Chapter 14. A Conical Theory of Quantum Gravity

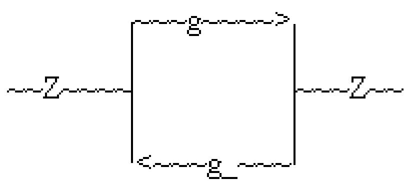
Our topics for this section include the balance of matter and antimatter, the propagation of gravity waves by the graviton, the collapse of the wave function, and the basic theory of quantum thermodynamics, including a consideration of density and the relationships among density, thermodynamics, and gravity.

We begin this section with a survey of the processes by which the lightest particles manifest. Once you are familiar with the procedure, you can extend the system to the more complex heavier particles. It all follows the same pattern and shows that the matter and antimatter in the universe are perfectly balanced.

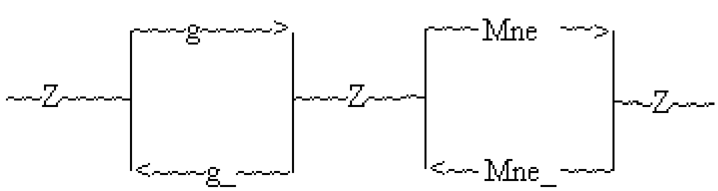
We begin with virtual pair production from the vacuum state. This is mediated by the (Z) boson. Particles can be boosted (or decayed) via the (W) boson once they have manifested. Using these two boson operators on the vacuum state, we'll work our way up to the Proton-Neutron ensemble. From there you can continue the building process to generate the nucleons of the various atoms.

Virtual pair creation is not observable unless the particles have charge and have enough energy that they separate far enough in space/time that their tracks can be measured with a detector and a magnetic field. The squiggly sign in our diagrams represents the vacuum state. The (Z) and (W) bosons are the operators that work from the vacuum state to generate massive particles. The g-bosons (photons) are the basic building block. They have no rest mass.

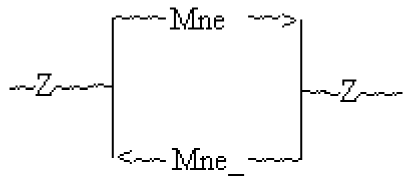
Photon Pairs:



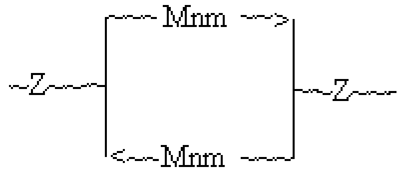
Neutrino Pairs:



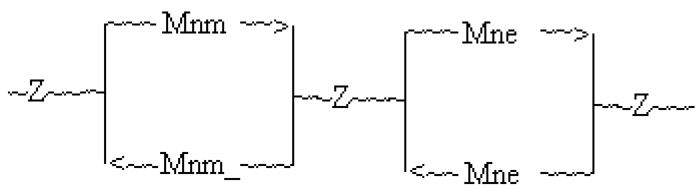
(Photon Pair "Amped" to Neutrino Pair)



(Electron Neutrino Pair)

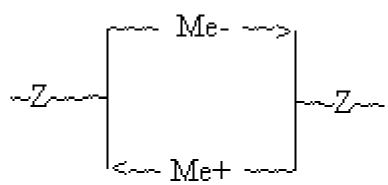


(Muon Neutrino Pair)



(Neutrino Pair Production with Decay)

Electron Pairs:

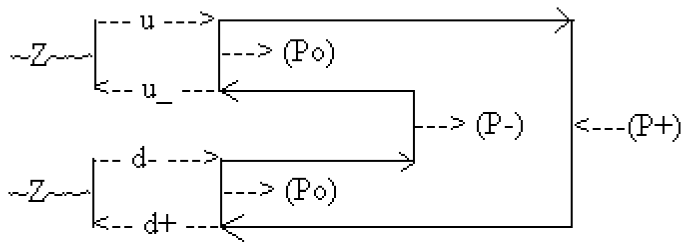


Meson Production:

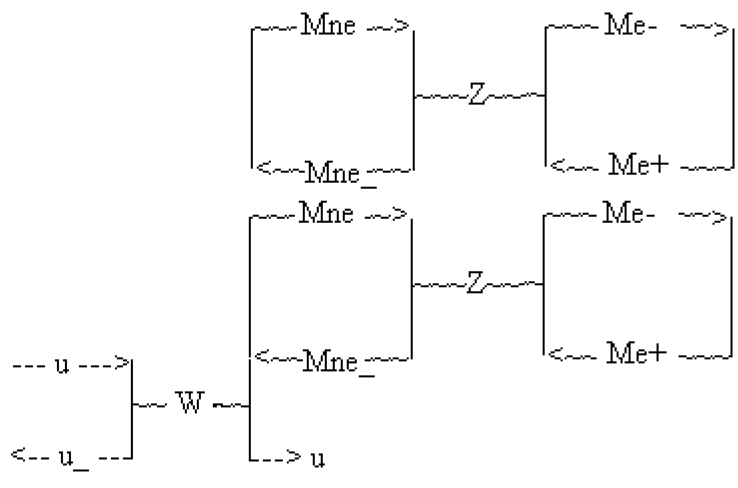
Pions generally decay into muons and muon neutrinos. Kaons are the same as Pions, but more energized. They generally decay into pions, muons and muon neutrinos. But the energized Kaons have (s) quarks instead of (d) quarks. Mesons are all virtual particles pulled from the vacuum by the presence of massive particles. They are mediated by (Z) bosons, but if the massive particle nearby is charged, it will bias the meson toward a conjugate charge. For example, the positively charged Proton (Mp) will interact with a negative Pion and thereby enter its Neutron phase state (Mn), at the same time producing a corresponding neutral resonance:

* P-, Mp --> Xo, Mno.

The negative Pion originates from a (Z) mediated pair creation or is drawn from a decay process. The resonance (Xo) decays into a Pion pair: (P- P+). The innately chargeless mesons include the "Uponium" Neutral Pion meson (u u_) and the "Charmonium" meson (c c_). Also we may find the "Upcharmium" Delta (u c_) and the "Charmupium" Delta (c u_). The other neutral mesons are formed by cancelling charges: "Downium" Neutral Pion (d- d+), "Strangium" (s- s+), "Bottomium".(b- b+), and "Toponium" (t- t+), as well as charge cancelling combinations of unlike quarks, such as the Neutral Kaons (d- s+), (s-d+) and so on. All other quark pairs have charge. The mesons generally form a cloud of virtual particles around a nucleon, but they can be separated from their hosts and used momentarily in various interactions.



The Proton-Neutron Phase State Oscillation: (For individual particles there is an energy gap between the two phase states.)



* [(Me-) (Mne_)] (u) (Me+) (Mne) (u_) (Mne) (Me+) (u) (Mne_) (Me-).

The neutron consists of an ensemble of eleven fundamental particles in a perfect balance. The electron and antineutrino in brackets represent the portion of the neutron that pushes out of the core ensemble when the neutron goes into proton mode. The proton core ensemble thus consists of nine fundamental particles. It is non-local and asymmetric. This gives it the tendency to form clusters. The neutron by itself is unstable.

Symmetry is gained at the expense of stability, but it stabilizes itself when clustered with other (proton)-neutrons.

Another way of representing the ensemble shows the role of (d) quarks in the Neutron. In the Proton the (d-) quark has decayed into a (u) quark. The quarks are generated by the (Z) boson: (Z--> u u_), (Z --> d- d+). Then the (W) boson downsteps the (d) quarks to (u) quarks and leptons.

Neutron:

* u
* d- --> u, Me-, Mne_
* d+ --> u_, Me+, Me+, Mne, Mne, Me-, Mne_.

The Proton-Neutron Oscillation shows a spontaneous symmetry-breaking system. The symmetry is fully restored only with the Helium atom. Thus Helium, a 4 (Mn) multiple, is the most stable and inert element of all. Hydrogen, on the other hand, though simpler than Helium and decay resistant, is highly reactive.

The above diagram shows that the Proton is really an "antiparticle" at heart because the positron charge aspect predominates. Of course the nomenclature is relative. We really should call protons "matter" and electrons "antimatter" because the mass associated with solid matter is mainly derived from the heavy (u) quark "neutrinos" in the protons. Neutrons are proton oscillations, and electrons are proton components. The electrons are actually only the foci of vortices. Ultimately the matter and antimatter of the universe perfectly balances out. The single extra (u) quark mixes and balances with the (u) antiquark and the antineutrino. The appearance of solidity in matter is due to the resistances of the electrical charges pushing out to generate the illusion of space. The reason the matter and antimatter can coexist in the nucleon is simply due to the dynamics of the wave harmonics. Standing waves have hills and valleys. In the nucleon those hills and valleys correspond to opposing charges and matter types.

