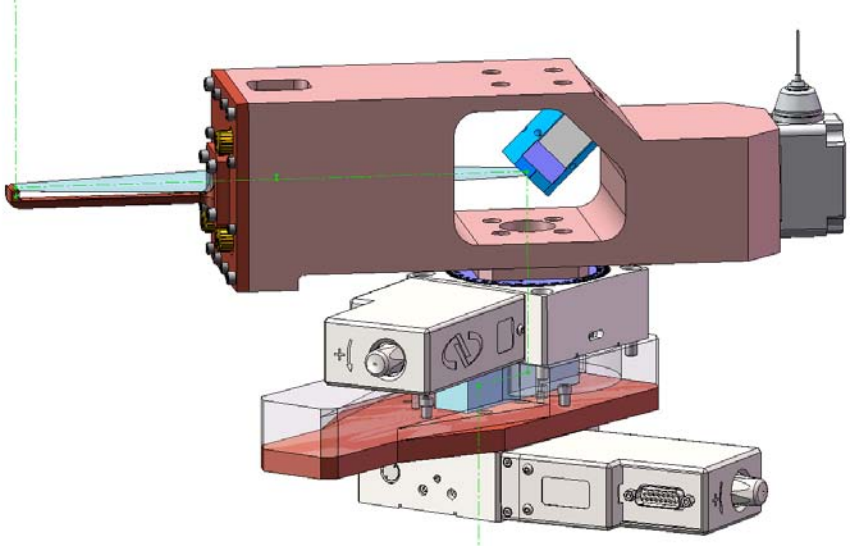
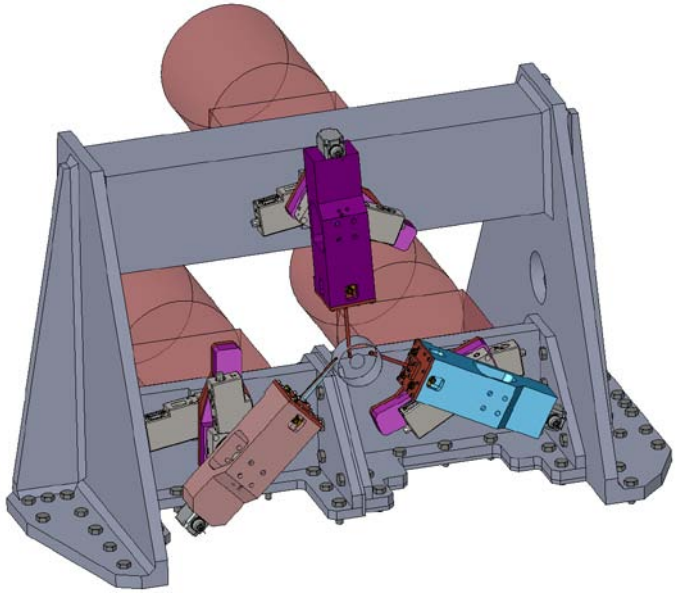


