SECTION 18

A Model for the Universe (8) -- Radioactivity

Radioactivity is the process in which an atomic nucleus spontaneously divides into two (or more) lighter nuclei. Usually the process consists of the emission of a relatively light particle, referred to as the emitted particle, and a resulting slightly reduced remaining nucleus. The relatively light particle emitted is usually an electron (- beta), positron (+ beta), helium nucleus (alpha), Hydrogen nucleus (proton), or a neutron. The process appears to be spontaneous for the unstable nuclear specie and does not occur at all for the stable ones.

The reasons for nuclear stability / instability have already been discussed in the preceding section. Nuclei having sufficient mass / energy to make up the decay product particles plus provide their escape energy (having positive separation energy) are unstable. Those with negative separation energy experience stability enforced by the principle of conservation. However, the unstable nuclei do not promptly decay. If they did there would be none of them present now and they would most likely be completely unknown to us. The decay is a process extended in time in various amounts depending on the particular situation.

Characteristic of radioactive decay is that the rate of decay for a particular decay process of any particular nuclear specie continuously declines exponentially according to equation 18-1.

(18-1) $$N = N_0 \cdot \varepsilon^{-t/\tau}$$

where: N = number of decays during time t.

N_0 = number of nuclei in the sample at time t = 0.

ε = the natural exponential base, $\varepsilon = 2.718282....$

τ = (Greek letter "tau", a constant characteristic of the particular specie and the decay.

The form of this decay is depicted in Figure 18-1 on the following page.

This behavior comes about as follows.

ANALYSIS OF RADIOACTIVITY

As has already been presented, the wave form of the various nuclear specie, that is the variation with time of the oscillation of the supercenter-of-oscillation that is an atomic nucleus, is quite complex. In order for that nucleus to exist as it is at one instant of time and to exist an instant later as a different specie plus a second particle / specie the transition must be smooth and continuous. And conservation must be maintained.

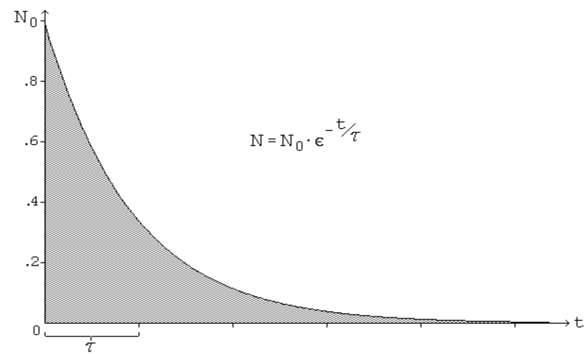

Figure 18-1

The requirement that the transition be smooth and continuous amounts to placing the following requirements on the oscillation wave forms throughout the transition. (See Detail Notes *DN 1 - Differential Calculus, Derivatives*).

(18-2) (1) The wave form must be smooth:

$$U[{}_Z Sym^A]_{before} = U[{}_Z Sym^A]_{after} + U[{}^{emitted}_{particle}]$$

(2) The rate of change of the wave form must be smooth:

$$\frac{d}{dt}\left[U[{}_Z Sym^A]_{before}\right] = \frac{d}{dt}\left[U[{}_Z Sym^A]_{after}\right] + \frac{d}{dt}\left[U[{}^{emitted}_{particle}]\right]$$

(3) The rate of change of the rate of change of the wave form must be smooth:

$$\frac{d^2}{dt^2}\left[U[{}_Z Sym^A]_{before}\right] = \frac{d^2}{dt^2}\left[U[{}_Z Sym^A]_{after}\right] + \frac{d^2}{dt^2}\left[U[{}^{emitted}_{particle}]\right]$$

(4) And so on for all successively higher rates-of-change / derivatives.

