As developed in Sections 4 and 5, there is one single streaming outward *Flow* from every particle and that *Flow* carries, produces, both the effect which we call gravitational field and that which we call electric field or, when it is changing, electro-magnetic field.

Light is an electro-magnetic field phenomenon; both light and gravitation are carried by the same streaming outward *Flow* from all particles.

Deflection of the one, light,
is deflection of the other, gravitation.

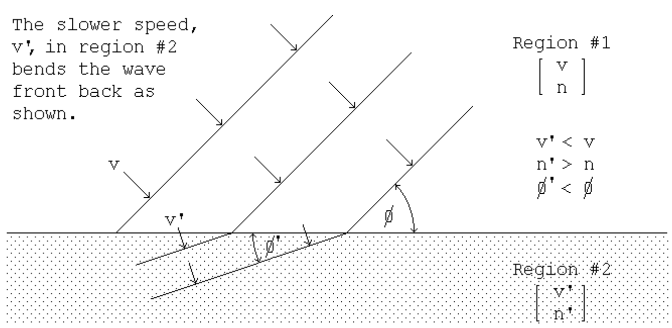
SECTION 6

Natural Deflection of Light

There are plentiful examples of natural deflection of the *Flow* that carries light as presented below. Because that *Flow* is the sole single outward *Flow* from all particles, deflection of it is also deflection of the *Flow* that causes gravitation.

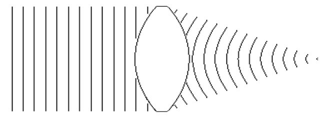
By investigating deflections of light we investigate deflection of gravitation.

Light normally travels in a straight direction. But, when some effect slows a portion of the light wave front the direction of the light is deflected. In Figure 6-1 below, the shaded area propagates the arriving light at a slower velocity, v', than the original velocity, v, so that the direction of the wave front is deflected from its original direction. The index of refraction, $n = c/v$ where c is light speed and v is the velocity of propagation.



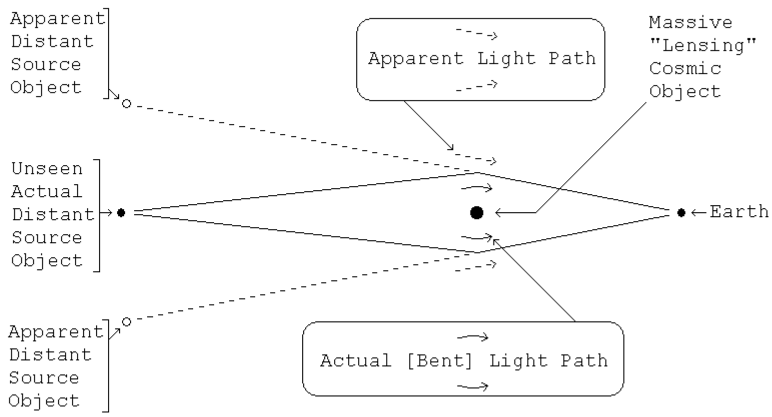
Deflection of Light's Direction by Slowing of Part of Its Wave Front
Figure 6-1

A slowing of part of its wave front is the mechanism of all bending or deflecting of light. In an optical lens, as in Figure 6-2 below, light propagates more slowly in the lens material than outside the lens. The amount of slowing in different parts of the lens depends on the thickness of the lens at each part. In the figure the light passing through the center of the lens is slowed more than that passing near the edges. The result is the curving of the light wave front.



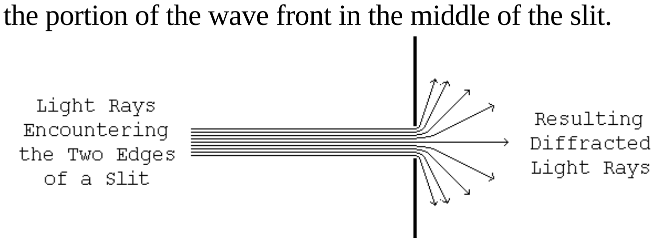
The Bending of Light's Wave Front by an Optical Lens
Figure 6-2

"Gravitational lensing", shown below, is an astronomically observed effect in which light from a cosmic object too far distant to be directly observed from Earth becomes observable because a large cosmic mass [the "lens"], located between Earth observers and that distant object, deflects the light from the distant object as if focusing it, somewhat concentrating its light toward Earth enough for it to be observed from Earth. The light rays are so bent because the lensing object slows more the portion of the wave front that is nearer to it than it slows the farther away portion of the wave front.



Gravitational Lensing Bending of Light Rays
Figure 6-3

The same effect occurs on a much smaller scale in the diffraction of light at the two edges of a slit cut in a flat thin piece of opaque material as shown below. The bending is greater near the edges of the slit because the slowing is greater there. The effect of the denser material in which the slit is cut slows the portion of the wave front that is nearer to it more than the portion of the wave front in the middle of the slit.