Now we are ready to continue our study of Quantum Gravity.

In the previous section we built a model of quantum gravity based on the geometry of a pair of conjugate cones and the various conic sections. In our model particles move along the surface of the cone, and their trajectories are determined by the conic section curves generated when the observer establishes a viewpoint. This viewpoint can be interpreted in our model as a plane that intersects the cone at some angle. That intersection angle ranges over + / - 90 degrees relative to the vacuum equilibrium zero point, which is represented graphically as the horizontal axis. Each positive angled plane has a partner with negative angle. Planes that intersect only above the "horizon" have reflections below the "horizon".

We also proposed in our model that the upper nappe represents our physical world of experience, and the lower nappe represents our mental world of thoughts and beliefs.

The "upper" and "lower" orientation is strictly conventional. The two cone sections match. Whatever trajectory is formed in the upper cone is a reflection of a conjugate trajectory formed in the lower cone. The reflection is projected from one nappe to the other through the central point "lens". Thus there is always a set of four conjugate curves generated whenever an intersection occurs. In the case of ellipses and parabolas, there are two crisscross curves in each cone. In the case of the hyperbola, the two sets of planes and curves are parallel to each other, and each plane slices all the way through both cones along the cones' vertical axis, though not necessarily parallel with the cone axis.

In this way we can interpret the conic sections as a FOUR-WAVE MIXING PHASE CONJUGATION system. The whole system functions like a "gravity" laser. We recall that the principle of four-wave mixing phase conjugation is completely general and applies to any system that is composed of interacting waveforms. Therefore, if gravity expresses itself as a waveform, it must interact in this way. Circles and the center point are degenerate cases. The center point acts as the non-linear conjugate mirror between the upper and lower nappes. Massive particles move about on the cones' surfaces. The foci of curves act as conjugate mirrors with respect to the relation between particles and their directrices.

In our last section we described how the graviton energy reflects back and forth between the directrices in the intersecting planes. The gap between the directrices ("antigap" for hyperbolas) is just like a resonant cavity of a laser, except that the gravitational waves are bent by the presence of massive particles. The bending is quite similar to the refraction that occurs when light passes through dense media. Just as light has an index of refraction for various media, so gravity has an index of eccentricity for various types of curvatures in space/time caused by the presence of massive particles.

In the case of light we find that the speed of light in empty space is given by:

* $c = (w / k) = 1 / (eo\ mo)^{1/2}$.

However, if the light passes through a denser medium, then the relationship changes by a dielectric constant (kd) and a relative permeability constant (kp), each of which is special for the particular medium. Thus the velocity of light in a medium (Vm) will generally be slower than in space.

* $Vm = 1\ (kd\ eo\ kp\ mo)^{1/2} = c / (kd\ kp)^{1/2}$.

If the object is transparent, then (kp) approaches 1. So the index of refraction (n) is the ratio of the speed of light in a vacuum to its speed in a medium.

* $n = c / Vm = (kd)^{1/2}$.

The speed of light equation derived by Maxwell basically has the same form as the Velocity Equation. Instead of writing the group velocity (Vg) and phase velocity (Vp), Maxwell wrote a particular pair of constant values that were assigned arbitrary dimensional units for the convenience of solving certain types of problems in electromagnetism -- (eo^-1) and (mo^-1).

The index of refraction for light is a pure number since it is a ratio of velocities. The same is true when we look at our model in terms of velocity. Let' s assume that we have a point (P) on a trajectory. The two foci are (F1) and (F2). This gives us two "gravity beams", (PF1) and (PF2). The perpendiculars from the point (P) to the directrices form lines (PQ1) and (PQ2). We can interpret all these line segments as velocities. The eccentricity (Ke) is a pure number, an index.

* (Ke) (PF1) = (PQ1).
* (Ke) (PF2) = (PQ2).
* (Ke)^2 = (PQ2 / PF1) (PQ1 / PF2).

I crisscrossed the factors, but it does not matter. This relation holds for all the conic sections.

The way in which the gravity waves refract and reflect to form "beams" through the plane of intersection is very reminiscent of the way that a four-wave mixing system sets up a quantum bubble that will carry out automatic tracking of a moving object. Recall that if you insert a reflective object into the macroscopic quantum field bubble of a phase conjugating system, a beam will form between that object and the nonlinear pumped medium. As you move the reflective object about, the photon beam will automatically follow the object.

The same thing happens in our gravitational system. For example, as a planet orbits a star, the coherent quantum gravity bubble formed by the "pumped up" nonlinear gravitational medium of a large mass automatically coalesces into a gravity beam that runs between the two massive objects, reflecting back and forth. The principle is exactly the same. The smaller massive object acts as a reflector, and a beam forms between it and the gravity well. As the object orbits the gravity well, the graviton beam to and from the gravity well automatically tracks its motion.

When the orbit is not circular, but elliptical, then the central focus (the pumped core medium in the four-wave mixing scheme) is split into two foci. One has positive mass, and the other has negative mass, and they form two poles. A virtual beam also forms between the two foci. This beam is parallel to, but shifted a distance from, the beam that runs between the two directrices and through the orbiting object. This is similar to the way a beam of light gets shifted a certain distance when it passes through a refractive medium such as glass. When it emerges from the glass, it resumes its normal passage through the air or space. Snell' s Law gives the angles by which the light beam bends when entering and exiting the refractive medium.

* n1 Sin A1 = n2 Sin A2.

Here (n) represents the index of refraction of a medium, and (A1) is the angle of incidence, and (A2) is the angle of refraction. Of course, some of the light also reflects, with the angle of reflection equaling the angle of incidence. The angle of incidence is between the wave front and the surface of the denser medium that the wave front encounters. We can also call it the angle between the trajectory of the photon and the perpendicular to the medium' s surface. The angle of refraction is the angle that the wave front inside the denser medium makes with the medium' s surface or that the photon trajectory makes with the perpendicular inside the denser medium. When the wave front bends, the wavelength must shift. When the angle gets smaller inside the medium, the wavelength between wave fronts gets shorter. The wavelength is related to the velocity as follows:

* L = V f.

Here (L) is the wavelength, (V) is the velocity, and (f) is the frequency. The frequency does not change as the light transits the glass, so the velocity **must** change. The speed of light is determined by the ratio of its wavelength to its frequency. In free space it is always (c). However, when the wavelength shortens as the wave front refracts, the speed of light drops -- as long as the frequency is unchanged. When the light exits the denser medium, the bending is reversed and the wave front continues on at its original velocity and angle. But the beam or ray has been displaced a relative parallel distance in space by its zigzag passage through the denser medium.

Why does the gravity beam exit its passage through the denser gravity field of an elliptical orbit resuming its path without displacement in space? The light beam refracted in glass is only affected in one direction. The gravity beam loops around and is bent in two opposite directions that cancel each other. The foci are nonlinear media in a conjugate mirror system. They function like conjugate mirrors and reflect back a conjugate beam exactly at the angle of incidence retracing its path reversed in time. The beam between the foci is a virtual beam generated by the opposite masses of the foci, inertial and gravitational. This is just like in the case of a pair of virtual particles created from the vacuum state by the (Z) boson operation. Time displacement is negligible, as we shall see, because the graviton propagates at a superluminal speed, and because of the time reversal.

You can get the same effect of restoring the distance displacement with light by using a mirror to reflect the beam that exits from the glass back through the glass along the same path it exited. The light beam will retrace its path, passing back through the glass, bending back and returning out the other side of the glass along its original trajectory. You can get the phase conjugation effects of the gravitational system with light by using a phase conjugate mirror. For example, you can mimic the auto-tracking feature and the incident-angle reflection feature. Thus, by using phase conjugation techniques for the foci, ordinary mirrors for the directrices, and a refractive medium for the "orbiting object", we can build an actual working model with light of how gravitational waves reflect and refract in a solar system.

The index of refraction for light varies not only with the medium, but with the frequency of light. So light of different frequencies bends at different angles, leading to the principle of dispersion. This is the principle used in prisms to separate colors of light.