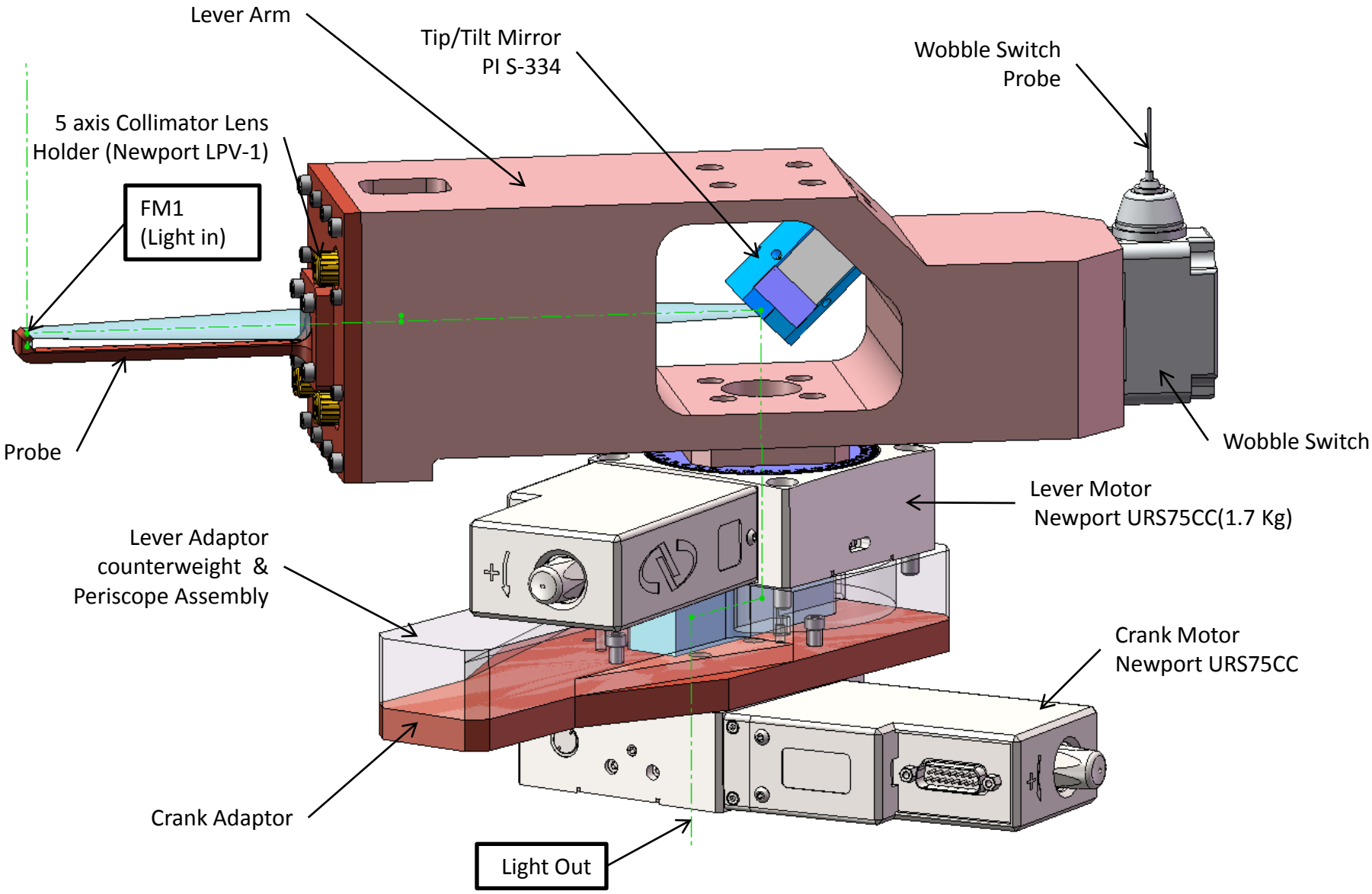


NGAO OSM

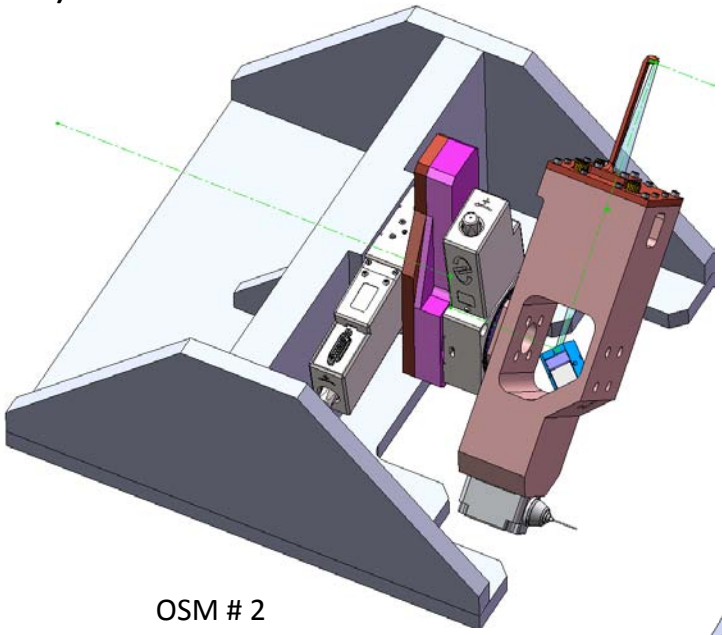
Design Study Update

Alex Delacroix
08/31/2009
Version 14