Diffraction at a Slit Causing Bending of Light Rays
Figure 6-4

In both of these cases, gravitational lensing and slit diffraction, the direction of the wave front is changed because part of the wave front is slowed relative to the rest of it. In the case of gravitational lensing the part of the wave front nearer to the "massive lensing cosmic object" is slowed more. In the case of diffraction at a slit the part of the wave front nearer to the solid, opaque material in which the slit is cut is slowed more.

But, neither of the cases, gravitational lensing and slit diffraction, involves the wave front passing from traveling through one substance to another as in the Figure 6-1 example, above. The wave front in the gravitational lensing case is traveling only through cosmic space. The wave front in the slit diffraction case is traveling only through air. There is no substance change to produce the slowing. What is it that slows part of their wave fronts thus producing the deflection ?

In the case of gravitational lensing the answer is that the effect is caused by gravitation. There is no other physical effect available. But how does gravitation produce slowing of part of the incoming wave front so as to deflect it ? Gravitation, at least as it is generally known and experienced, causes acceleration, not slowing. The answer is, of course, as follows.

As presented in the preceding Section 4, the μ_0 and ε_0 are inherent in the substance of the oscillation, which means, μ_0 and ε_0 are also inherent in the outward propagation. Each particle's *Propagated Outward Flow* contains and carries its own μ_0 and ε_0.

Upon encountering other particle's *Flow* an arriving *Flow*'s μ_0 and ε_0 (scalar quantities not vector) combine with the μ_0 and ε_0 in the "encountered" *Flow*, the combined μ_0 sum and the combined ε_0 sum being larger values than in the "encountered" original *Flow*.

The result is that that "encountered" outward *Flow* is slowed relative to its prior otherwise speed. That is, its speed of *Flow* is determined by a combination of the parameters μ_0 and ε_0 larger than its *Flow*'s otherwise natural values. The speed of *Flow* is determined by the well-established relationship:

$$\text{Speed} = \frac{1}{\sqrt{\mu_0 \cdot \varepsilon_0}} \qquad (6\text{-}1)$$

In the case of slit diffraction Figure 6-4 above, the *Flow* from the opaque material particles that are nearer to the slit is more dense, its μ_0 and ε_0 greater because of their *Flow* being less inverse square reduced, as compared to *Flow* from particles farther away. The more dense *Flow* slows the part of the light *Flow* nearer to the slit edges more than that farther from the edges.

In the case of gravitational lensing the light *Flow* nearer to the lens encounters more concentrated *Flow* from the particles of the lens, encounters greater μ_0 and ε_0.

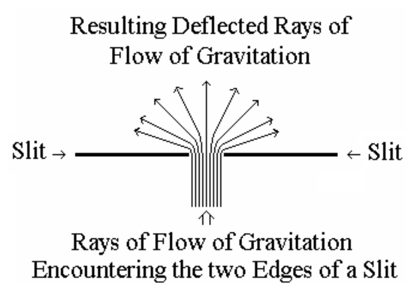
In both cases it is the μ_0 and ε_0 in the *Flow* from the lens or slit material that adds to that in the incoming light *Flow* so as to slow the part of the light nearer to the source of the additional μ_0 and ε_0 more than that more distant.

Deflecting the Gravitational Flow

As developed in Sections 4 and 5, there is one single streaming outward *Flow* from every particle and that *Flow* carries, produces, both the effect which we call gravitational field and that which we call electric field or, when it is changing, electro-magnetic field.

Light is an electro-magnetic field phenomenon; thus, both light and gravitation are carried by the same streaming outward *Flow* from all particles. Deflection of one, light, is deflection of the other, gravitation.

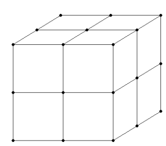
The general vertically upward outward *Flow* of gravitation can be deflected by deflecting part of a local region's gravitational *Flow* away from its normal vertical direction. Figure 6-5 below [the slit diffraction figure from earlier above but now rotated 90º] illustrates such deflection using a single slit.



Slit Diffraction, the Basic Element of a Gravitation Deflector
Figure 6-5

Multiple such slits parallel to each other would spread the deflection left and right in the figure. Additional multiple such slits at right angles to the first ones would spread the deflection over a significant area.

The edges of the slit in the above Figure 6-5 are actually rows of atoms. A cubic crystal, such as of Silicon, consists of such rows of atoms, multiple rows and rows at right angles, all equally spaced – a naturally occurring configuration of the set of slits required for deflection of gravitation.



A Small Piece of a Cubic Crystal
Figure 6-6

The *Flow* from each of the cubic crystal's atoms is radially outward. Therefore its concentration falls off as the square of distance from the atom. The amount of slowing of an incoming gravitational *Flow,* and therefore the amount of its resulting deflection, depends on the relative concentrations of the atoms' *Flow* and the overall gravitational *Flow*.

