SECTION 4

Analysis of a Cubic Crystal Gravitation Deflector (P)[5]

TAPPING THE ENERGY OF THE GRAVITATIONAL FIELD

The general vertically upward outward *Flow* of gravitational energy can be tapped by deflecting part of a local region's gravitational *Flow* away from its normal vertical direction. Figure 4-1 below [the earlier slit diffraction Figure 3-4] illustrates such deflection using a single slit.

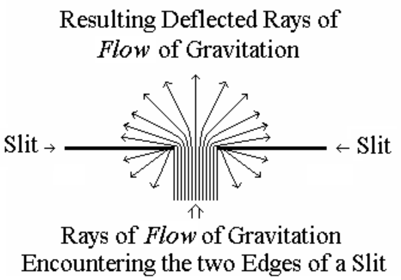

Figure 4-1 - Slit Diffraction, the Basic Element of a Gravitation Deflector

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.

GRAVITATION DEFLECTOR DESIGN

The edges of the slit in the above figure 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.

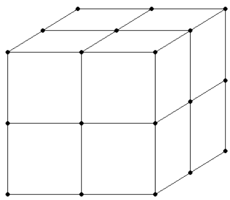

Figure 4-2 - A Small Piece of a Cubic Crystal

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 it 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, it will pass through a concentration of the slit atom's *Flow* comparable to the concentration in the Earth's gravitational *Flow*.

The spacing between the edges of the diffracting slit, Figure 4-1, 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*. A still finer inter-atomic spacing of less than $3 \cdot 10^{-19}$ *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 *Flow* of gravitation by slightly tilting the cubic crystal's structure relative to the vertical.

The following Figure 4-3 [Figure 2-4 repeated] illustrates the tilting, schematically and not to scale, and shows how it increases the number of crystal atoms closely encountered by the upward gravitational *Flow*.

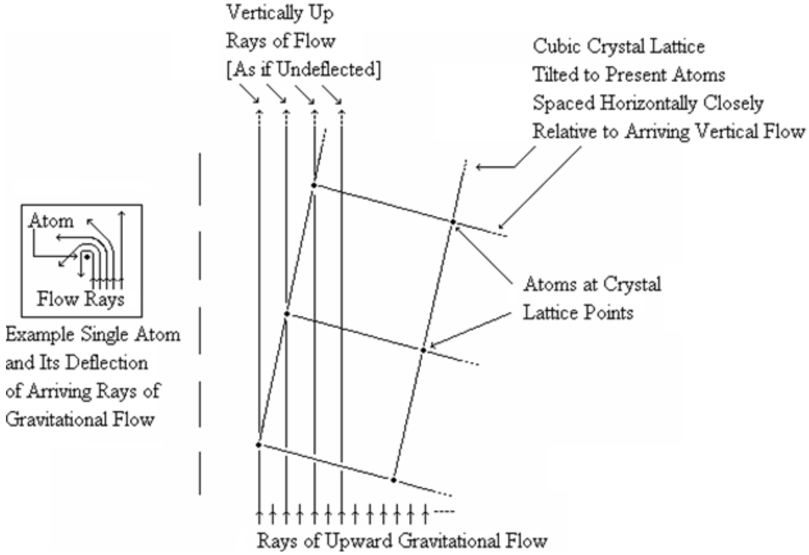

Figure 4-3 - Cubic Crystal Lattice Tilted for Effective Gravitational Flow Deflection

By appropriate tilting of the cubic structure each of its $5.4 \cdot 10^{-10}$ *meters* inter-atomic spaces is 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 produces such an effect, producing a tilt `tangent = 0.015` for a `tilt angle = 0.86°` that produces the objective effective sub-division of the crystals' natural inter-atomic spacing, a sub-division that acts only on vertical *Flow*, as 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 a large, thick piece of Silicon cubic crystal rather than the thin wafers sawed from the "mother" crystal for "chip" making.

Per the detailed analysis further below, The Silicon cubic crystal ingot for the deflector is to be:

- `30 cm` in diameter,
- `50 cm` or more thick,
- with the orientation of the cubic structure marked for proper placement of tilt-generating shims, and
- with the bottom face of the cylinder sawed and polished flat at a single cubic structure plane of atoms.

A CUBIC CRYSTAL DEFLECTOR

A small portion of a Silicon cubic crystal is depicted below.