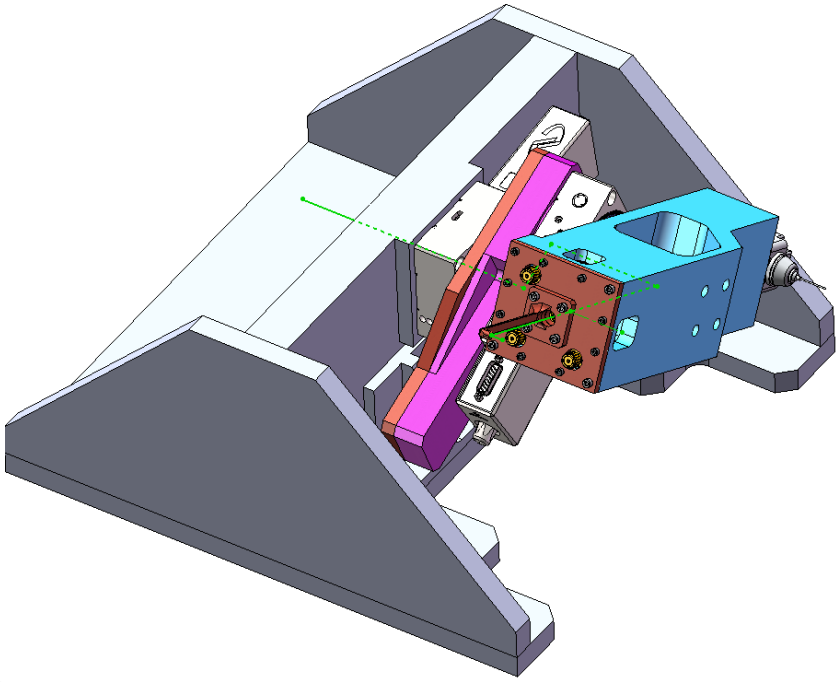
1) Design With Stages **Downstream** the light path



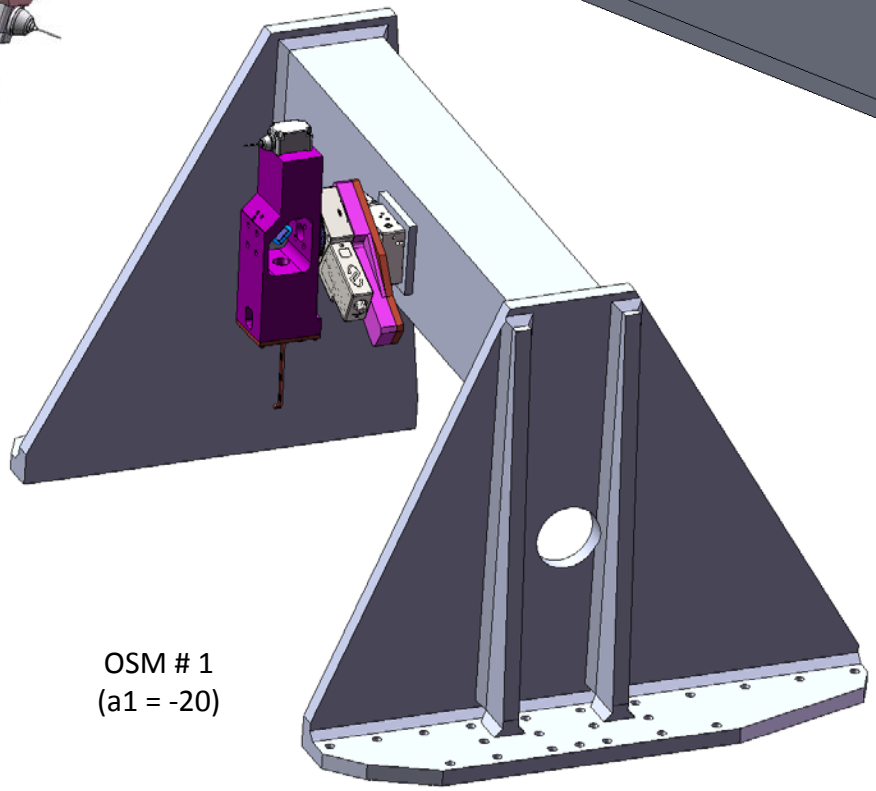
2) OSM UNITS WELDED STRUCTURE



OSM # 2
(a1 = -5)

