Fundamentals and the Optics Analogy

Gravitics treats the behavior and management of gravitation, the name being analogous to optics which treats the behavior and management of light.

INTRODUCTION

Universal physics, as developed in *The Origin and Its Meaning*[1] by Roger Ellman © 1997, shows that all material reality consists of *centers-of-oscillation* and the flow outward from them of *medium*. The *core* of each center-of-oscillation consists of an original [at the universe' beginning] supply of medium, which has been and continues to be very gradually depleted by the loss of medium to the outward flow, that process is the *universal decay* (exponentially with a time constant on the order of over `11 billion years`).

The *medium* in the *core* and the resulting medium flowing outward both oscillate. That which is oscillating is the medium amount. The core oscillation and the propagated oscillatory *wave* are of the form

(1-1) $\text{Core} = \pm U_c \cdot \varepsilon^{-t/\tau} \cdot \left[1 - \text{Cos}\left[2\pi(f \cdot t) \right] \right]$

(1-2) $\text{Wave} = \pm U_c \cdot \varepsilon^{-t/\tau} \cdot \left[1 - \text{Cos}\left[2\pi(f \cdot t - \frac{d}{\lambda}) \right] \right] \cdot \frac{1}{4\pi \cdot d^2}$

where the "$\pm$" is because there are cores (and their propagated waves) oscillating in medium *(-)* that is opposite to the other medium *(+)*. The total amount of medium in each of the two types is the same so that collectively they sum to zero, to the original nothing before the beginning of the universe.

Equation *(1-2)*, the wave, describes an oscillation in time, *t*, after the Beginning, the Big Bang, (at *t=0*) at any particular distance, *d*, from the source core (at *d=0*). It also describes an inverse-square decaying oscillatory distribution of medium in space, *d*, for any particular time, *t*.

The amplitude, U_c, in the above equations is the original amplitude at *t=0*, *d=0*. The frequency, *f*, determines the type particle that the core is: proton, electron, etc. The frequency is very large, on the order of 10^{23} *Hz* (cycles per second) for a proton. The factor, $1/4\pi \cdot d^2$, in the *Wave* formulation is because the waves, which are referred to as *U-waves* (*Universal* waves), propagate radially outward in all directions from the core. That causes their amplitude to decrease inversely as the square of their distance from the core.

λ [Greek lambda] is the wavelength of the U-wave propagation in space and equals c/f, where *c* is the speed of propagation of the medium. That speed is what we refer to as the speed of light in free space.

The terminology "refer to" is used because light does not travel in itself. That which we call light is merely a modulation, an imprint, on the propagating U-waves. Because the U-waves propagate, the light imprint on them travels with the U-waves on which it is imprinted, so traveling at the speed of those U-waves. [But see more further below on the speed of light travel in various materials.]

This <u>nature of light</u>, the distinction between U-waves, themselves, and a light modulatory imprint that may or may not be present on a particular sample of U-waves is important. We tend to think of light as an independent thing in itself because of not having

known of U-waves and its dependency on them. The distinction modifies some of the traditional physics understandings of the cause of some optical behaviors.

Gravitics is the physics of U-wave flow and has as its objective the planned, useful control of gravitation by control of its cause, an aspect of U-wave flow. The control of U-wave flow could be used for controlling any of the effects produced by U-waves, which include: electrostatic effects, magnetic effects and gravitation. All of those except gravitation are already well managed by the techniques of electricity, magnetism and electronics. But, gravitation has remained beyond our control. It is therefore primarily sought to use the principles of gravitics to control the gravitation effect caused by U-waves, hence the name *gravitics* in analogy to optics, which is the physics of the flow of light.

The analogy to optics, because light is merely a fixed imprint or modulation on flowing U-waves, leads to examining the thoroughly developed science of optics in search of information on U-wave behavior.

OPTICS

The behavior of light is complex and involves some aspects of its behavior that U-wave flow does not. The reason for that is that light is a transverse oscillation of an electromagnetic propagation. U-wave propagation is a longitudinal oscillation of flowing medium amount.

Light interacts with matter in various ways. It can be absorbed at certain discrete frequencies by atomic orbital electrons, elevating them to a higher discrete orbit by the energy acquired from the light. That energy can later be partially or completely re-emitted as light at certain discrete frequencies by an electron falling to a lower discrete orbit.

Light can otherwise be absorbed and immediately re-radiated at a variety of frequencies by atomic electrons. In this case the frequency restrictions involved with atomic orbital electrons are not

necessarily involved. This is the mechanism of reflection, a process in which the light incident on the reflecting surface is absorbed and re-radiated in the reflective direction, that direction mandated by conservation of the linear momentum in the incident light.

