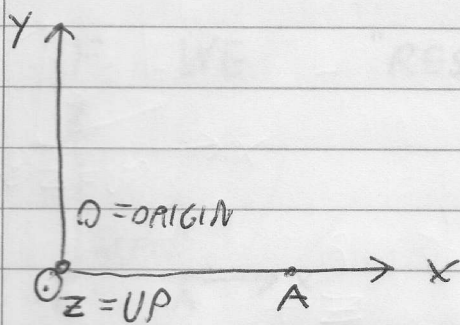


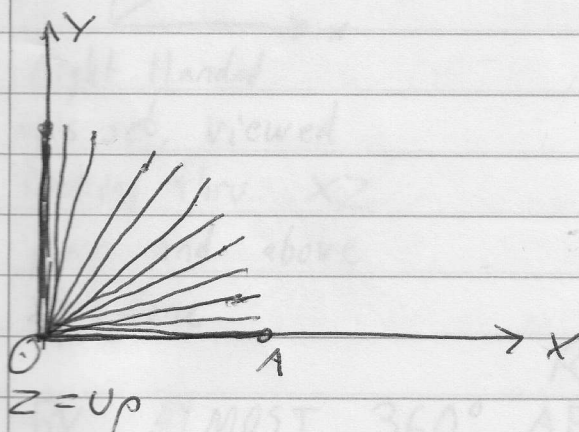
RESIDUE ROTATION - A GEOMETRIC OPERATION



CONSIDER LINE
SEGMENT $\overline{OA}$ ALONG
+X AXIS.

TO FORM A PATTERN BY
"RESIDUE ROTATION" BY AN ANGLE Θ
IS TO TAKE THE ORIGINAL STRUCTURE,
AND SLOWLY ROTATE IT, SETTING DOWN
AN IMAGE OF THE STRUCTURE AT
SUCCESSIVE ~~STEPS~~ ~~POSITIONS~~
ANGLES ~~OF ROTATION~~ AS THE
ROTATION PROGRESSES TO Θ .

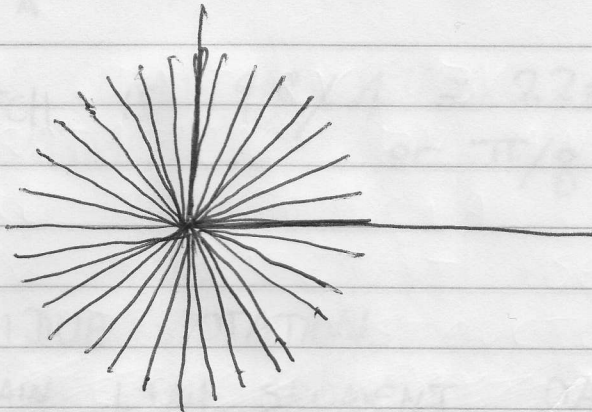
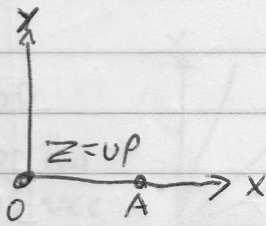
EXAMPLE. TO "RESIDUE" ROTATE"
THE ~~LINE~~ LINE SEGMENT $\overline{OA}$ ABOVE BY
 90° ABOUT +Z IN RIGHT HAND SENSE
PRODUCES THIS PATTERN:



A FANLIKE STRUCTURE,
EACH LINE SEGMENT
HAS SAME LENGTH
AS $\overline{OA}$.

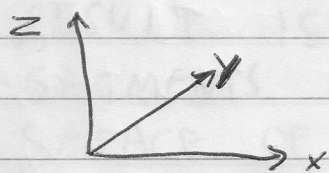
"SPOKES OF WHEEL"

IF WE "RESIDUE ROTATE" $\overline{OA}$ IN RIGHT HAND (RH) SENSE BY ~~JUST~~ JUST UNDER 360 DEGREES WE GET



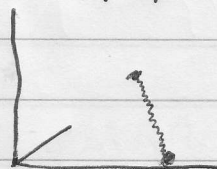
SPOKES OF A WHEEL.