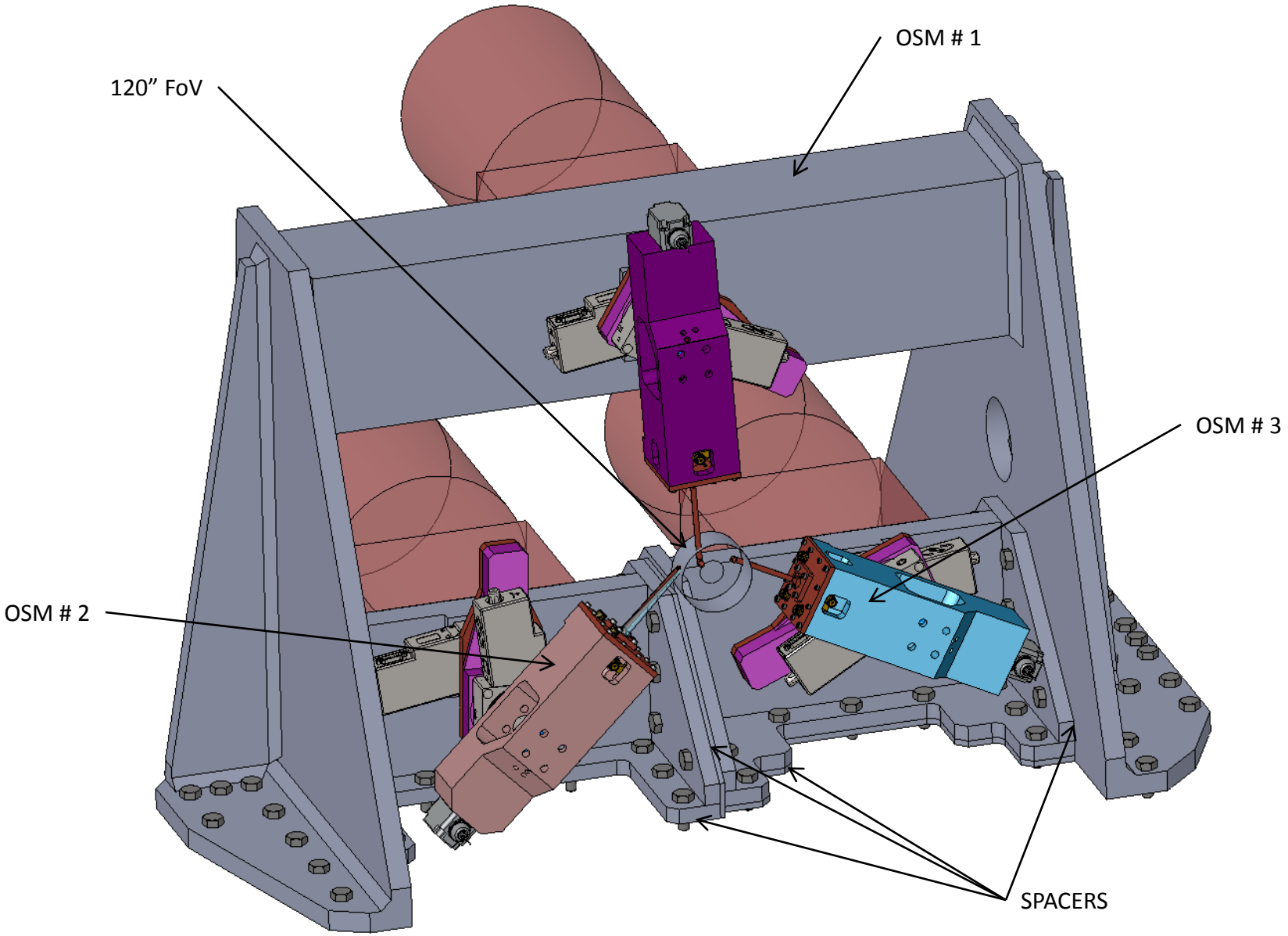


OSM # 3
(a1 = 10)

