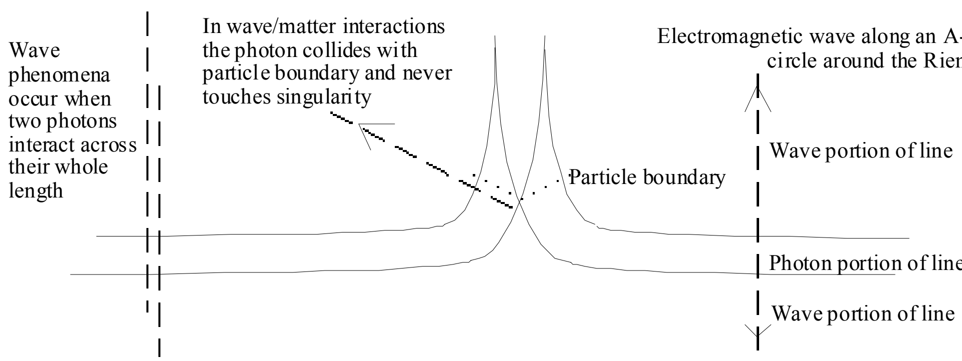
TOEs, fingers and the nose on your face

[Continued]

c. Specifics of the model

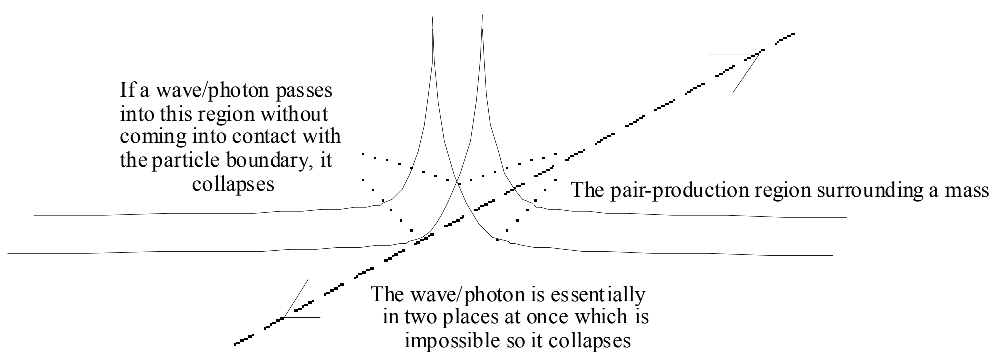
The representation of electromagnetic waves/photons in the five-dimensional universal field model is both simple and straightforward. As already stated, the electromagnetic wave lies along an A–line, with the photon/particle portion being that segment of the line that cuts across the 'effective width' of the space-time sheet. When two or more waves interact across the whole length of their lines in five-dimensional space, wave phenomena are observed. On the other hand, when the portion of the wave crossing the 'effective width' of the sheet, the photon portion of the wave, interacts with matter, the electromagnetic wave acts as a particle. There is no true wave/particle duality.



The wave is a complete closed line on a Riemannian sphere, cutting across the sheet while it remains perpendicular to the sheet. It has only two ways of interacting, one of which is wave to wave and the other that is wave to particle. An electromagnetic wave is restricted to interact with a particle as a photon because it comes into contact with a particle by physically touching the particle boundary within the 'effective width' of the space-time sheet before it can come into contact with the perpendicular surface of the singularity portion of a particle.

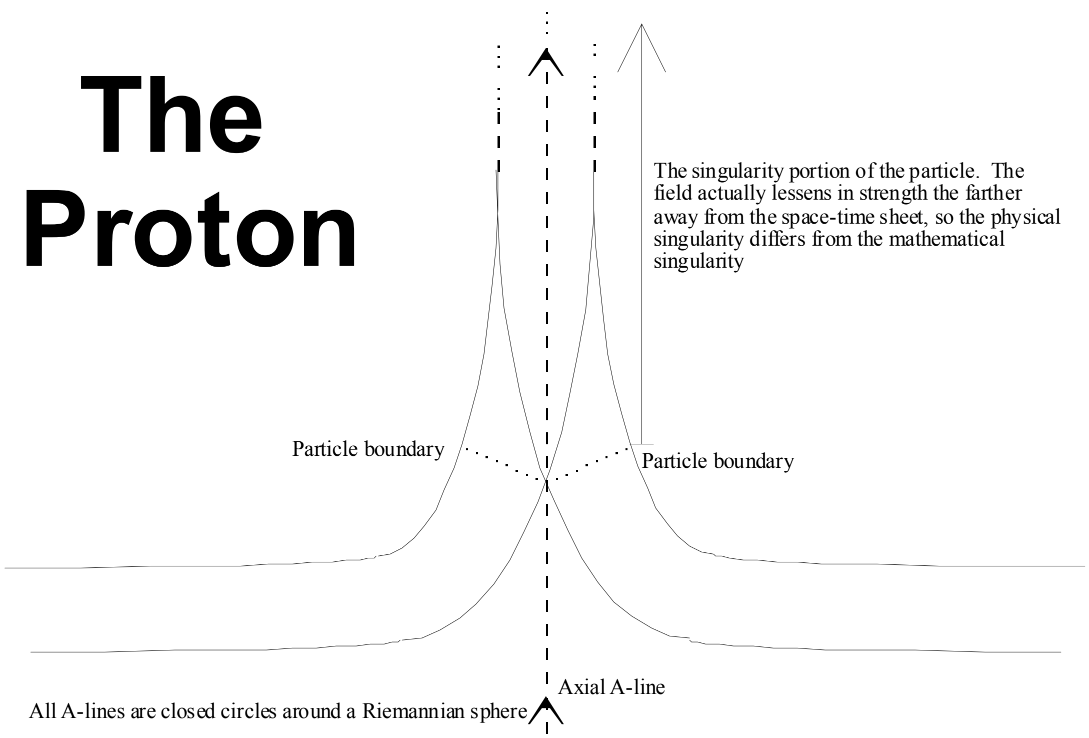
Another curious feature of electromagnetic waves is the ability to propagate through space either as a spherical wave surface or a photon. The reality along the A-line is actually both. In the above diagram, the A-line is only depicted in one of the three dimension of normal space. Since the electromagnetic wave is not restricted to a curved surface of the sheet in space-time, although it is connected with all else in the universe across A-lines in five space as are particles, and the connectivity/interstitial constants (μ_o and ν_o) are equivalent in all directions of space-time, the electromagnetic wave is not restricted to a single position in three space but can propagate naturally in all directions. There is a corresponding decrease of intensity at any position in three-space according to the inverse square of distance, but this is a characteristic of the structure of space itself. Electromagnetic waves can thus propagate as a wave front. However, when individual waves interact with matter, as described above, anywhere along their wave front, they do not continue to spread out in space. Instead, they collapse to photons. This action is equivalent to the 'collapse of the wave function' in material particle interactions. Since the collapse takes place only in five-space in a direction perpendicular to the space-time sheet, the connectivity constants play no role in the collapse, which occurs instantaneously. Under special conditions, photons can be coupled together to act in concert, such as in a laser beam.

Electromagnetic waves can interact with matter in yet another way, through pair production. If an electromagnetic wave/photon comes close enough to a particle or group of particles without boundary contact, it still follows the space curvature that extends beyond the boundary of the particulate object. If the curvature is steep enough, the A-line, which the wave/photon follows, will make contact with the space-time sheet on both sides of the particulate object simultaneously.



The wave/photon cannot exist in two places at once so it collapses with its energy being equally shared by an electron and an anti-electron. Since symmetry must prevail and charge and energy conserved, these two particles will be the same as far as normal space is concerned except that they will have opposite electrical charges. These two particles will, however, have opposite curves in the space-time sheet. The particle having a curve on the underside of the sheet is an anti-particle. All anti-particles are characterized by having curves on the underside of the sheet. The underside of the sheet is just that portion of the sheet that lies on the inside of the five-dimensional Riemannian sphere. Due to the conservation/symmetry rules, the particles are identical in all respects except for their opposite charge and oppositely directed curvatures extending from the space-time 'sheet.' More will be said about anti-particles below, after the fundamental particles are discussed.

The major elementary particles of any concern are the proton, the electron, the neutron and the

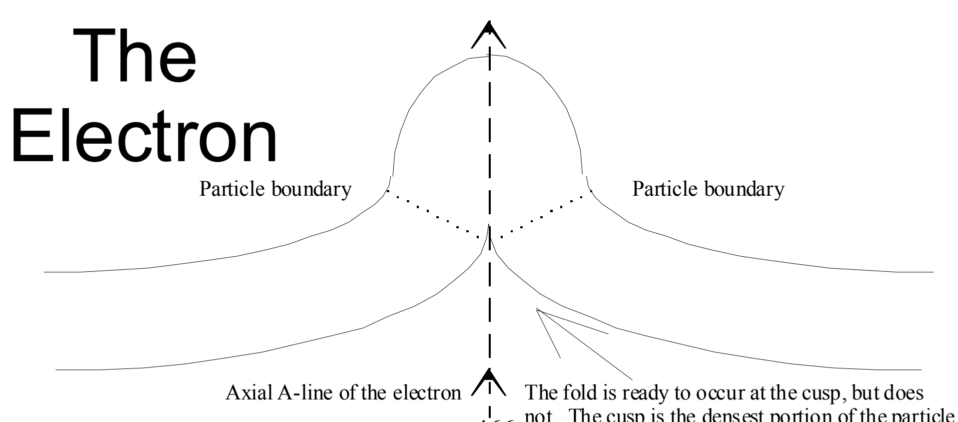


neutrino.

