chiral antineutrinos have been detected. This illustrates the difference between chiral systems and single entities - and is another good illustration of the differences between the standard model and deterministic quantum mechanics.

Because the core premise of the standard model is: particles are probability waves, even their ***identity*** can change. A good illustration of this concept is neutrino oscillation - a consequence of newly discovered neutrino mass, conveniently explaining the neutrino deficit (the aggravating discovery that far less neutrinos have been detected, as predicted by convention, from solar nuclear reactions). But, doesn't this open a 'can of worms'? Shouldn't we detect proton decay or electron oscillation? A far simpler