In passing through transparent or translucent material the electromagnetic field of light interacts with the electric charges in the matter, primarily with its electrons. That interaction tends to slow the speed of the light while traversing the matter. This electromagnetic effect varies with the frequency of the light so that the amount of slowing of the light so varies.

The terminology "light" means all transverse oscillation of an electromagnetic propagation imprinted on flowing U-waves. That includes "light" at lower frequencies than visible light [e.g. infra-red or "heat" and radio waves] and at higher frequencies [e.g. ultra-violet, x-rays]. The energy that the light carries is directly proportional to its frequency.

But, the U-waves which underlie the flow of light are not transverse electromagnetic field but longitudinal medium flow oscillating in its usual *[1 - Cosine]* manner. That flow does not exhibit the behavior of light that is dependent on its electromagnetic nature, but it does exhibit the behavior of light that is dependent on its wave nature – or rather just the inverse – light exhibits the behavior of medium flow that is due to the wave nature of medium flow plus some additional behavior due to the E-M nature of light.

The optical behavior of light includes the phenomena: speed, refraction, diffraction, reflection, interference and polarization.

- *Speed* is, of course, simply the rate of flow.

- *Refraction*. While the speed of light in free space is a constant (neglecting the very gradual universal decay), in different environments (e.g. air, glass, water) it is different. Refraction is the bending of the direction of flow when it passes from a region of one speed to one of another speed.

- *Diffraction*. When the flow of light passes an edge of an opaque substance the flow on the far side of that boundary is seen to diffuse into the "shadow" area. One of the more significant instances of this is the passage of light through a slit, which is two opaque edges very near to each other

- *Reflection*. Light "bounces" off of many surfaces.

- *Interference*. If light waves suitably encounter other light waves a standing wave pattern with its characteristic maxima and minima results.

- *Polarization*. Light the oscillation of which is in a particular direction.

Speed

In optics, rather than using the speed of propagation directly in analysis a related quantity, the *index of refraction*, is used. This is defined as follows.

(1-3) Index of Refraction

$$n = \frac{c}{v}$$

where: n = index for a particular substance
         c = speed of light in free space
         v = speed of light in the substance

Some typical values are:

Substance	n
free space	1 (exactly)
atmosphere	1.00029
water	1.33
glass	1.46 – 1.96

Because light travels as an imprint on U-waves carrying it, the "speed of light" in optics is actually the speed of propagation of the underlying U-waves as further reduced by light's interaction with any matter through which it passes. For U-waves always and for light in

free space, which has no matter with which the light can interact, that quantity, c, is per equation *(1-4)*, below

(1-4)

$$c = \frac{1}{\sqrt{\mu_0 \cdot \varepsilon_0}}$$

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μ₀ = the permeability or magnetic
     constant of free space, i.e. of
     the "vacuum".
ε₀ = its [di]electric constant.
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and in any substance it is for light, v,

(1-5)

$$v = \frac{1}{\sqrt{\mu \cdot \varepsilon}}$$

```
where μ and ε are the constants
for the substance through which
the light is passing.
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In addition to the slowing of light by it's electromagnetic interaction with electrons in matter through which it passes, the matter slows the speed of the actual U-waves carrying the light. That slowing is the same effect, discussed in <u>The Origin and Its Meaning</u>, as that which produces the mass effect by focusing of U-waves and produces the gravitational effect. The slowing depends directly on the U-wave concentrations involved. [See equation *(2-1)* in the following <u>Section 2</u> and its related discussion for details on this effect.]

Refraction

Refraction occurs when a wave, propagating through a region of one propagation speed, v (one index of refraction, $n = {}^c\!/_v$), passes into another region of propagation speed, v' (index of refraction, $n' = {}^c\!/_{v'}$). In the new region the wave front is bent at an angle relative to that in the old region. This is illustrated in Figure 1-1, on the following page.

U-waves, and unfocused light travel radially outward from their source. The wave front of their outward propagation is the surface of a sphere. For clarity in Figure 1-1 the wave front is taken to be plane, as would the wave front from a far distant source appear to approximate.
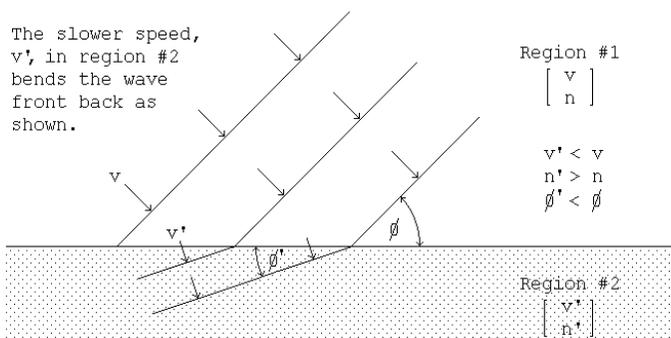
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The slower speed,                           Region #1
v', in region #2
bends the wave                                  ⎡ v ⎤
front back as                                   ⎣ n ⎦
shown.
                                            v' < v
                                            n' > n
                        v                   ∅' < ∅

            v'                      ∅
                            ∅'                Region #2

                                                ⎡ v' ⎤
                                                ⎣ n' ⎦
```