The most common particle, as described in the diagrams above, is the proton. A proton occurs when the space-time sheet is curved so radically that it is doubled over itself or folded. The overlap of two portions of the sheet gives the proton incredible stability. An elementary particle is symmetric in all directions in three-space and is therefore spherical as experimentally detected. As the sheet doubles over to create the proton, it actually splits open above the particle and the field density decreases with respect to distance from the space-time sheet in the fifth direction. So, while the particle may seem to form a mathematical singularity that is infinite, the physical singularity is not infinite. The proton will have an 'effective height' in the fifth direction, after which the field density becomes so small that the axial A-line is nearly all that is left of the singularity until the line closes around the Riemannian sphere on the other side of the sheet at the position of the particle. The A-lines which make up the particle, correspond to mathematical points internal to the particle's boundary and all curve back to meet the particle on the under side of the sheet. Of all these A-lines, the axial A-line has the greatest density at any point along its closed path relative to the surrounding A-lines. In essence, the axial A-line defines the particle in five space the greater the distance from the four-dimensional sheet.

Recent deep scattering experiments have indicated a three 'partedness' of hard centers within the proton. These scattering effects would be expected in the five-dimensional model. The incoming particle would have a very high relativistic kinetic energy in order to complete the deep penetration of the proton. At such high speeds, the incoming particle would be Lorentz contracted (explained in detail later) in the direction of its motion relative to the target proton. The high speed and resulting Lorentz contraction would cause the incoming particle to split its own dimensionality into a 1+2 configuration as opposed to its normal three-dimensional electrical configuration in normal (nearly flat) space-time when it is scattered. The incoming particle literally 'sees' and thus interacts with the partially separated constituent spatial dimensions of the proton due to its own relatively high speed. The effect is further enhanced due to the increasingly steep space-time curvature of the proton itself. This fractionalization of space into its constituent dimensions and the resulting fractionalization of the particle's electrical characteristics would seem to be a property of the proton since the proton would be moving at the same high speed relative to the incoming particles' frame of reference.

The electron represents a different and unique geometrical and physical shape. With an electron, the space-time sheet is curved, but does not fold and double over on itself. The proton represents the point where the curvature overlaps completely, while the electron represents the point just before the overlap occurs. The electron also represents the least amount of curvature that creates a dense enough portion of the universal field to create stability.



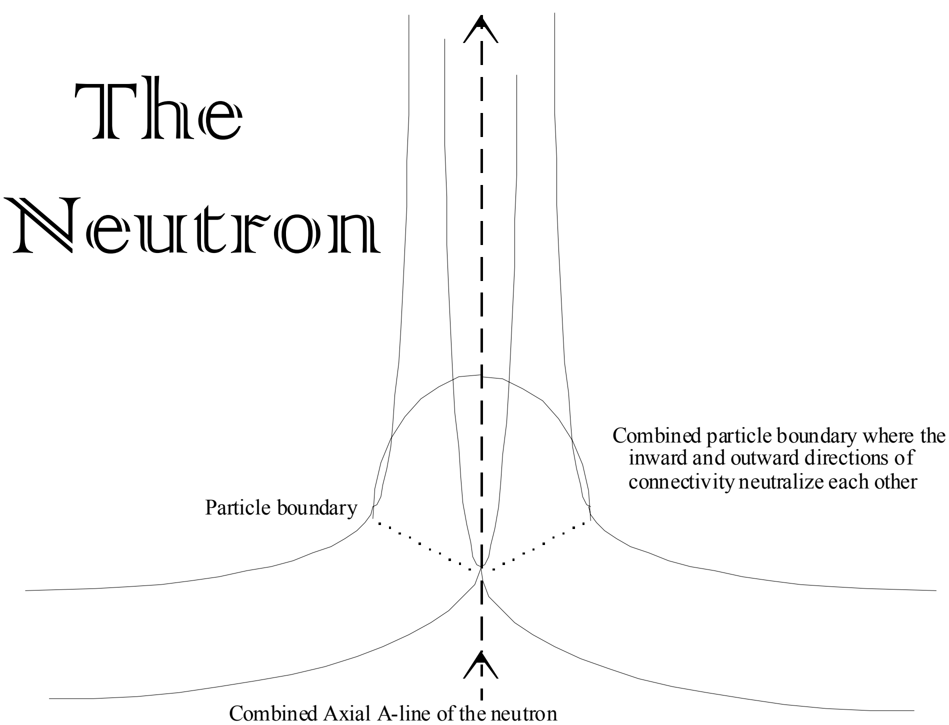
Thus the electron and proton are two extremes of the curved sheet. As such, they have opposite charges. There would be a tendency or oppositely directed stress across the 'effective width' of the space-time sheet at a particle's boundary with the rest of the 'sheet' for each particle at the two extremes of curvature. It would be an inward directed stress for one extreme (say the electron) and an outwardly directed stress for the other extreme, yielding the other particle's opposite charge (for example the proton).

All electrical charges are quantized units and equal to the same value, except for sign, because the permittivity and permeability of free space are constants and the 'effective width' of the space-time sheet at the particle's boundary is constant and equal across the whole universe. Each of the three dimensions of space contributes to the charge equally. The overall unit of charge is a product of the 'effective width,' the three dimensions and the connectivity of contiguous points of space across the five-dimensional width of the sheet. Since the electron and proton are the two extremes of curvature, they have opposite electrical charges. At the boundary interface between particles and the space-time sheet, the connectivity can be directed 'inward', 'outward' or 'both.' The normal connectivity of space proceeds in 'both' radial directions from the particle boundary in three-space displaying electric neutrality, but the formation of a particle boundary splits the normal two-way connectivity to stress one direction or the other. The attractive and repulsive electrical forces perceived in four-dimensional space-time are just the spatial attempt to seek the same equilibrium of neutrality of connectivity.

The 'outward' or 'inward' orientations cause a stress in the connectivity from point to point which is propagated through the interior of the space-time sheet in the form of a field, the electric field. This electric field differs from the gravitational field in a completely fundamental manner because electricity is an intrinsic property of the sheet and gravity is an extrinsic property of the sheet. This fundamental difference explains why it has been so difficult to unify electromagnetism and gravitation in a single theory. As an intrinsic or interior property of the sheet, electricity can be blocked or canceled by an opposing orientation in connectivity or an oppositely directed stress emanating from a particle of the opposite charge. The cut-transformation of Kaluza's theory isolates and thus represents electromagnetic fields because it literally 'cuts' across the sheet. An explanation of magnetism and the magnetic field is left for an explanation of special relativity and the concept of motion through space.

There is quite a large pantheon of particles in modern physics, but only the principle particles bear mention at this time. Among these are the muon and tauon, both of which have characteristics (such as charge and magnetic moment) similar to the electron, but greater masses. These particular elementary particles are higher energy resonances of the electron. As such, they have greater curvatures in the fifth dimension resulting in their greater masses. However, as resonances they do not share the electron's stability. Still higher resonances will not form since higher energies are dissipated away. On the other hand, neutrons and neutrinos have their own special characteristics that render them fundamental to the five-dimensional explanation of physical reality.

Since it has a neutral charge, it would be suspected that the neutron has somehow equalized the inward and outward disparity of stresses in the continuum, and that is exactly the case. The neutron is a hybrid particle, but it is also a unique particle. It is a compound of an electron and a proton coupled together although they essentially lose their identities within the neutron. Under proper conditions, an electron and proton can combine around a single point in space to create a neutron. The conditions are those that will allow the axial A-lines of each individual particle to overlap or coincide geometrically. Since the two axial A-lines of the electron and proton degenerate into a single axial A-line, the neutron is a unique particle and the electron and proton lose their individual identities. However, the neutron will share the curvature of the two and thus have the mass of both. It also inherits the connectivity of both at its boundary and thus has both inward and outward connectivity, which is electrically neutral.

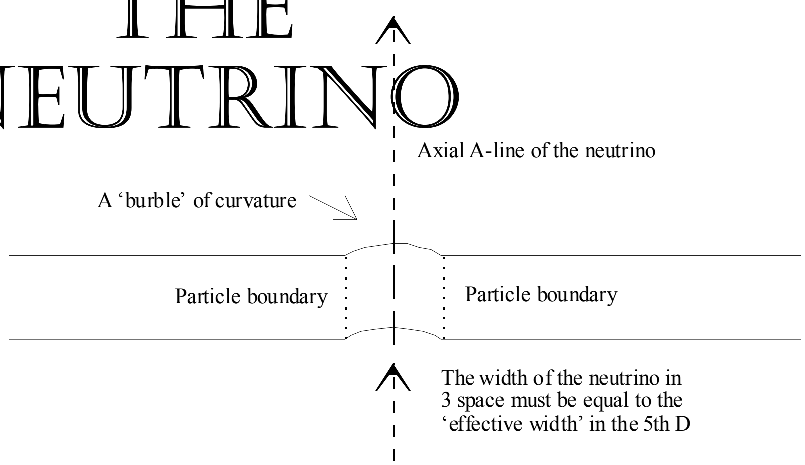


While the neutron is normally stable as a unique particle, conditions can occur in which it will decay into a proton, electron and an antineutrino. Again, to conserve charge, the proton and electron will take opposite charges during this decay. The conditions for the decay must be those that allow the axial A-line of the neutron to split into the axial A-lines of the proton and neutron and separate the proton's cusp from the electron's cusp, the two areas of greatest field density.

The final elementary particle of any note is the neutrino. The neutrino is a by-product of decays, particle interactions and cosmic events. During these various processes and workings of nature, there may be dense portions of the sheet that are 'left over' at the conclusion of an event, *i.e.*, the decay of a nucleus. This dense area occurs in multiples of a basic 'quantum,' or equivalent sized lumps of field density, and exists within the sheet centered symmetrically on a single A-line, just like other particles. This 'quantum' of slightly higher density within the space-time sheet causes a small 'burble' of curvature in the sheet, which is detected as a very minute mass, but it is so small that the corresponding mass is negligible for most cases.