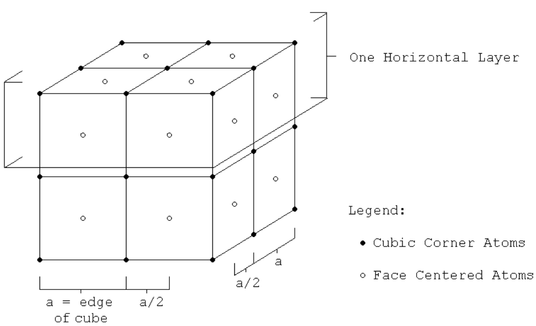

Figure 4-4
A Silicon Cubic Crystal

In the Silicon cubic crystal the edge of the cube, a, is $5.4 \cdot 10^{-10}$ meters. The effective horizontal interatomic spacing for vertically upward traveling U-waves is half the edge, $a/_2 = 2.7 \cdot 10^{-10}$ meters. From the figure the vertical layer thickness is $a = 5.4 \cdot 10^{-10}$.

The edges of the slit that produces the light diffraction pattern of Figures 3-1 and 3-123 on which the Section 3 analysis of U-wave deflection is based consist of atoms spaced along the slit edge at an interatomic spacing that is essentially the same as a cubic crystal's interatomic spacing, about $2.7 \cdot 10^{-10}$ meter. The only difference between the light diffraction $5.4 \cdot 10^{-6}$ meter wide slit and a cubic crystal's interatomic spacing is that in the cubic crystal the "slit" width is that same interatomic spacing, about $2.7 \cdot 10^{-10}$ meter.

The diffraction pattern of Figures 3-1 and 3-2 is determined by the edges of the slit. The edges are the limit of the "slice" of incident light that passes through the slit and the light at those edges is the most deflected because it is the nearest to the deflecting atoms of the slit edge. Similarly, the edges jointly define the mid point of the diffraction pattern which is where the action of the two edges are equally strong so that their deflecting effects cancel each other to no net deflection.

In the cubic crystal those defining points are only apart $2.7 \cdot 10^{-10}$ meter as compared to $5.4 \cdot 10^{-6}$ meter apart in the case of the slit. The calculations of equations 3-1 through 3-5 must be re-calculated for that $2.7 \cdot 10^{-10}$ meter slit. That requires evaluating γ for its Cauchy-Lorentz Distribution. That is the same as in equation 3-2 except that the value of the slit width is changed to $2.7 \cdot 10^{-10}$ meter. The result is equation (3-2').

$$(3\text{-}2')\quad \gamma' = [74\%\text{ of}]\big[[\text{slit width}]\cdot \text{Tan}[4.39°]\big]$$

$$= [0.74]\cdot[\,2.7\cdot 10^{-10}\text{ meter}]\cdot[0.077]$$

$$= 1.5\cdot 10^{-11}\text{ meter}$$

Calculating the portion, P, of the total amount of the incident U-waves entering that slit that is deflected through $\Theta = -45^o$ to the left of the mid point of the diffraction pattern and its Cauchy-Lorentz Distribution using $\gamma = 1.5 \cdot 10^{-11}$ meter per equation (3-2') is as follows.

1 – Calculate the displacement, d, of Figure 3-3.

(3-4') $$d = \mathrm{Tan}[\Theta] \times [\text{slit width}]$$
$$= \mathrm{Tan}[-45^o] \times [2.7 \cdot 10^{-10}]$$
$$= -2.7 \cdot 10^{-10} \quad [\text{this example of } \Theta = -45^o]$$

2 – Calculate $P = f_{cum}(d;mid,\gamma)$ from equation (3-3).

(3-5') $$P = f_{cum}(d;mid,\gamma) = \frac{1}{\pi} \cdot \arctan\left[\frac{d - mid}{\gamma}\right] + \frac{1}{2}$$
$$= \frac{1}{\pi} \cdot \arctan\left[\frac{(-2.7 \cdot 10^{-10}) - (0)}{1.5 \cdot 10^{-11}}\right] + \frac{1}{2}$$
$$= 0.018$$

Again the portion of the total U-wave flux that is deflected by $\Theta = 45^o$ or more is $P_{45} = 1.8\% + 1.8\% = 3.6\%$. The result is unchanged from that in the case of the $5.4 \cdot 10^{-6}$ meter slit. The reason for that is that the parameters of the Cauchy-Lorentz Distribution describing the deflected U-wave amounts in the various directions of deflection are determined by the two opposed slit edges. Contracting their spacing correspondingly contracts the distribution.