In the case of diffraction of the *Flow* of light at a slit the concentration of the *Flow* from the atoms of the slit material is comparable to the concentration in the horizontal *Flow* of the light, because the light originates from a local source, not from the Earth's immense gravitation.

But for the *Flow* from the atoms of the slit to deflect the much more concentrated vertically upward *Flow* of Earth's gravitation the *Flow* from the atoms of the slit must also be much more concentrated. The only way to achieve that more concentrated *Flow* is a configuration in which the *Flow* of Earth's gravitation is forced to pass much closer to the atoms of the slit so that, per the inverse square variation in the atoms' *Flow*, it will pass through a much greater concentration of the slit atom's *Flow*, properly designed one comparable to the concentration in the Earth's gravitational *Flow*.

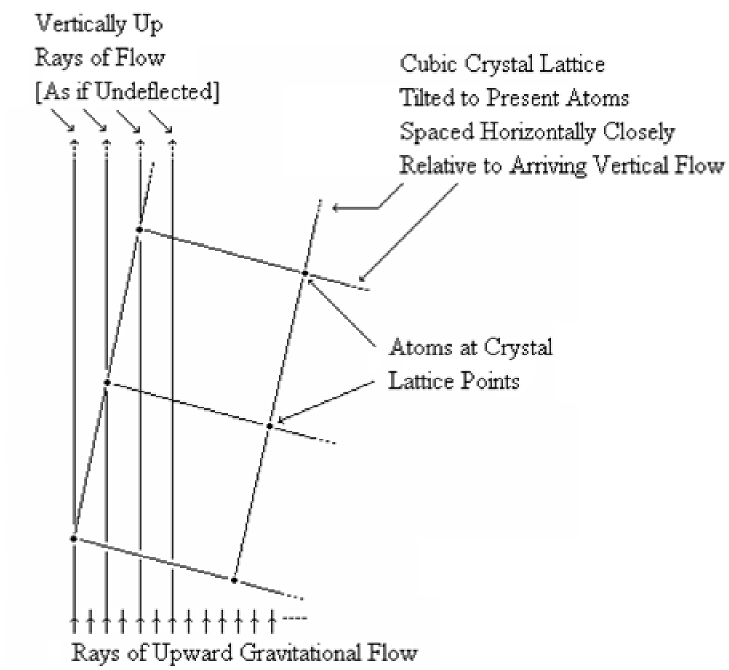
The spacing between the edges of the diffracting slit is about $5 \cdot 10^{-6}$ *meters*. The spacing of the atoms at the corners of the "cubes" in a Silicon cubic crystal is $5.4 \cdot 10^{-10}$ *meters*. But, per Appendix C, the medium *Flow* concentration must be increased at least by the factor 10^{15} for its density to be comparable to Earth natural gravitation. That requires reducing the atomic spacing in the Silicon cubic crystal as follows.

(6-2) Taking Silicon's spacing of $5.4 \cdot 10^{-10}$ rounded as 10^{-11} *meters*
and taking the square root of the rounded 10^{-15} as being 10^{-8}
the required atomic spacing must be less than
$[10^{-11}] \cdot [10^{-8}] = 10^{-19}$ *meters.*

An inter-atomic spacing of less than 10^{-19} *meters*, much closer than the natural spacing in the Silicon cubic crystal, is required to obtain deflection of a major portion of the incoming Earth's gravitational *Flow*.

Such a close atomic spacing cannot be obtained by directly arranging for, or finding a material that has, such a close atomic spacing. However, that close an atomic spacing can be effectively produced relative to just the vertical component of the *Flow* of gravitation by slightly tilting the Silicon cubic crystal's cubic structure relative to the vertical.

The following Figure 6-7 illustrates the tilting, schematically not to scale, and shows how it increases the number of crystal atoms closely encountered by the upward gravitational *Flow*.



Cubic Crystal Lattice Tilted for Effective Gravitational Flow Deflection
Figure 6-7

By appropriate tilting of the cubic structure each of its $5.4 \cdot 10^{-10}$ *meters* inter-atomic spaces can be effectively sub-divided into 10^{10} "sub-spaces" each of them $5.4 \cdot 10^{-20}$ *meters* long and with an atom in each. A *4.5 mm* shim on a *30 cm* diameter Silicon cubic crystal ingot would produce such an effect, producing a tilt *tangent = 0.015* for a *tilt angle = 0.86°* that would produce the objective effective sub-division of the crystals' natural inter-atomic spacing, a sub-division that acts only on vertical *Flow* as components of gravitation.

Pure, monolithic, Silicon cubic crystals up to *30 cm* in diameter are grown for making the "chips" used in many electronic devices. The gravitation deflector requires, instead of the thin wafers sawed from the "mother" crystal for "chip" manufacture, a large, thick ingot of Silicon cubic crystal a half meter or more in length as is the "un-sawed" mother crystal.

However, the foregoing analysis only presents the general principles on which a gravitation deflector could be based. We now proceed to detailed mathematical analysis of the problem and of the solution.