THE NEUTRINO

Yet this



‘burble’ or bulge of curvature restricts the neutrino from moving at the speed of light, even though it has such a small mass that it can travel at very nearly the speed of light. The neutrino represents the smallest amount of local curvature of the sheet that can exist as a variance from (or independent of) the overall non-local curvature due to the universe as a whole. These ‘burbles’ can only occur as the result of other physical processes, but they do have the general characteristics of particles. Part of the unique character of the neutrino results from its left-handedness. When a neutrino is created, it immediately reacts to the five-dimensional Coriolis effect of the expanding universe (explained later), much as the unique direction of a hurricane in the northern hemisphere results from a Coriolis effect, and thus the neutrino favors left handedness as opposed to a right handedness.

Like other elementary particles, neutrinos have anti-particles. Anti-particles are merely particles that are formed by a local curvature on the opposite or under side of the sheet. Pair production has been explained as the decomposition of an electromagnetic wave/photon due to its contact with two different points in the space-time sheet at the same time. No physical entity can be in two places at the same time. It is a physical impossibility. Yet there is another phenomenon that acts in the opposite manner to pair production, the mutual annihilation of particles with their anti-particles. The only difference between particles and their anti-particles are the opposite curvatures along different sides of the sheet and opposite electrical charges. Both of these differences are subject to the properties of the five-dimensional model and the reality of the space-time sheet.

When a particle and its anti-particle come into physical contact, their curvatures cancel one another in much the same way that as the simple cancellation of waves known as destructive interference. Two particles cannot exist at the same place at the same time, but anti-particles can coincide for the moment before annihilation because they are positioned on opposite sides of the sheet and have opposite charges. From the four-dimensional view they occupy the same position but from the five-dimensional view they do not. So, as soon as they come to coincide they mutually disintegrate or annihilate each other so that the two views match, as required by relativity. The basic principle of relativity requires that any event be the same from different perspectives or points of view. When this annihilation occurs a photon or photons of equal energy are emitted.

The energy conversion discovered by Einstein in his work on special relativity, $E = mc^2$, controls this process and all similar processes where energy and mass are converted. However, for simplicity and philosophical accuracy, it would be better to express the matter/energy equivalence in terms of the connectivity constants such that $E = m/ :_{o} ,_{o}$, reflecting the true nature of the continuum. Connectivity is more intimately tied to the interchange of energy and mass than the speed of light 'c' is. During annihilation, the opposite charges of the particle and anti-particle neutralize to reestablish the connectivity of the dimensions of three-space at the boundaries of the annihilated particles. The connectivity of free space is in a sense 'repaired' within the sheet to its normal conditions of the neutral state.

One of the curiosities of the particle/anti-particle pair is the fact anti-particles have all of the same characteristics of their particles except for the charge. Why do anti-particles not display anti-gravity or other anti-properties? The anti-gravity problem is easy to understand within the five-dimensional framework. It does not matter whether the curvature is outward above the sheet and away from the Riemannian sphere or inward below the sheet, gravity acts the same way from the four-dimensional perspective. In either case, as another particle of matter approaches, it will experience the same amount of grade or steepness of curvature and thus the same gravitational acceleration. Gravitational acceleration is the product of the geometry of the curvature and nothing else, so it does not distinguish between the two cases of outward or inward curvature. Since a particle and its anti-particle have the same mass, the degree or gradient of the curvature is equal at similar points relative to an axial A-line. Anti-gravity, therefore, does not exist.

Another interesting fact literally pops out of this model. When regarded as a particle, the photon acts as is its own anti-particle. This fact is easily explained because the photon exhibits no curvature and is therefore neutral to the outside/inside direction of the overall space-time curvature of the Riemannian sphere. No other theory can account for this fact. In fact, physicists have probably never asked the question, even though this theory suggests an answer.

All particles and anti-particles fall into two basic groups, bosons and fermions. Fermions seem to include most, if not all, of the fundamental particles in nature, but both groups are significant in modern physics. Bosons are characterized by an even number of quantum spin units while fermions all have an odd number of quantum spin units. The supersymmetry upon which superstring theory is based allows the establishment of a physical relationship between bosons and fermions that is missing in all other theories. However, there is no tangible evidence that nature is supersymmetric. Supersymmetry deals with the fact that fermions must be rotated through two complete turns of 720 degrees to return to their original quantum state, thus yielding a ±½ spin. Bosons return to their initial quantum spin state after only a 360-degree rotation and thus have a ±1 spin. These differences indicate that an unusual geometry must affect the physics of fermions and bosons.

There is a specific symmetry of Riemannian spaces, which fits this case quite well. There are two general types of Riemannian geometry, the single and double polar. The single polar Riemannian space has the property of reversing (left for right) any object that moves through the space and returns to a lower dimensioned space. Simon Newcomb was the first to discover this property (Newcomb, 1877), but counter claims of discovery have been made for Felix Klein (Monro, 1877) and F.W.F. Frankland. (Frankland, 1876) H.G. Wells even used this discovery in his science fiction tale "The Plattner story." (Wells, 1897) Using a single polar geometry to describe bosons and fermions reduces the difference between odd and even numbered quantum spins to simple geometrical differences in the five-dimensional model. If the Riemannian five-dimensional sphere is single polar, then a trip around the sphere from the top of the sheet to a corresponding point of the underside of the sheet, a single circuit of the sphere, would alter an object by exchanging left for right and vice versa. It would take a particle's axial A-line two complete circuits around a single polar Riemannian sphere to return to the 'sheet' in its original orientation. But the axial A-line only completes a single circuit of the Riemannian sphere in the fifth dimension, so it returns to the underside of the 'sheet' at the site of the particle in an opposite orientation. This yields the ±½ spins of fermions like the proton and electron. So the five-dimensional model can account for the difference between the spins of fermions and bosons.

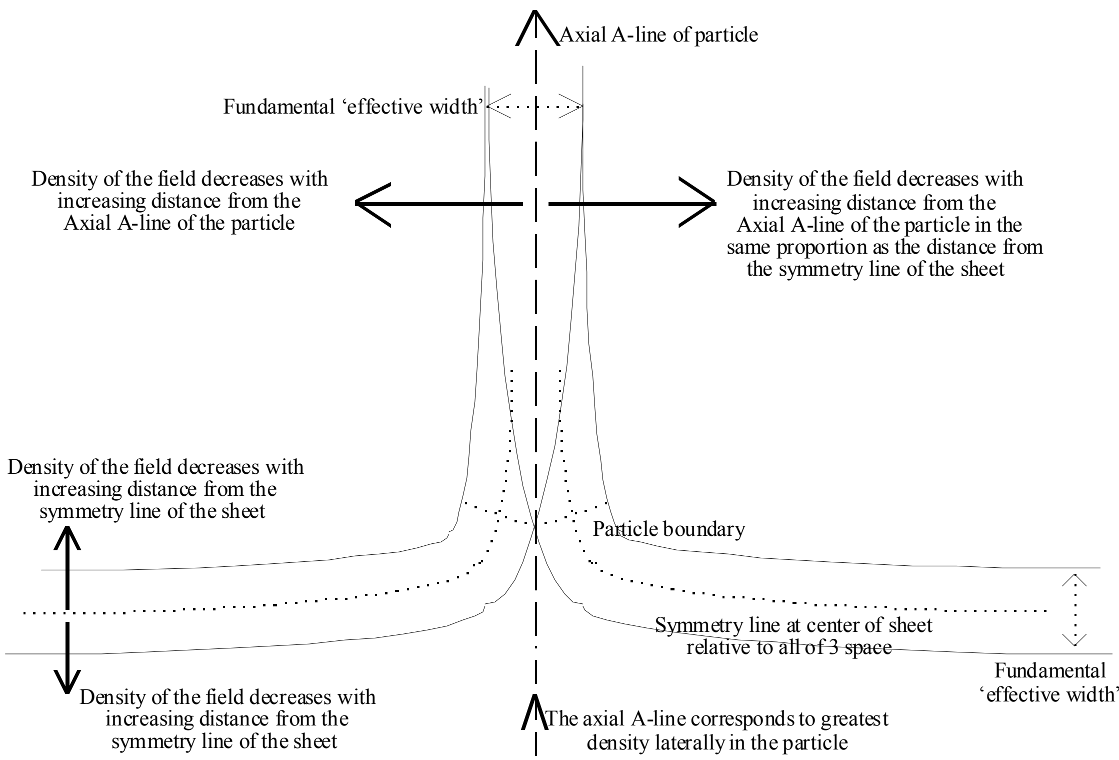
According to present theory, the universe was created in a process known as the 'Big Bang.' A primary singularity seems to have decayed and our physical universe evolved into the world that we perceive today from its remnants. One of the major problems with this model is the existence of particles, the vast majority of which are matter rather than anti-matter composed of anti-particles. In other words, there is no reason why there should be a dominance of particles over anti-particles in our universe. The two sided-ness of the space-time sheet can be offered as a simple explanation of the preponderance of matter in our universe at the expense of anti-matter. When the primary singularity burst into our universe, a Riemannian sphere began to develop and expand outward from the event. The first particle created after the initial event would have been formed on the outward surface of the sphere, that is, given the fact that curvature is a real extrinsic property of space-time and not just a intrinsic mathematical feature of the geometry. If the initial Riemannian sphere was very small relative to the three-dimensional size of a proton when it was formed, the first particle could only have formed on the outward surface, not the inside of the sphere. As the sphere expanded, the impetus of change would have been from the inside to the outside of the spherical curvature of space-time, the direction of expansion, which would also have favored the development of particles rather than anti-particles and anti-matter. So, matter is dominant in our universe and gross quantities of anti-matter are a rare occurrence.

d. Quantum theory revisited

As an approximation, all particles obey Newton's laws of motion, Universal gravitation and Maxwell's electromagnetism. However, Newton's laws of motion degenerate in the submicroscopic world of the quantum where gravitational forces are considered too weak to affect particle motion. Quantum and wave mechanics fill the void left by the inability of these classical theories to completely describe the interactions of elementary particles. Quantum mechanics utilizes a probabilistic interpretation of wave mechanics with which many scientists have felt ill at ease, but have accepted because of the successful predictions of the theory. It has already been argued that the probability distribution of quantum mechanics merely mimics the space-time continuum, but cannot really account for space or time as field effects. The probability distribution is merely a mathematical device used to mimic spatial extensions of point positions while the waves of wave mechanics represent some type of real physical quantity. There is no independent evidence that the probability distributions have physical reality. So, while the probability distributions and the waves themselves correspond nicely, they seem to be mathematical equivalents, they are not the same 'thing,' physical or otherwise.

