This result states that the fractional reduction in the velocity, c, of waves propagated by an encountered center, which reduction is due to the effect of incoming waves that the encountered center's waves must pass through, is proportional to the squared ratio of the Planck length, l_{Pl}, to the distance, d, that the encountered center is from the source of the incoming waves. That squared ratio is, of course, the usual inverse square effect. Here it is the ratio of the wave amplitude at distance d from the source center relative to the wave amplitude at distance l_{Pl} from the source center.

This result also means that at distance $d = \sqrt{2\pi}\cdot l_{Pl}$ from the source center the slowing, Δc, is equal to the full velocity of propagation, c; at that point $\Delta c/c = 1$. In other words, at that distance from the source center all incoming propagation from the encountered center is brought to a complete stop. That is the physical significance of l_{Pl} or, rather, of $[2\pi]^{½}\cdot l_{Pl}$. It is so fundamental that it is hereafter designated simply δ, (Greek lower case *delta* corresponding to Roman "*d*" for <u>d</u>istance). Equation 19-34 then becomes equation 19-35, below.

$$(19\text{-}35)\qquad \frac{\Delta c}{c} = \frac{\delta^2}{d^2} \qquad\qquad [\delta \equiv \sqrt{2\pi}\cdot l_{Pl}]$$

Equation 19-35 implies that out at the distance δ from the center of a center-of-oscillation the waves that that center propagates are at their maximum amplitude, are "as propagated" so to speak, since δ is the reference value in the equation and Δc cannot be greater than c. (Further implications of δ are developed later in this section.)

(The $\sqrt{2\pi}$ comes about as follows. In traditional 20th Century physics the Planck constant<u>s</u>, m_{Pl}, l_{Pl}, and t_{Pl}, were defined in terms of $h/2\pi$, <u>the</u> Planck's constant, h, divided by 2π, and the expressions for them are all under a radical, a square root sign. That definition was arbitrary because the physical significance and role of the Planck constant<u>s</u> was not understood and there was no theory or hypothesis of gravitation that meaningfully related to them. The division by 2π was most likely due to the misunderstanding of orbital electron quantization. That is, traditional 20th Century physics speaks in terms of quantized angular momentum and uses $h/2\pi$ to measure it.

(It has already been shown in the earlier section *15 - A Model for the Universe (5) - Quanta and the Atom* that orbit quantization is dependent on the orbital electron matter wavelength, which is physically meaningful and is mathematically analogous to quantized angular momentum, which is not so physically meaningful. The, wrong, unnecessary and complicating $h/2\pi$ should have been simply h in the Planck constant<u>s</u>.)

The equation 19-35 result can also be obtained directly from solely the consideration of how the slowing is caused by μ and ε, as follows.

> For propagating medium, at the instant of its propagation and with its normal behaving by itself, responding to its own μ_0 and ε_0, the value of those two are constant at what we term their *free space values*. Those values are inverse square reduced as the medium carrying them propagates outward from their source center-of-oscillation. (As discussed in section *16 - A Model for the Universe (6) - The Neutron, Newton's Laws*, the speed of wave propagation remains the same because the U-waves also are inverse square reduced in amplitude.)

(19-36) (1) The values at distance δ from the center of the source center-of-oscillation, the first place where the propagated medium appears and the place where its concentration is the greatest, are the free space values:

$$\mu = \mu_0 \qquad \text{and} \qquad \varepsilon = \varepsilon_0$$

(2) Because of the inverse square law the values at distance "d" from the center of the source center-of-oscillation are:

$$\mu(d) = \mu_0 \cdot \frac{\delta^2}{d^2} \qquad \text{and} \qquad \varepsilon(d) = \varepsilon_0 \cdot \frac{\delta^2}{d^2}$$

Then, the overall net effective values when flowing medium from a distant center [per 19-36(2), above] passes through the outward propagation of an encountered center [per 19-36(1), above] are:

(19-37)

$$\mu_{net} = \left[\mu_0 + \mu_0 \cdot \frac{\delta^2}{d^2}\right] = \mu_0 \cdot \left[1 + \frac{\delta^2}{d^2}\right]$$

$$\varepsilon_{net} = \left[\varepsilon_0 + \varepsilon_0 \cdot \frac{\delta^2}{d^2}\right] = \varepsilon_0 \cdot \left[1 + \frac{\delta^2}{d^2}\right]$$

The resulting net speed of propagation is, then

(19-38)

$$c_{net} = \frac{1}{\left[\mu_{net} \cdot \varepsilon_{net}\right]^{1/2}} = \frac{1}{\left[1 + \frac{\delta^2}{d^2}\right] \cdot \left[\mu_0 \cdot \varepsilon_0\right]^{1/2}}$$

$$= \frac{c}{\left[1 + \frac{\delta^2}{d^2}\right]} = \frac{d^2}{d^2 + \delta^2} \cdot c$$

and the amount of the slowing is

(19-39)

$$\Delta c = c - c_{net}$$

$$= c \cdot \left[1 - \frac{d^2}{d^2 + \delta^2}\right]$$

$$= c \cdot \frac{\delta^2}{d^2 + \delta^2}$$

$$= c \cdot \frac{\delta^2}{d^2} \qquad [d^2 \text{ is much greater than } \delta^2]$$

so that

(19-40)

$$\frac{\Delta c}{c} = \frac{\delta^2}{d^2}$$

which is identical to equation 19-35.

With the definition of δ per equation 19-35 the simplest statement of the universal gravitation constant, G, is

(19-41)
$$G = \frac{c^3 \cdot \delta^2}{h}$$
[Substituting δ for $2\pi \cdot l_{Pl}^2$ in equation 19-28]

The length δ is a true universal constant joining c, q, h, and π as fundamental constants that characterize the universe and completing that family.

All of the analysis of gravitation to this point depends on the assertion earlier above that the focusing of the incoming wave onto the encountered center plays no role in gravitation, that focusing occurs but to no gravitational effect. To demonstrate that gravitation is independent of focusing even though the simultaneously occurring Coulomb effect does involve (and requires) focusing the development is as follows.

(1) Stating Newton's law of gravitation and Coulomb's law in the units of this Universal Physics, the ratio of their effects is as follows.

(19-42)
$$F_{grav} = G \cdot \frac{m_s \cdot m_e}{d^2}$$
[The same form as in SI units because the complexities of ε do not affect gravitation as they do the Coulomb law.]

$$F_{coul} = \frac{Q_s \cdot Q_e}{4\pi \cdot d^2}$$
[Coulomb's law as it naturally occurs from Section 12]

$$\frac{F_{grav}}{F_{coul}} = 4\pi \cdot G \cdot \frac{m_s \cdot m_e}{Q_s \cdot Q_e}$$

$$= \frac{m_e \cdot a_{grav}}{m_e \cdot a_{coul}} = \frac{a_{grav}}{a_{coul}}$$

(2) Stating the gravitational acceleration and the Coulomb acceleration as derived in this Universal Physics, the ratio of their effects is as follows.

(19-43)
$$a_{grav} = \Delta c \cdot f_s$$
[Per equation 19-29]

$$= c \cdot \frac{\delta^2}{d^2} \cdot \frac{1}{T_s}$$
[Per equation 19-35 and $f = {}^1/T$]

(19-44)
$$a_{coul} = \frac{U_s \cdot c}{d^2} \cdot K_{cs} \cdot \lambda_e \cdot U_e \cdot c$$
[Equation 16-15, which also is the Coulomb's law derivation step 4 Section 12, adjusted per equation 12-32.]

(Note that equation 19-43 does not involve any effect of focusing at the encountered center whereas equation 19-44 has the full effect of that focusing.)

Now taking the ratio of equation 15-43 to equation 15-44 it is found that the ratio reduces to being identical to the ratio found in equation 15-42, above, as follows.