Now for the 1.8% on each side of the Cauchy-Lorentz Distribution to pass its deflecting atom within a distance equal to 1.8% of the slit width, the new value of that distance is the value for the cubic crystal slit, $[0.018 \times (2.7 \cdot 10^{-10}) = 4.9 \cdot 10^{-12}$ meter]. If it could be arranged that all of the vertically upward U-wave gravitational flux were to pass within that close a distance of an atom of the cubic crystal lattice, then 100% of the gravitational flux should be deflected by 45^o or more.

EARTH'S GRAVITATION VS. A SURFACE LIGHT SOURCE

However the light-and-slit analysis deflections and calculations in Section 3 were for light traveling in the U-wave flux density generated by the Earth surface light source not the much more concentrated Earth overall gravitational U-wave outward flux. The deflections and calculations for diffraction of light as developed in Section 3 must be adjusted to compete at the level of Earth gravitational U-wave flux rather than at that of an Earth surface light source if there is to be a noticeable deflecting affect on Earth gravitation.

The U-wave flux of interest, that is that involved in the light-and-slit diffraction effects, is that flowing in the same direction as the beam of light that is diffracted at the slit. That flux derives partly from the ambient air [the flux if the light source were removed] and partly from the light source. At the slit the two are inter-mixed and the diffracting action deflects all U-waves indiscriminately, not the light U-waves selectively.

The ratio of the Earth's surface gravitational acceleration, $9.8\ ^{m}/_{sec^2}$, to, from Table A-8, the gravitational acceleration of air, $4.81 \times 10^{-17}\ ^{m}/_{sec^2}$, is about $2 \cdot 10^{17}$. From that table, the gravitational acceleration of metals is on the order of $10^{-14}\ ^{m}/_{sec^2}$ as compared to the Earth's overall gravitational acceleration of about $9.8\ ^{m}/_{sec^2}$ for a ratio of about 10^{15}. Consequently, the flux actually carrying the light [generated by a metallic light source] and entering the slit is the dominant factor.

The U-wave fluxes are proportional to the acceleration that they produce. The ratio of the accelerations, which is the ratio of the U-wave fluxes, is as given in equation 4-1, below.

$$\text{Ratio} = \frac{\text{Acceleration of Earth Gravity}}{\text{Acceleration of Diffracted Light U-waves}} \tag{4-1}$$

$$= \frac{\text{Earth Gravity U-waves Flux}}{\text{Slit Diffracted Light U-waves Flux}}$$

$$\approx 10^{15}$$

Therefore the U-wave concentration which all vertical rays of gravitational U-wave flux must be forced to encounter by being forced to pass close to the cubic crystal's atoms must for this purpose be made 10^{15} times greater. The gravitational U-wave flux must be forced to pass accordingly even closer to the cubic crystal's atoms.

However, the U-wave concentration from the atoms is inverse-square reduced with distance from the atom and accordingly so increases with nearness to the atom. Consequently, to increase the concentration by a factor of 10^{15} requires reducing the separation distance by a factor of only the square root of that, about $3.2 \cdot 10^{7}$.

The earlier above found effective interatomic spacing to be forced by tilting the cubic crystal, $2 \times [4.9 \cdot 10^{-12}] = 9.8 \cdot 10^{-12}$ meter, must now be that divided by $3.2 \cdot 10^{7}$ the result for which is $3 \cdot 10^{-19}$ meter. That arrangement, arranging that all of the U-wave gravitational flux must, at some layer, pass within $3 \cdot 10^{-19}$ meter of an atom of the cubic crystal will result in essentially 100% of the gravitational U-wave flux passing so close to some atom that it should be deflected by 45° or more..

With the cubic crystal's natural interatomic spacing being $2.7 \cdot 10^{-10}$ meter and the effective spacing to be forced is $3 \cdot 10^{-19}$ meter then each natural interatomic space must be subdivided into $9 \cdot 10^{8}$ "pieces". If the crystal is tilted such that each of the layers of the crystal lattice is located offset from the layer below it by $[^{1}/_{9 \cdot 10^{8}}] \cdot [2.7 \cdot 10^{-10}] = 3 \cdot 10^{-19}$ meter in each of the two horizontal directions of the orientation of the lattice then the objective is met.

The direct implementation of that would require a tilt at an angle whose tangent is the offset divided by the interatomic [layer-to-layer] spacing, $[3 \cdot 10^{-19}] \div [5.4 \cdot 10^{-10}] = 5.6 \cdot 10^{-10}$, an angle of about $6.4 \cdot 10^{-8\,\circ}$. That means that the tilt causes each successive layer to offer its atoms a further $3 \cdot 10^{-19}$ meter offset so that enough layers will produce offering the atoms at every $3 \cdot 10^{-19}$ meter increment in each $2.7 \cdot 10^{-10}$ meter horizontal interatomic space. See Figure 4-5, next page.