Figure 1-1
Refraction

From the geometry of Figure 1-1 it can readily be shown that

(1-6) $\dfrac{Sin\emptyset}{Sin\emptyset'} = \dfrac{v}{v'}$

from which, using equation *(1-3)*, the following, Snell's Law, is obtained.

(1-7) $n \cdot Sin\emptyset = n' \cdot Sin\emptyset'$

In analyzing these aspects of wave behavior it is more convenient to deal in terms of *rays* rather than *wave fronts*. The ray representing a wave front is a straight line pointing in the direction of propagation of the waves, that is, perpendicular to the wave front [because U-wave and light propagation are in a straight line until some speed change causes bending of that path]. Figure 1-2, on the following page, depicts the refraction of a wave in terms of rays.

In the Figure 1-2 depiction the wave passes from a region of greater speed of propagation, *v*, to one of lesser speed (smaller index of refraction, *n*, to greater). Under those conditions the ray is refracted toward the perpendicular to the boundary surface as shown in the figure.

7
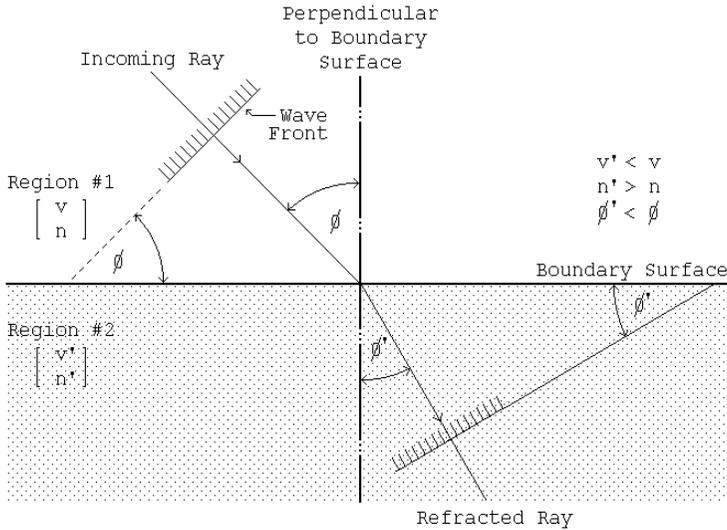
The angle, $\emptyset$, between the wave front and the boundary surface is the same as the angle between the ray and the perpendicular to the surface.

Figure 1-2
Representing Wave Fronts as Rays

In the opposite situation, the wave passing from a region of less speed of propagation, v, to one of greater speed (greater index of refraction, n, to smaller), the ray is refracted away from the perpendicular to the boundary surface. Figure 1-3, on the following page, shows several different amounts of such refraction as the incoming wave encounters the boundary at different angles, $\emptyset$.

The angle $\emptyset_2$ in Figure 1-3 is referred to as the *critical angle* because it represents the boundary case between the incident ray being bent to a new direction in the new region and its being bent so much that it re-enters its initial region. For that boundary case, the middle ray in Figure 1-3, incident at angle $\emptyset_2$, must be refracted at angle $\emptyset_2' = 90°$, as in the figure.

That is, from Snell's Law, equation *(1-7)*,

8

(1-8) $n \cdot Sin\emptyset_2 = n' \cdot Sin\emptyset_2'$
$$= n' \cdot Sin[90^\circ] = n'$$

$$Sin\emptyset_2 = \frac{n'}{n} = Sin\emptyset_{critical}$$

the critical angle occurs when the sine of the angle of incidence equals *n'/n*, which is less than *1.0* when passing from greater *n* to lesser *n'* (lesser speed to greater speed).
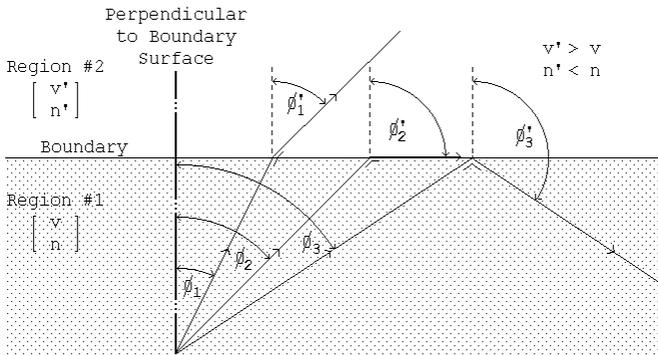