If the light source originates in the denser medium, at a certain critical angle (Ac), it will achieve total internal reflection and no longer refract. This corresponds to an angle that according to Snell' s Law equals or exceeds 90 degrees. The sine can not exceed a value of 1. After that its value reverses and begins to decrease. Thus 90 degrees corresponds to a dimensional shift. We can use this principle to model the way that photons turn in on themselves to form particles.

The microscale explanation of refraction provided by QED involves the interaction of photons with the molecular structure of the refracting medium. However the principle of Snell' s Law operates without regard to any of that detail the same way that thermodynamics laws work without going into the details of each microstate or even the material of the medium. We can use the principle of Snell' s Law and pretend that we are talking about a single photon moving through space. In space the index of refraction is 1. However, the photon moves with a wavelike motion, and has energy determined by the frequency of the waves. As the frequency increases, the wavelength gets shorter. This increases not only the energy, but the energy density. This density occupies space because of the wave motion of the photon. As the photon oscillates, it deviates slightly from a straight-line trajectory, first to one side, and then to the other side. This creates a slight angle. We can use this slight angle, plus the concept of energy density, to apply Snell' s Law in a thought experiment and predict the eventual formation of particles from high-energy photons.

We can assume the same tiny angle with respect to space, and, instead of varying the angle while keeping the refracting medium constant (as in the case of a light beam in glass), we vary the energy in the vicinity of the photon. This is like modifying the density of a refracting medium (a self-interacting refractive medium!) and increasing its index of refraction. At the point of a 90-degree shift, the index and the sine of the angle become reciprocals. So for example, glass has an index of 1.5, and a critical angle (Ac) of around 41* 50' . (Here * means ' degrees' .) We imagine a beam passing through an empty container with a smooth, flat, non-refracting boundary. We gradually introduce a refracting gas that incrementally increases the index. We begin with an empty gap and an internal beam at 41* 50' . So at the start, with empty space inside and outside the container, (n1) equals 1 and (Sin A1) equals .666 and (n2) also equals 1 and (A2) also equals .666. As we add gas to the container, (n1) increases. Since (n2) remains constant, the exiting beam is pulled down toward the surface of the container. The angle increases until it reaches 90*, at which point the beam refracts along the surface of the container' s boundary and no longer exits. At this point and beyond, the beam can only reflect internally from angle (A1) or any larger angle.

If we have a photon moving through space with a wave motion, the photon trajectory always differs very slightly from normal to the wave front in one direction or the other. Let' s pretend that the divergence from normal is 10' . This gives us a value for (Sin A1) of (.0029). The value of (n2) is fixed at 1. So Sin A2 = Sin A1. And we hold (A1) constant.

* n1 (Sin A1) = n2 (Sin A2).
* (1) (.0029) = (1) (.0029).

However, we can increase the index value of (n1) until (Sin A2) becomes 1. That means that (n1) must become the reciprocal of (Sin A1), which has been held constant. We therefore find that when the index (n1) reaches the large value of 344.827..., the photon does a dimensional shift and wraps around on itself.

* (344.827...)(.0029) = (1) (1).
* n1 = 344.827...

Thus, given a divergence of 10' from normal of the photon relative to its wave front, an energy density refraction index of 344.827 will cause the photon to chase its own tail and turn into a mini black hole. If we keep the amplitude of the wave the same, and just vary the wavelength, as the energy increases, the angle of divergence from normal also increases. This lowers the required (n1) index value considerably. In fact, as the wavelength decreases at very high energies, the divergence from normal gets closer and closer to 90*. By the time it has reached 45*, for example, (Sin A1) already is at .7071. This only requires that n1 = 1.414.... That is less than the index for glass.

If we place the wave front horizon at the "zero point" of a photon oscillation, the wavelength extends above and below the horizon. Low energy ELF waves are quite flat. The energy of the photon at the critical "particle" threshold wavelength (Lc) is

* E = h c / Lc.

When the wavelength shortens so that it passes through the zero point at almost exactly 90*, the index of (n1) falls to 1, and we get the same effect of 90* dimensional shift. From the Einstein relation,

* E = Mx c^2.

We combine the two energies:

* Mx c^2 = h c / Lc.
* Mx c = h / Lc.
* Mx = h / c Lc.

The critical wavelength (Lc), according to our calculations is around 3.16227766 meters, the uncertainty spatial interval for the lightest neutrinos. Working backwards, we find that the energy at this wavelength is around 6.626x10^-26 J.

So we use

* E = H c / %.

We get a natural quantum unit of energy at 10^-26 J. At around 10^-26 J the photon energy starts to oscillate into neutrino particles. But neutrinos do not really have a stable particle configuration. They tend to oscillate and shift about.

At around 8.2x10^-14 J, the wavelength reaches 2.4241x10^-12 m. At this point the photon whips around into a whirlpool and takes on a charge -- the electron vortex. This is still not a "true" particle. It is a sub-component that depends on the proton. But it does keep a stable particle shape. So this is the beginning of the window for "stable" particles.

The first truly stable particle is the proton with an energy of around 1.5x10^-10 J. This corresponds to a wavelength of 1.3252x10^-15 m.

Having taken this brief digression to explore indices of refraction and the creation of particles with mass from pure energy, let' s continue our discussion of the gravity cone from the standpoint of velocity. Dividing each distance component by a unit of time such as a second reinterprets all the distances into velocities.

In our model the distances of various trajectory curves from the central point are relative. The observer' s viewpoint can shift about, and the particles can slide up and down as they curve around the cones. We want to find a distance (i.e. a velocity) that remains constant no matter what kind of conic section shows up. This would be a nice candidate for (c), the velocity of light in our system.

We find that, no matter what sort of conic section curve we generate, there is always a constant distance (velocity) for each figure. It may be oriented in different ways, but it is always there. Let' s describe it.

In the case of the ellipse, the conjugate intersecting planes are parallel, reflecting across the vacuum equilibrium line between the upper and lower nappes. Therefore, each orbit can be thought of as a series of end points for a bundle of line segments that runs through the center point. The length of each line in the bundle is the same. That is, the distance between the particle orbiting in the upper nappe and its conjugate particle in the lower nappe is always the same, even though the motion and position of the particle may appear to change. This is the orientation for an invariant "velocity" for ellipses. But it is a derivative constant and not the fundamental constant that represents (c).

All four directrices are mutually parallel, so the lines that reflect between them are all equal. The true value of (c) in our model is the perpendicular shortest path from any point in any particular elliptical trajectory to the plane that passes through the center point and is parallel to the intersecting plane that generates the trajectory. This path is always a constant for any ellipse and is also equal to the corresponding orthogonal paths for all three of the other conjugate ellipses that form the four-trajectory conjugate ensemble in the cone structure.

Earlier we made a simple model of the Velocity Equation using a standard rectangular microwave klystron tube. We showed that a klystron tube splits a microwave into its three component velocities, each moving differently. The photon moves at (c) zigzagging back and forth bouncing off the walls of the tube at a certain angle. Because of the zigzagging, its actual progress down the tube slows down to less than (c). This forward progress of the photon down the tube is called the group velocity (Vg). On the other hand, the wave front is orthogonal to the photon trajectory, and, as the photon zigzags down the tube, the wave front flashes back and forth strobing up and down great sections, or even the whole length, of the tube at superluminal velocities. This is the phase velocity (Vp) of the microwave.

In our model of the elliptical gravitational system, the velocity (c) is the constant light-velocity vector the orbiting object (P) maintains normal to the parallel plane that passes through the center point. The group velocity (Vg) is the varying speed at which the orbiting object travels in its orbit. It can be represented by the kinetic motion vector which is tangent to the trajectory at point (P) in the direction the object is moving. When the object at (P) is near its perigee its speed is maximal. When it gets to its apogee, its speed is minimal. But the orbiting object' s speed is always less than the speed of light (c).

The phase velocity (Vp) of the orbiting object is represented by the exchange of gravitational energy between the orbiting object and the observer at the center point (O). This is the graviton vector (PO). Yes, the observer is interacting with the system and actually controls it from the central point through his superluminal will vector (OP), that is the conjugate to the superluminal graviton vector. The whole physical system is also mirrored inside his mind (the lower nappe). The graviton exchange velocity vector is always superluminal, because there is no orthogonal line between any position of the orbiting object in its orbit and the center point.

The only orthogonal to the geometry of the trajectory goes from (O) to the midpoint between the foci (F1) and (F2). Thus all possible lines (PO) are greater than (c). However, each (PO) when added to its lower nappe conjugate (O P') also has a constant value. This is the bundle constant referred to above.