(19-45)
$$\frac{a_{grav}}{a_{coul}} = \left[c\cdot\frac{\delta^2}{d^2}\cdot\frac{1}{T_s}\right]\cdot\left[\frac{d^2}{[U_s\cdot c]\cdot[K_{cs}\cdot\lambda_e\cdot U_e\cdot c]}\right]$$

$$= \frac{\delta^2}{T_s\cdot U_s\cdot U_e\cdot K_{cs}\cdot\lambda_e\cdot c}$$ [Simplification]

$$= \frac{\delta^2\cdot f_s}{U_s\cdot U_e\cdot[{}^{c}/_{4\pi\cdot h}]\cdot[{}^{c}/f_e]\cdot c}$$ [Per equation 12-25 $K_{cs} = {}^{c}/4\pi\cdot h$. Also $T = {}^{1}/f$, $\lambda = {}^{c}/f$]

$$= \frac{4\pi\cdot\delta^2\cdot[m_s\cdot c^2/h]\cdot[m_e\cdot c^2/h]}{U_s\cdot U_e\cdot[{}^{c}/h]\cdot[c]\cdot c}$$ [$f = {}^{m\cdot c^2}/h$]

$$= \frac{4\pi\cdot\delta^2\cdot c\cdot m_s\cdot m_e}{U_s\cdot U_e\cdot h}\cdot\frac{c^2}{c^2}$$ [Simplified and multiplied by ${}^{c^2}/_{c^2}$]

$$= 4\pi\cdot G\cdot\frac{m_s\cdot m_e}{Q_s\cdot Q_e}$$ [$G = [c^3\cdot\delta^2]/h$ per equation 19-41 and $U\cdot c = q\cdot c = Q$]

which is identical to equation 19-42.

Equation 19-35 clearly implies that gravitation depends only on the relative amplitudes or concentrations of the incoming and encountered waves. The determining ratio of equation 19-35 is a reference to the inverse square relationship, which derives from the surface of a sphere ($4\pi\cdot radius^2$) of the designated radius.

(19-46)
$$\frac{\Delta c}{c} = \frac{\delta^2}{d^2} \quad\text{implies}\quad \frac{4\pi\cdot\delta^2}{4\pi\cdot d^2}$$ [Equation 19-35 then modified by 4π factors]

Gravitation is effected by a dimensionless quantity, a pure ratio, and involves no specific amount of medium flow, whether focused flow or mere interception. Gravitation depends on the medium amplitude, its amount or "head".

But, of course, the ratio of equation 19-46 is created by the comparison and interaction of the relative U-wave propagation amplitudes of the source center waves, as inverse square reduced in traveling to the encountered center, and the encountered center waves, which are not inverse square reduced having not yet traveled any distance. Those two are as follows.

(19-47)
$$\Delta U_w\Big]_{grav} = U_s\cdot\lambda_s$$ [The source waves at the source center per equation 12-23 ...]

$$= U_s\cdot\lambda_s\cdot\frac{\delta^2}{d^2}$$ [... and then at the encountered center]

(19-48)
$$\Delta U_e\Big]_{grav} = U_e\cdot\lambda_e$$ [The encountered center per equation 12-23 ...]

$$= U_e\cdot\lambda_e\cdot\frac{T_s}{T_e}$$ [... and per period, T_s, of the source center.]

The gravitational effect and Newton's law of gravitation are then derived as follows. Per equations 19-13 through 19-18

(19-49)
$$R_\Delta = \frac{\Delta U_g}{\Delta U_e} = \frac{\Delta U_w\big]_{grav}}{\Delta U_e\big]_{grav}}$$
[19-14 repeated and referred to 19-52 and 19-53]

$$= \left[U_s \cdot \lambda_s \cdot \frac{\delta^2}{d^2}\right] \cdot \left[\frac{1}{U_e \cdot \lambda_e \cdot \frac{T_s}{T_e}}\right]$$

(19-50)
$$a_{grav} = \frac{\Delta v}{T_s} = \frac{c \cdot R_\Delta}{T_s}$$
[Equation 19-18 and substitution per equation 19-17]

$$= \left[\frac{U_s \cdot \lambda_s}{U_e \cdot \lambda_e} \cdot \frac{\delta^2}{d^2}\right] \cdot \left[\frac{T_e}{T_s}\right] \cdot \frac{c}{T_s}$$
[Substitution of equation 19-49 into 19-50]

$$= \left[\frac{\lambda_s}{\lambda_e} \cdot \frac{\delta^2}{d^2}\right] \cdot \left[\frac{c \cdot f_s{}^2}{f_e}\right]$$
[$U_s = U_e = U_c$]
[$f = {}^1/_T$]

$$= \frac{c}{c} \cdot \frac{\delta^2}{d^2} \cdot c \cdot f_s$$
[$f \cdot \lambda = c$]

$$= \frac{\delta^2}{d^2} \cdot c \cdot \frac{m_s \cdot c^2}{h}$$
[$f = m \cdot c^2/_h$]

$$a_{grav} = G \cdot \frac{m_s}{d^2}$$
[$G = [c^3 \cdot \delta^2]/_h$ per equation 19-41]

which is Newton's law of gravitation.

Thus gravitation joins the other fundamental physical laws: Coulomb's law, Ampere's law, and Newton's Laws of Motion, in ceasing to be a mere empirically valid observation becoming instead a requisite behavior aspect of natural reality derived from the fundamentals of its origin.

The points in the derivation can be summarized as follows.

(19-51) (1)

The change in the speed of the encountered center-of-oscillation equals the change in that center's propagation speed toward the source center. That is required in order to maintain continuity of medium flow and prevent a void, an infinity.

$$\Delta v_e \equiv \Delta v_{\text{encountered center}} = \Delta c_{\text{its propagation}}$$

That change is imposed on the encountered center by the source center's waves and equals the value of "c" before the change times the ratio of the amplitude of the (inverse square reduced) source waves to the encountered center's waves as propagated by it.

$$\Delta v_e = \Delta c = c \cdot \frac{\delta^2}{d^2} \qquad \text{[Equations 19-31 thru 19-40]}$$

(2)
The oscillatory source waves produce such a change each cycle of their oscillation. The resulting acceleration is therefore:

$$a_e = \frac{\Delta v_{center}}{T_s} \qquad \text{[Definition of "a"]}$$

$$= f_s \cdot \Delta v \qquad [f = {}^1/_T]$$

$$= f_s \cdot c \cdot \frac{\delta^2}{d^2} \qquad \text{[Substitute above } \Delta v\text{]}$$

$$= c \cdot \delta^2 \cdot \frac{f_s}{d^2} \qquad \text{[Rearrange]}$$

$$= c \cdot \delta^2 \cdot \frac{\left[m_s \cdot c^2 / h\right]}{d^2} \qquad [m \cdot c^2 = h \cdot f]$$

$$= \left[\frac{c^3 \cdot \delta^2}{h}\right] \cdot \frac{m_s}{d^2} \qquad \text{[Rearrange]}$$

$$a_e = G \cdot \frac{m_s}{d^2} \qquad \text{[Equation 19-41]}$$

$$F_e = m_e \cdot a_e = G \cdot \frac{m_s \cdot m_e}{d^2} \qquad \text{[Newton's Law of Gravitation]}$$

COMPARISON OF GRAVITATION AND THE COULOMB EFFECT

Acceleration, of whatever type, occurs when the net effect of waves from "source" centers arriving at the "encountered" center is to produce an imbalance in the required pattern of propagation. That is, when the net effect of the arriving waves makes it necessary for the encountered center to propagate differently in the various directions, forward, rearward and laterally, than it is currently propagating in those directions. If the center must change its pattern of propagation an unavoidable component in that overall change is a change in the center's velocity, as was presented in section *13 - A Model for the Universe (3) - Motion and Relativity*. Cyclical waves imposing repetitive such changes impose an acceleration equal to the velocity change per cyclic period.