Figure 1-3
Refraction at From Greater n to Lesser n ' [Lesser v to Greater v']
at Various Angles of Incidence

When the angle of incidence is greater than the critical angle, as in the case of $\emptyset_3$, then the ray re-enters region #1 from region #2. It is then again refracted in the usual manner. That means that the ray is bent toward the perpendicular to the boundary surface at the new angle of incidence [$\emptyset_3'$].

Again, using Snell's Law, the new angle of refraction, $\emptyset_3''$, can be expressed in terms of the original angle of incidence, $\emptyset_3$, as follows.

(1-9) $n' \cdot Sin[\emptyset_3'] = n \cdot Sin[\emptyset_3'']$

$$Sin[\emptyset_3''] = \frac{n'}{n} \cdot Sin[\emptyset_3']$$

9

But, from the first refraction,

(1-10) $n \cdot Sin[\emptyset_3] = n' \cdot Sin[\emptyset_3']$

$Sin[\emptyset_3'] = \dfrac{n}{n'} \cdot Sin[\emptyset_3]$

so that, substituting equation *(1-10)* into equation *(1-9)*, the result, equation *(1-11)*, is that the final angle of refraction equals the initial angle of incidence. It is exactly as if the incident ray were reflected from the boundary surface.

(1-11) $Sin[\emptyset_3''] = \dfrac{n'}{n} \cdot Sin[\emptyset_3']\ \dfrac{n'}{n} \cdot \left[\dfrac{n}{n'} \cdot Sin[\emptyset_3]\right]$

$= Sin[\emptyset_3]$

$\emptyset_3'' = \emptyset_3$

So long as the angle of incidence is greater than the critical angle, the purely speed dependent process of refraction produces the same result, for light, as if a perfect reflection were taking place. "Normal" reflecting is essentially always partial and in optics one speaks of the amount of reflection, the "reflectivity", of a surface. This 100% "reflecting" of light is most useful when done in a system with ninety degree right prisms.

Ninety degree right prisms are a solid having a triangular cross section and having its third side perpendicular to that cross section. A ninety degree right prism is one having for its cross section an isosceles right triangle (one having the angles $90° - 45° - 45°$). Recalling equation *(1-8)*, above, for the critical angle of refraction, a suitable ninety degree right prism is one having its critical angle in air and in free space less than $45°$.

That is not a difficult requirement. Glass, even taken at its smallest index of refraction, 1.46, has such a critical angle in air and in free space.

(1-12) $Sin[\emptyset_{critical}] = \dfrac{n'}{n} = \dfrac{1.00029}{1.46} = 0.68 \dots$

$\emptyset_{critical} \approx 43° < 45°$

When the angle of incidence is greater than the critical angle the refraction at the boundary surface is back into the original surface. The final angle of refraction is equal to the initial angle of incidence. The appearance is as if the incident propagation reflected from the boundary surface, departing at an angle identical to the angle of incidence.

A ninety degree right prism with the incoming propagation incident on the hypotenuse of the triangular cross section at a $45°$ angle of incidence reflects that propagation at another $45°$ angle producing a total direction change of $90°$. With the incoming propagation incident on a leg of the triangular cross section the propagation is re-directed to the opposite direction by two successive reflections. These effects are illustrated in Figure 1-4, below.
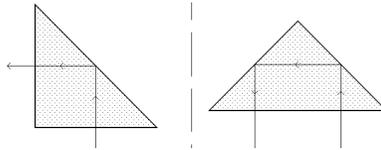
Figure 1-4
Reflecting Action of a 90° Right Prism