In the case of the parabola, the conjugate intersecting planes are also parallel, but run parallel to the tangent edge of the cone. The distance from a particle in the upper nappe to its conjugate in the lower nappe is the same, but the sign is reversed and the conjugate reflection is mirrored outside the lower nappe in the gap. We can start from the vertices of a pair of conjugate parabolas and run a line from an upper particle (P) to its lower conjugate particle (P'). This defines the "origin" or zero orientation of the parabolas. Then, as the particle swings along either arm of its trajectory, a perpendicular to the parallel plane will be equal to a perpendicular from the conjugate particle to its parallel plane. Because the two intersecting planes are parallel, any perpendicular between them will always have the same distance. The value of (c) in the physical world represents the shortest path vector distance between any point (P) on the parabola trajectory and the plane tangent to the cone' s edge and parallel to the intersecting plane that defines the parabolic trajectory.

As the moving object nears the vertex of its trajectory, its velocity increases. At the vertex the velocity actually instantaneously equals (c). This is the light-speed slingshot that propels the object around the focus and off toward infinity. The parabolic trajectory is an idealization. There is no such trajectory in real life for solid objects. There are only approximations to it for intervals of time. Light from an object at its "parabolic" vertex travels down the tangent to the center point. The observer can adjust his lens at the center point (O) so that the central plane tilts to put any point (P) on the parabolic vertex and thus accessible to direct perception at the center point (O). Otherwise the light from (P) proceeds normal to its unadjusted trajectory plane and arrives at a corresponding point on the unadjusted parallel central plane outside (O). The center plane is like a movie screen. The photons from the various objects on the cone' s surface project down from World Space and up from Mental Space onto the screen, just like a movie. This creates an illusory light show of perceptions in the present moment. The screen is made of quantum foam -- the Seven Dwarves and their magical "Prince Charming" gems that we introduced in the last chapter. These can generate multiplicities of cones oriented at any angle. Shifting of the central plane by an observer does not really involve much. The cone is generated from a bubble of quantum foam. You just rotate the tiny quantum bubble at the center (O) by the angle you want in order to reverse project any point (P) into the center point (O). This shift of viewpoint allows direct perception of any object in the here and now. (Vp) becomes (c). We can call this a reverse parabolic projection. Instead of being experienced as an illusory form, the object is experienced as pure light.

When a projectile is hurled into the air from the earth, the parabolic slingshot principle is reversed. At the parabola' s vertex the velocity becomes zero. This inverted parabolic trajectory is closely approximated in physical systems. But the slingshot version does not happen because of relativistic constraints. You can only experience it as the slingshot vertex of pure light called enlightenment. However, we can think of physical World parabolic "orbits" as very eccentric orbits with eccentricities of nearly 1. They occur in meson interactions, in which a quark may slingshot so tightly that it reverses in time. If we assume that our cone has a 90-degree spread at its vertex, then the normal vector from the parabola' s vertex to the cone' s vertex at the center follows the cone' s edge and represents (c). The distance from any other position (P) on the parabolic trajectory to (O) other than the vertex is (Vp) > (c). As the object swings out past its maximum velocity at the vertex of its trajectory -- very close to (c) --, its group velocity gradually and continually decreases. Of course we know that its outward path is just the reversed parabola path. When the object reaches zero velocity, then it begins its fall back to the inner focus and vertex. It closely resembles the oscillation of a spring. Thus there are no persistent parabolic orbits in nature, only momentary approximations.

In the case of the hyperbola the parallel planes are more vertically oriented and each plane passes through both nappes. In the middle on both sides of the central point is a forbidden zone into which the trajectories may not enter. The observer has a resistance to these objects. The value of vector (c) is one half the shortest distance between the parallel conjugate planes. If these planes are perpendicular to the vacuum equilibrium horizon that passes through the central point, then (c) is the shortest vector from a point on the trajectory to a point on the plane that intersects the cone' s vertical central axis. This extreme tilt to the projection plane is evidence also of the observer' s resistance. He is looking away from the light. Since the light counterpropagates, the only way you can "look away" from the light is by turning 90 degrees. Under this condition you see no light, but just imagine objects lunging at you. It can be pretty scary. The whole World is threatening to pound on you, and you can not see a thing. A 90-degree oriented hyperbolic plane represents the "Dark Night of the Soul." Unknown stuff, which you also can not see, comes surging up from the hidden depths of your Mind. All of this is due to the observer' s angle of viewpoint. All he has to do is shift his viewpoint and everything becomes clear.

The hyperbolic group velocity (Vg), as usual, is the velocity of the object in its trajectory. It is represented by a kinetic vector tangent to the trajectory and oriented in the direction of the object' s motion. The graviton vector represents the phase velocity (Vp) from any point (P) to the center point (O). As usual (Vp) = (PO) and is always larger than (c), which is always larger than the motion of (P) in its trajectory (Vg).

A universal principle of this model of gravitational/inertial velocity is that the observed motion of the object in its trajectory (the kinetic vector) will always be orthogonal to its light-speed "vector". In our klystron model we found that the ratios of the component velocities formed a "twisted" pattern of similar triangles:

* c / Vp = Vg / c.

However, in the klystron case, (Vg) and (Vp) are proceeding parallel along the tube, and (c) is a diagonal that crisscrosses the tube' s width. In the case of conic sections (Vg) and (c) are normal to each other, and (Vp) is a diagonal which is also normal to (Vg), but not to (c). We generate (Vg) as follows:

1. Draw a line from (P) to (O). This is the graviton attractor / will resistor conjugate vector system (Vp) = (PO) = -(OP).

2. Draw a perpendicular (PC) from (P) to the plane that is parallel to the trajectory plane and passes through (O). This is the light-speed vector (c). It has a conjugate pair. The advanced photon is the attention photon (CP), and the retarded photon is the object photon (PC).

3. From point (C) on the parallel plane erect a perpendicular to (PO) at (G).

4. Segment (PG) represents the length of the kinetic vector (Vg). The kinetic vector has a conjugate vector in the Mind Space that is equal and opposite.

5. Draw a tangent to the trajectory at point (P). (Use Radius of curvature.) This is the kinetic trajectory according to Newton' s first law, and expresses the kinetic energy of the object (P) as inertial motion.

6. On the tangent mark off (PH) = (PG). This is the kinetic vector in its proper location and with its proper length. The conjugate kinetic vector mirrors the kinetic vector in Mind Space.

The whole system follows Newton' s laws of motion.

I. Inertial Motion Law. The object (P) has kinetic energy that expresses as motion. The motion is inertial and continues until acted on by forces. (Vg) expresses (P)' s inertial motion.

II. Force Law. The gravitational force curves (P)' s trajectory via the tractor (G) beam (F1 P) according to Newton' s law of force in its gravitational form:

* Fg = G (MP) (MF1) / (F1 P)^2.

(MP) is the mass of the orbiting object, and (MF1) is the mass of the gravity well at (F1). (F1 P) is the length of the tractor (G) beam that forms between the orbiting object and the gravity well object.

III. Equal Action Law: The inertial (I) beam (P F1) generated by the kinetic motion of (P) balances and equals the tractor (G) beam at every point of (P)' s trajectory, but, as a vector, is oriented in the opposite direction. The kinetic (K) beam (F2 P) and its conjugate detractor (D) beam (P F2) balance each other and relate to the (G) beam and (I) beam as follows:

* (F1 P) + (F2 P) = 2 A,

where (A) is the semimajor axis of the orbit.

The whole system is attracted to the observer' s Origination center point (O). As the system settles down kinetically, it will tend to shrink and sink down the cone into the (O) point. This is the attractor (A) beam (PO). A resistive will (R) beam counterbalances the attractor beam and keeps the whole thing going in both Mind Space and World Space.

There is another way of looking at the system. The angle of the cone can change as (Vg) changes if we want to hold the intersecting plane normal to the cone' s axis. The two ways of looking at the system are equivalent. One view keeps the cone still and tilts the intersecting plane. The other view keeps the plane normal and varies the angle of the cone' s edge.