The problem becomes more than casually evident when the wave collapses to form a physically real particle that has spatial extension. The probability distribution that represented the particle before the collapse represented only a collection of mathematical points that constitute a mathematical space, but have no real extension which is a property of a real space. So the collapse of the wave function represents a discontinuity of concept, a paradox for quantum theory. This paradox disappears, as does the wave/particle duality, in the five-dimensional universal field theory model. In fact, they are intimately related.

In the five-dimensional model, a portion of the sheet literally turns or rotates in the fifth direction of the continuum by folding or bending. This gives the axial A-line a substantial reality as the densest part of the resulting particle. The field density along the axial A-line decreases as the distance from the space-time sheet increases in the fifth direction. By the same token, A-lines extend in a lateral direction perpendicular to the axial A-line (parallel to the sheet). The field density decreases as the distance from the axial A-line increases across the fifth dimension by the same proportion as distance from the sheet.



The probability distribution of quantum mechanics emanates outward from a point which coincides with the intersection of the axial A-line and the symmetry line at the center of the sheet. However, the probability distribution also coincides proportionally with the field density distribution along the axial A-line of any given particle.

The probability distribution of quantum mechanics is a three-spatial quantity which is manifest in the fifth direction as a mathematical representation of the axial A-line. On the other hand, the wave function represents the five-dimensional volume of the particle itself. In a 1928 paper, W. Wilson derived an equation that became upon substitution identical to Schrödinger's equation in wave mechanics. Wilson used the concept of a 'Volume' in five-dimensions, whereas the normal quantum mechanical interpretation of the wave function is a probability distribution. He continued to derive a second equation which he showed to be equivalent to Schrödinger's equation for the Hydrogen atom under a proper choice of limits. From these derivations, Wilson concluded that Schrödinger's wave function Q was a five-dimensional 'Volume.'

> If a particle at some instant is actually within a 'volume' M_o it will be within a volume V, Which is the parallel displacement of V_o, at some time later (or earlier) instant. If its position at any time is unknown, the probability that it is in a specified volume will depend in some way on V. This is, in fact, the usual meaning of V or Q. (Wilson, 1928, 441)

The correlation between Schrödinger's equation and those derived by Wilson was complete. But Wilson had only derived what is today known as the Klein-Gordon equation. Coincidentally, Klein and Gordon developed the equation that bears their name by considering "a zero mass wave equation in five dimensions" in the Kaluza theory. (Appelquist, 10)

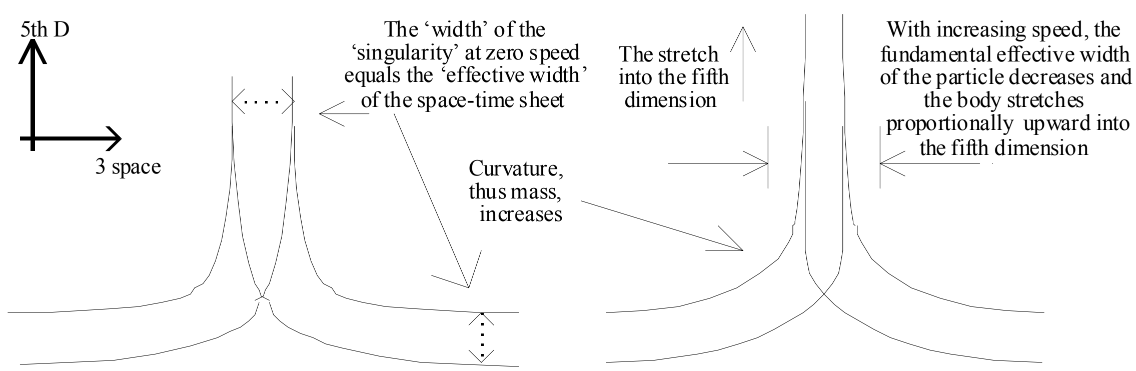
Although the Klein-Gordon equation is important in wave mechanics, the Dirac equation is far more important. The Klein-Gordon equation is a second order differential equation, which describes the motion of a particle at relativistic speeds. The equation can be generalized for a particle that interacts with an external electromagnetic field. However, the equation is not fully consistent with general transformation theory. Dirac was bothered by this lack of consistency (Schweber, 57-58) as well as the possibility of a negative probability density, so he derived a competing equation which was not only consistent with the general transformation theory, but always yields a positive probability density. The Dirac equation, as it is called, utilizes a first order derivative with respect to time instead of the second order derivative. The Dirac equation was a step forward in applying wave mechanics to physical situations. The Dirac equation has also been equated to five-dimensional space-times by other researchers. (Flint, 1966, 111; Jonsson, 1942)

The further interpretation of the probability equivalence to the fifth dimension awaits a consideration of special relativity. The dependence of a complete explanation of the quantum on special relativity marks a strange turn of events since classical quantum mechanics is independent of relativity theory and indeterministic while relativity is deterministic. However, it should have become evident by this point that there is no 'collapse' of the wave function and there is no discontinuity due to the 'collapse' so there should be no further inconsistencies between quantum theory and special relativity. What has been called the 'collapse' of the wave packet is only the mathematical transition (or mapping) of the probability to the actual wave, which merely represents two different ways of interpreting the phenomenon without explicitly demanding the physical reality of the 'collapse.' The emphasis therefore changes to explaining how the probability fits into the five-dimensional picture.

e. What's so special about special relativity?

Although special relativity was originally developed as a theory of electrodynamics, it is more often and more commonly regarded in its disguise as a mechanical theory explaining what happens to material particles moving at speeds closer and closer to the speed of light. Within this context, there are several formulas that describe changes of a material body's (or a single particle's) characteristics due to its relative motion. The first of these is the Lorentz-Fitzgerald contraction. The moving object contracts by an amount dependent on the relative speed of the object to an observer. The resulting contraction of the body can be easily depicted in the five-dimensional model.

As the body moves, it undergoes the deconstruction/reconstitution process from moment to moment. But as its position in space changes by greater and greater amounts with respect to the constant progression forward in time, the deconstruction/reconstitution process is not as effective due to the connectivity constants. This is part of the same process that limits the speed of the object to the speed of light. The reconstitution process literally stretches the curvature further into the fifth dimension as the particle approaches the speed of light.



A particle or material body in a stationary position

The same particle or body as it would appear at a moment during its motion, relative to the space-time sheet

The five-dimensional volume of the particle itself must remain constant, so the particle contracts in the direction of the motion. The contraction leads to a greater or steeper curvature and hence a greater mass for the moving particle. The above diagram only depicts a single dimension in the three-space direction of motion, so that direction represents the direction of contraction. The body's boundaries remain constant in the other two directions of three-space.

In essence, the particle becomes more wavelike or light-like as it approaches the speed of light. By light-like, it is meant that the density of the field becomes spread more evenly over the entire length of the axial A-line mimicking the A-line of a light wave. However, the particle or material body cannot become truly light like since it is only contracting in the direction of the motion. Its width or measure in the other two dimensions remains the same. A light wave is unique in that it has no width in any direction in three-space, so it can spread out evenly without physical obstruction in all three directions and propagate spherically from a light source. One might say that light is Lorentz-Fitzgerald contracted to zero (or some minimum as thickness approaches zero) in all three-dimensions of normal space at the same time.

So, while the instantaneous speed of a material particle or body can be considered the time derivative of change of position in three space as the time change approaches zero ($^{d}/_{dt}$ [x] = v) such that the change of position (dx) occurs in the same direction as the contraction, the instantaneous speed of light is the change of position of the light wave in all three contracted directions simultaneously as the change in time approaches zero ($^{d}/_{dt}$[3 space] = c). Therefore, the light wave can spread out in all three dimensions of normal space simultaneously creating the spherical wavefront. The moving particle tries to mimic this behavior or quality of light at high speeds, but it cannot because its remaining two dimensions are not contracted to 'no width' at, or rather near, the speed of light. The particle may approach the speed of light, but it never reaches the speed of light because it cannot become light-like in just one dimension independent of the other two dimensions.

However, as an elementary particle moves closer to the speed of light and its fundamental 'effective width' in the direction of travel contracts relative to a stationary object, its contracted width can become so small that the connectivity of space in the one direction can be detected independent of the other two directions. This means that the quantum electric charge of the particle, at the very high energy where this 'minimum effective width' is attained, would appear to split into two different charges of one-third, representing the portion of the charge in the direction of travel, and two-thirds, the portion of the charge representing the other two directions. This splitting of the fundamental electrical charge, which can only occur at extremely high energies, has been interpreted as independent particles called quarks in modern physics. Quarks have never been detected independent of the particle that they supposedly constitute, nor will they ever be so detected because they are not independent particles but rather reflect a condition of true particles moving at very high speeds and thus carrying very high kinetic energies. Quarks have no more independence as individual particles than we can split and detect the three spatial dimensions of the space-time continuum.