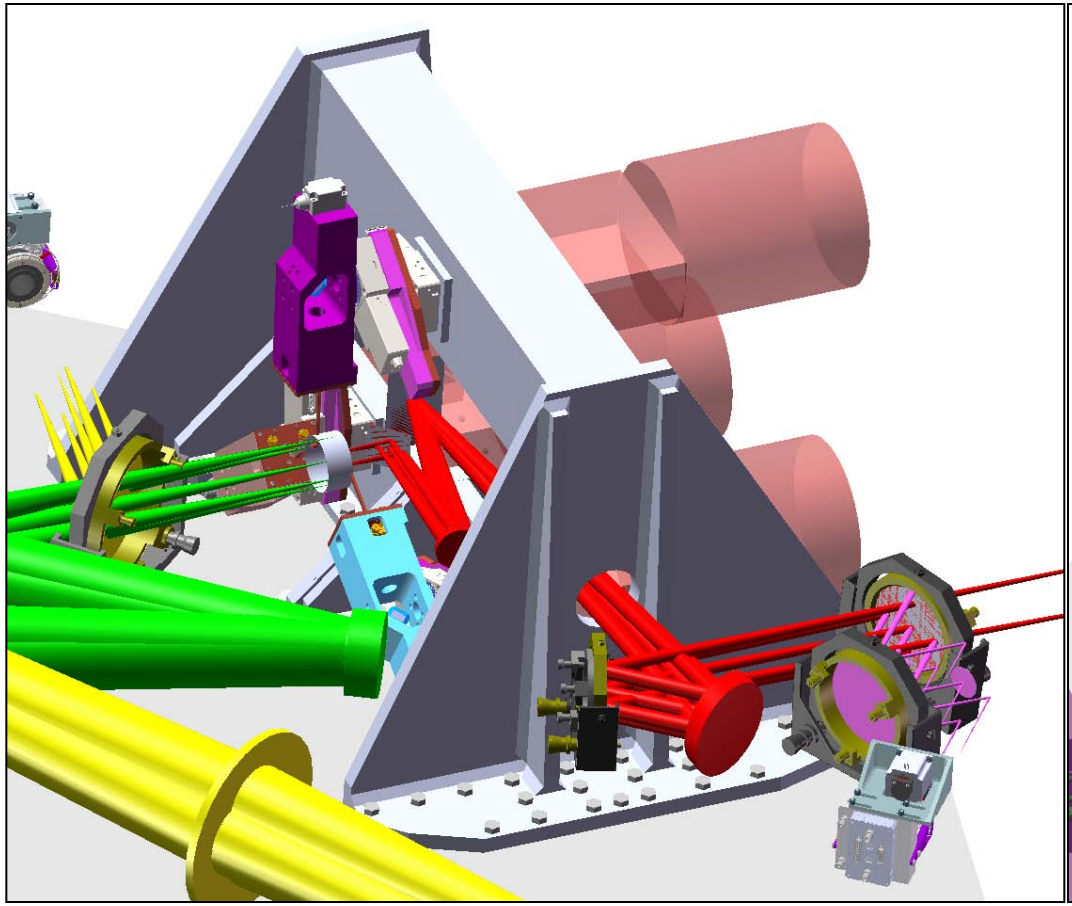


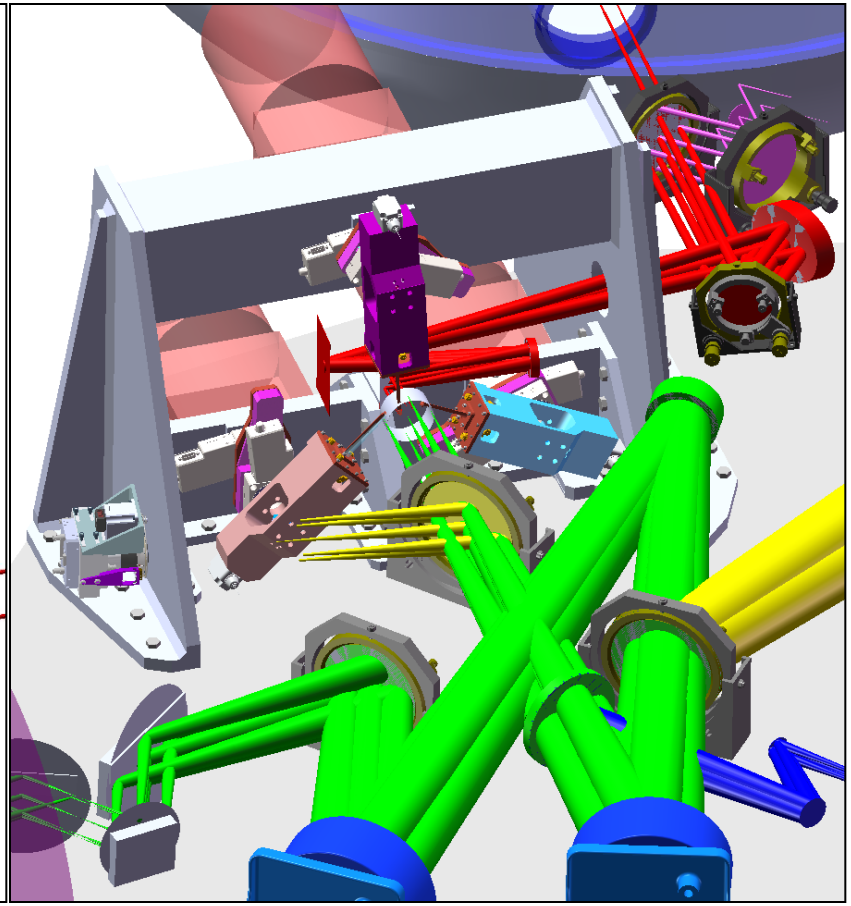
OSM # 1
(a1 = -20)