The waves producing those effects are a flow of medium. Any and every flow (water or electricity, for example) involves the <u>flow</u> rate and the <u>potential</u> driving it (for example water flow rate and its pressure or "head" or electric current and its potential or "voltage"). Medium flow is the amount of medium passing a location per time. Whether the medium flow has been concentrated by an action such as Coulomb focusing or not does not change its medium potential.

Medium potential is how much medium there is at a location ("how deep it is" so to speak). The speed of light, the speed of the propagation, the medium flow, depend on the value of the medium potential. It is the medium potential that carries the values of μ and ε. (One might almost say that those "carried" values are the medium potential.)

In the case of electrostatic or magnetic applied force and resulting acceleration (actions and effects that involve the inertial mass of the encountered particle / center) the arriving waves create the imbalance by their medium flow. A center-of-oscillation's propagation must at all times produce continuity of the medium flow. Failure to do so, a step change or discontinuity, would be an infinity, which cannot occur in material reality. Since the arriving waves are delivering the medium flow that they deliver, the center must adjust its propagation so that smooth continuity of overall medium flow, that arriving plus that of the center, is maintained.

The effect depends on the inertial mass of the encountered center because the amount of medium flow creating the imbalance is determined by the focusing action of the encountered center and that net action varies directly as the frequency, the mass, that is the inertial mass, of the encountered center.

In the case of gravitational acceleration (action involving the gravitational mass of the source center / particle) the arriving waves create imbalance by changing the local value of the speed of light on the encountered side of the encountered center. That action is produced by the medium potential as set out in equations 19-36 through 19-40.

Of course, both effects, that of medium flow (inertial) and that of medium potential (gravitational) go on at the same time. If there is a net electrostatic or magnetic effect (which there might not be because of the $^{+}/_{-}$, $^{\text{attractive}}/_{\text{repulsive}}$, $^{\text{north}}/_{\text{south}}$ nature of those effects) it is so much greater than the gravitational effect that the gravitation cannot be noticed. But if the net electrostatic and magnetic effect of the arriving waves is overall neutral, as is usually the case with bulk matter, then the only net effect is that of gravitation and it is noticed. And, because there is no opposing effect the gravitation builds up center by center, interaction by interaction to large magnitudes.

As indicated in all of the above and in Figure 19-5, the changes in the local value of c on the encountered side of the encountered center, c_{grav}, are continuous and oscillatory. However, just as was found to be the case with the effect of the wave form gradient in inertial mass focusing, it is the peak value of the oscillatory part of the arriving wave form, not the detail of its shape, that determines the magnitude of the gravitation effect. One way to see that is to note that, per arriving wave cycle, the change in v_{center} is equal to the peak change in c_{local}. It also develops exactly as it did for inertial mass, as follows.

The momentary, instant by instant change in the local value of c is the amplitude difference at two adjacent points in the arriving wave form. The associated acceleration is that difference divided by the time between the two adjacent points. That ratio is the slope, the first derivative of the wave form. The acceleration per cycle of the arriving wave form is, then, the sum of such adjacent point increments, the integral of that slope, over the period of increasing amplitude.

That is, to get the acceleration per cycle, one must integrate the wave form first derivative between the zero and peak points. But the integration takes the antiderivative, returns to the wave form itself as it was before the taking of the derivative. And, the evaluation of that integral between the zero and peak points is simply the peak value of the arriving wave form.

Thus the gravitational acceleration is simply proportional to the difference between the arriving wave form peak and its preceding minimum, those summed per repetitive cycle of the wave form and the sum divided by the period of that repetition.

This dependence only on the peak values of the oscillatory portion of the wave form means that the average value of the wave form, which corresponds to the Atomic Number, Z, and the charge, has no effect on mass as, of course, is the case in reality. Of even greater significance is that this dependence for the gravitational effect is not only identical to the behavior of inertial mass in the Coulomb effect; it also derives from the identical line of reasoning applied to the same wave forms.

The above paragraphs' reasoning is identical to that presented following equation 16-39. That immediately produces the especially important result of <u>analytically proving</u> that:

The <u>inertial mass</u> and the <u>gravitational mass</u> are <u>identical</u>.

That conclusion, that inertial and gravitational mass are the same, has long been thought by 20th Century physics to be the case but has been beyond proof because of the lack of understanding of gravitation.

THE GENERAL GRAVITATIONAL FIELD

The gravitational effects, discussed and analyzed here for the purpose of investigating gravitation, occur in the usual Coulomb action as discussed in earlier sections of this work. But, the amount of these effects is so minute (gravitation compared to Coulomb) relative to the magnitude of the Coulomb effect that gravitation is not detectable by us as an anomaly in the Coulomb effect. But, when the source of the incoming waves is overall electrically neutral, as is the case with atoms, the attractive and repulsive Coulomb effects cancel while the always attractive gravitational effects add and are the only net effect. A corollary of this state of affairs is that gravitation, as a detectable effect, is a property of atoms not of individual charged particles.

In anti-matter atoms, of which we have little direct experience, the gravitational effect is attractive, just as in our "ordinary" matter, because it results from exactly the same effect as in matter atoms. The gravitational interaction between matter and anti-matter atoms is one of attraction, also, for that reason. (If matter and anti-matter so attracted to each other were to combine they would mutually annihilate in an immense explosion of energy.)

So far the gravitation of only one atomic component particle has been addressed; however, in general we experience gravitation at the macroscopic level, gravitation of material bodies composed of many atoms. Of course, each and every atom has its own gravitational field propagating radially outward from it into space. That field is the sum, the net effect, of the individual fields of each of the orbital electrons and of the atom's nucleus.

Likewise, the gravitational field of a material body is the sum of the gravitational fields of each of the atoms, of each of the centers-of-oscillation of which the body is composed. One would be initially inclined to visualize such a field as smooth, as the sum of a very large number of oscillations at various relative phase angles, so that the overall sum appears to have no oscillations at all. (The various relative phases of the individual oscillations should form a flat, uniform distribution because, not only are the individual centers-of-oscillation unlikely to be synchronized, but the relative phase in the propagated field depends on the relative locations of each of the source centers, locations which are not coordinated and which are constantly changing.)

In fact, taking that smooth visualization a step further, since the source of all of those oscillations is an overall charge-neutral body, the smooth sum of all of the positive should just cancel with the smooth sum of all of the negative and give the appearance of no field at all, of the zero overall average level.

That point of view is incorrect for two reasons.

- First, no matter how many uniformly-distributed-phase sinusoids are summed, the sum can never be smooth. The peak of each is a point, not a region. Only a truly infinite number of components can produce a theoretically smooth sum.

- Second, in any such sum the individual components are still, nevertheless, there; are still acting effectively individually; and still can and must be treated as distinct separate effects. As stated earlier in the section on the neutron, "The sum sound of a symphony orchestra includes many waves at many frequencies and would not at all "look" like a sinusoid if it were to be viewed. It would "look" like the sum that it is. But we distinctly and separately hear each of the different instruments and each of the different notes in spite of the sum."

The gravitational field of a material body is the sum of a large number of individual fields acting collectively individually. Each participates in its own set of effects as described in all of the preceding pages of this work at each center that it encounters. The overall net effect at an encountered center is the sum of those individual effects acting collectively individually.

Thus all of space is permeated by gravitational field, the universal field of U-waves. One might call it the "fabric of space" somewhat as the way Einstein thought of it.