As a particle's relative velocity increases from rest, the particle's center of field density extends further into the fifth dimension according to the rules of special relativity. This causes an additional stress in the space-time continuum where it is already stressed by the existence of electrical charge. However, this added stress does not act directly between contiguous points of space extending radially outward from the surface of the charged particle in three-space, as does the electric field. The relative change of position of a particle's center of field density in the fifth direction acts somewhat like a torque in the extra dimension. So, like a changing torque vector it causes a stress that is perpendicular to direction of the vector, or the stress would occur in a plane surface in three-space. This is a torsional stress whose strength is directly proportional to the relative speed of the particle. This new stress, commonly called magnetism or the magnetic field, is also perpendicular to the direction of motion of the particle that caused the torque-like change in the fifth dimension. Only charged particles display this torsional stress since only charged particles cause an electrical stress in the surrounding space-time continuum.

The relatively high speed of a moving particle can explain still other quantum aspects of reality. Since the five-dimensional volume remains the same but the field density across the axial A-line changes as speed increases, the particle becomes more wavelike. So it would be characteristic of the particle to act more like a wave. Indeed, this is exactly what it does according to its deBroglie wavelength. A particle which has zero velocity, essentially has an infinite wavelength according to deBroglie's formula $\lambda = h/mv$. Written as a deBroglie frequency, this expression has far more meaning. Using the dispersion relation of $E = hf$, the deBroglie frequency can be written as $f = p^2/2m\lambda^2$. This formula works for a non-relativistic particle. If the relative speed of an object with respect to an observer is zero, then the object has a deBroglie frequency of zero.

In the case where a particle moves at relativistic speeds, the dispersion relation becomes

$$(hf)^2 = (m_o c^2)^2 + (hc/\lambda)^2 .$$

If we say that the wavelength goes to zero as the speed approaches that of light, then the frequency becomes infinite. In this formula, the second term on the right would become infinite as the wavelength goes to zero. So it is impossible for a material object to travel at the speed of light. But as a particle or material object approaches closer and closer to the speed of light, its deBroglie wavelength would become smaller and smaller and the second term in the dispersion relationship would dominate. At slower relative speeds, the rest mass energy dominates the frequency relationship. This whole system is compatible with SR only in so far as the frequency of a matter wave has any physical meaning. In the case of an electromagnetic wave, the frequency denotes a real 'vibration' or 'oscillation' of the combined electric and magnetic fields, but this is not true for matter waves. The frequency of a matter wave only makes sense within the context of the deconstruction/reconstitution process, which changes with changing relative speed. Both the object and the observer undergo the same rate of deconstruction/reconstitution as time progresses forward when their relative speed is zero. But as the object moves relative to the stationary observer, its deconstruction/reconstitution rate differs from that of the observer by a factor of the deBroglie frequency. The maximum difference between the deconstruction/reconstitution rates would occur as the relative speed between two objects approaches the speed of light.

This may seem to imply the discrete nature of time as opposed to the continuous nature of time, but time remains continuous. Since progress forward in time is continuous, one would think that the deconstruction/reconstitution frequency would be infinite, or rather the process would occur instantaneously. The fact that it can be changed by a constant calculable factor implies that the frequency is not infinite, but discrete and thus time is discrete. However, the particle's physical boundary extends into the past and future just as it extends to the right and left or up and down. The space-time sheet has a thickness in the dimension of time, so the particle boundary at the point in time that a deconstructing particle from the moment just past overlaps the reconstituting particle in the next moment of the future, guaranteeing continuity while the frequency of the deconstruction/reconstitution process can remain finite and still be increased by a constant factor. The constant factor of frequency increases in proportion to the amount of stretch of the particle in the fifth direction, or rather the increase of effective extension in the fifth dimension. The amount of stretch or extension is not infinite since the A-lines are closed circles on a large, but finite closed Riemannian five-dimensional sphere. There is a practical limit to the frequency change factor and a 'minimum width' that the Lorentz-Fitzgerald contraction can attain which is directly related to the distance around the Riemannian sphere and thus the overall curvature of the universe. This value is related to the Planck length, $L_p = (hG/2\pi c^3)^{½}$ or 1.6×10^{-33} centimeters.

These quantities are related to another important phenomenon, the tunneling effect. According to quantum theory, it is possible for a particle to escape through an energy barrier, out of a potential well, that it does not have the energy to overcome. Tunneling events have been 'observed' in the laboratory and are normally used to explain radioactive decay. In essence, the probability distribution of a particle is extended over space including areas of space beyond a particle's boundary and the potential barrier. There is always a small probability, even if it is only infinitesimally small, that the 'collapsing' wave function will leave the particle elsewhere than where it has the greatest likelihood of being, where the probability is the greatest. So, there is a very small possibility that the particle will end up 'outside' of the barrier when its wave function collapses. Consciousness can cause the wave 'collapse' as it is called in quantum mechanics under the proper conditions, but human consciousness is not 'necessary' for a wave to 'collapse.' The deconstruction/reconstitution process could certainly be called the 'collapse' of the wave function since it is the same thing, but this process proceeds normally without the intervention of human consciousness due to the complex entanglement of the rest of the universe. It is a relative, not a quantum, process which occurs at the quantum level of the continuous field that constitutes the universe.

There are two, and only two, distinct types of energy in space-time, kinetic and potential. Potential energy is an energy of relative position while kinetic energy is the energy of relative change of position. (Clifford, 1880) In the five-dimensional model, this changes. There is only energy of relative position, the potential. Kinetic energy in the four-dimensional space-time continuum reduces to potential energy in the five-dimensional worldview just as four-dimensional dynamics becomes five-dimensional kinematics. A particle with a constant relative velocity in space-time, when 'viewed' from the five-dimensional perspective will have an extended density along its axial A-line, relative to the density distribution along the axial A-line when the particle is stationary. This relative density (position) change is detected as a kinetic energy in the four-dimensional space-time, but it is a potential in the five space-time framework. When a particle accelerates, the relative density shifts up or down the axial A-line, for increasing and decreasing speed respectively. So, at higher relative velocities the density dispersion along the A-line renders a deBroglie frequency (or wave) corresponding to the particle. This corresponds to a higher dispersion of the probability density perpendicular to the axial A-line in three-space, increasing the probability that the particle can be elsewhere than its primary expected position. In a sense, the particle has less of a presence in the four-dimensional sheet at higher relative speeds so it is less 'anchored' to its fixed position in space-time and thus has a greater 'relative' probability of being (tunneling or reconstituting) elsewhere.

As the particle moves forward in time, undergoing deconstruction/reconstitution, there is a small possibility, due to its motion and/or interactions with other fields and other particles, that the particle can deconstruct at one point in space and subsequently reconstitute at a point in space that is not continuous with its previous position in space. Since external fields affect the particle's potential energy, in the classical sense, then these external fields and connections with other particles will also affect this process. Even when the particle is not moving, it is still subject to the effect of other fields so this same possibility exists, perhaps to a much smaller degree and perhaps not, depending upon the relative positions of other particles and their associated fields. Anything which changes the aspect (universal field distribution) of a particle along its axial A-line will change the wave function of the particle as well as its probability distribution in three-space to which it is directly proportional.

In an atomic nucleus, an individual nucleon will have a higher relative aspect along its axial A-line due to the extreme degree of the additive affect of curvature coupled to the 'fundamental effective width' of space-time, so it will have a more wavelike character. Therefore, it will have a greater probability of being elsewhere outside of the potential barrier of the nucleus unless it is more tightly bound by its axial A-line to the other nucleons. Under the correct conditions, a nucleon can thus 'tunnel' out of a nucleus as has been 'observed' in the laboratory. A further discussion of this process must await a description of the nucleus in the five-dimensional model. The point is that tunneling is dependent upon the relative position and is thus explained by a combination of quantum theory and relativity theory.

f. Relating to special relativity

It is quite apparent that relativity and the quantum are intimately bound to one another. The Lorentz-Fitzgerald contraction is tied to the deBroglie frequency (wavelength) which is related to a particle's aspect (universal field distribution) along its axial A-line which is in turn related to (or corresponds to) the particle's probability distribution in quantum mechanics. The fact that $\int|\Psi|^2dx = 1$ in quantum mechanics merely translates that the total amount of linear field density along the axial A-line is constant which is equivalent to saying that the volume in five-space (which equals the wave function) is constant, a new conservation law.

In the original Kaluza theory, the fifth field component γ_{00} was set equal to one. This act has been criticized as artificial, 'ad hoc,' without cause and merely a mathematical device to make the theory work, without physical meaning and perhaps even over restrictive. But the choice of this value for γ_{00} was actually quite meaningful, even if Kaluza did not realize its significance. While the probability distribution of quantum mechanics is a mathematical device used to locate a particle's position during interaction with an electromagnetic field and/or other particles, as in the case of orbital electrons, there is a definite probability that it does exist, *i.e.*, the sum total of all the probabilities at each and every possible location of the particle is one. In wave mechanics this means that the square of the wave function is one, $\int|\Psi|^2 dx = 1$, or the trace of $\psi\psi^*$ is one. The fact that the probability of finding a particle is unity guarantees the physical reality of the particle even if its momentum and position cannot be known simultaneously. In effect, setting the probability equal to one contradicts or countermands the very Heisenberg uncertainty principle that requires the probabilistic interpretation of physical reality. Neither scientists nor philosophers have ever questioned this paradox.