The least complex such radioactive decay transition is probably that of the neutron. In that case the initial wave form (from Section 16),

$$\textit{(16-3)} \quad U[{}_0 n^1] = U_c \cdot \left[Cos[2\pi f_{e,n} t] - Cos[2\pi f_{p,n} t]\right]$$

must transition into the two final wave forms,

$$\textit{(16-1)} \quad U[{}_1 p^1] = U_c \cdot \left[1 - Cos[2\pi \cdot f_{p,r} \cdot t]\right]$$

$$\textit{(16-2)} \quad U[{}_{-1} e^0] = -U_c \cdot \left[1 - Cos[2\pi \cdot f_{e,r} \cdot t]\right]$$

while satisfying the requirements of equation 18-2, above. (The proton and electron are initially emitted at their escape velocity frequencies, $f_{p,n}$ and $f_{e,n}$. Ultimately, however, they must have their rest frequencies, $f_{p,r}$ and

$f_{e,r}$ as adjusted for their actual motions). Graphically the beginning and end of the transition appear as in Figure 18-2, below (where, of course, the ratio of the proton frequency to the electron frequency is shown as greatly less than is actually the case).

$${}_0n^1 \Rightarrow {}_1p^1 + {}_{-1}e^0 + \bar{\eta}$$

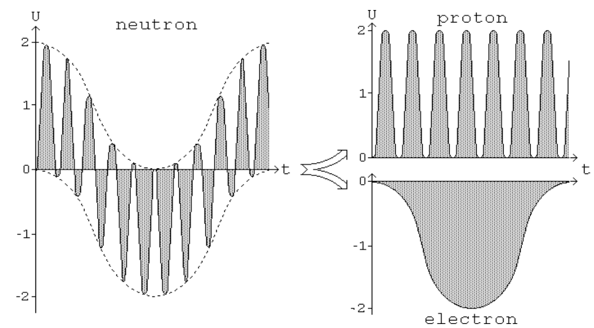

Figure 18-2
Radioactive Decay of a Neutron into a Proton and an Electron

A more typical case would be the radioactive decay of *Helium 6* into *Lithium 6* by the emission of a *-beta* particle, an *electron*.

$${}_2He^6 \Rightarrow {}_3Li^6 + {}_{-1}e^0 + \eta(?)$$

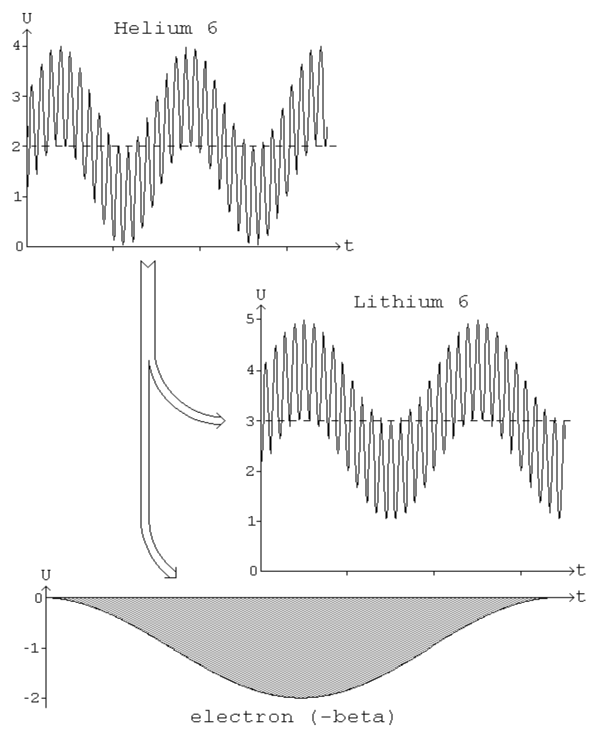

Figure 18-3
Radioactive Decay of Helium 6 into Lithium 6 and an Electron

The $\eta(?)$ indicates that a neutrino emission is involved if required in order for conservation of energy and momentum to be simultaneously maintained. That can be a problem when there are only two product particles because energy depends on $velocity^2$ and is scalar while momentum depends on $velocity^1$ and is vector. The neutrino is treated later in this section.

(As is apparent from the depiction of the emitted electron in each of the two figures, the scale of the depiction of the *Helium 6* decay is quite different from that used in depicting the neutron. Also, again, the ratio of the proton frequency to the electron frequency is shown as greatly less than actual.)

The equations for this transition, corresponding to the decay of equation 16-3 into equations 16-1 and 16-2, above, are equation 17-2 with the appropriate values of $Z,\ A,$ and N substituted as follows.