UNIFICATION

It can now be observed that there truly is only one field, the field of U-waves propagated by centers-of-oscillation. Those waves and those centers interact in a manner yielding many effects as already presented, all of the effects known to us and included under the subject "physics". But there is only one field: the universal field, which is the "unified field" sought by physics for so long.

Those many effects appear to us as a variety of forces: electrostatic, magnetic, gravitational and so forth. But, there is only one cause, one action:

the interaction of incoming wave and encountered center: the universal interaction, the "unified force" sought by physics for so long.

THE IMPLICATIONS OF δ

The gravitational slowing is given by equation 19-35 solved for Δc.

$$\Delta c = c \cdot \frac{\delta^2}{d^2} \tag{19-52}$$

where the value of δ (from equation 19-41 using the CODATA bulletin values of G, c and h) is

$$\delta = 4.050{,}84 \cdot 10^{-35} \text{ meters} \tag{19-53}$$

The proton wavelength is $1.321{,}410{,}0 \cdot 10^{-15}$ *meters*, for comparison. Therefore δ is extremely small, even on the scale of the fundamental particles, being about $3 \cdot 10^{-20}$ of a proton wavelength.

At the distance δ from the center of a center-of-oscillation all incoming propagation is brought to a complete stop. The center-of-oscillation would appear to be not simply a single point singularity but rather a minute spherical entity of radius δ. A center must be able to absorb impulses in order to absorb momentum from the portion of incoming waves that encounter it. In the classical physics sense it can only do that by reducing the incoming waves' velocity, by reducing that velocity to zero for complete absorption. Classically that would indicate that the center has, in effect, a greater than zero cross-section, surface area, volume -- the effect of having a radius, δ.

But, the issue of that *core* is more complex than the classical view. The significance and characteristics of the *core* volume of radius δ and its reconciliation with being a singularity are developed in section *21 – The Probable End*. The *core* and its radius, δ, also bear directly on understanding of how Coulomb focusing operates, which is addressed in detail notes *DN 10 - Analysis of Coulomb Focusing Details* at the end of this section.

GRAVITATION AND RELATIVITY

Per equation 19-18, re-produced below, where Δv is the increment of velocity change produced by a single cycle of the U-wave propagation incoming from the “source” center-of-oscillation,

$$a_{grav} = \Delta v \cdot f_{source} \tag{19-18}$$

the gravitational acceleration produced by the “source” gravitating center is directly proportional to the source frequency. That refers, of course, to the gravitating effect of a single particle, a single center-of-oscillation. The gross acceleration produced by a multi-particle mass is the accumulation of the individual participating particles’ effects.

Now, referring to Figure 13-5, reproduced below, it is clear that the value of f_{source} depends on the direction of the motion of the “source” center relative to a straight line drawn between that “source” center and the “encountered” center, the one being acted on gravitationally. That is, if the "source center" is moving directly toward the "encountered center" then the source frequency is f_{fwd}. If it is moving directly away the source frequency is f_{rwd}. If it is moving at right angles the source frequency is f_v. And, if it is moving at an angle between $0°$ and $90°$ then the source frequency is the consequent resultant.

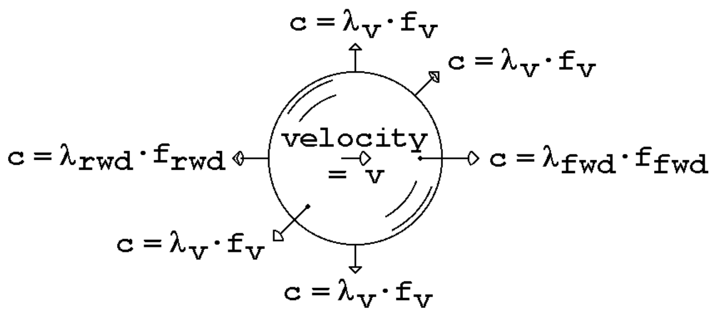


Figure 13-5
The Wave as Propagated By the Center at Velocity v
[As Observed From At Rest]

If the "source center" is perfectly at rest then the source frequency is f_r in all directions.

From this it is apparent that the gravitational effect of a gravitating mass depends on the velocity, its magnitude and its direction, of the gravitating mass and that that dependency is due to the same relativistic effects that make the mass's inertial mass relativistically dependent.

While at rest inertial and gravitational mass are identical, the above does not exactly mean that they are identical when not at rest. The reason for the difference is that the effective gravitational mass varies with the relative direction of motion as just described.

In the case of the "encountered" center-of-oscillation the situation is much more simple. The frequency encountered at the "encountered" center does vary according to its direction of motion relative to a line joining the "source" and "encountered" centers, that is relative to the direction from which the incoming U-waves are coming, but the frequency of the "encountered" center has no overall effect on the gravitational action. That is pointed out in connection with the original of the above equation 19-18 at the bottom of page 359 and top of page 360 where it is stated:

> "[The] time period, Tw, the incoming wave period, which is identical to Ts, the source center's period, might enclose an exact full cycle of the encountered center's oscillation, only part of a cycle, or more than a full cycle. The consequent momentary acceleration in each of those instances would be different, but over a large number of cases the net average acceleration would be independent of that factor, independent of the encountered center's frequency and wavelength of oscillation and of how they relate to the source center's period."

Thus, while their rest masses are identical, the relativistic effects of motion result in inertial mass behaving moderately differently from gravitational mass when not at rest.

Of course, gravitation is a very weak force. It only has significant effect when very large masses are involved. In general for such masses to be at velocities where relativistic effects become significant is very unlikely. The Hubble's Law interpretation of astronomical redshifts has lead to inferred immense velocities of far distant galactic objects a result not anticipated at the time of the original positing of that law and at which our ability to observe such far distant / high redshift objects did not exist.

That contradictory or "unreasonable" behavior of high redshift objects led to the hypothesis that it is not those objects that are moving with such high velocities but that, rather their space, itself, is so expanding, carrying those objects with it in its expansion. That further led to the positing that, while large scale galactic space is expanding, nevertheless local and atomic level space is not, and remains our "ordinary" space.

Such a set of positions is quite unreasonable in its own right. In spite of the long term acceptance of the Hubble - Einstein cosmological concept there are fundamental questions about it that are unanswered. The concept is a direct result of Einstein's General Theory of Relativity for which space, itself, is some kind of "substance" [not Einstein's terminology] capable of expanding and capable of being "curved" by the effect on it of gravitating masses in it. That concept leaves the problem, "... relative to what" ? If space is expanding then the expansion must be relative to some static, non-expanding reference. If space is curved than the curvature must be relative to some flat, uncurved reference. One cannot have relativity without relativity. Any change or effect must be relative to a previous unchanged reference or previous unaffected state. Otherwise the change or effect would be undetectable.

So, what do we call that "static, flat, uncurved reference"? It is space itself; and it is, and it must be, the framework that expansion of the universe is relative to. And flat, uncurved rectilinear space is and must be, the framework that curved motion due to gravitation is relative to. And that space must have always existed unoccupied [and, therefore actually "nothing"] until the "Big Bang" introduced matter and energy into it.

The resolution to the problem of high redshifts and the implied unreasonable recession velocities is the Universal Exponential Decay, which is developed in Section *21 - The Probable End.* The Universal Decay is the principal cause of redshifts. There must be some Doppler content in redshifts because those astral sources do have reasonable velocities away from us, the observers, but the Doppler effect accounts for only about 10% or less of the total redshift. The Universal Decay produces the redshifts because when we observe light from distant astral sources we are observing light emitted long ago, which was emitted less decayed than our local contemporary light. Being less decayed it appears redshifted to us because we compare it to our local, decayed-to-date light and spectra. The decay is of the length, $[L]$, dimensional aspect, which affects the wavelength. There is no decay of the period, $[T]$, nor its inverse, the frequency.