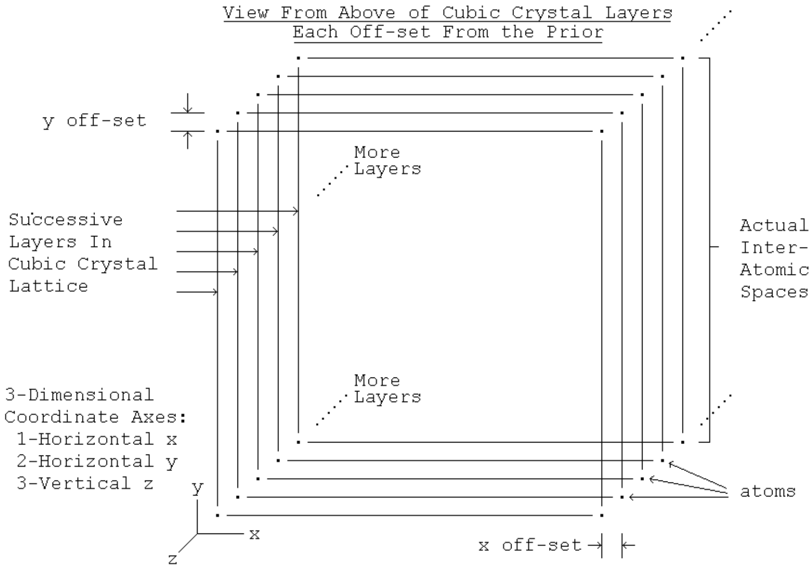

Figure 4-5
Crystal Layers, Offset Slightly, Achieving Effective Close Interatomic Spacing
[The z-axis is vertical. The x- and y-axes are in layers.]
[Not to Scale.]

The required number of layers is one layer for each of the $9 \cdot 10^{8}$ "pieces" into which each $2.7 \cdot 10^{-10}$ $meter$ horizontal interatomic space is divided: $9 \cdot 10^{8}$ layers.

Such a fine tilt angle and its precision are unlikely if not impossible to set up. The solution to that is that the successive layers need not each supply the minute offset relative to their adjacent layers. If the layers as depicted in Figure 4-5, above, were shuffled into any order whatsoever, they would still have the same effect that no vertical ray could avoid passing within $3 \cdot 10^{-19}$ $meter$ of an atom, some atom, not necessarily one in the immediately next layer.

Of course, the layers in the cubic crystal cannot be shuffled or re-arranged, but that is not necessary. All that is necessary to operate using a larger tilt angle is that the same sufficient number of layers overall be employed and that the tilt be such ["workable tilt"] that the actual *x-axis offset* and the actual *y-axis offset* be such that, after that "same sufficient number of layers overall", each required effective atomic position appears somewhere, in some layer, even though not necessarily in "sequential order".

"Unworkable tilts" are those that duplicate needed atomic positions or that fail to produce all needed atomic positions, or both. The problem of what successfully workable tilts are and how they relate to unworkable tilts is developed in Appendix C, Cubic Crystal Tilt Requirements and Calculations.

The number of layers required, $9 \cdot 10^{8}$, requires a cubic crystal thickness of that number of layers multiplied by the individual layer thickness, which is $9 \cdot 10^{8} \times 5.4 \cdot 10^{-10} = 0.50$ meters or 50 cm.

Each "slit" in the cubic crystal is a pair of atoms spaced apart horizontally by the crystal lattice interatomic spacing of $2.7 \cdot 10^{-10}$ meter; or, more precisely, each "slit" is a linear "string" of such atom pairs, in any single layer of the crystal, and running from one side to the other of the crystal just as the slit edges in the case of light diffraction by a slit is a linear "string" of the atoms of which the slit edge consists.

For each such $2.7 \cdot 10^{-10}$ meter wide "slit" the above tilt procedure implements arranging that out of all of that portion of the total gravitational U-wave flux that passes through it, the $^{1}/_{9 \cdot 10^{8}}$ or $1.1 \cdot 10^{-7}\%$ on either side, a total of $2.2 \cdot 10^{-7}\%$, passes within $3 \cdot 10^{-19}$ meter of an atom of the cubic crystal lattice and will be deflected by $45°$ or more away from its pre-deflection vertically upward direction. That leaves the issue of what happens to the balance of the gravitational U-wave flux entering each such "slit".