3) LOWFS ASSY BOLTED STRUCTURE



4) LOWFS ASSY INTEGRATION





5) Restricting the Optical Equation: : a = b Should be the same for each OSM

Consequence: The length of the lever arm is now the variable!

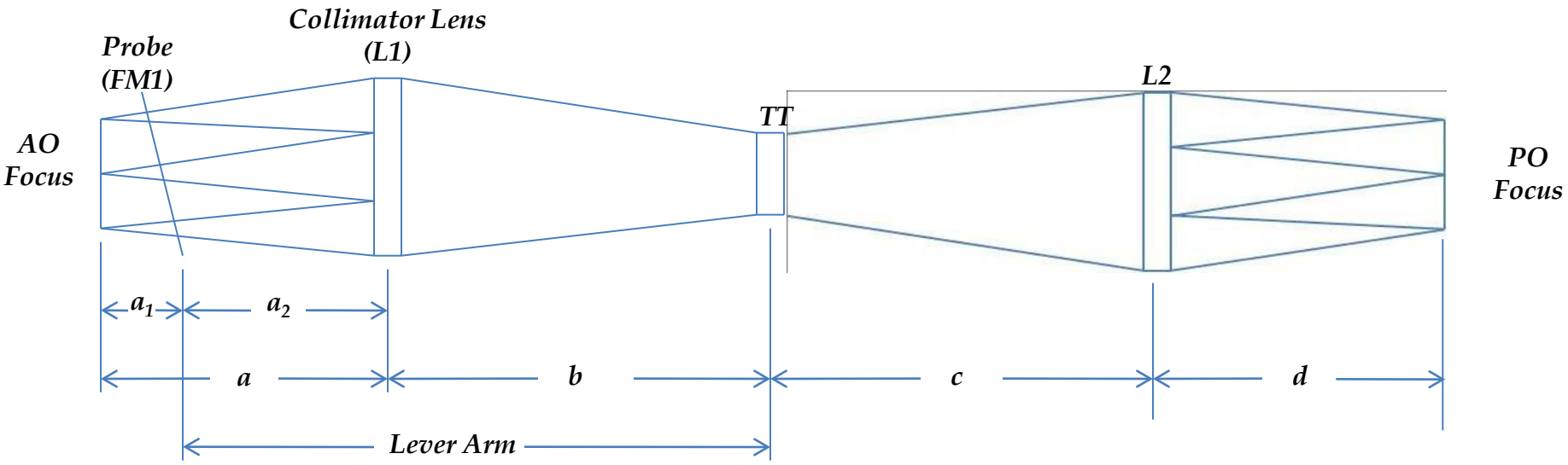


Fig. 3

Optical Layout (Fig. 3) is optimized when the following equations are verified:

5.1) a = b & c = d

5.2) a + b = x (c + d)

Keeping the AO Focus away from the Probe mirror (FM1) gives:

5.3) $a = a_1 + a_2$

Keeping each Lever arms on a different plane to avoid collision between each other gives a different value of a1 for each OSM