The angle that the cone' s edge forms with the vacuum equilibrium depends on the relative velocity of (Vg). If (Vg) is relatively motionless, the cone degenerates. As soon as (Vg) begins to move, the relationship between it and (c) and (Vp) begins. We can follow its evolution most easily by assuming a circular orbit. Then the intersecting plane is not tilted, but runs parallel to the vacuum equilibrium plane. When (Vg) is very small compared to (c), the cone' s edge forms a very acute angle with the vacuum. Thus the ratio (c / Vp) is very small. As (Vg) moves faster, the cone' s angle rises. We can always find the ratio between (Vp) and (c) by the Pythagorean relation, but (Vg) is usually the observable that the attention goes to. So we calculate from there. As (Vg) approaches the speed of light, the ratio (c / Vp) approaches 1. The cone' s angle approaches 90 degrees, and (Vg), (Vp), and (c) all become equal. The cone degenerates into a spindle of height (Vp = c). Effectively we have a black hole. The orbiting object is now a photon whirling around a center of mass.

The size of the cone is relative. The ratios say nothing about the distances. The Planck length is our only limitation. And, of course, if (Vg = 0), then there is no orbit and the cone degenerates.

The conjugate (G) beam and (I) beam pair balances and holds the object in its circular orbit just as if there were a material beam between the gravity well and the orbiting object. If the orbital radius stays the same and the velocity increases, then we know that the gravity well mass must increase correspondingly. Otherwise the orbital radius will increase and the beam will stretch.

The whole system is defined by the belief system of the Observer and operates pivoting as a phase wave projection from the central point of awareness.

Thus the whole system is a cleverly balanced light show, and the Observer does ALL the "work". He creates it, he maintains it, and, when he' s done playing with it, he dissolves it all back into his projector Lens at Source point (O).

We have calculated a very fast speed called the Planck Velocity. This velocity is based on the ratio between the volume of a sphere and the area of a circle. That ratio of geometry is then related in a ratio to Planck Time, which is the fundamental dimension for ladling out energy.

Orbiting objects sweep out equal areas on the orbital disk in equal amounts of time. And of course each orbit has a mean radius and sweeps out a complete disk in a single complete orbital period. This is the connection between a circular area and time.

The graviton' s wave on the other hand, propagates in all directions just like a photon' s wave, filling the area of a sphere within a unit of time. Both of these events -- orbiting and radiating -- are occurring simultaneously over the same units of time. The particle is sweeping through an orbit of fixed area, and the graviton' s wave is propagating a spherical bubble into 3-D space at a fixed speed. The ratio of the bubble to the area is thus a constant distance per second (4/3) (R), where (R) is the radius in meters. This can also be a velocity if we consistently interpret in terms of velocity. But for now we refer to distances. The gravitational well generates a beam of length (R). In one second its graviton "radiation" extends from the singularity to fill a spherical space with a bubble radius of 10^42 m, encompassing the universe.

Planck Time is based on the minimal unit of energy. All time is a measure of change in energy status. It may be periodic, or it may just tend in a particular direction. A pendulum clock is periodic. Entropy is a directional tendency for all defined systems. Generally we prefer periodic timekeepers just like we prefer periodic rulers, with equal distances marked out on them. But there's no reason we couldn't use squiggly, stretchy rulers and non-periodic clocks. Some cultures prefer that way of looking at space and time. A lady once told me her boyfriend was always late for dates, but never by any predictable interval. That must have been an interesting relationship.

Planck Time is determined by the minimum quantum of energy that will interact and thereby generate time. It is the tiniest quantum unit for tracking change. Unfortunately it is so small that we do not have a really accurate measurement of it. Also, it is at a level of creation where uncertainty totally swamps any particular measurements. Nevertheless, we can get a pretty good ballpark estimate. Our calculation puts it at around (4/3)x10^-42 s. Other versions vary slightly. It doesn't matter. What does matter is the value of the spatial interval that we choose. This is the metric in space to which we attach our Planck clock in order to look at velocity of change, whether transformational, translational, or rotational. If we use the Planck length, then we get (c) as the Planck Velocity. However, if we use a measure from the scale of our usual viewpoint, such as (Ru) = 1 meter, then we get a value of 10^42 m / s, which gets you across the universe in a blink of an eye. If we use the D-Shift value 3.16227766, then we get pretty much the same answer. The ratio is completely washed out by the immense scale. If we use the Compton radius for an electron or a proton, then we get something else in between. Is there a criterion for choosing?

We know that the speed of light is constant for all observers as far as we can tell. Either gravity goes at (c) or it doesn't. Well, maybe it does both! We recall that light has two components that form a conjugate pair. One is retarded light and travels from the object to the observer. The other is advanced light, and it travels from the observer to the object. If no one observes, then whether or not there are photons, or light, or anything else, is a moot point.

When photons begin to run around in circles and generate particles and mass and charge and so forth, then we can begin to see things. If there are no charged terminals such as electrons, then there is no place for photons to land, and they just fly around forever as uncollapsed wave functions. As soon as an observer takes a position and makes a measurement, he detects a photon -- or perhaps many, many photons. When the photon curls into a terminal, it becomes like a wave guide. Wave guides split light into group waves and phase waves. One wave goes around in a circle, and the other goes off into mental space. The former is the source of the "left-handed" spin on the neutrino. The latter is the right-handed pool of advanced waves in the mind of the observer. When the observer observes something, he sends an advanced wave of attention to the object.

It moves backward in time like an antiparticle. It is an anti-photon. It stimulates the object to emit a retarded photon, and the two photons travel together to the observer. The advanced photon does not really make a round trip, it travels from the present into the past. To the observer it may seem as if it jumped suddenly from the observer's mind in the present to the object's condition in the past, and then propagated back to the observer. This is the quantum leap.

The quantum leap is superluminal and essentially instantaneous. Experiment has shown that the collapse of the wave function is non-local and simultaneous between correlated particles to the resolution of our instruments. I propose that the collapse of the wave function propagates at approximately (Pv = 10^42 m / s). We choose this value because it defines the scale at which we, the observers, function. We set it by the value of (Ru) that defines the ratio between the quantum charge unit and the speed of light (c). This ratio gives us the illusion of a particle called the proton that appears to have mass. The Planck Velocity is the speed of the will. The observer, of course, can deliberately decide his scale of reference and vary the speed of his attention, just as photons can be sent through various refractive media. But the default "free space" value is set by the "here and now".

In our model the "here and now" is located at the center of the cone (O), the point where the two conical nappes join. Every point on a trajectory curve that a moving particle may occupy forms a wave function that maps through the "here and now" point (O) into the mental image that reflects in the lower nappe. The field of beliefs and their mutual interactions is reflected faithfully in the field of experience and vice versa. There may be distortions, but the conjugate image also reflects the distortions. The quantum foam screen at the vacuum equilibrium forms the parallel plane that passes through the center point. Mind Space and World Space both project onto the quantum foam screen to give us the impression of the moment, a frame from a movie of all the various trajectory wave functions and their various dynamic denizens.

One of the principles of this model is truthfulness. The cones are always perfectly honest. The magic conjugate mirror never lies. The quantum foam displays whatever is happening in the (M) and (W) Spaces. Furthermore, whatever is in your mental realm will be faithfully reproduced by your physical world. There is no cheating or stealing. And there are no shortcuts. The rays pass in straight-line (c) paths through the parallel center plane, and the superluminal (Vp) rays pass right through the (O) point of the observer's Origination lens of awareness from his Mind to his World, and from his World to his Mind.

You can drop straight down from a circle above to a circle below, but you will not be on the conjugate point. That is on the opposite side. If the orbit shifts to elliptical, you will find yourself way out of position, even though you are on one of the conjugate ellipses. This image reversal and displacement is the source of a lot of confusion in the world.

The distance between a point on an upper nappe curve and its conjugate below may be very, very far. But the connection is made via superluminal phase waves and they travel virtually at infinite speed (10^42 m / s). Recall our discussion of the klystron wave guide. The photon' s wave function is split into three components. The wave front reflects from side to side following a zigzag path down the tube at the speed of (c). The wave progresses down the tube at the group velocity, which is slower than (c) because the wave has to zigzag back and forth. The phase wave is generated by the interaction of the wave front with the side of the tube. This wave flashes back and forth down the tube at superluminal speeds. It has no speed limitation, but it gets this freedom to roam superluminally in space and time from the tradeoff of a boundary imposed on it by the klystron tube.

In the same way the particle (P) on the cone' s surface moves as a subluminal group wave along its trajectory as a result of the interaction of inertial-gravitation forces. It maintains a constant relationship with the parallel plane via its orthogonal relationship, the (c) vector. Remember that the photon' s wave front is also normal to the direction the photon moves. The group velocity (Vg) is the resultant actual forward kinetic motion of the photon. This is true in our cone model as well. The particle moves in a resultant trajectory that is on one of the intersecting planes. Its invariant connection to the parallel plane is orthogonal. The particle trajectory is a wave front normal to the photon that has been warped by the gravitational effects of the masses involved in the system.