The U-wave propagation of each such atom falls off in concentration inversely as the square of the distance from it. The $3 \cdot 10^{-19}$ meter closeness is required to obtain the $45°$ deflection. Of the total gravitational U-wave flux entering that slit, at ten times farther away from an atom, $3 \cdot 10^{-18}$ *meter*, the concentration is reduced by a factor of $[1/10]^2 = 1/100$. There the angle of deflection is reduced by approximately that factor to about $0.45°$. That deflection is experienced by about $1.1 \cdot 10^{-6}\%$ on either side out of the total gravitational U-wave flux that passes through the "slit", a total of $2.2 \cdot 10^{-6}\%$.

Still farther away, at $3 \cdot 10^{-17}$ *meter* from an atom, the concentration is reduced by a factor of $[1/100]^2 = 1/10{,}000$. There the angle of deflection is reduced by approximately that factor to about $0.0045°$ and applies to about $2.2 \cdot 10^{-5}\%$.

Thus far more than $99\ \%$ of the total U-wave flux entering the "slit" experiences negligible deflection. That is, until layer-by-layer in the crystal lattice further portions having earlier experienced that negligible deflection then experience the "$3 \cdot 10^{-19}$ *meter*" condition until, eventually, all of the U-wave flux experiences the "$3 \cdot 10^{-19}$ *meter*" condition and is deflected by $45°$ or more.

Returning to the mean free path analysis at equations *(2-5) – (2-7)* it is now found to be the case that the target interatomic spacing to be achieved by the tilt of the cubic crystal is $3 \cdot 10^{-19}$ *meters* instead of 10^{-18} *meters*. The mean free path in the Earth for that same $3 \cdot 10^{-19}$ *meters* target size then is calculated as follows.

$$(4\text{-}2) \qquad MFP = 1/C \cdot A = \frac{1}{[C,\ \text{Atoms Per Unit Volume}] \times [A,\ \text{Atom Cross Section Area}]}$$

For the Earth the concentration of atoms is on the order of $C = 5 \cdot 10^{28}$ *per cubic meter*. In the cubic crystal deflector the target spacing achieved by the tilt is $3 \cdot 10^{-19}$ meters. Each target has cross sectional area space available to it equal to a circle of that diameter so that

$$(4\text{-}3) \qquad A = \pi/4 \cdot [3 \cdot 10^{-19}]^2 = 7.1 \cdot 10^{-38}\ \text{meter}^2$$

and, for such targets the mean free path per equation *(2-5)* in the Earth's outer layers is

(4-4) $MFP = 2.8 \cdot 10^8$ meters.

That is to be compared to the mean free path in the cubic crystal deflector being one-half the cubic crystal thickness of *0.50 meters* or *0.25 meters*.

The gravitation deflector is about 10^{10} times more effective than the natural Earth at intercepting Earth's natural gravitation.

However, that effectiveness is only for vertical rays of *Flow*.

The Silicon crystal's mean free path for non-vertical *Flow* – *Flow* already once deflected within the crystal – is that of Earth, $2.5 \cdot 10^9$ *meters*, which takes the once-deflected *Flow* out of the crystal.

The overall deflector consists of:

- A support having a verified perfectly horizontal upper surface for the cubic crystal deflector bottom face to rest upon;
- The monolithic Silicon cubic crystal ingot as follows:
    - *30 cm* in diameter,
    - *50 cm* or more thick,
    - with the orientation of the cubic structure marked for proper placement of tilt-generating shims, and
    - with the bottom face of the cylinder sawed and polished flat at a single cubic structure plane of atoms.
- Precision shims *4.5 mm* thick for producing the tilt of the cubic crystal ingot, the shims located at the mid-point of two adjacent sides of the horizontal plane of the cubic structure as in Figure 4-6 on the next page.
- Alternatively, a precision tilt-generating mechanism.
- For an array of ingots for a larger area than a single ingot can provide, the individual ingots can be machined to fit

snugly together. That could be done by machining them to a square cross section or, better, to a hexagonal one.