Helium 6, the initial wave form,

(18-3)
$$U\left[{}_2He^6\right] = \left[6 \text{ protons} + [4 = 6-2] \text{ electrons}\right]$$
$$= U_c\cdot\left[6 - \mathrm{Cos}[2\pi\cdot 6\cdot f_p\cdot t] + -\left[4 - \mathrm{Cos}[2\pi\cdot 4\cdot f_e\cdot t]\right]\right]$$
$$= U_c\cdot\left[2 - \mathrm{Cos}[2\pi\cdot 6\cdot f_p\cdot t] + \mathrm{Cos}[2\pi\cdot 4\cdot f_e\cdot t]\right]$$

transitions into *Lithium 6* and an *electron*, the two final wave forms,

(18-4)
$$U\left[{}_3Li^6\right] = \left[6 \text{ protons} + [3 = 6-3] \text{ electrons}\right]$$
$$= U_c\cdot\left[6 - \mathrm{Cos}[2\pi\cdot 6\cdot f_p\cdot t] + -\left[3 - \mathrm{Cos}[2\pi\cdot 3\cdot f_e\cdot t]\right]\right]$$
$$= U_c\cdot\left[3 - \mathrm{Cos}[2\pi\cdot 6\cdot f_p\cdot t] + \mathrm{Cos}[2\pi\cdot 3\cdot f_e\cdot t]\right]$$

(16-2)
$$U[{}_{-1}e^0] = -U_c\cdot\left[1 - \mathrm{Cos}[2\pi\cdot f_e\cdot t]\right]$$

The frequencies indicated in the above, f_p and f_e, are intended as symbols to generically represent the particular frequencies appropriate to the particle type.

All of these oscillations are quasi-periodic in that the overall oscillation is the sum of purely periodic individual oscillations. (*Periodic* means that the wave form identically repeats itself after some period. For simple wave forms that period is the wavelength.) The overall oscillations are termed as being quasi-periodic because the overall pattern may never repeat exactly even though composed of simple repeating forms.

The inability to repeat exactly is because the frequencies involved are, in general, irrational numbers. They are the A and N multiples of frequencies corresponding to the mass / energy input to the theoretical assembly of the nucleus; they are frequencies corresponding collectively to the actual mass of the nucleus.

However, the periods of the purely periodic individual components of those overall oscillations are quite short, the longest, that of the electron being on the order of 10^{-20} seconds. Thus over periods of time equivalent to a large number of such minute periods, the wave form will have passed through essentially all of the possible combinations of relative phase of the various component individual oscillations in the overall oscillation. That is, the overall oscillation comes quite close to repeating itself, nearly does repeat itself over some relatively long periods of time.

Those time periods can still be quite short on the macroscopic level. A billionth of a second nevertheless contains on the order of 10^{11} of the longest periods in any of the overall oscillation components. Depending on how incompatible are the irrational numbers that are the frequencies of the various component oscillations, the quasi-period of the overall oscillation could vary from less than billionths of a second to minutes, days or years.

Referring back to the criteria for being smooth and continuous, equations 18-2, A typical complex nuclear oscillation wave form cannot be expected to meet those requirements much of the time. The types of transitions depicted in Figures 18-2 and 18-3 and requiring the conditions of equation 18-2 in order to execute must find only rare occasions in the quasi-period of the overall oscillation when all of the conditions are correct for a radioactive decay transition to take place.

Most likely exactly correct conditions never occur. However, most likely, from time to time conditions become close enough to exactly correct that the defect is quite minor -- minor enough to be bridged by minor adjustment in the kinetic energy of a product particle or to be bridged by variation in the energy and / or momentum of a neutrino emitted as part of the decay.

If a particular nuclear type's oscillation is such that it enters into such a state, one in which a radioactive decay transition is physically possible according to the limitations imposed by conservation and equations 18-2, then the specie's entering the state should occur at that regular interval, the quasi-period of the wave form.

For example (and using rest frequencies where the kinetic frequencies actually should be used) the neutron involves two frequencies, those of the proton and the electron. As pointed out in earlier sections, to the best available measurement accuracy there are $1{,}836.152{,}701$ proton (rest, not kinetic) cycles in every $1{,}000{,}000$ such electron cycles. To that accuracy the two oscillations "come out even" and repeat every $1{,}000{,}000$ electron cycles.