The (Vp) vector goes from the tangent at point (P) on the trajectory to the center point. It is also normal to the kinetic vector. But the (Vp) vector is NOT normal to the (c) vector. It forms an acute angle as in the klystron.

The (Vp) lines that pass through the center point in the case of the ellipse pivot like levers. They get "velocity leverage." The limitation imposed by the fixed point allows them to wave back and forth over huge distances just like the phase wave that whips back and forth inside the klystron tube.

However we have achieved something remarkable here in our model which does not occur in the case of the klystron. We have shown how information can be transmitted faster then light! The superluminal (Vp) strobe in a klystron tube can not transmit information. The superluminal collapse of the wave function in the case of quantum correlated particles in the EPR experiment gives us no control over the whole non-local field of information. The receiver gets information superluminally, but it is garbage, because he is only getting half-bits at a time!!

With our cone the situation is totally different. The lower nappe is the observer' s own mind, his consciousness. Everything that is in his physical world is reflected simultaneously and instantaneously (at the Planck Velocity) in his mind. He can focus his attention down any particular ray belonging to any particular trajectory and see what' s happening. This happens instantly. He uses the superluminal property of the attention' s attractor (A) beam. He can also shift his attention about in his mind to another trajectory or point on the same trajectory, and the attention shifts over immediately. He can rotate a quantum bubble and tilt his perspective to instantly experience the slingshot (c) vector value of any object and shift into direct experience of pure light. The time lag is totally under the observer's control. He can also manipulate the whole thing from the Origination center point (O) without even going anywhere physically OR mentally!!!!

We now have a tool for using phase waves as a means of communicating and transmitting information at any arbitrary speed. There is no limitation. As Harry Palmer says (**Avatar Journal**, Summer 2002, Volume 16, Issue 3, cover quote), "You are bound only by your decision to have boundaries."

In the case of "parabolic" and hyperbolic trajectories, the manipulations may involve objects separated at the far ends of the universe, way out at the top of the upper nappe. Perhaps these objects are 10^34 times the distance light can travel in a reasonable interval of our time as judged by the distance between the parallel planes, which is our gauge for (c). No problem. The phase waves pass through the center point. Our minds are our minds. All the data is stored in there. We can manipulate the whole scene from the center point.

The observer has his belief system "stored" as various attention automata in his consciousness in the lower nappe. Continuous recreation of particular belief systems and their projection into world experiences is based on the ability of undefined awareness to generate attention automata. The subject of creating and discreating and general management of such automatons is covered in detail in Palmer's **Avatar Materials** under the subject of "Persistent Masses". But we can understand a great deal of the mechanics of such things by studying the prototype of the proton.

An observer's belief system is a complete map of his world. He projects this mental universe through the central point into the upper nappe at a virtually instantaneous speed. It is projected just like an image is projected through a lens onto a screen. It is a total, holistic projection, with parallel processing, not one bit at a time. It is an optical processor, except that it is not limited to the speed of light. It moves at the speed of the will, which is (Pv) = 10^42 m / s. The physical world interacts as a collection of physical group waves at subluminal velocities, or as photons at a maximum velocity of (c). Thus ordinary subluminal physics is a subset of superluminal Observer Physics.

The observer has experiences, because his physical world reflects back to him his beliefs and how they all fit together and interact.

At a level far up in the upper nappe, an object may appear to move slowly through a huge orbit. But from the "here and now" perspective at the center pivot point, there is just the tiniest little tilting of a viewpoint angle. With a proper use of lenses he can redirect an orbit from the central point. Just a tiny bias in the central lens will make a great shift in the projected object.

Experiment: You can try this for yourself by setting up a bright light source that shines onto a blank wall. Then place you hands near the source and make tiny movements.

They will appear as giant shadows that move rapidly across the wall. Making shadow images is a popular party game. It demonstrates the value of functioning close to or from the viewpoint of Source and manipulating the world via phase waves. The phase waves you make in this exercise are subject to the limit (c), but phase waves generated by the will are not so limited. They propagate non-locally at the speed of the collapse of the quantum wave function. You may not feel that playing with shadow puppets will really change the world, but you may not be adjusting the appropriate projection for the change you wish to achieve. In ancient Greece Archimedes already understood this principle when he commented that with the right kind of lever and the right place to apply it he could move the world.

One of the major issues that is often discussed with regard to the possibility of FTL -- Faster Than Light -- communication is the problem of causality violation. The classic example of such a violation is the paradox of my going into the past and killing my father before he met my mother. The real issue regarding causality violations is concerned with responsibility. Notions of causality are all based on the belief that something "out there" other than "me" is responsible for events that happen in my world. Patricide is probably not a very good example of responsible behavior.

If the observer takes full responsibility for everything that he does, then the causality problem immediately disappears. Anything becomes possible. Such an assumption of responsibility requires a shift of viewpoint that some people may not be ready to make. If so, they will remain in a world that reflects beliefs about causality. Whatever you see and experience in the upper nappe of your world cone, that is your physical world. That is a perfect reflection of the beliefs that you hold in your own awareness. If you believe that you can not change your physical world, guess what? Your reality will be that you can' t change your physical world.

Now we are ready to understand the "quantum leap" or collapse of the wave function and the apparently strange properties of quantum statistics. Any system in the cone is complete. The whole path of the trajectory is there in principle, independent of time. It is just like the quantum wave function. In fact it IS a wave function for a defined automaton system. And it is quantum mechanical because we can interpret it that way if we choose to as long as we consistently take a quantum mechanical view and do not contradict ourselves. Now a funny thing happens as you draw a mental wave function closer and closer to the "here and now" point. The "bubble" of the ellipse -- if that is what the mental trajectory of the attention automaton is -- gets smaller and smaller. It is as if the whole cone is shrinking. When you get it down to the center point, the whole thing explodes. The trajectory disappears into a point. In that point is every other trajectory. It is a point of all possibilities. And it becomes a moment of direct experience for the observer. The bubble pops.

This is the collapse of the wave function. What was once an abstract non-local trajectory in space/time collapses into a single point. If the attention happens to be directed to a particular point in the trajectory, that will be the value it seems to have had.

But actually the point value is transcendental. It expands to include the whole cone. Remember that the whole cone shrank into a point. So now, speaking in terms of relativity, that is the same as if the point had suddenly blown up to include the whole cone. The point is both local and non-local. As a point it is local. But as the mapping point for all projections, it is very non-local. It is the whole ball of wax.

This brings us to the problem we began discussing back in chapter one. Why it is that quantum particles seem to show up in random locations in the wave function whenever the function collapses? We can never predict where they are going to be. We only know that they will tend to fall somewhere within the shape defined by the wave function -- what we call in our model the "trajectory".

At the "gross" level objects have mass. They have significant mass and are made of many component particles. Therefore they tend to function as automatons. They fall into their statistically most probable macrostate condition, and that is pretty restricted. If you put a cup on the table and come back and look at it again tomorrow, it will still be there unless your wife decided you were messy and washed it and put it away.

If you have a beam of photons or electrons passing through a small aperture you might expect them to all land on a screen behind the aperture at the same location. But they don't do that. They show up all over the place, generally following a pattern that would be suggested by wave interference. If you have two slits, the waves interfere and make a more interesting pattern. You can show that each individual photon seems to pass through BOTH slits and interfere with itself. You can see this by reducing the beam to single photons and closing one slit and then the other. Closing a slit stops the two-hole interference. But both slits open gives interference even with single photons. Yet you can not predict where a particular photon will go. As a wave it goes through both holes, but as a particle it shows up in a specific but unpredictable location. How can it do this?

When the attention moves to subtler, more refined levels of awareness, it becomes less localized, and less subject to bias. It becomes more like a wave function. It can be in several places at once. When bias disappears, being here and being there does not make much difference so long as one adheres to the game plan -- that is, the wave function. You find more and more uncertainty in space and time as you relax your bias regarding the "here's" and "there's" of things.

When you get to the transcendental field, the wave function collapses into the point of all points. There is no bias at all. Thus awareness becomes omnipresent.