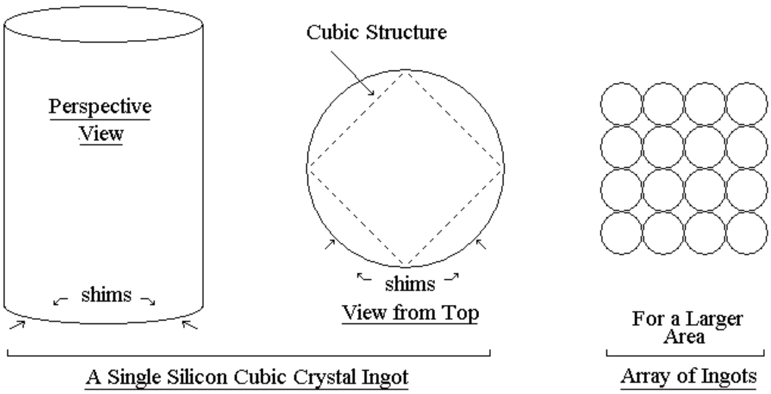

Figure 4-6 – The Silicon Cubic Crystals Arrangements

PRACTICAL ASPECTS AND DESIGN ENGINEERING

While the net gravitational field is vertically upward, i.e. radially outward from the Earth's surface, local gravitation is radially outward from each particle of matter. As in Figure 4-7 below, a mass above the Earth's surface receives rays of gravitational attraction from all over the Earth's surrounding surface and from the underlying body of the Earth.

The net effect of all of the rays' horizontal components is their cancellation to zero. The net effect of all of the rays' vertical components is Earth-radially-outward vertically acting gravitation.

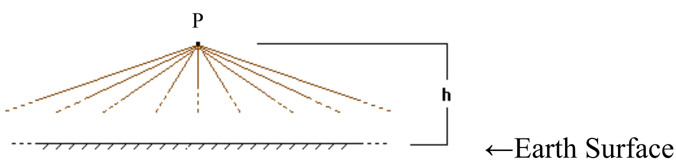

Figure 4-7 - Rays of Gravitation from the Surroundings

<u>*Gravitational Ray's Horizontal and Vertical Components.*</u>

One can consider all of the net gravitational effect on objects as being due to the vertical component of all of the myriad rays of gravitational field *Flow* at a wide variety of angles to the horizontal. This "components aspect" is valid because of the "components aspect" appearance in the "Gravitational Lensing" effect on cosmic light.

The various rays of the *Flow* propagation from the individual particles of the gravitating body [for example the Earth] are from each individual particle of it to the selected point [above the gravitating body] on which their action is being evaluated. That is the point P in the above Figure 4-7.

The Earth's gravitational action along a ray of *Flow* takes place from the Earth's surface to deep within the Earth. The inverse square effect, that the strength of a *Flow* source is reduced as the square of the increase in the radial distance of it from the object acted upon, is exactly offset by that the number of such sources acting [per "ray" so to speak] increases as the square [non-inverse] of that same radial distance. That is, the volume, hence the number, of *Flow* sources for a ray of propagation at the object is contained in a conical volume, symmetrically around the ray with its apex at the object acted upon.

However, because the net gravitational effect is produced only by the vertical component of each ray of *Flow* propagation, the effectiveness of each ray is proportional to the Cosine of the angle between that ray and the perfectly vertical as the angle θ in Figure 4-8 below.

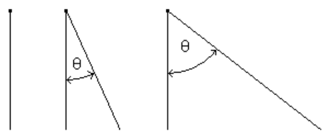

Figure 4-8 – The Gravitational Field Ray Angle to the Vertical

The actual total gravitational action includes all rays from $\theta = 0$ through to $\theta = 90º$. That would require an infinitely large deflector to act on all such rays, a disk of infinite radius. For lesser values of the maximum θ addressed, the portion of the total gravitation sources included is the integral of $Cos[\theta] \cdot d\theta$ from $\theta = 0$ *to* $\theta = Lesser\ Value$. The integral of the *cosine* is the *sine*. Example lesser portions of the total gravitational action addressed as θ varies are presented in Table 4-9 below.

θ	Sin [θ] = Fraction of Total Maximum Gravitational Action
0º	0.000
30º	0.500
45º	0.707
60º	0.866

Table 4-9

The gravitational deflector as a disk beneath the *Object* to be levitated must extend horizontally far enough to intercept and deflect the $Chosen\ Lesser\ Value$ of angle θ rays of gravitational wave *Flow* that are able to act on the *Object* of the deflection as depicted in Figure 4-10 below.