The real period over which the electron and proton component oscillations of the neutron "come out even" and repeat is undoubtedly much greater than $1{,}000{,}000$ electron cycles; that is, with better measurement accuracy it would most likely be found that the ratio of the two frequencies f_p/f_e is $1836.152{,}701{,}xxx{,}xxx{,}...$ rather than the exact $1836.152{,}701$ which is the limit of present measurement capability. As already stated, quite likely, the two component frequencies never "come out even" exactly and f_p/f_e is an irrational number.

However, the requirements of equation 18-2 are somewhat flexible in that there is a range of energies that the "before" and "after" particles can have. Those energies correspond to minor variations in the particles' oscillation patterns. Thus the satisfaction of equation 18-2 can occur over a limited range of points in the oscillation pattern. An exact "match" to one single state of the oscillation is not required because the variations in acceptable energies create some leeway. Even if the f_p/f_e ratio is an irrational number and the oscillation pattern never exactly repeats it still has an approximately cyclic nature that can cause portions of ranges in which the "match" to equation 18-2 is close enough given the leeway of energy variations.

The conditions expressed in equation 18-2, above, include the allocation of the energy and momentum of the nucleus before decay partly to the remaining nuclear specie after the decay, partly to the emitted particle, and the remainder to an additional gamma, neutrino or whatever that may be radiated in conjunction with the decay as part of conserving both energy and momentum. There is no fixed constraint on the allocation among them except that of energy and momentum conservation. (Of course charge, also, must be, and is, conserved.) The allocation among the particles to the decay process will depend upon the direction in which the emitted particle is emitted and its velocity, and the new direction and velocity of the remaining nucleus.

This results in there being a pair of relatively free variables in the decay process: whether or not there is an additional radiation (gamma, neutrino or whatever) and if so which type, and how the energy and momentum before decay are allocated among the after decay participants in the process. These variables provide a certain amount of "leeway" to the decay. There can be a range or "window" of states within which the decay can occur, portions of the supercenter's total oscillation over its total period within which portions the oscillation is such that the requirements of conservation and of equation 18-2 can all be satisfied. If the actual oscillation passes into any of the states within the "window" then the decay can occur. The quasi-periodicity of the oscillation causes this to happen at some approximately regular interval.

However, there is another factor involved, one that continuously interrupts and modifies the then on-going pattern of oscillation of particles. Unless they are at absolute zero temperature and energy all particles are in motion. Their oscillation pattern depends on their velocity, its speed and its direction. These particles regularly emit and absorb photons of radiation -- the usual Rayleigh-Jeans or black body radiation activity. The particles' energies are continuously changed in consequence. That means that their velocities change and thus their oscillation patterns change. The changes, as discussed in section *13 - A Model for the Universe (3) - Motion and Relativity*, are the expression of the change in energy due to the motion.

In a sample of material made up of all one nuclear specie, the individual oscillations of each of the many individual nuclei are not synchronized. Rather, the total set of nuclear oscillations is distributed essentially uniformly over the range of relative points along the complex pattern of oscillation at which they could be at any particular instant of time. The reason for this is that:

- Their energies and motions (even in a solid) vary among the individual nuclei and vary continuously with time,

- They are continuously bombarded by U-waves and photons which action produces continuous changes in their oscillation patterns,

- Each has a different history of motion, energy and encountered U-waves.

- (Note that this <u>uniform</u> distribution is of where in the periodic oscillation of the supercenters of the nuclear specie the various individual nuclei are at a particular instant. It is not the distribution of their energies, which would be a statistical distribution around an amount corresponding to the sample's overall energy.)

At any instant of time some individual nuclei are just a moment away from entering a state within a "decay window", some are within the "window", some are just leaving such a state. Most are uniformly spread over the range of states between the "windows".

If the average time between the beginnings of decay windows, the average duration before entry into a decay window, is referred to as τ then during a minute time interval Δt the fraction of the total number of nuclei in the sample that will progress in their oscillation pattern to the point of being in a decay window state is $\Delta t/\tau$. If there were no other factors affecting the process then the same fraction, $\Delta t/\tau$, would decay each Δt.