SOME FANTASIES THAT, PERHAPS, MIGHT BECOME REALITIES

"Captain, a subspace message coming in from Starfleet Command !"

"Yes, it seems we are needed for an emergency on Alpha Centauri Five. Navigator, how far are we from there ?"

"Five hundred seventy three point two two light years, sir. It should take about eighteen hours at warp three."

"Engineering, we have to get moving. Can you complete the repairs to the force field shields in three hours ?"

"Yes sir, captain, but I'll have to postpone doing the maintenance check on the ship's artificial gravity."

"All right. Throw a 'tractor beam on that capsule out there. Set course for Alpha Centauri, warp three. Engage !"

. . . .

Faster than light communication, via "subspace", faster than light travel, via "warp", "force fields", artificial gravity, 'tractor beams, anti-gravity: are any of those in the realm of the possible ?

In the October 1942 issue of *Scientific American* (a magazine published monthly by Scientific American, Inc, 415 Madison Ave, New York, N.Y., who holds the copyright) a highly prestigious and respected publisher of articles of current interest and current results in all fields of science for over a century and a half, the following comments appeared in an article (reviewed in the October 1992 issue of the magazine):

> "The business of smashing atoms to release great gusts of energy is a profitable sport -- for news reporters. But it is not an item that has much standing in physics laboratories. Radioactive materials, of which there are only minute amounts in the earth, disintegrate and slowly release large amounts of energy. If radium, for example, were as plentiful as copper, atomic boilers using radium as fuel might be practical, but there just is not very much radium available.
>
> "As far as artificial disintegrations are concerned, the verdict thus far seems to be definitely thumbs down on such operations for giving a net yield of energy. Far more energy has to be put into the operation than can be got out.
>
> "There is some evidence that one of the isotopes of uranium, if relatively pure, might, upon bombardment with neutrons, disintegrate to give a net yield of a rather large amount of energy. But this isotope of uranium is one of the rarest of rare materials."

This is not cited for the purpose of subjecting *Scientific American* to ridicule. Far from it. It is cited in order to demonstrate how difficult it is to envision the progress that may be made beyond the currently reasonable or currently foreseeable possibilities of science. With that *caveat* the following would nevertheless seem to be reasonable comments on the possibility of the above various science fiction effects becoming realities.

FASTER THAN LIGHT COMMUNICATION & TRAVEL

These are impossible in traditional 20th Century physics and that conclusion is well founded. It is clear from all of the preceding that communication within the universe can only be via U-waves which have c as their only possible speed. It is also clear that any material body within the universe must be composed of centers-of-oscillation for which c is an upper limit on possible speed, a limit that perhaps can be approached but not reached by a material body.

The import of the concepts "subspace" and "warp" is, however, the bypassing of the speed of light limit by somehow operating outside of the space of our universe, another "space" where, presumably, there is no medium and no speed limit, c. At present we know absolutely nothing about the [any] extra-universal regime and without such knowledge there is no way to know whether it "exists" and can be used.

It does seem reasonable to observe, however, that access to such a regime from our regime, our universe, would appear to be only available at the center of a center-of-oscillation, a place very difficult to access and of minute size (on the order of δ). Furthermore for faster than light travel by a material body to occur via such a regime it would be necessary that the centers-of-oscillation of which the material body is composed and the U-wave propagation among them somehow be transferred to the extra-universal regime in a manner in which they continue to function as within our universe or at least sufficiently so so as to still be the same material body upon exiting "warp" and returning to our universe.

At best this would all appear to be no more available to us than was television available to Charlemagne. More likely it is completely impossible.

"FORCE FIELDS" & ARTIFICIAL GRAVITY

These topics are joined because they are essentially the same. Artificial gravity (such as a system that gives the appearance of gravity to all persons and objects within a space ship in free fall, that is, coasting) would be essentially a "force field", attractive in its direction and producing on the order of the same acceleration "downward" as we experience on the surface of the Earth. In science fiction concepts a "force field" is usually a field that repels anything moving toward it, an action similar to artificial gravity except that the direction is repulsive rather than attractive and the acceleration produced is much larger than that of gravity as we experience it (in science fiction the strength of the force field is sufficiently larger than gravity so as to protect against all but immense attacks upon it).

Force fields certainly are possible. Any mass exhibits a gravitational force field. Any charge exhibits a Coulomb force field. The issue is whether or not we can construct specific directed forms of such fields to accomplish our objectives.

In particular, we are not much interested in a Coulomb force field as such because it only acts on other objects that have a net charge of some kind. The desired objective is to obtain force fields that act upon charge-neutral material bodies (such as people, furniture and incoming war-heads), that do so by a means other than assembling a sufficient mass, and that may be repulsive or attractive according to our intended application.

At present we know of no such field other than natural gravitation itself, which is always attractive and which requires the assembly of a large mass to produce a significant magnitude field.

[AT]'TRACTOR BEAMS (AND [RE]'PELLER BEAMS)

These are special cases of force fields, that is they require a force field that can be focused into some small portion of space onto some target to attract or repel it. The only force fields that we know of would have to consist of propagating U-waves; therefore the problem would be how to focus those U-waves. U-waves do experience a deflection of their path when passing through other U-waves if a gradient in the encountered waves' density exists across the path of the propagating waves as already discussed. It might be possible to construct arrangements of charges the fields of which tend to focus the desired U-wave propagation onto an intended target, a kind of "U-wave gun". Whether this is possible in practice, and whether the effort is worth while could only be determined by attempting to develop such a system.

ANTI-GRAVITY

Anti-gravity means either a system for causing a material body to be independent of gravitational attraction, unaffected by a gravitational field, or for causing the material body to respond in a controllable fashion to a gravitational field. The former would make possible the levitation of massive objects (just as would attaching to the massive object a suitable balloon). The latter would include the former and the entire range of reducing the (gravitationally) apparent mass of an object through zero to negative values that would cause it to experience repulsion in a gravitational field rather than the natural attraction.

This would be extremely useful for both transportation and freight on a planetary surface and for space travel. However, the action of gravity is so fundamental to the nature of a material body, the slight slowing of the propagated U-waves from encountered centers caused by those waves passing through the incoming U-waves from other centers, that it is most likely impossible to alter that natural behavior of matter.

In conclusion it would appear that most of the *Some Fantasies that, Perhaps, Might Become Realities* are quite unlikely to do so.

DETAIL NOTES 10

Analysis of Coulomb Focusing Details

The Coulomb effect begins with the total flow of medium outward from the source center, not a density of so much medium per unit area but the total flow.

At any distance, d, from that source center the flow density is the total outward flow from the center divided by the surface area of a sphere of radius d, that is $4\pi \cdot d^2$. That is how the inverse square effect enters into the Coulomb effect. The effect on an encountered center is due to the amount of that flow that is focused onto the encountered center. That focused flow is equal to the amount of the total flow that would be intercepted by a hypothetical equivalent area that corresponds to the effect of the focusing. The Area of equation 16-8 is the equivalent area that the focusing action of the encountered center must produce for the Coulomb effect.

Treating the case of two simple centers-of-oscillation, that equivalent area develops as follows.

(DN10-1) a = acceleration per equation 16-15

$$= \frac{c}{T_e} \cdot \frac{\Delta U_{w,inw}}{\Delta U_{e,fwd}}$$

$$= \frac{c}{T_e} \cdot \frac{[\text{Source Center Flow Rate} \cdot T_e] \cdot \left[\dfrac{\text{Equivalent Focus Area}}{4\pi \cdot d^2}\right]}{[\text{Encountered Center Flow Rate Forward} \cdot T_e]}$$

$$= \frac{c}{T_e} \cdot \frac{[U_c \cdot c \cdot T_e] \cdot \left[\dfrac{A_{equivalent}}{4\pi \cdot d^2}\right]}{[U_c \cdot c \cdot {}^1/_{4\pi}] \cdot T_e}$$

$$= \frac{c}{T_e} \cdot \frac{A_{equivalent}}{d^2}$$

$A_{equivalent}$ is the area (as a target that intercepts without the help of any focusing) which the encountered center would have to have in order to collect the amount of arriving source medium flow that it actually collects by focusing.