Diffraction

Optical diffraction, illustrated in Figure 1-5a, below, is the bending of light at an edge of an opaque material as at the two edges of a slit.
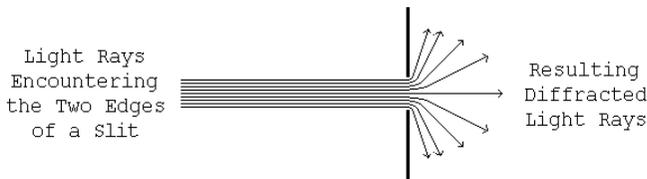
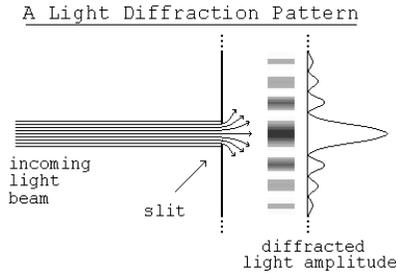*Figure 1-5a*
Diffraction of Light Rays

A Light Diffraction Pattern

Figure 1-5b
A Light Diffraction Pattern

Light diffraction produces interference patterns, Figure 1-5b, above. It is to those that principal attention is paid in physics analyses of diffraction. The interference patterns are analyzed in terms of Huygens's Principle.

Huygens' Principle which can be useful in constructing the propagation of a wave front through a changing environment is as follows.

Every point of a wave front <u>may be considered</u> the source of minute wavelets that propagate outward in all directions from that point at the speed of propagation in the substance(s) encountered in each particular direction. The new wave front after any time is the surface tangent to the wavelets at that time (taking account of the general direction of propagation). See Figure 1-6.
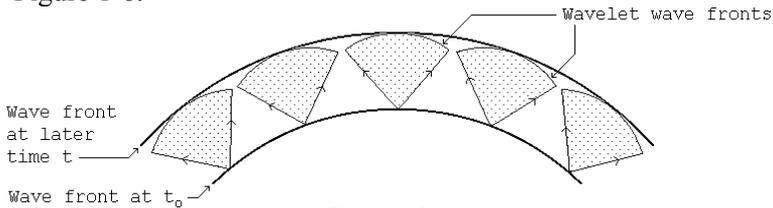
Figure 1-6
Huygens' Principle

Huygens's Principle is not a description of the actual behavior of wave propagation. Each point on a light wave front does not propagate outward in all directions. It propagates in whatever direction the U-waves, that carry it as a modulatory imprint, are themselves traveling.

If that were not the case focusing of light would be severely impaired for the initial result of the focusing would be quickly blurred by the spreading out of the light of each "wavelet". In fact, experience shows that that does not happen. Focused beams of light such as searchlights and laser light beams stay mostly focused (except for a small amount of dispersion caused by dust or fog in the air).

Light propagation is in straight lines outward from its source until that direction is changed as by reflection, refraction, diffraction or any change in the direction of the U-waves carrying it. The diffraction effect in Figure 1-5a is due solely to change in the direction of the light-carrying U-waves.

The diffraction effect occurs with other wave forms such as sound and water waves. The diffraction of sound and of water waves is a different phenomenon from diffraction of light. Sound and water waves are longitudinal oscillations of a variation in the pressure and velocity of individual particles [atoms and molecules] in the air or water, an oscillatory compression - decompression. They propagate without spreading only when surrounded on all sides of their direction of propagation in their medium of propagation, air or water, by like waves propagating in the same direction. At a slit or an edge that condition is removed so that the waves spread into the unoccupied region adjacent to the propagating sound or water waves.

Light, x-rays and other such propagations are a transverse oscillation of electric and magnetic fields expressed as a modulation of the underlying U-waves, which are a continuous, non-particulate flow of medium, carrying the electromagnetic fields. They propagate in the direction of the U-waves carrying them independently of conditions along side their path unless those conditions affect their underlying U-waves as in diffraction. [In refraction the direction

change is due to both electromagnetic interaction and U-wave slowing.]

Reflection

Light incident on a reflecting surface is absorbed and re-radiated in the reflective direction, that direction being mandated by conservation of the linear momentum in the incident light so that the reflection is at the same angle of incidence as that of the arriving waves. Not all surfaces support reflection. Non-reflecting surfaces absorb the light but do not re-radiate it, at least not as light. Of course, most surfaces are partially reflective and partially absorptive.

Interference

When two light waves not in phase pass through each other a pattern of maxima and minima results as, for example, in Figure 1-5b, above. The instantaneous observed amplitude at any point is the sum of the individual amplitudes of the two interfering wave trains.

Polarization

Light, oscillates in a plane perpendicular to the direction of propagation. The electric and magnetic fields of light oscillate at right angles to each other in that plane. The orientation of those two fields' oscillations corresponds to the polarization of the light.

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[1] R. Ellman, *The Origin and Its Meaning*, The-Origin Foundation, Inc., http://www.The-Origin.org, 1997. [The book may be downloaded in .pdf files from http://www.The-Origin.org/download.htm]