However, within that sample each nuclear supercenter is continuously interacting with incoming U-waves and photons. The status of its oscillation is continuously being changed by those encounters and the consequent changes in energy and motion of the nucleus. For the purpose of determining where a particular nucleus is along its pattern of oscillation from one decay window to the next, each of the nuclei are continuously being shuffled and reshuffled, distributed and redistributed over the range of possibilities, effectively randomly, and effectively uniformly.

Thus the state of the above sample progresses as follows.

(1) Uniform distribution of states.

(2) Fraction $\Delta t/\tau$ decays (a minute fraction since Δt is minute).

(3) The states of the undecayed fraction, $[1 - \Delta t/\tau]$ of the original total, are redistributed uniformly.

(4) Fraction $\Delta t/\tau$ of that undecayed remainder decays.

(5) The states of the undecayed fraction, $[1 - \Delta t/\tau]$ of the then undecayed remainder, again are redistributed uniformly,

(6) And so on.

This process yields an exponential decay as presented in equation 18-1 as follows.

(18-5) $N \equiv$ the number of undecayed nuclei in the sample.

$dN \equiv$ the change in the number of undecayed nuclei during infinitesimal time interval, dt.

Fraction of N decays in dt, $\Delta t/\tau \rightarrow dt/\tau$ as $\Delta t \rightarrow 0$.

$$dN = -N \cdot \frac{dt}{\tau}$$

(18-5, continued)

$$\frac{dN}{N} = -\frac{1}{\tau}\cdot dt \qquad \text{[Rearranging]}$$

$$\log_{\varepsilon} N = -\frac{1}{\tau}\cdot t + C \qquad \text{[Integrating]}$$

$$N = N_0 \varepsilon^{-t/\tau}$$

[Rearranging and evaluating C, the constant, as the sample at time t = 0, which is N_0.]

The quantity τ is called the decay constant. The rate of decay is frequently expressed in terms of its *half life*, the time for half of the nuclei in the sample to decay. By setting $N = ½$, $N_0 = 1$ and solving for t, the half life is $t_{½} = 0.693\cdot\tau$.

On the basis of the above it would seem, theoretically, possible to measure a specie's decay data, analyze that specie's particular oscillation form as a supercenter, and obtain a correlation of the two. One would expect to obtain a form and procedure from which one could calculate the decay constant in a manner analogous to the calculation of mass in earlier sections.

Unfortunately, with respect to measuring the decay the real decay process is not quite so simple. Generally speaking, a decay window corresponds to a process in which there is an amount of energy available to allocate among the daughter decay products. Such a window could result in a variety of different actual decays in each instance. Those could be multistage decay in which the daughter nucleus passes through one or more intermediate *excited* (excess energy) states before reaching its *ground* (final) decay state by successive gamma or other radiations. Each such transition would have its own decay constant. The overall decay constant of a sample would depend on that of all the individual decays of a large number of nuclei within the sample and would be the composite effect of all the various decay paths employed by the sample.

Consequently, in observing radioactive decay and collecting data one is confronted with a variety of daughter particle energies (a "spectrum" of them) and an observed overall decay constant that is a composite of many somewhat different processes, not all of them known and the individual decay constants of which cannot be separately measured in general.

Neutrinos are quite difficult to detect let alone to subject to specific energy and momentum measurements. Theory requires that they carry off just the correct momentum and energy to maintain conservation so those quantities are attributed to the involved neutrino. But in order to correlate decay data with supercenter oscillation specific measurement of all of the decay products including the neutrino would be necessary.

The analysis of the entire range of states that a parent supercenter's oscillation can pass through, the comparison of those states (and their rates of change) with the corresponding entire range of states (and their rates of change) that the daughter nucleus and daughter emitted particle can take, and the correlation of those to observed decay constant and daughter products' energies and momenta (assuming that they could be precisely known) would appear to be an almost hopelessly impossible task. Certainly it would require an immense amount of computer power to address the problem.

In short, while such an investigation might be attempted, given sufficient resources, it is beyond the resources and scope of the present work. While the results would be of some interest they are neither necessary to the validation of this already well validated Universal Physics nor would they be of much real world practical usefulness.