The same acceleration as in equation DN10-1 above, results from the Newtonian force and mass as follows.

(DN10-2) $$\text{Force} = m_e \cdot a \qquad [m_e = \text{encountered mass}]$$

$$a = \frac{\text{Force}}{m_e} = \frac{Q_s \cdot Q_e}{4\pi \cdot d^2 \cdot m_e} \qquad [\text{Section 9 derivation of Coulomb's law as it naturally occurs}]$$

$$= \frac{Q^2}{4\pi \cdot d^2 \cdot m_e} \qquad [\text{For two electrons or two protons}]$$

The above two accelerations are one and the same.

(DN10-3) $$a = \frac{Q^2}{4\pi \cdot d^2 \cdot m_e} = \frac{c}{T_e} \cdot \frac{A_{equivalent}}{d^2}$$

$$A_{equivalent} = \frac{T_e \cdot Q^2}{4\pi \cdot m_e \cdot c}$$

$$= \frac{\left[{}^1/_{f_e}\right] \cdot Q^2}{4\pi \cdot \left[{}^{h \cdot f_e}/_{c^2}\right] \cdot c} \qquad [T = {}^1/_f] \quad [m \cdot c^2 = h \cdot f]$$

$$= \frac{c \cdot [c^2 \cdot q^2]}{4\pi \cdot h \cdot f_e^2} \qquad [Q = c \cdot q]$$

$$= \frac{c \cdot \lambda_e^2 \cdot q^2}{4\pi \cdot h} \qquad [c = f \cdot \lambda]$$

$$= K_{cs} \cdot \lambda_e^2 \cdot U_e^2 \qquad [K_{cs} = {}^c/_{4\pi \cdot h} \text{ and } q = U]$$

which is equation 16-8.

The magnitude of that area can be evaluated on a relative basis. That is, since it varies directly with the encountered center's wavelength squared, it can be expressed in terms of that wavelength as follows.

(DN10-4) $$A_{equivalent} = \frac{c \cdot \lambda_e^2 \cdot q^2}{4\pi \cdot h} \qquad [\text{from DN10-3 above}]$$

$$= \pi \cdot \left[\lambda_e^2\right] \cdot \left[\frac{1}{\pi} \cdot \frac{c \cdot q^2}{4\pi \cdot h} = 294.188{,}54\right]$$

$$= \pi \cdot \left[17.151{,}925 \cdot \lambda_e\right]^2$$

$$R_{equivalent} = \left[\begin{array}{c}\text{Implied radius} \\ \text{of } A_{equivalent}\end{array}\right] = 17.151{,}925 \cdot \lambda_e$$

This states that the magnitude of the Coulomb effect and its focusing is such that the amount of medium flow collected and focused onto the encountered center is the amount that would be intercepted by a target area having a radius of about 17 times the wavelength of that encountered center. Clearly no such actual target area exists at the encountered center, nor could it exist there because the final focusing takes place within a half wavelength of the encountered center. As illustrated in Figure DN10-1, below, the focusing action could not collect rays from over a circular area of radius $17\cdot\lambda_e$ and focus them onto the center in a travel of only $\frac{1}{2}\cdot\lambda_e$.

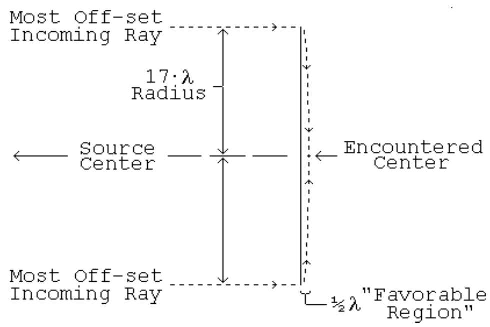


Figure DN10-1

As is apparent from the figure (which does not depict the problem as severely as an exact to scale depiction would) there are two problems with this conception of the Coulomb focusing action. One is that enormous ray bending power would be required. The other is that, given the first, the net result would be that most of the source center's rays would approach the encountered center at almost right angles to the intended flow, at almost right angles to the center line joining the source and the encountered centers.

It would appear, then, that the focusing action must involve a much smaller equivalent target area intercepting a much greater density flow, their product equalling the product of the above impractically large $A_{equivalent}$ and the overall average flow density at the encountered center, which is the total source flow divided by $4\pi\cdot d^2$. But, how could that much greater flow density, that concentration, come about ?

The factors bearing on this issue are as follows.

(1) <u>The focusing must precisely aim the rays from the source center to at the center of the encountered center</u>. That must be the case because the center's propagation is radial to the exact center of the center. Thus only incoming rays that are aimed exactly at the center of the encountered center can experience identical gradients on all sides and, therefore, no further focusing. The focusing naturally focuses all rays onto the exact center of the encountered center.

And, if rays aimed near to, but not precisely at, the center of the encountered center did enter into the Coulomb effect then Coulomb's law would have to include some dimension of the encountered center to define the acceptable area into which rays could be aimed. Of course, there is in Coulomb's law no such dimension.

(2) The encountered center is always in motion (unless its temperature is absolute zero). Since the focusing must precisely aim the rays from the source center to at the center of the encountered center, then only "last moment" focusing can produce the final end effect. Any earlier focusing results in rays that are somewhat mis-aimed upon their arrival in the vicinity of the encountered center because of that center's change in location after those rays were aimed by that earlier focusing.

Of course that "last moment" focusing only happens at all when the waves of the encountered center that are immediately adjacent to that center are of the negative gradient type, the focusing not defocusing half cycle of the wave form -- the "favorable region".

(3) No net focusing can take place during the travel of the source rays from the source to the encountered center. What is meant here is that concentration of the medium flow cannot take place during the travel. That is essential because otherwise the amount of such concentration would be directly proportional to the separation distance, meaning that the greater the separation distance the greater the effect of focusing and the smaller the mass of the encountered center.

Since the encountered center's waves are present and causing ray bending throughout that space, the only way that there can be no focusing concentration during the rays' travel over that distance is for the effect of the encountered center's waves to be a self-cancelling alternation of focusing and defocusing as already presented. Because the focusing effect is independent of distance, because the inverse square effect and the needed angle of deflection effects cancelling each other as already presented, the alternations of focusing and defocusing are equal and opposite and continuously cancel each other.

(The effects of the focus / defocus alternations continuously cancel each other out during the travel of the rays of medium from the source to the encountered center. As a result the encountered center (any center) produces negligible absolute ray bending on the rays of (all) other centers except when those rays are quite near ($\frac{1}{2}\lambda$) to the encountered center. In other words, the myriad centers in bulk matter do not significantly disturb each others' field of propagated waves other than for their own specific Coulomb / Newton behavior.)

(4) If the first half cycle of encountered center waves that the source center's waves encounter is a defocusing half cycle then:

- a subsequent even number of half cycles *en route* to the encountered center will alternately restore those rays to as they were at the moment of their departure from the source center and again defocus them.
- a subsequent odd number of half cycles *en route* to the encountered center will do the same except it will omit the

last defocus; the waves will end up as if they had encountered nothing during their travel.

If the first half cycle of encountered center waves that the source center's waves encounter is a focusing half cycle then:

· a subsequent even number of half cycles *en route* to the encountered center will alternately restore those rays to as they were at the moment of their departure from the source center and again focus them. They will arrive at the encountered center at a concentrated density.

