SECTION 11

Deflector Design Details

GENERAL DEFLECTOR DESIGN

In general the deflector consists of the following.

- A support having a verified perfectly horizontal upper surface for the cubic crystal deflector bottom face to rest upon;
- The Silicon cubic crystal ingot for the deflector as follows:
    - *30 cm* in diameter,
    - *50 cm* or more thick,
    - with the orientation of the cubic structure marked for placement of the 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 11-7 below.

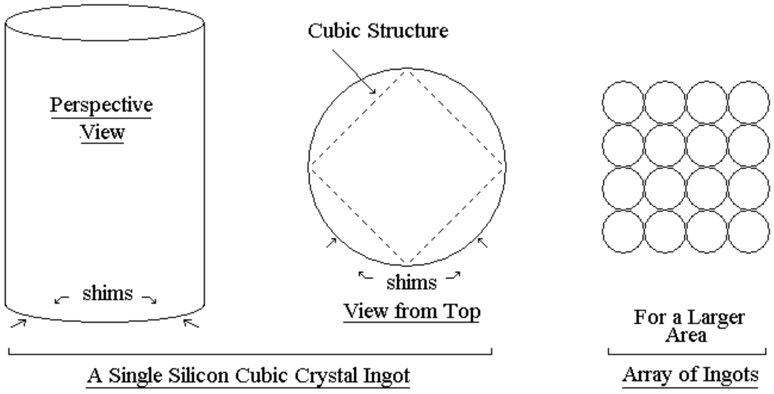

Figure 11-1
The Silicon Cubic Crystals Arrangements

- 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.

PRACTICAL ASPECTS AND 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 11-8 below, a mass above the Earth's surface receives rays of gravitational attraction from all over its surrounding surface and the underlying body of the Earth.

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

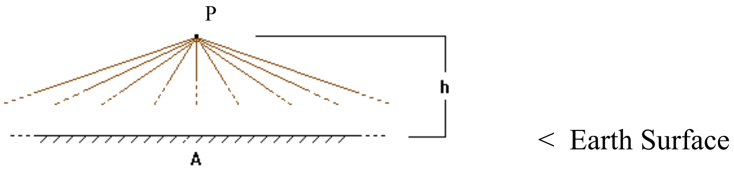

Figure 11-2
Rays of Gravitation from the Surroundings

1 - Gravitational Ray's Horizontal and Vertical Components.

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.

The various rays of the *Flow* propagation from the individual particles of the gravitating body [e.g. 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 11-8.

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 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 vertical angle θ in Figure 11-9 below.

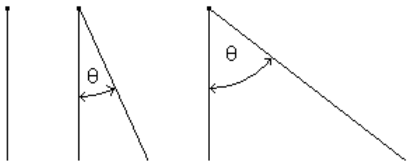

Figure 11-3
The Gravitational Field Ray Angle to the Vertical

The actual total gravitational action includes all rays from $\theta = 0$ through to $\theta = 90^{\circ}$. That range would require an infinitely large deflector to act on all such rays. That is the deflector would have to be 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 $\text{Cos}\ \theta\cdot d\theta$ from $\theta = 0$ to $\theta =$ Chosen 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 the table below.

θ	Sin θ = Fraction of T Gravitational Action
0º	0.000
30º	0.500
45º	0.707
60º	0.866

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 11-10 below.

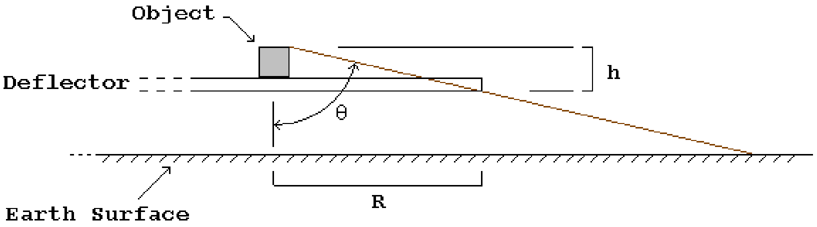

Figure 11-4
Size Requirements for a Disk Shaped Deflector

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

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 $\theta = 90^{\circ}$ is to wrap the deflector up the sides of the *Object* to be levitated as shown below.

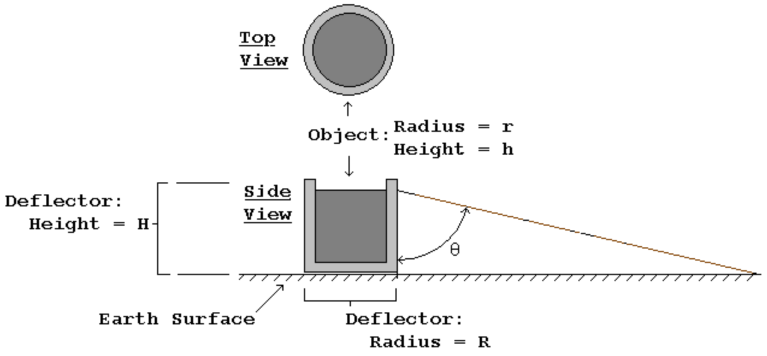

Figure 11-5
A Cup Shaped Gravitation Deflector

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.

2 - The Array Structure and Size.

The Deflector consists of an array of Silicon cubic crystals. The crystals forming the disk-shaped "base" of the "cup" need to be 0.5 m in height to achieve their maximum deflection effectiveness. Those forming the "sides" of the cup can be the same kind of 0.5 m crystals stacked and aligned vertically.

The crystals can effectively be grown in diameters up to about 30 cm, however those cylindrical pieces must then be machined down to hexagonal cross section so that a number of them can fit together with negligible open space between. The hexagonal cross section area would be about $A = 0.06\ m^2$

For an *Object* to be acted upon by the deflector, the object of height, h, and diameter, d, meters the deflector would have the following parameters for $\theta = 60º$. [The number of crystals must be the integer next higher than the calculated number.]

Base Disk: Thickness = 1 Crystal Layer = 0.5 m
Diameter = d
Area = $\pi\cdot d^2/4 = 0.785\cdot d^2$
Number of crystals = $\pi\cdot d^2/4\cdot A$
= $13.1\cdot d^2$

Cup Sides:

Thickness = 0.85 m
Outside diameter [OD] = d + 2·thickness
= d + 1.7
Inside diameter [ID] = d
Height = h + 2·0.5
= h + 1.0

Height number of Layers = $\text{Height}/0.5$

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

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

Total Number of Crystals:

Number of Crystals =
= Base Disk + [Layer Number × Number of Layers]

Some examples of these data are presented in the table below.

d	h	Cup Disk Base		Cup Sides			Total Crystals
		Area	Crystals	Nr of Layers	Area	Crystals	
1	1	0.785	14	2	4.94	99	212
10	10	78.5	1,310	20	28.97	580	12910

3 - 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 it.

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, as in Figure 11-12.

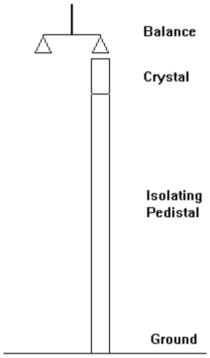

Figure 11-12

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 insuring that the base of each crystal is a single plane of atoms of the cubic structure.

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 B, 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 may be of no significance except that it potentially may call for crystal thicknesses moderately greater than `0.5 m`.