There remain, however, three matters with regard to radioactivity yet needing clarification: the difference between the neutron and the anti-neutron, the nature of the neutrino, and treatment of the extensive family of particles found as the products of high energy physics collision experiments.

THE NEUTRON VS. THE ANTI-NEUTRON

The problem of the neutron versus the anti-neutron is that their wave forms would appear to be identical. The equations have opposite signs, but the appearance of the oscillations would seem to be identical except that at any particular moment one appears as the other "upside down". How, then, does a neutron always decay into a proton and an electron ? How does an anti- neutron always decay into a nega-proton and a positron ? How does each "know" which it is ?

The reason is that, because the oscillations of the neutron and anti-neutron are the inverse of each other, then at the point of the "decay window" the net wave form of one of them is the inverse of the net wave form of the other. At the "decay window" they are the inverse of each other and the requirement that the transition be smooth and continuous, equations 18-2, therefore produce the daughter particles that are the inverse of each other. The neutron decays into a proton and an electron and the anti-neutron decays into the inverse of a proton and an electron, a nega-proton and a positron because a discontinuity, an infinity would otherwise occur.

THE NEUTRINO

The question with regard to the neutrino is what is it ? What is its form ? How does it fit in with, participate in, the universe of centers-of-oscillation and their propagated U-waves ?

A center-of-oscillation is a continuing source of U-waves. Because of that it exhibits a characteristic that we term rest mass (and rest energy). An oscillation that is a source of propagated U-waves has rest mass; one that is not such a source has no rest mass (e.g. the proton, electron, neutron and nuclear specie on the one hand versus the photon on the other hand).

If a center-of-oscillation is in motion then its oscillation becomes unsymmetrical, becomes so to speak an arrow pointing in its direction of motion having shorter wavelength in the forward direction and greater wavelength in the rearward direction. This change in the shape of the center's oscillation corresponds to the center's having energy-of-motion and momentum. Momentum of a particle having rest mass would then appear to correspond to an unsymmetrical oscillation, to one that "points" in the direction of the vector-momentum.

The only particle of zero rest mass addressed so far in this work is the photon. The photon is an oscillation in the sense that it consists of a half-cycle of oscillation at its photon frequency. Because of that it has energy-of-motion corresponding to that frequency. Because the photon's oscillation is not continuing but only a half-cycle the photon has no rest mass.

The photon exists merely as a fluctuation in an otherwise unvarying field of U-wave propagation from the particle from which the photon was emitted. It is the change in the U-wave field that results in the photon's energy.

The photon also carries momentum. Momentum being a vector quantity (having direction as well as magnitude) and since the momentum of a center-of-oscillation is represented by a lack of symmetry in the direction of that momentum, then the momentum of a photon must be represented by a lack of symmetry in the photon's half-cycle fluctuation in the U-wave field upon which the photon is "riding". The momentum that a photon carries is primarily angular momentum. That should consist of a "couple" a pair of non-colinear equal magnitude and opposite direction linear vectors.

Furthermore, the momentum that a photon carries is not in the direction of the photon's motion anyway; it is in the direction necessary to conserve momentum taking into account the change in the momentum of the particle that emitted the photon. Upon delivering itself to another particle (the photon being absorbed by another particle) its tendency is to cause the other particle to move in the direction necessary to conserve momentum relative to the momentum change of the particle that emitted the photon. The photon is a carrier of that conserving momentum vector, both in magnitude and direction.

The principal characteristics of the neutrino are, the only basis for evaluating how it behaves and what it is is, as follows.

- They have been detected over energy ranges from as low as 1 to $10^{17}\ eV$ ($eV = electron\ volts$), on the order of 10^{-9} to $10^{8}\ amu$.

- They have no charge.

- They are generally thought to have no rest mass; however some hypotheses have suggested a minute but non-zero rest mass.

- They have an extremely small interaction with matter. That is, a neutrino can pass through an immense amount of matter with no apparent interaction (e.g. the vast majority of solar neutrinos that encounter planet Earth simply pass completely through the Earth with no interaction.) That is why neutrinos are so difficult to detect.

What, then, can be hypothesized with regard to the form of the neutrino ?