Given the previous explanation of the relationship between the probability distribution and the field density distribution along the axial A-line of a particle, the probability that a particle exists somewhere along the axial A-line, relative to the space-time sheet, must be one. This is the true meaning for the value of one for the fifth component γ_{00}. So the choice of the value of one, which Kaluza used to guarantee that the other field components would normalize as well as guarantee that the fifth dimension could not be perceived, has the same meaning in quantum mechanics. It guarantees the existence of the particle at some point or place in space-time.

In any beginning class on quantum theory, a student learns about the Kronecker delta function (which is related to the Dirac delta function). The delta function represents a method of normalizing a non-behaving function to a value of one. The infinite plane waves that arise in quantum theory are not normalizable to unity in some cases because their eigenfunctions are not quadratically integrable over all of space. In such cases, the delta function is applied to allow the normalization to progress smoothly. The delta function is defined as equal to one in cases where the discrete variables are equivalent and zero where they are not equal. So, a well behaved function can be found and written for a function with undefined spots, when it is limited by a delta function, such that

$$f(y) = \int_{-\infty}^{+\infty} \delta(x,y)\, f(x)\, dx \quad .$$

The delta function $\delta(x,y)$ is zero everywhere in space except where the x and y variables are very close in value, or rather in the limit where the value of x approaches the value of y. Physically, this is the same as saying that the resulting wave function f(y) represents a superposition of two waves that interfere constructively to give a well behaved function with no infinities. (Merzbacher, 82) The infinities have been canceled by destructive interferences.

In the Kaluza theory, the fifth component γ_{00} is nature's equivalent to the delta function. According to Mach's principle, the mass (and thus the curvature of space-time) of an individual particle depends upon the mass of the rest of the universe. If that particle is represented by a wave function, as normally defined in quantum mechanics, the mass would be infinite. But taken relative to the rest of the universe, in the real physical situation, the wave function of the particle interferes with the collective wave function for the rest of the matter in the universe, such that the infinity at a point of mass is canceled. The whole universe must be collectively taken into account so that the waves of all particles cancel in this manner. This act can only be accomplished in a fifth dimension, where the singularity occurs as a real curvature, with γ_{00} acting as a natural, and thus real, delta function. In other words, the universe as a whole acts to normalize the real particles even though mathematics cannot always normalize the quantum theory's point particle equivalent of a real particle. This interaction is called 'entanglement' in quantum theory, but it is the ultimate expression of Mach's principle and relativity in the five-dimensional field theory. It is the 'entanglement' or the connectivity of all matter in the universe at any given moment. The space-time sheet could thus be portrayed as the collective 'destructive interference' due to the sum total of all matter waves in the universe. In reality, the interference could not really cease to exist and thus attains a minimum measurement called the fundamental 'effective width.'

While the delta function helps to explain the spatial components of reality, it does nothing for time. It is purely spatial and thus acts kinematically, not dynamically. Time dilation offers a far more unique perspective on the space-time continuum that emphasizes the difference between the time and spatial dimensions. Lorentz-Fitzgerald contraction, energy, and mass (space-time curvature) all return to normal when the velocity of the moving particle returns to a relative speed of zero. However, the dilated time frame of the particle and any other material body that moves relative to a state of rest is a permanent and lasting condition. This fact alone guarantees the uniqueness of time even as it causes grave difficulties in understanding that uniqueness and the nature of time. As a particle (or other material body) moves at higher and higher relative speeds, approaching the speed of light, the deconstruction/reconstitution rate in the time dimension decreases and the field density shifts further into the fifth direction along the axial A-line. It could be said that the particle tries to detach itself from the sheet of normal space-time as much as possible, but it cannot detach itself so it stretches itself further into the fifth dimension dragging its portion of the sheet with it. However, it cannot stretch the time component of the sheet upwards, since the time direction has not yet deconstructed and reconstituted itself.

The center of universal field density along the axial A-line would normally be located at the cusp where the space-time sheet folds to mark a particle's physical boundary. At higher speeds, especially closer to the speed of light, the center of field density moves upward in the fifth direction along the axial A-line. Time is not experienced at the same rate as the center moves up the A-line. Just as a light wave can spread out spherically in three-space due to its constant field density along its own axial A-line, without physical restrictions, the wave corresponding to a material particle can spread out over the time dimension so that a moment of time is extended in duration as compared to the rest frame. This process occurs in proportion to the mass increase and contraction and relative to the speed by the same ratio. However, the uniqueness of time and its special properties cause time duration to change as the reciprocal to the factor which affects all three processes, $(1 - v^2/c^2)^{1/2}$. Since deconstruction/reconstitution occurs only in the time dimension, and its rate decreases as the relative speed changes, the time dilation causes permanent changes in a material body's life that do not occur in the other dimensional variations with relative speed increases and decreases.

The inverse effect of time is evident in deBroglie's relationship between matter and wave and can thus be viewed as a product of the wave/particle duality. As demonstrated earlier, a material body has a deBroglie wavelength of $\lambda = h/p$ or h/mv in three-space while it has an equivalent frequency of $f = p^2/2m\lambda^2$ in the non-relativistic case. This reduces to $f = ½mv^2/h$ in terms of classical kinetic energy. The position and effect of the speed v of the particle is inverted between the frequency (time component) and the wavelength (space component). In Newtonian physics, these quantities represent momentum (mv) and kinetic energy ($½mv^2$). Both momentum and kinetic energy are measures of the combined quantity of motion and matter. In a manner of speaking, these two physical, and only these two physical quantities, characterize 'matter in motion.' The mass m represents matter and the speed v represents motion. So these two quantities are ways of representing 'matter in motion' as a single unique measurable quantity. These two quantities are thus intimately related to one another by a single formulation.

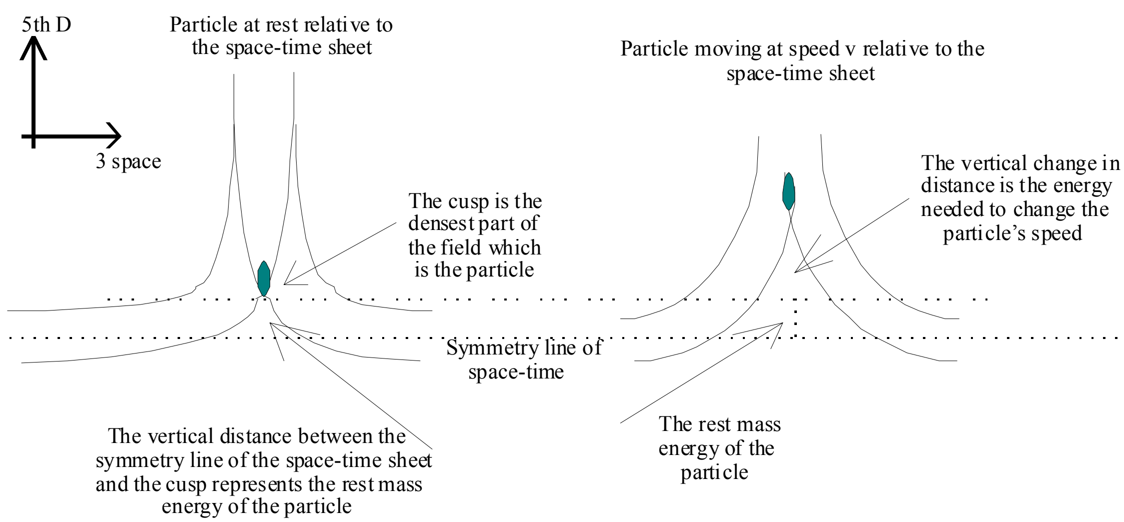
$$\frac{d}{dv}\left(\tfrac{1}{2}mv^2\right) = mv$$

or in its integral form

$$\int mv\, dv = \tfrac{1}{2}mv^2 .$$

Kinetic energy is the time rate of change of momentum, or the time rate of change of matter in motion. In other words, if we sum up (∫) all of the infinite number of infinitesimally small changes of simple moving matter, momentum (mv), over a varying velocity, we have a kinetic energy. However, in a real sense, the variations are in the position with constantly changing time. This mathematical process describes the reconstruction/reconstitution process of a moving particle in classical terms. Kinetic energy is the overall affect of a moving particle when it is deconstructed/reconstituted as time progresses forward since mass is no more than space-time curvature and velocity is no more than the relative change in position of that curvature. This formulation demonstrates the inverse symmetry between the space and time dimensions.

Kinetic energy is the expression of the moment-to-moment change of the state of motion of a material particle or body. If the state of motion is changing (there is an acceleration), then there is a moment-to-moment change in its aspect along the axial A-line. The aspect is the relative position of the cusp of a particle along the axial A-line. When the particle moves at constant relative speed its cusp



remains at the same fixed position relative to its state of rest. The aspect remains constant.

As a particle's speed increases, the cusp moves vertically along the axial A-line relative to its rest position. The rest position of the cusp, the center of field density along the axial A-line relative to the symmetry line of the space-time sheet, is measured as the rest mass energy of the particle according to the relation $E_o = m_oc^2$, or better still $E_o = m_o/\mu_o\nu_o$. The use of the connectivity constants rather then the speed of light in this relationship reflects the real physical relationship between the curvature (m) the rest mass energy (relative position of the cusp) and the connectivity of points in the sheet. The particle's speed increases according to the amount of kinetic energy added to the particle. This kinetic energy increases the distance between the original cusp position in the fifth dimension and thus the five-dimensional potential of the particle. This change of energy has been described by Einstein's relativistic formula

$$E_{kin} = mc^2 - m_o c^2,$$

which is easily rendered into the five-dimensional framework and interpreted accordingly as the change in relative position in the fifth dimension, or the change in aspect. E_{kin} is the relativistic kinetic energy while the total energy (or aspect in the fifth dimension) is mc^2 and $m_o c^2$ the rest mass energy, except that $c^2 = 1/\mu_o \nu_o$. In other words, the kinetic energy of space-time becomes a measure of the position of the center of field density along the axial A-line in the fifth direction relative to its rest position. This is added to the rest mass energy, which determines the total aspect of the particle. The aspect is a measure of the potential. In the final analysis, matter is curved space-time, momentum is variations in that curvature and kinetic energy is curvature variation from the temporal perspective. The classical concept of a force translates as changing variations of curvature.