NEXT EXAMPLE:



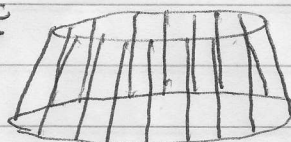
Right Handed axis set, viewed looking thru xz plane and above xy plane

consider line segment from $\begin{pmatrix} 5 \\ 0 \\ 0 \end{pmatrix}$ to $\begin{pmatrix} 4 \\ 0 \\ 3 \end{pmatrix}$



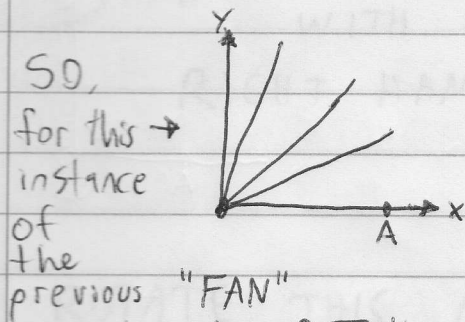
RESIDUE ROTATE IT BY ALMOST 360° ABOUT $+z$ IN R.H. SENSE.

RESULT: THE LAMPSHADE



CIRCLES ADDED TO EASE DRAWING.

THE "PITCH" OF A RESIDUE ROTATION:
The angle between successive images is defined as the "pitch"



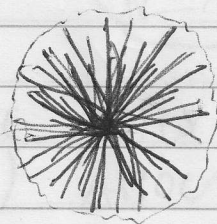
example the PITCH IS $90^\circ / 4 = 22\frac{1}{2}^\circ$
or $\pi/8$ radians.

NEXT EXAMPLE

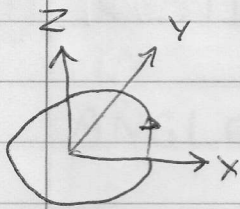
DOUBLE RESIDUE ROTATION.

CONSIDER AGAIN LINE SEGMENT OA ON
+x AXIS. R.H. RESIDUE ROTATE IT ABOUT
+z TO FORM "SPOKES OF WHEEL" AS BEFORE.
THEN, RH ROTATE THE "SPOKES OF WHEEL"
PATTERN ABOUT +y AXIS BY JUST UNDER 180°

RESULT IS A COLLECTION OF LINE
SEGMENTS EMANATING FROM ORIGIN TO
SURFACE OF A SPHERE OF RADIUS OA,
THE "FIBRE OPTIC LAMP"

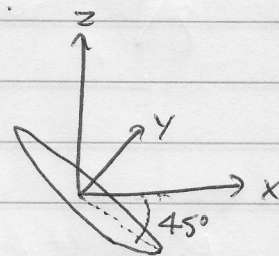
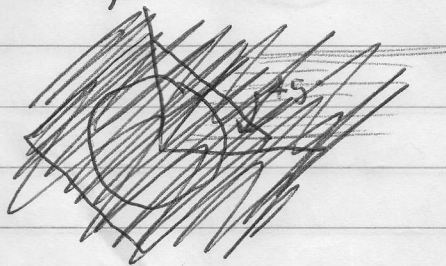


THE ORBITSphere IN 4 STEPS:

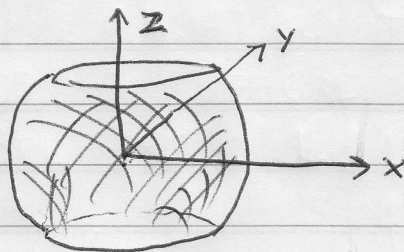


CONSIDER A CIRCULAR RING OF CHARGE ~~IN~~ IN XY PLANE, WITH CHARGE CIRCULATING IN RIGHT HAND (RH) SENSE WITH RESPECT TO +Z AXIS.

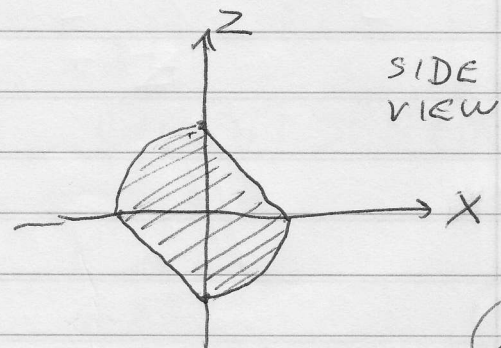
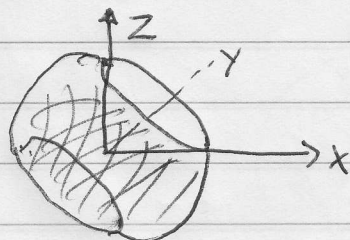
- ① ROTATE THIS RING OF CHARGE BY 45° (R.H.) ABOUT +Y AXIS.