In describing the process of Transcendental Meditation, Maharishi is fond of using an analogy to bubbles rising in a pond. The bubbles start at the bottom (in the quantum foam) and rise to the surface. As they rise, they become more expanded. When they reach the surface, they have their largest size and greatest level of excitation. The process of TM is like turning the attention around. Instead of looking at the largest, most excited bubbles, we begin to notice the path by which the bubbles arise in the mind. We retrace that path backward to subtler and subtler, finer and finer levels of thought impulses until the bubble collapses into a point. It then loses its structure and the mind expands to become totally non-local. This is called Transcendental Awareness. In Transcendental Awareness the mind is not biased. Everything is OK this way or that, however it wants to be. It just is.

At the subtler levels near to the Source of Awareness, the trajectory is so small that the object can easily "tunnel" from one location to another in the trajectory. Or it can even tunnel to another trajectory. Ordinarily it seems unlikely we can walk through a macrostate like a concrete wall. But an electron can tunnel through an apparently impenetrable barrier given the right conditions. Tunneling is also possible at the level of concrete walls, but that would take a bit more finesse. We understand how an electron can tunnel once we know that the electron is nothing but an energy vortex. By modulating its wave function, we can cause the vortex to dissolve at one point and reform at another. Barriers are irrelevant. What counts is the fluid dynamics. You can do the same thing with vortices in a stream of water by manipulating the current with some rocks.

Finally we should say a few words about thermodynamics. This is a big field, but it has some simple principles. These principles are related to the study of quantum gravity because the conjugate form of gravity is kinetic excitation. Generally speaking, kinetic excitation is the same thing as thermal excitation. There are many good treatments of thermal physics, so there is no point in going into details. We have listed some good sources in the bibliography. We only wish to make a few key points that are relevant to our introduction to Observer Physics. Let' s begin with some preliminaries.

Energy is recognized and measured in terms of motion or the ability to generate motion. The dimension of energy reflects this concept of energy -- a mass times a velocity times a velocity, or a force projecting through a distance. It ranges from highly specific and organized motion to random motion. Organized motion is called work, and disorganized motion is called "heat." Heat is an expression of random motion. It is possible to do work with heat by organizing its flow on a macroscopic level. In that case you are treating the organized flow of kinetic motion as a mechanical energy. But it is not possible to convert heat completely into work because of the **definition** of work. Some of the heat is always too random to do work. That means that the kinetic motions of the system all cancel out. The cancellation of kinetic motions in a system is called equilibrium. A state of equilibrium can not do work, because everything is balanced, and all the forces cancel out. Equilibrium states can only BE. They can not DO.

The range of energy goes from nucleonic energy, which is highly localized in a nucleus, to electromagnetic energy, which is expressed through the linear motions of photons, to chemical and mechanical energy, which are just gross forms of electromagnetic energy, on to the random kinetic energy of heat. Heat is often considered the "lowest" form of energy, because, when a system reaches a thermal equilibrium, you can not get any more work out of it. It gets permanently lazy. Or at least that' s the way it looks, and that is how it is treated in the study of thermodynamics.

Heat is energy, and energy ultimately is heat. Hotness is a relative term indicating a comparison of relative amounts of random kinetic energy and therefore is concerned with systems made of multiplicities of components.

In studying thermodynamics it is useful to start by playing with an ideal gas. This is a relatively dilute collection of identical (monatomic) particles with random velocities moving about in a volume of space. The gas has no internal structure. The particles of the ideal gas are dilute enough that there are no significant EM or gravitational interactions and the average particle separation is greater than a particle diameter. Particles can have many types of energy relationships, including translational motion, vibrations and rotations, electron orbiting energy, electrical potential, intermolecular forces, magnetic field effects, center of mass, and perhaps others. Usually heat is concerned primarily with translational kinetic energy, but the other interactions may also become significant under special conditions of temperature and/or pressure.

Generally we measure the relative hotness of composite objects by establishing a gauge called temperature. Temperature is a gauge for measuring the relative "hotness" of composite objects -- that is, their relative willingness to transfer energy of some form to another object. Thermal energy generally transfers via convection, conduction, or radiation. All of these transfer methods are ultimately EM interactions.

In general energy (E) can transfer to or from a system via heat (thermal transfer) or via work. In the latter case the system does work on its surroundings, and one (or more) of its external parameters changes.

The ideal gas law had been derived experimentally by the nineteenth century:

* $PV = N k T$.

The pressure (P) times the volume (V) equals the number of molecules (N) times the absolute temperature (T) times Boltzmann's constant ($k = 1.38 \times 10^{-23}$ J / K), which is a proportionality between energy and temperature. (T) is the temperature on the Kelvin scale (K). Boltzmann's constant is independent of the particular gas. It gives the number of Joules per Kelvin and is thus just a conversion constant between Joules and degrees Kelvin. The pressure is related to the density and refers to the number of collisions the gas particles make on a surface in a given time interval, given we can figure out their average momentum.

The usual way of looking at heat in a dilute ideal gas from the molecular level is as the average random translational kinetic energy of its particles. We take (N) as the number of particles, (Mx) as the average mass of a molecule in the gas, <v> as the average velocity, (V) as the volume, and (k) as Boltzmann's constant. The pressure (P) on a wall of the gas container is:

* $P = (1/3)\, N\, Mx \langle v \rangle^2 / V$.

(The value 1/3 indicates one of three equal spatial dimensions.)

* $PV / N = k T$.
* $PV / N = (1/3)\ Mx \langle v \rangle^2$.
* $(1/3)\ Mx \langle v \rangle^2 = k T$
* $(1/2)\ (Mx) \langle v \rangle^2 = (3/2)\ k T$.

Since energy is quantized, as Planck discovered, heat is also quantized. Planck discovered the constant (H) that started quantum mechanics while studying the thermal radiation from a black body.

Heat means nothing in terms of a single quantum particle. We must consider ensembles of many particles, each with a certain amount of kinetic excitation in order to detect heat. We see the relevance of thermal energy to gravity when we consider a large cloud of gas in space. It can either remain a cloud, or it can collapse and form a star or other celestial object. However, an ideal gas in open space is not the same as an ideal gas enclosed in a container. In open space it is gravitational attraction that moves the gas in the direction of coming together to form a denser object. The kinetic excitation of the individual gas particles acts to keep the gas in the gaseous state, or even to diffuse the gas more widely in space. Thus density is a key consideration in the discussion of thermal physics, and we will have to revise our kinetic equation to deal with a dilute ideal gas in space.

There are three "laws" of thermodynamics, and we may as well structure our discussion of "gravitational" thermodynamics around them.

The first law of thermodynamics is the law of conservation of energy. This general law of physics applies to thermodynamics because heat is a form of energy. The total kinetic motions of the constituent particles of a system will be conserved as long as the system is closed, and has no energy flowing in or out, or as long as the inflows and outflows are equal. The conservation law stated in terms of thermodynamics thus says that the energy input caused by the heating of a system equals the change in energy plus any work that the system does.

* $DU = Q - W$.

Here (DU) is the difference in energy. (Q) is the energy that can be transferred by heat flow, and (W) is the work. Work, as we mentioned, requires the energy to move as a "block" in a particular direction. A whole bunch of particles must move as an organized ensemble within the system. Thus Work is an indication of "orderliness" or "organization" and is defined as a force through a distance. And, of course, Work has the dimension of Energy. A system in thermal equilibrium can do no work because the random kinetic motion thoroughly interferes with itself destructively, canceling out any organized displacement. Thermal equilibrium is thus totally disaligned kinetic energy.

The first law of thermodynamics, the heat form of the energy conservation law, tells us that the total energy of a system is changed by the work done on it and the heat flow into it.

At face value this is a circular definition. To say that the energy of a system is conserved if the inflows and outflows are equal to the change in energy is about the same as saying that if the energy is conserved, the inflows and outflows will be equal. It's just a definition of conservation.

It is possible to suddenly expand a gas into a larger volume by removing a barrier. This is called sudden adiabatic expansion. No heat is added in the process. Such an expansion shows no change in the kinetic energy of the gas. Only the volume of the space has changed. You can also allow a gas to expand slowly and adiabatically, but allowing the gas to do some work on a piston along the way. This will remove heat from the gas. But you can add some heat at the end and reach a final condition that is identical to the sudden expansion. This shows that the "heat" of this system is only in the thermal kinetic energy of the gas and nothing else. Heat -- random kinetic excitation -- is therefore the exact opposite of gravity.

* P V = N k T.

* Fg = G M1 M2 / R^2.
* Fg R = G M1 M2 / R.