- The neutrino is not a center-of-oscillation because it has no rest mass. (If the minute rest mass hypothesis were correct then the neutrino wavelength would be immense. If that were so it would seem quite unlikely that it would have so little interaction with matter. In any case zero neutrino rest mass is the more accepted hypothesis.)

- The only alternative form for the neutrino is, then, as a fluctuation in the U-wave field. As such, since neutrinos exist in a wide range of energies they must exist as U-wave field fluctuations of a wide range of frequencies. In this sense neutrinos would be similar to photons. Furthermore, since neutrinos carry momentum and do so for reasons similar to photons, it can be expected that neutrinos exhibit momentum in the same manner as photons: as a non-symmetry in the direction of the momentum vector.

- The most distinguishing characteristic of neutrinos is their lack of interaction with matter. That special characteristic is essentially the only difference between a neutrino and a photon, which interacts with matter quite readily.

There is one other difference between a neutrino and a photon, however: the manner in which they are generated.

> Photons are generated by orbit changes of atomic orbital electrons. The orbital electrons have angular momentum and that angular momentum changes when the orbit changes so that the photon emitted carries off the change in the angular momentum of the electron.
>
> Neutrinos, on the other hand, are generated by changes in non-orbiting particles, primarily atomic nuclei. By "non-orbiting" particles is meant particles that do not have the relatively large and significant angular momentum that atomic orbital electrons have. They may have some small angular momentum due to motion of the overall atom, but the amount is much less than that for an orbital electron.

The detection of neutrinos is a matter of detecting changes that they produce in encountered orbiting electrons. But, because the neutrino lacks the angular momentum necessary to be delivered to an orbiting electron to cause it to change orbits the neutrino seldom produces such a change. Now and then, but rarely, the circumstances may allow a neutrino-caused electron orbit change. The circumstances would be a neutrino encountering an electron where the spatial relationship of the neutrino's linear momentum to the electron's orbit were such that the neutrino need supply only a linear momentum change to achieve the effect of an angular momentum change on the electron.

The neutrino is, then, a photon that carries little or no angular momentum. Photons are generated in actions that include a major change in angular momentum (orbital electron orbit changes) and the photons carry that change to later interactions where they deliver their energy and angular momentum. Neutrinos are generated in actions that include a significant change in linear momentum. They can only further interact, the requirements of conservation will only permit that they interact, in encounters that permit delivery of that linear momentum.

"STRANGE" PARTICLES

During the twentieth century, from the development of the cyclotron in 1930 on, as the energies available in particle accelerators steadily increased physics researchers have had to deal with the problem of discovering an ever increasing number of new particles. The new particles have been categorized (baryons, leptons, etc.), described (flavor, charm, etc.), simplified via ingenious hypotheses (quarks), further described (up, down, etc.) and so on.

The following is quoted from section *9 - The Problem of Physics*, back near the beginning of this development.

> "Acknowledging that the analogy is somewhat brutal, nevertheless the research [in high energy physics] is conducted in a fashion analogous to the study of the composition and fundamental parts of a limousine by hurling everything from roller skates to motorcycles at it with as much energy as possible and then analyzing the resulting pieces. It is true that little alternative seems to be available for experimental procedures for studying the atomic nucleus, but to take the resulting "pieces" very seriously as a key to understanding the nature of matter makes only quite limited sense when the magnitude of the disruptive energy used to generate the pieces is considered. Furthermore, those "pieces" may not be so much fundamental "building blocks" of matter as the fragments into which the matter naturally breaks under such energies, so to speak a reflection of the "fault lines" in the matter.

The statement is valid.

Of all of the many particles so discovered:

- Those having rest mass are centers-of-oscillation (pieces that are centers smashed out of existing centers).
- Those having charge have oscillations with a non-zero average level
- Those having momentum have a non-symmetrical oscillation, the "arrow" pointing in the direction of the momentum.
- Those not having rest mass are fluctuations in the U-wave field.
- Etc.

But, what about "spin" ? There is no way that a center-of-oscillation can have "spin". On the other hand, the complexity of centers other than fundamental ones such as the proton and electron is such that they can exhibit many varied behaviors. Spin is not an observed phenomenon. It would be impossible to "see" these particles let alone see them spinning. Spin is a hypothesized behavior to explain externally observed data. The oscillation's complexity is the cause of that data.