- ② RESIDUE ROTATE THIS RING IN RH SENSE ABOUT +Z AXIS, THRU ANGLE JUST UNDER 360° . THIS GIVES US THE "STRING BARREL"

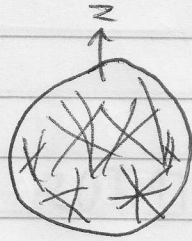


- ③ ROTATE THIS STRING BARREL BY 45° (R.H.) ABOUT +Y AXIS



④ RESIDUE ROTATE THIS STRING BARREL
IN RH SENSE ABOUT $+Z$, THRU
ANGLE JUST UNDER 360°

AND THE RESULTING PATTERN IS
THE ORBITSPHERE, UN-NORMALIZED



A STRING BARREL ALIGNED WITH
NET ANGULAR MOMENTUM ALONG $+Z$

SIDE VIEW



RESIDUE ROTATE STRING BARREL ABOUT $+Z$
R.H. nearly 360°

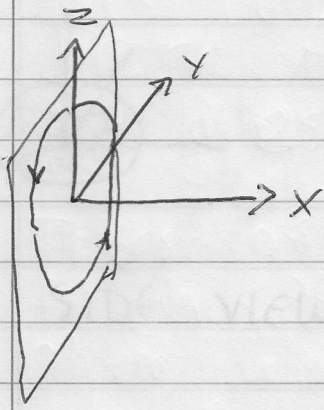
The Result:



the
ORBITSPHERE

Angular momentum $+Z$ AXIS
ALONG

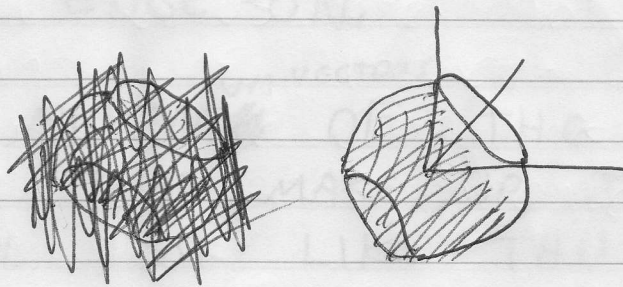
THE ORBITSPHERE IN 2 STEPS.



START OUT WITH
CIRCULATING RING OF
CHARGE IN YZ PLANE,
CENTRED ON ORIGIN,
CIRCULATING R.H. ABOUT +X.

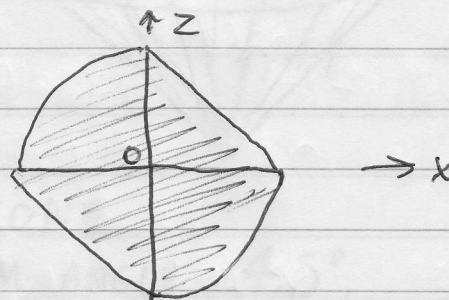
- ① RESIDUE ROTATE ABOUT $\begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$ DIRECTION
R.H., thru nearly 360°

THE RESULT :



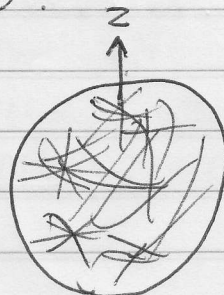
A STRING BARREL ALIGNED WITH
NET ANGULAR MOMENTUM - ALONG $\begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$.

SIDE VIEW :



- ② RESIDUE ROTATE STRING BARREL ABOUT +Z
R.H., nearly 360° .

The Result :

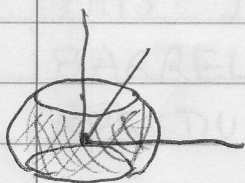


the
ORBITSPHERE.

Angular momentum ~~scribble~~ +Z AXES.