The notion that relative change in position in three-space over a period of time can cause a change of some type, such as a distance in another dimension (the fifth) perpendicular to space-time may seem strange, if not totally irrational, but the basic idea behind the notion is a common and well known concept in classical physics. When a bit of matter moves but changes direction, torque results. There is no torque with straight-line motion, but as motion varies from the straight line, a torque develops. In the special case of circular motion or rotational dynamics, the change in each of the two dimensions of space is the same, so the torque is constant and perpendicular to the plane of the circular or rotational motion. In a manner that is not completely dissimilar to this classical case of torque, if any change of speed occurs during a change in time, a 'torque' of sorts occurs perpendicular to both three-space and time. This 'torque' is orthogonal to the space-time sheet in a fifth direction. So an alternate descriptive view of changes along the axial A-line of a particle can be found as a 'torque' resulting from a complex motion in three-dimensional space and the normal progress of time into the future.

A very interesting question presents itself from these considerations. Did Einstein have an intuitive feeling for a model or framework such as this? Einstein worked on several variations of Kaluza's five-dimensional model when he was searching for the unified field theory. Einstein's work on those theories bears enough resemblance to this model to assume that he did have some idea of such a structure. He also assumed that the quantum would eventually pop out of the mathematics of his unified field theory.

And finally, he argued against the Copenhagen Interpretation of quantum and wave mechanics. He accepted the experimental results of quantum mechanics, but had no faith in the standard interpretation of the theory. Einstein certainly had a profound, gifted and intuitive feel for nature and the physical processes that characterize our reality. His intuitive feelings told him that quantum theory was not what it seemed to most other scientists, especially Niels Bohr and Werner Heisenberg.

Einstein's primary argument against the Copenhagen Interpretation of quantum mechanics was presented in the EPR (Einstein, Podolsky and Rosen) paper of 1935. Einstein and his colleagues argued that at some point after two particles had interacted (collided), it should be possible to measure the position or momentum of one particle and the momentum or position of the other particle and then infer from these measurements the other complementary measurement of each particle. So, it was possible to know the exact position and momentum of a particle simultaneously in principle, even if it was not practically possible. This would constitute a direct violation of the Heisenberg uncertainty principle, which prohibits the simultaneous knowledge of a particle's momentum and position. The EPR argument carried enough weight within the scientific and general academic community that it was not forgotten over the intervening years, in spite of the spectacular successes of the quantum theory. Eventually, EPR was reformulated and reinterpreted to cover the quantum states of spin for two interacting particles. It was thought that particle spin represented an equivalent method of measuring the validity of the EPR argument as opposed to the Copenhagen Interpretation in the 'gedanken' experiment suggested by EPR. Experiments were designed and conducted along these new lines of thought and seem to have demonstrated the inaccuracy of the EPR argument in favor of the standard interpretation of quantum mechanics. However, experiments testing the spin of particles that interact quantum mechanically neither prove nor disprove the EPR argument. They do not really settle the dispute between Einstein's worldview and the Copenhagen Interpretation of the world of the quantum. The fact that quantum mechanics is not 'complete' in the sense that Einstein originally intended is still a valid issue.

Einstein was a relativist, through and through. He was weaned on Mach's principle and Ernst Mach's argument against the necessity of Newton's absolute space, based on Mach's 'gedanken' experiment limiting the universe to a single particle. The EPR argument was an extension of Mach's argument. If space is relative, as Einstein assuredly thought, then two particles and only two particles would be necessary to determine the relativity of space and time. The existence of relativity would dictate that the position and momentum would both exist, simultaneously, independent of any quantum mechanical argument to the contrary, or the two particles could not act or interact relative to each other. The

Heisenberg uncertainty principle and the Copenhagen interpretation of the principle did not allow this possibility, so they were at odds with the most basic concept of relativity in Einstein's eyes. The 'proven' existence of relative space and relative time was overwhelming enough for Einstein to conclude that the quantum mechanical worldview by which the Heisenberg uncertainty principle limited our knowledge of the world was 'incomplete.' Neither spins nor 'hidden variables' were necessary to support the EPR arguments even though there was nothing in the EPR argument to expressly prohibit such interpretations. Both have become popular at one time or another in pursuit of determining the validity of Einstein's arguments. Nor is there any reason to believe that the spin of two particles determines the relativity of space, so the spin experiments do not answer the questions raised by Einstein and his colleagues. The essence of Einstein's point of view has never been fully understood nor explored, since later developments led to other tangential interpretations of EPR.

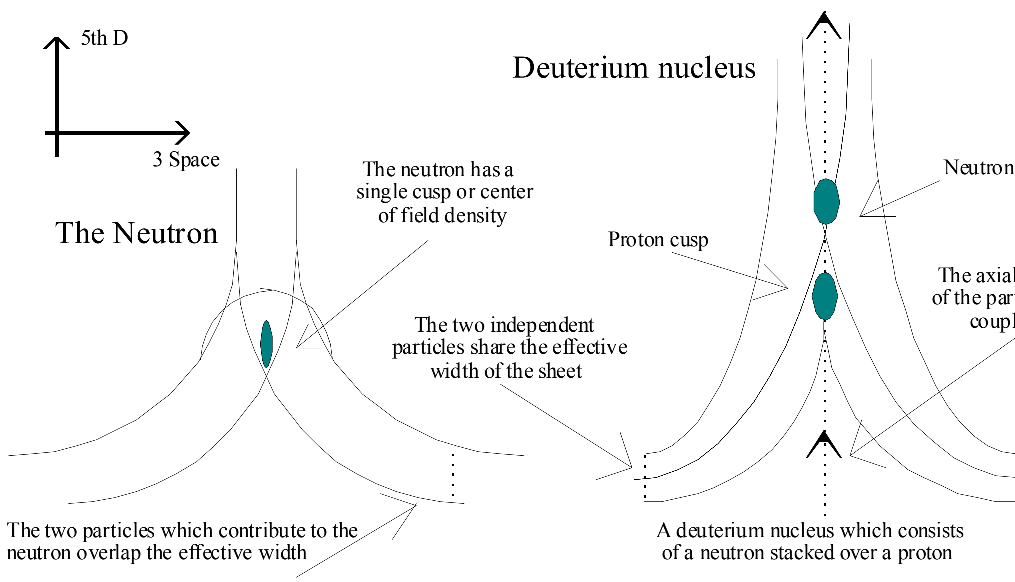
In this new five-dimensional theory the tables have been turned. The relativity of space and time is inherent in the model. Particles are coupled together across the fifth dimension and therefore must act in concert, relative to one another. The space-time sheet is not an absolute, but its overall makeup, characteristics and properties are determined relative to the universe as a whole and thus conform to Mach's principle. Even cases where matter waves, in Schrödinger's sense of the term, are concerned, the connectivity of space, from axial A-line to axial A-line independent of the space-time sheet, assures that the five-dimensional model is completely relative. It would seem that even if our scientists cannot determine the position and momentum of particles simultaneously as Einstein suspected, the universe as a whole still knows the momentum and position of the particles, as well as all of their other physical properties. The entanglement of the universe is complete and overwhelming. Both the wave and the probability distribution that correspond to a particle are interacting with the rest of the universe at each and every moment of time.

A rather interesting historical and relevant fact should be noted at this point. At the time that the EPR argument was leveled, Einstein was in the middle of a decade and more of theoretical work on unified field theories based upon a five-dimensional model of physical reality. So it would seem that Einstein may have had an intuitive feeling for such a theory as this even if he was unable to express his ideas.

g. Tying up loose ends

In every theory, there are loose ends that need to be 'taken care of' and clarified. A TOE would have no such loose ends or it would not be a theory of 'everything.' Physics is presently filled with many such loose ends and two of the most disconcerting operate in opposite realms of the universe. Physics has no adequate models for either the atomic nucleus or the spiral shape of galaxies. Both are considered serious problems in their respective fields. There are some models by which we can understand some facets of these phenomena, but no single model completely explains the nucleus or spiral galaxies. Although these two mysteries have defied the full explanation that is their due, the present five-dimensional model does give some insights into their solutions.

There is a very important clue in the five-dimensional model of particles, as presented, which can lead to an effective (if not complete) theory of the nucleus. The neutron is essentially a combination of an



electron and proton superposed and stretched into the fifth dimension, although it is in reality a unique particle. This structure of the neutron provides the clue to the structure of the nucleus.

There is also an old dictum in science that says no two particles can occupy the same space at the same time. This 'rule of thumb' is essentially true in a four-dimensional space-time, but it is not necessarily true in a five-dimensional space-time as the existence of the neutron demonstrates. The nucleus follows the example of the neutron and utilizes the fifth dimension for its structure. A nucleus is a single mass with a single curvature, consisting of neutrons and protons that are stacked one upon the other in the fifth dimension. However, unlike the electron and proton that constitute the neutron, the neutrons and protons retain their individual identities in the nucleus.

This model demands that the axial A-lines do not combine into a single A-line for the whole nucleus. Their A-lines may coincide or overlap, but their centers of density or cusps do not combine at a single point in the fifth dimension. As the neutrons and protons stack one upon the other in the fifth direction, their overall curvatures add because their mass is collective, but their three-space boundaries across the width of the sheet must taper into the same single fundamental 'effective width' at their collective border with the four-dimensional sheet. So they also spread outward in three-space to increase the overall nuclear diameter while retaining their combined curvature. The nucleus thus remains fairly spherical, rather than lumpy, as it would be if the particles would just smear or clump together in normal three-space when they came into contact.