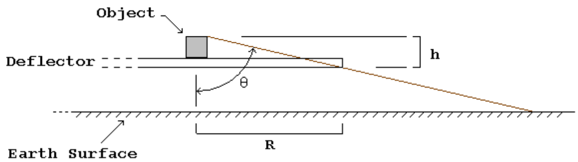

Figure 4-10 – Size Requirements for a Disk Shaped Deflector

For the perfectly vertically traveling rays of gravitation waves the required vertical distance that must be traveled within the cubic crystal is the previously presented at least $50\ cm$ and 0 horizontal distance is traversed in so doing. But a ray at angle θ, in order to traverse the required 50 cm vertically, must traverse horizontally

$50 \cdot Tan[\theta]$ cm, at the same time. For θ more than $45º$ that can become quite large and the deflector likewise.

Because the deflector disk must extend over a large area to deflect most of the gravitation, an alternative, and better, solution to the problem of rays of gravitation arriving over the range from $\theta = 0$ to $\theta = 90º$ is to wrap the deflector up the sides of the *Object* to be levitated as shown below.

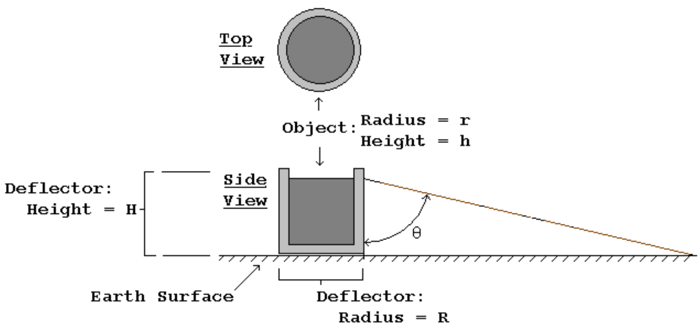

Figure 4-11 – A Cup Shaped Gravitation Deflector

In this configuration the deflector takes up little more space than the *Object* levitated. However, the non-perfectly vertical traveling rays must still travel within the cubic crystal the horizontal distance $50 \cdot Tan[\theta]$ cm. That requires that the horizontal thickness of the vertical sides of the cup-shaped deflector must be of that $50 \cdot Tan[\theta]$ cm thickness.

Because the value of $Sin[\theta]$ and, therefore, the fraction of the total gravitational action, increases relatively little above $\theta = 60º$ whereas the value of $Tan[\theta]$ increases quite rapidly, from 1.7 to ∞ above $\theta = 60º$ that $\theta = 60º$ is the appropriate value to which to design. The thickness of the "walls" of the "cup" would then be $50 \cdot Tan[60º] = 85$ cm. The deflector would be only slightly larger than the *Object* levitated.

Gravitation Deflector Design Parameters

The Deflector is a cup shaped array of monolithic Silicon cubic crystals. The crystals forming the flat "base" of the "cup" must be $0.5\ m$ in height. The "sides" of the "cup" will be the same kind of $0.5\ m$ crystals stacked and aligned vertically. The thickness of the "sides" must be $0.85\ m$.

The crystals are grown with circular cross-section and in diameters up to $30\ cm$; however, those cylindrical pieces must then be machined to hexagonal or square cross section for a number of them to fit together with negligible open space. The cross-section area of these crystals is $\pi \cdot d^2/4 = 0.785 \cdot d^2$

For a circular deflector the configuration is poorly compatible with arranging the crystals in a close-fitting array unless the it involves a large number of crystals each of small cross-section relative to the horizontal cross-section of the overall deflector. For that case the crystals should be machined to hexagonal cross-section. For smaller deflectors the configuration should be of rectangular cross-section and the crystals machined to square cross-section.

Case	Preferred Crystal Cross-Section	Crystal Cross-Section Area	Percent Used of Original Crystal
Circular Deflector	Hexagonal	$[\sqrt{3}/3] \cdot d^2 = 0.577 \cdot d^2$	73.5
Rectangular Deflector	Square	$d^2/2 = 0.500 \cdot d^2$	63.7

Table 4-12

a. Circular Cross-section Gravitation Deflector Structure

A circular cross-section gravitation deflector structure to provide deflection for an object of height, h, and diameter, d meters would have the following parameters.