Believe it or not, the ideal gas equation and Newton's gravity equation say the same thing! The only difference between these expressions is that the former deals with the average behavior of a gas cloud of many particles and the latter deals with only two massive solid particles. Also, the gas law expresses itself in a volume of space, whereas the gravity law, being limited to only two bodies, involves a one-dimensional interaction between the two centers of mass. (M1) and (M2) are considered spherical and thus taken to be equivalent to point particles. Otherwise these two laws are the same.

If we have an isolated cloud in free space, and allow its temperature -- that is, the average kinetic energy level of the gas particles -- to drop, "gravity" causes the gas to contract. If we add kinetic energy -- that is, add heat and generate a higher T value -- that causes the cloud to expand. There is thus no difference between allowing a gas to cool and allowing it to contract gravitationally. This is the proper "equivalence principle" that Einstein should have used when he developed his theory of General Relativity. Einstein's elevator example is misleading, because it appeals to our habit of looking at gravity in terms of large individual objects. In reality gravitational systems mainly involve macrostates that contain microstates on the order of thermodynamic systems.

How do we remove the kinetic energy of a gas? Imagine that a certain percentage of the gas's kinetic energy converts to thermal radiation and escapes by radiating away into space. The gas cools. As it cools, it shrinks. It might as well be contracting gravitationally. If it shrinks faster than it loses kinetic energy, then the temperature rises. The gas has grown denser, and the kinetic motion is now in a more confined space.

Beyond a certain threshold of density, molecules begin to interact, and the ideal gas law no longer governs the cloud. Other agencies come into play.

Our main principle here is that gravity and heat are conjugate partners. They are both somewhat complicated by the occurrence of various phase states for materials. Nevertheless, gravity is a random force. It propagates evenly in every direction as an attractive "force". Heat is also a random force. It also propagates evenly in every direction as random kinetic motion. Gravitational equilibrium and thermal equilibrium are the same thing.

However, we do know that heat is quantum mechanical. The heat in a particular gas is always a function of how many particles are in the gas. The number of particles per volume of space is the density. The number of collisions per unit area with a certain average momentum determines the pressure. Our molecular translation equation gives us the average kinetic energy times the density. A single isolated particle therefore has NO heat. A single isolated particle also has NO gravity. It takes two -- or more -- to tango. Thus gravity is also a quantum phenomenon. The smallest fermionic mass interacting as a pair defines the quantum unit of gravity.

The exchange of gravitational energy can occur through thermal radiation at the speed of light. However, this is a converted form of gravitational/thermal energy. The usual boson for exchange of gravitational "energy" is the graviton, which moves at a superluminal velocity and is the conjugate of the will. The conduction and convection transfers of heat occur primarily through fermion interactions, which are ultimately electromagnetic in nature. Gravitational energy exchanges are usually most observable as changes in the relative kinetic motions of fermionic particles or particle ensembles, the "group wave" aspect of gravitational interaction.

If we are correct that heat is "antigravity", then the conservation law also applies to gravity. In fact, this law is considered to apply to all forms of energy and is a fundamental invariance in physics. The law of conservation of energy in quantum mechanics corresponds to the invariance with regard to time. The reversibility of any quantum mechanical process implies the reversibility of time. Reversibility of gravity means antigravity. Quantum thermodynamics is therefore the theory of quantum antigravity.

This brings us to the second law of thermodynamics. This is known as the law of **entropy**. This law creates a lot of confusion, because it seems to create a contradiction between the macroscopic classical scale and the microscopic quantum scale. Also it seems to contradict the notion that time in quantum mechanics and in classical mechanics is reversible. Yet it fits our experience that time does not seem to be reversible. What goes on here?

The second law says that if we have a system containing a large number of particles, and we let it do whatever it wants without disturbing it, it will end up in the macrostate of greatest probability and stay there. This macrostate of greatest probability is also called equilibrium.

Another way of stating the second law is to say that heat does not by itself go from lower to higher temperatures. This is another way of stating the reasonable principle that particles with a certain average kinetic energy will not by themselves start moving faster. To get them to move faster, you have to add some more energy from outside the system of particles. You can see how this law of thermodynamics is related to Newton' s first law of mechanics that an object at rest or in motion will tend to maintain its status unless acted upon by some external influence. When we get into the study of wave packets in quantum mechanics, we realize that this principle does not hold up. But it seems to work fine for macroscopic systems.

The second definition of the second law is pretty clear. The first definition takes a little more attention to understand. When a system has many different microstates, and many different component particles, the possible number of states of the system is usually very, very large compared to the rate of transition from one microstate to the next. The macrostates of a system are the general categories of the system considered without looking at the details of the microstates. For example, if we shake a box of coins and then look at the coins, we will find them scattered all about the box. However, if we look at the distribution of heads and tails, we will find that generally half will be heads and half will be tails. The relative amounts of heads and tails, disregarding which specific coins are heads and which are tails, is an example of a macrostate. It is a big brush stroke picture of things. A hundred coins will show quite a bit of statistical fluctuation from shake to shake. But a bottle of gas that contains billions of molecules will not show much fluctuation once it reaches its equilibrium macrostate even though the microstates are transitioning quite rapidly. The phase space is just too large to show much macrostate variation once equilibrium is reached.

However, this brings up the relationship between energy -- which is what a thermodynamic system is all about -- and time. We assume when we speak of randomness that the components of the system will periodically change state, and at each change of state they will have equal opportunity to change into any of the possible microstates of the system. If the process is left to itself and continues in a random manner as we have defined above, sooner or later -- probably later if there are a very large number of microstates -- there will be significant random fluctuations in the macrostate. We have discussed briefly in an earlier chapter such fluctuations and referred to them as Poincare Peaks. The problem here is that the time frame for a system with a phase space containing a very large multiplicity of microstates to experience significant Poincare fluctuations is way out of our league. It gets very "non-local" in time, beyond the age of the earth, and even beyond the age of the universe in many ordinary cases such as the molecules of air in a room.

Therefore, the second law of thermodynamics gives us a wonderful paradox. At the microstate level, time is reversible, and every transition can go either way. We see this as the common way of life among the subatomic particles. They switch directions in time quite easily when they bump sharply into a vector boson. Yet at the macrostate level, time marches on inexorably bringing systems to increasingly larger states of equilibrium. The randomness of such states is also sometimes compared to "disorder." The world seems to be headed inexorably toward more and more disorder, a rather dismal prospect.

However, before we get depressed, we should realize that the concept of entropy is a **mental** mathematical device, born of the large numbers of component particles in many systems. It only expresses a viewpoint, a certain way of looking at physical systems, not necessarily the only "inevitable" way things are. To manage such large numbers of microstates, mathematicians use the logarithm to keep track of them. Given a number of microstates (Ns) that a system can assume, the entropy (S) is:

* $S = \log (Ns)$.

For example, if there are 8 possible states in a binary system, the entropy is 3. If there are n^20 possible states in a system, the entropy is 20.

Thus entropy is a function of the number of particles, the energy, and the volume of the system, at a minimum. These parameters determine the number of states possible. But **anything** that distinguishes possible states can be used. The second law is a very general principle. The law of entropy tells us that the entropy of a system stays the same or increases as a result of **any** process that occurs with the system.

The universe, when looked at as a mechanical, physical phenomenon, does indeed appear to be subject to an inexorable law of entropy. However, appearances can be deceiving. Entropy is a result of the natural tendency of physical systems to find thermal equilibrium -- assuming that they are "abandoned", mindless systems. Entropy applies ONLY to dumb automatons that someone has created and then abandoned to wander around in their mental and physical space. This means that the kinetic motions of the various component dumb particles are going this way and that randomly instead of in some particular direction of flow that seems to go somewhere or is directed by a deliberate conscious will. We think of work as getting something done. Randomly putzing around is not considered work. These are just different viewpoints. A "negative feeling" about entropy and desire to minimize it may be just a symptom of addiction to a "work" ethic belief system.

Exercise: What do you believe about work? What do you believe about putzing around? What do you believe about mindlessness? What do you believe about abandonment? Do Exercise # 16, "Self-Deception Signals" in **ReSurfacing**. Consider carefully the questions asked after each section.

From the viewpoint of Observer Physics we suggest that thermal energy is not necessarily just random particles putzing around. It may indicate the degree to which a system has put itself into the ideal condition for the operation of its conjugate form, gravity. If a system is all moving in one organized direction, such as a rocket that is headed off on a journey, then the system will be very resistive to gravitational attraction.