There is a particular stacking order for neutrons and protons that determines the relative stability of any given nucleus. The stacking order is obvious if you start at the beginning of the periodic chart (Z = 1) and work upward, including all of the various isotopes of the elements. The most stable nucleus is one in which the protons and neutrons alternate in the stack and are in equal numbers. The Tritium configuration of neutron-proton-neutron only has enough stability to exist, otherwise it is unstable and will eventually decay. It has too much neutron for its proton. The normal Helium atom with two neutrons and two protons is the most stable nuclear configuration possible and this has been designated the alpha particle which demonstrates its innate stability. As nuclei grow larger, more neutrons become necessary to stabilize the growing number of protons and thus stabilize the nuclear structure.

This method works well as long as there are roughly an equal number of protons and neutrons, but after the number of protons climbs past twenty, the number of neutrons relative to the number of protons becomes disproportionally larger. Calcium, which has a stable isotope with an equal number of neutrons and protons (twenty of each), is the last such stable isotope as the atomic number Z increases.

> For light nuclei, the neutron and proton numbers are roughly equal. However, for heavy nuclei, the Coulomb repulsion term Z(Z-1) begins to grow rapidly, so extra neutrons are needed to supply additional binding energy. Thus heavy stable nuclei all have N > Z. There are no stable nuclei with A = 5 or 8. The alpha particle $^{4}_{2}H_{2}$ is a particularly stable nucleus (B/A = 7.07 MeV); a nucleus with A = 5, such as $^{5}_{2}He_{3}$ or $^{5}_{3}Li_{2}$, will quickly (10^{-21} s) disintegrate into an alpha particle and a neutron or proton, and a nucleus with A = 8 such as $^{8}_{4}Be_{4}$, will quickly break apart into two alpha particles. (Krane, 240).

Several other characteristics that are displayed by atoms and their isotopes also impact the stability of the nucleus. A nucleus can be very stable if it has a specific number of either protons or neutrons. The special numbers that seem to guarantee stability are called the magic numbers. Nuclei with 2, 8, 20, 50, 82, and 126 neutrons or protons are both more stable and more numerous. The last nucleons to complete these 'shells' have higher binding energies while the energies for the first excited state of these nuclei are larger than for nearby nuclei with nearly the same numbers but not having magic numbers. There is also a tendency for nuclei with even numbers of protons to form more different stable isotopes than nuclei with an odd number of protons. This last tendency seems to indicate that proton pairs form more stable nuclei than odd numbers of protons, while the magic numbers further indicate this same tendency but stress that the secrets to the true structure of the nucleus are more complex and lie deeper within the numbers.

The existence of the magic numbers led to the development of a 'shell' model of the nucleus based rather loosely upon the concept of the electronic shells that surround the nucleus. On the other hand, C. von Weiszäcker noted that the nuclear properties connected with mass, binding energy and size are similar to those for a drop of liquid, so he proposed the liquid drop model of the nucleus in 1935. This five-dimensional model shares aspects of both the fluid and the shell models of the nucleus, but it is neither. It is a fluid model due to the blending or tapering of individual nuclear particle boundaries to fit a single 'effective width' of the space-time sheet. In a sense, each particle is 'spread' throughout the whole nucleus, like a fluid, from the point of view of the nuclear boundary in three-space. Yet the five-dimensional model is also like a 'shell' model since the neutrons and protons are stacked in a specific order in the fifth direction.

If the axial A-lines are coupled or overlap without discrepancies, then the nucleus is stable. But sometimes they do not overlap totally and the nucleus is unstable. If the nucleus is unstable, then it can decay during the deconstruction/reconstitution process with a particle reconstituting outside of the nucleus. As indicated above, the nucleus (also called an alpha particle) is particularly stable, so it forms a primary stability that acts as a template for other nuclei. The deuterium nucleus can also be regarded as a template. The alpha particle consists of two deuterium nuclei that are very tightly bound or coupled together in a stable configuration of axial A-lines. Three alpha particles can bind together to give a very stable and common isotope of carbon ($^{12}{}_{6}C$) and four are bound together in the most common form of Oxygen ($^{16}{}_{8}O$). However, two alpha particles yield a very rare form of Beryllium which has a half-life of only 0.07 femtosecond (10-15 seconds), so there is more to building the most stable nuclei than just adding together alphas. The most abundant form of Beryllium has a nucleus of two alpha particles with an extra neutron. Each individual alpha template comprising the Beryllium nucleus is so stable that they need the extra neutron to hold them together. This structure indicates the necessity of extra neutrons in larger nuclei to hold the nucleus together.

The magic numbers can be duplicated by building successive complex units of the basic alpha particle and throwing in an occasional Deuterium nucleus for stability. This nuclear model is simple, but far from comprehensive. There is a great deal more to explaining the nucleus, if for no other reason than because this number game does not include an explanation of the stability of nuclei with an odd number of protons. It cannot be considered a complete theory as yet, at least until an explanation is given of the stability of the alpha particle and deuterium nucleus in terms of the five-dimensional theory.

Another problem is raised when the nucleus is compared to large extended objects that are composed of tightly packed particles, *i.e.*, black holes. A black hole is a singularity, as is an atomic nucleus, but the two are entirely different except for their singular nature and a few other obvious facts. This model accounts for the singularity that represents individual particles as well as the singularity that constitutes atomic nuclei. But black holes offer a still different phenomenon that must be considered in a different manner. The particles in black holes do not stack in the fifth dimension, but the particles are in boundary-to-boundary contact with their neighboring particles. In this case, the collective gravitational attractions of a large number of tightly packed particles have grown so strong, in spite of the relative weakness of gravity compared to electromagnetic forces, that the repulsive electric forces between individual particles is overwhelmed. The overall curvature of the singularity in this case results from the additive effect of the 'effective width' of the space-time sheet. Each particle inward toward the center of the black hole sits higher in the fifth direction than the next particle outward toward the physical edge of the black hole. There is no special coupling between the axial A-lines of individual particles as exists in the nucleus. So, the black hole has an event horizon that is a product of the individual curvatures of particles that extends well beyond the physical boundary of the black hole. An event horizon for a nucleus coincides with the outer nuclear boundary in three-space because there is five-dimensional stacking and the axial A-lines are coupled.

The concept of a black hole transplants the dynamics and subatomic structure of matter to the macroscopic realm of nature. In the macroscopic realm of space-time the galaxy is the one of the largest, if not the largest, type of distinguishable material structures. The dynamics that lead to the basic spiral form exhibited by most galaxies is a mystery to astrophysicists and cosmologists. The fact that the spiral is so prevalent in the galactic world would seem to indicate a pattern that bears explanation, but there is presently no theory to explain the shape. However, the five-dimensional model is able to account for the predominance of the spiral shape of galaxies when the observed expansion of the universe is taken into account.

If a real fifth dimension is assumed, as above, then the expanding universe will represent a new motion whereby the four-dimensional spherical sheet is growing larger in the direction of the fifth direction. The notion that small material bodies moving in the space-time sheet produce a 'torque' of sorts that extends into the fifth dimension, stretching the particle singularity further in the fifth direction as relative speed increases, is also true for astronomical bodies such as galaxies. In so far as the stars and bodies that form a galaxy act in concert with each other, forming a loosely bound physical 'body,' they have a collective 'torque' in the fifth dimension. This 'torque' is moving as a whole as the universe expands. Just as any vector whose position in space-time is changing, the change will induce as added component of rotational acceleration in the collective 'body' of the galaxy. As this acceleration is 'felt' by individual stars and formations in the galaxy, a pinwheel or spiral is formed. The 'body' of the galaxy cannot precess as a whole as a wheel would since the gravitational forces binding the individual stars in the galaxy are far too weak. So a spiral shape results.

In other words, there is a weak precessional action on large combinations of stars which cannot make them move collectively as a solid body because they are too loosely bound to the 'body' even though they are tightly enough bound to act in concert as a galaxy. The group of stars collectively acting as a galaxy experiences a Coriolis effect in a manner similar to a water spout, a hurricane, a tornado or even the great red spot of Jupiter. This Coriolis effect is due to the complex of different motions within the space-time sheet and the motion of the sheet as a whole due to the expansion of the universe. This effect acts like a torque with torsion.

Under conditions where the balance of binding forces is not as weak or strong as those between stars in a spiral galaxy, other galactic shapes occur, such as globular clusters. This torsion acts on all matter of all sizes and proportions. The same Coriolis effect occurs within smaller material systems, like small eddies within the flowing waters of a river or stream. It affects the evolution of individual star systems such that planets evolve around the central star. The evolution of a star's system of planets, asteroids, comets and other planetoids from vast gas clouds speckled with dust particles depends on this torsion. So, planetary systems are the rule rather than unique occurrences within the universe. The particular makeup of any one planetary system depends on the relative forces acting within the system as it evolves, which is in turn dependent on the relative proportions of different forms and kinds of matter and their distribution at the moment that the evolution process begins.

This torsional effect will also add a small component of precession to individual planetary bodies since they act as single entities or cohesive bodies. Again, the course that this effect takes on any individual planet will depend on that body's internal makeup. And finally, this torsional effect acts all the way down to the level of atomic nuclei and individual material particles, although the effect is much smaller in this realm. The universe as a whole exerts a twist on both nuclei and individual particles that is perceived or detected as a torsion. In a nucleus, this twist or torsion acts to bind the individual axial A-lines to a slightly greater degree than they would be bound without it and is the source of the weak nuclear force. This twist is so small that evidence of it can only be detected when nuclei decay and the energy from this torsional twist is released.

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