Base Disk: Thickness = t = 1 Crystal Layer = 0.5 m

Diameter = d + 2·[t = cup sides thickness]

Area = $\pi \cdot [d + 2 \cdot t]^2/4 = 0.785 \cdot [d + 1.7]^2$

Cup Sides:

Thickness t = 0.85 m

Outside diameter [OD] = d + 2·t = d + 1.7

Inside diameter [ID] = d

Height = h

Height Nr. of Layers = $h/0.5$

Area of Layer = $\pi \cdot [OD^2 - ID^2]/4$

= $0.785 \cdot [OD^2 - ID^2]$

Taking Silicon at *1.00 $/kg* and its density at *2,329 kg/m3* the examples below obtain [MKS units and 1 m = 39.37″]. The *0.85 m* thickness of the "cup" "sides" requires *20* layers horizontally of *2″* crystals.

d	h	Cup Disk Base		Cup Sides		Total Volume	Total Cost $	Nr. of 2" Hex Crystals
		Area	Volume	Area	Volume			
1	1	5.72	5.75	4.94	4.94	10.7	24,897	13,280
10	10	131	1310	29	290	319	742,951	779,570

Table 4-13

b. Square Cross-section Gravitation Deflection Structure

A square cross-section gravitation deflector structure to provide deflection for an object of square cross-section side, *s*, and height, *h* meters would have the following parameters.

Base Square: Thickness = t = 1 Crystal Layer = 0.5 m

Side = s + 2·[t = cup sides thickness]

Area = $[s + 2 \cdot t]^2 = [s + 1.7]^2$

Cup Sides:

Thickness t = 0.85 m

Outside square side OS = s + 2·t = s + 1.7

Inside square side IS = s

Height = h

Height number of Layers = $^{Height}/_{0.5}$

Area of Layer = $OS^2 - IS^2$

Taking Silicon at 1.00 $/kg and its density at 2,329 $^{kg}/_{m^3}$ the examples below obtain [MKS units and 1 m = 39.37″]. The 0.85 m thickness of the "cup" "sides" requires 3 layers horizontally of 12″ crystals.

s	h	Cup Disk Base		Cup Sides		Total Volume	Total Cost $	Nr. of 12" Square Crystals
		Area	Volume	Area	Volume			
1	1	7.3	7.3	6.3	6.3	13.6	31,674	195
10	10	137	1370	36.9	369	1,739	4,050,131	2,486

Table 4-14

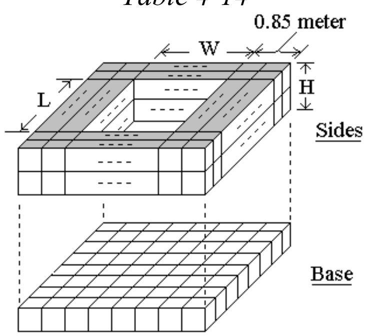

Figure 4-15

Calibrating the Individual Silicon Crystals

The individual crystals making up the deflector cannot be grown exactly identical to each other. In each the orientation of the long axis of the cubic crystal structure may vary minutely from each of the others. That is, it is not certain that each crystal's base is purely a single plane of atoms of the cubic structure and thus is exactly perpendicular to the long axis of the crystal.

To find the optimum tilt and orientation for a single crystal the tilt must be varied over the range of possibilities while the effect of gravitation from exactly below it is observed on a balance scale. But most of the effect of gravitation on a single crystal is not from exactly below.

The solution to that problem is to conduct the optimization atop a structure that, relying on the inverse square effect, effectively isolates the crystal from most of the gravitation from surrounding sources except that exactly below it – a high pedestal having a cross section comparable to that of the crystal, Figure 4-16.

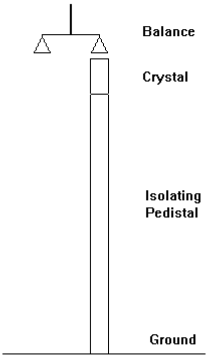

Figure 4-16

To conduct that calibration on thousands of crystals should not be necessary if a method can be developed to exactly measure the long axis orientation in any given crystal. The process can then determine the optimum orientation of the crystal tilt relative to the actual long axis of a few cubic crystals being calibrated. That same crystal tilt relative to the actual long axis can then be applied to each of the other crystals.

The long axis orientation problem could also be solved by a method of insuring that the base of each crystal is a single plane of atoms of the cubic structure.

<u>*Alternative to Calibration*</u>

Monolithic silicon cubic crystals are commercially available with the ends nearly a single plane, that is within *0.2 degrees* of the *(100)* plane of the cubic structure. In view of the various effects analyzed in Appendix C, and their resolution in its section *The Random Distribution Solution to The Crystal Tilt*, that amount or moderately more of inaccuracy in the crystal tilt is of no significance except that it potentially may call for crystal thicknesses moderately greater than *0.5 m*.

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[5] [Patent Pending *(P)*, January 13, 2011, USPTO #13/199,867.]