· a subsequent odd number of half cycles *en route* to the encountered center will do the same except it will omit the last focus; the waves will arrive at the encountered center at the same density as if no actions had taken place during their travel.

(5) In summary of (4), if we omit any effect of motion of the centers and consider two centers separated by a distance that is an integer number of encountered center half wavelengths, then the source waves arriving at the encountered center are:

· much concentrated 25% of the time,

· at their natural density 50% of the time, and

· much deconcentrated 25% of the time.

Center motion will change these percentages, but over time the percentages will be valid on the average. Because the frequencies involved are so large the effective averaging time is negligible macroscopically.

This process, the effective concentration of the source center medium at the source, takes place at the surface of the core of radius δ of the source center. The effect is as if two steps are involved: selection and focusing.

The overall focusing takes place during the initial quarter wavelength of source wave travel from its source center (the source and encountered waves relative speed past each other is $2 \cdot c$ so that the $\frac{1}{2}\lambda$ favorable region is traversed as if $\frac{1}{4}\lambda$).

But it is exactly at the surface of the core where the selection is made (by the commencement of ray bending) of those radial source rays that will ultimately be bent into focus versus those whose radial divergence is too great to be overcome completely by the focusing power available.

The concentration of the source center medium at the source means that the encountered center can have a much smaller equivalent target area to operate on a much greater arriving wave flow density, one that is much greater locally at that encountered center. Their product equals the product of the overall average flow density, the total source flow divided by $4\pi \cdot d^2$, and the large theoretical $A_{equivalent}$.

Consequently, the Coulomb effect is the result of two actions or takes place in two stages:

- at the source center:

  Source center wave field concentration into a *beam* directed at where the encountered center was when it propagated those focusing waves (in effect the prevention of the source waves' otherwise radial dispersion or the preserving of their concentration as at the source to be so transmitted to the encountered center), and

- at the encountered center:

  Final aiming at the precise center of the then current location of the encountered center.

The tendency of the encountered center's focusing field is to aim source center rays at the center of the encountered center. When that focusing is so acting at the edge of the source center the encountered center is so distant that there is negligible difference between aiming the source rays at the center of the encountered center and focusing those rays to be parallel to each other. Any source center rays (which are radially diverging until focused) not focused to be at least so parallel will be effectively dispersed radially by the time they (would) arrive at the encountered center and will be unable to be involved in the action at the encountered center. Thus a narrow *beam* of parallel (actually minutely converging) rays directed at the encountered center is formed at the source center by the encountered center's focusing field.

However, all of the preceding analysis of medium amounts, of medium flow, has been of average amounts, essentially averages per cycle of the wave form. But, the *favorable region* is only "favorable" half the time; useful focusing can only occur during half of each cycle of the focusing wave form. To achieve the above average cross-sectional area, $A_{equivalent}$, the *beam* area must be twice as much on the average during the half-cycle when the *beam* exists at all, for in the other half-cycle defocusing prevents there being any focused *beam*.

Thus the *beam* consists of a stream of pulses or globs of focused medium traveling to the (to be) encountered center. Each increment of that stream of concentrated medium globules departs the source center aimed at where the (to be) encountered center was when it propagated the focusing field waves that produced that beam increment. During the time interval of the travel, over distance d to the source center, of those encountered center focusing waves the (to be) encountered center continued its own motion. It will so move still more as the newly formed increment of beam then travels (back) from the source center over a distance d to encounter the (then) encountered center.

But that increment of beam should therefore miss the intended target, the (to be) encountered center, because the beam increment is aimed at where the encountered center <u>was</u>, not at where it <u>is</u> at the moment of encounter. However; the increment of beam, its content now already determined at the initial focusing at the source center, is continuously alternately defocused and re-focused by the successive cycles of the encountered center's waves that it passes through. Each successive re-focusing aims the beam at where the encountered center was when it propagated the waves of that focusing half-cycle of its wave form. The final such re-focusing takes place just at the encountered center and aims the beam increment exactly at the encountered center before it can move farther.

The aim of the beam, of each globular increment of the local region of concentrated medium, is continuously corrected by the cyclically successive refocusings during its travel. Those corrections take account of the encountered center's on-going motion. The increment arrives at the then location of the encountered center. It arrives, however, not focused precisely onto the center of the encountered center; that action must and does take place at the last moment before the encounter. The target is not merely the *core* of cross-section δ, but its very center.

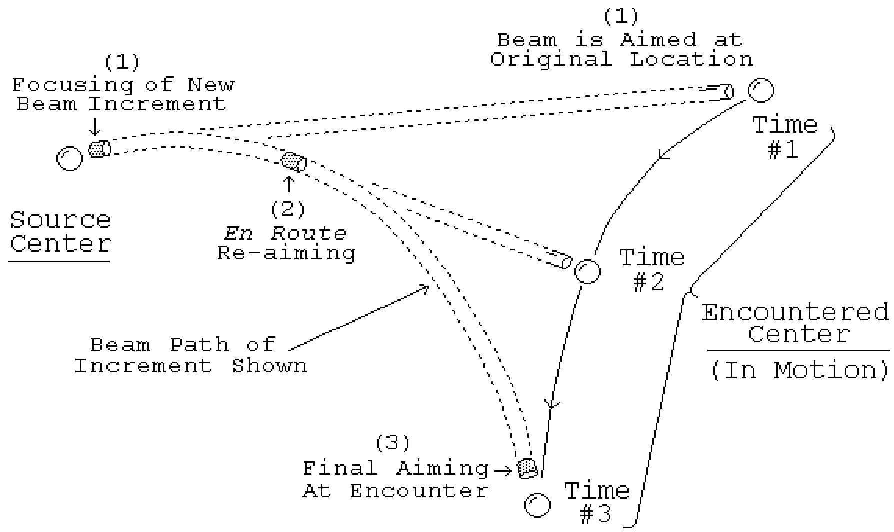
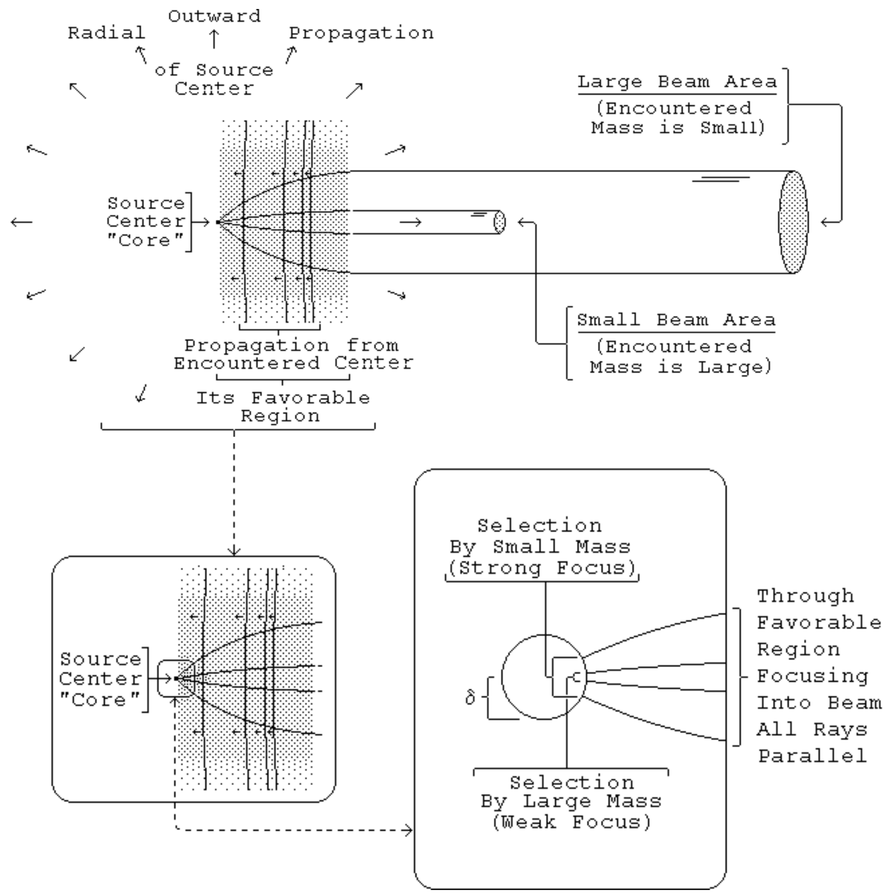