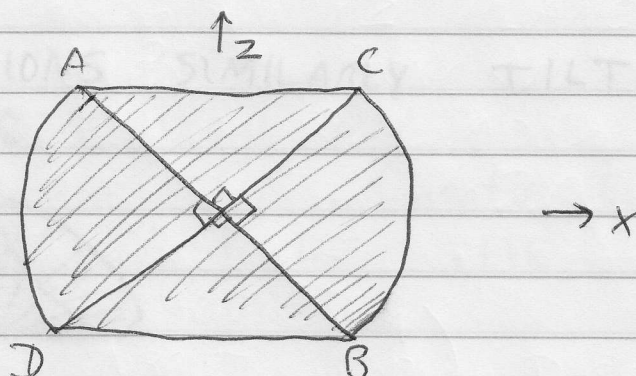
⑥

NEXT: MORE ON ANGULAR MOMENTUM



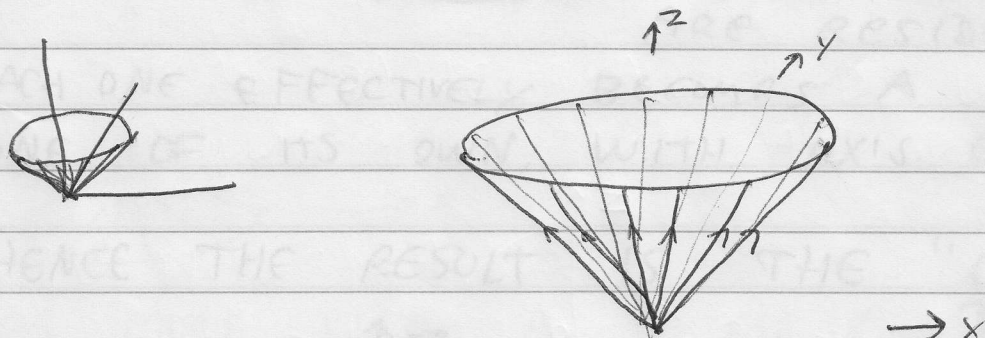
CONSIDER A STRING BARREL,
NET ANGULAR MOMENTUM ALONG
 $+Z$.

SIDE VIEW



AB and CD ARE GREAT CIRCLES
SEEN EDGE-ON.

THE ANGULAR MOMENT^{UM VECTORS} OF THE
GREAT CIRCLES THAT MAKE UP THIS
STRING BARREL LOOK LIKE THIS:



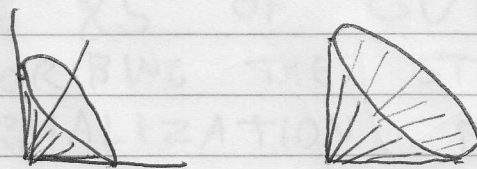
They form a CONE
VERTEX 90° RIM ANGLE 45° .

CALL THIS THE L-CONE OF THE
STRING BARREL.

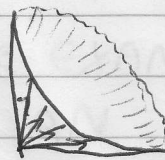
THE VECTORS ON THE OTHER HALF OF
THE L-CONE WILL, UPON RESIDUE ROTATION,
ALSO FORM SETS OF VECTORS ON THIS
"CONE-DOME"

TO FORM THE ORBITSPHERE FROM THIS STRING BARREL, THE STRING BARREL IS TILTED 45° THEN RESIDUE ROTATED THRU NEARLY 360°

THESE OPERATIONS SIMILARLY TILT THE L-CONE



THEN RESIDUE ROTATE IT ABOUT $+Z$, RH FOR THE RESIDUE ROTATION, CONSIDER THOSE VECTORS ON HALF OF THE L-CONE



ON THE SIDE FACING THE VIEWER.

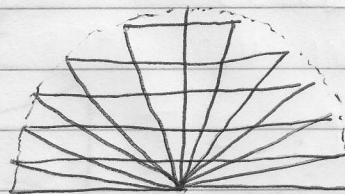
AS THESE VECTORS ARE RESIDUE ROTATED,

EACH ONE EFFECTIVELY BECOMES A CONE OF ITS OWN, WITH AXIS ON Z AXIS.

HENCE THE RESULT IS THE "CONE DOME"

$\uparrow Z$

SIDE VIEW



$\rightarrow X$



THE VECTORS ON THE OTHER HALF OF THE L-CONE WILL, UPON RESIDUE ROTATION, ALSO FORM SETS OF VECTORS ON THIS "CONE DOME".

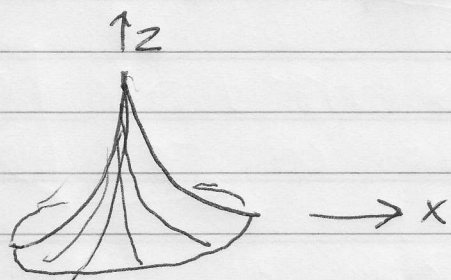
The "Cone Dome", THEN, IS A REPRESENTATION OF THE ANGULAR MOMENTUM VECTORS OF ALL OF THE GREAT CIRCLES THAT CONSTITUTE THE ORBITS PHERE.

IT IS SIMILAR TO THE CONSTRUCTION DESCRIBED ON PAGE 85 OF GUT-CP, Chapter 1, DESCRIBING THE START OF THE NORMALIZATION PROCESS.

QUESTION:

HOW DOES "NORMALIZATION" ALTER THE SHAPE OF THE "CONE DOME"?

DOES IT, FOR EXAMPLE, MAKE IT LOOK MORE LIKE AN UPTURNED FUNNEL



OR MORE LIKE A CIRCULAR BUILDING ?