Figure DN10-2
The Stages of Coulomb Focusing

The net effect, then, is that the concentration of the propagation as it is in the vicinity of the source center, the medium flow density per area there (within $¼\cdot\lambda$ or less of it), is preserved and transmitted toward the encountered center as a (to be) local concentration at the encountered center, as a small, local portion of the source center's overall wave front that has avoided the usual inverse square dispersion and density reduction in its travel to the encountered center. (The inverse square effect has been transferred from being due to the travel of the source center's waves over distance d to being due to the encountered center's waves' travel in the opposite direction over the same distance, the encountered center's focusing field's inverse square reduction in amplitude.)

The inverse square effect is in the amplitude, the power, of the focusing field from the encountered center that creates the beam at the source center. That focusing field amplitude determines the size of the *beam* (of globules), its cross-sectional area. The product of that focusing-determined cross-sectional area and the relatively great medium density at the source center is the amount of medium collected and transmitted toward the encountered center. It is the same as the inverse square reduced medium density at the encountered center multiplied by $A_{equivalent}$. The medium density at the source is much greater than as inverse square reduced at the source center so that the area of the *beam* is much less than $A_{equivalent}$.

A larger encountered center mass, having less powerful focusing, focuses a smaller size beam onto itself and is encountered by a smaller amount of source center medium flow. A smaller encountered center mass, having more powerful focusing, focuses a larger size beam onto itself and is encountered by a greater amount of source center medium flow, as indicated in Figure DN10-3 below.



Figur*e DN10-3*
Mass / Focusing Variation in Coulomb-Newton Interaction

The concentration in the medium flow selected at the source center is the same for all simple centers, the proton, electron, etc: it is the surface density of the source center's core. It (the concentration, not the total amount) is independent of the separation distance between the two centers. That medium density is

(DN10-5)
$$\text{Medium Density} = \frac{U_c}{4\pi\cdot\delta^2}$$

The portion of the total surface area of the core, $4\pi\cdot\delta^2$, that enters into the beam is quite small for large separation distances, d. As a result, for large separation distances the variation in beam cross-sectional area with the focusing power of the encountered center is essentially linear. Beam cross-sectional area is then directly proportional to λ_e (and, therefore, inversely proportional to the encountered center's frequency and mass, f_e and m_e). See equation DN10-6, below.

The beam cross-sectional area at the core's surface, the area of selected flow from the core, which flow is at the density of equation DN10-5, above is as follows.

(DN10-6) For $d >> \delta$:

$A_{beam} \equiv$ Cross-sectional Area of Focused Beam

$$= \frac{\delta^2}{d^2} \cdot A_{equivalent} = \frac{\delta^2}{d^2} \cdot \frac{c \cdot \lambda_e{}^2 \cdot q^2}{4\pi \cdot h} \quad \text{[Using Equation DN10-5]}$$

$r_{beam} \equiv$ Radius of A_{beam}

$$= \left[\frac{A_{beam}}{\pi}\right]^{\frac{1}{2}} = \left[\frac{c}{4\pi \cdot h}\right]^{\frac{1}{2}} \cdot \frac{\delta \cdot \lambda_e \cdot q}{d} \qquad [A = \pi \cdot r^2]$$

(DN10-7) For a proton (encountered center) acting on a source center at a distance of d = 1 meter:

$r_{beam} = 1.627{,}32 \cdot 10^{-48}$ meters

$= 4.017{,}23 \cdot 10^{-14} \cdot \delta$

If that proton is the Hydrogen atom's nucleus at a distance of $d = 5.291{,}772{,}49 \cdot 10^{-11}$ meters from the orbital electron:

$r_{beam} = 3.075{,}16 \cdot 10^{-38}$ meters

$= 7.591{,}41 \cdot 10^{-4} \cdot \delta$

(DN10-8) For an electron (encountered center) acting on a source center at a distance of d = 1 meter:

$r_{beam} = 2.988{,}00 \cdot 10^{-45}$ meters

$= 7.376{,}25 \cdot 10^{-11} \cdot \delta$

If that electron is the Hydrogen atom's sole orbital electron at a distance of $d = 5.291{,}772{,}49 \cdot 10^{-11}$ meters from the nuclear proton:

$r_{beam} = 5.646{,}47 \cdot 10^{-35}$ meters

$= 1.393{,}90 \cdot \delta$

That last result, in which the calculated selection area at the core surface is of a radius greater than δ, the radius of the core, cannot be in reality. That calculation is not valid because the actual situation is deeply into the Lamb Shift region. In the Lamb Shift the mechanics are different, being as presented at the end of section *16 - A Model for the Universe (6) - The Neutron, Newton's Law*, because of the closeness of the centers involved.

The Lamb Shift produces the effects discussed relative to Figure 16-21 due to its effect at the $n = 2$ orbit. That orbit, with its significant effect is 4 times (per equation 15-56) farther out from the nucleus than the $n = 1$ orbit in the above calculation for the electron. The r_{beam} for the $n = 2$ electron is, therefore, half that for $n = 1$ or $0.69695 \cdot \delta$. Even there, however the actual situation is an amalgam of the distant and Lamb Shift cases since there is there a significant Lamb Shift.

One might hope to reason as follows.

> The core radius, δ, is a universal constant. The relative mass of particles, of centers-of-oscillation, is due to their relative focusing power, their frequency and wavelength. But the particular absolute masses that exist in our universe depend on the value of δ. If δ were larger then all focused beams would have a smaller density and all masses would be greater. Conversely, if δ were smaller than all focused beams would have a greater density and all masses would be smaller. If the absolute focusing for some particular particle, the proton or the electron, could be determined then the value of δ could be obtained to the same accuracy as particle masses.

However, that reasoning misses the point that a larger δ while involving a lesser medium density in the beam also involves a greater beam cross-sectional area yielding the same amount of medium flow in the beam for the interaction of a particular pair of particles. The two effects cancel each other.

The radial angle through which the most deflected ray must be focused, α in Figure DN10-4 below, does not change as δ changes. The total amount of medium flow in the beam is independent of the value of δ. It depends only on the strength at the source center of the focusing from the encountered center.

Even the Lamb Shift is independent of variation in the magnitude of δ. In the figure below the change in the slope of the source center's radial propagation is the same for the same angle θ regardless of the value of δ.

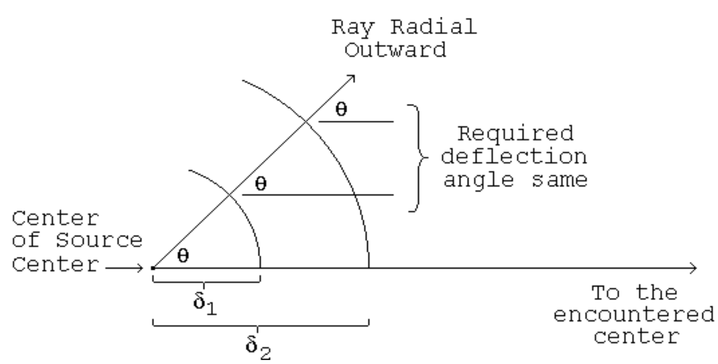


Figure DN10-4