The Lever Arm Length previously determined gives:

5.4) Lever Arm length = $b + a_2$

Replacing 3.3 & 3.4 in 3.1 gives: $a = b \rightarrow a_1 + a_2 =$ Lever Arm length $- a_2$

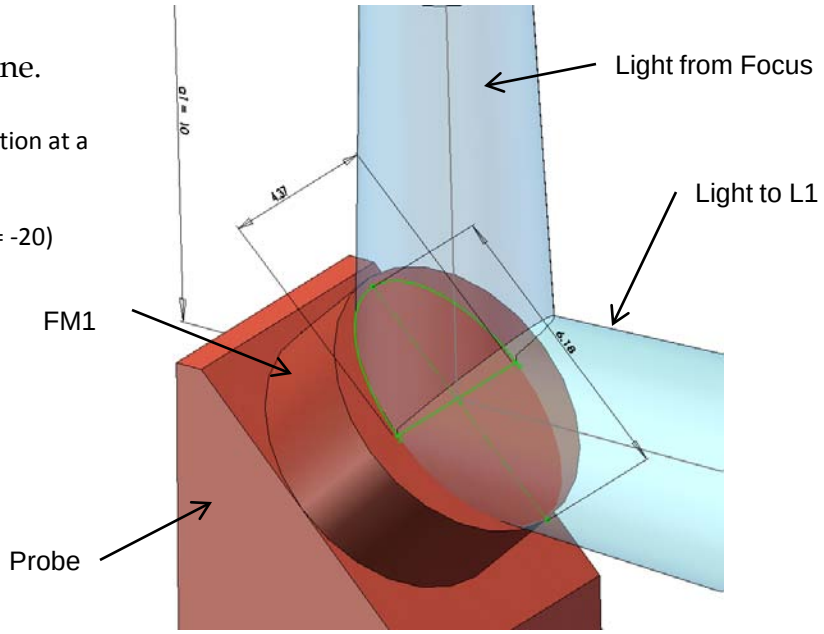
Solving for $a_2 \rightarrow 2a_2 =$ Lever Arm length $- a_1 \rightarrow$ **a_2 = (Lever Arm length - a_1)/2**

6) Sizing the Probe

6.1) Probe FoV size depends directly from it's distance from the Focal plane.

The probe Fold Mirror intercept the light beam at a 45 degree angle creating an elliptical projection at a distance a1 from the Focal plane.
The minimum diameter of the mirror needs to be larger than the Ellipse Major Diameter.
The Larger Fold mirror will be at the furthest distance from the Focal plane OSM #1 (a1 = -20)

Each Probe FoV is a potential vignetting of an other probe.



6.1.1) Largest FoV at the Fold Mirror #1 (FM1) is at OSM #1 (a1 = -20) Probe

Ellipse Minor Diameter:
d = d at Focus Plan + (a1 / f#)
= 5 X 0.727 + (20 / 13.66)
= 3.635 + 1.464
d = 5.10 mm

Ellipse Major Diameter:
D = d√2 = 5.1√2
D = 7.21 mm

6.1.2) Smallest FoV at the Fold Mirror #1 (FM1) is at OSM #2 (a1 = -5) Probe

Ellipse Minor Diameter:
d = d at Focus Plan + (a1 / f#)
= 5 X 0.727 + (5 / 13.66)
= 3.635 + .366
d = 4.00 mm

Ellipse Major Diameter:
D = d√2 = 4√2
D = 5.66 mm

6.1.3) Medium FoV at the Fold Mirror #1 (FM1) is at OSM #3 (a1 = 10) Probe

Ellipse Minor Diameter:
d = d at Focus Plan + (a1 / f#)
= 5 X 0.727 + (10 / 13.66)
= 3.635 + .732
d = 4.37 mm

Ellipse Major Diameter:
D = d√2 = 4.37√2
D = 6.18 mm

Choosing to standardize to an 8mmDiameter Mirror for each probe would facilitate manufacturing (Similar probe size, etc…) and purchasing, but would adversely increase the vignetting.
IS IT ACCEPTABLE?

6.2) Minimum Probe length:

The probe needs to be long enough to extend through the 120" Diameter FoV without vignetting any other portion of the FoV.

The smallest probe is OSM #3 (a1 = 10)

Then, using OSM #3, a_2 must be at least 120mm

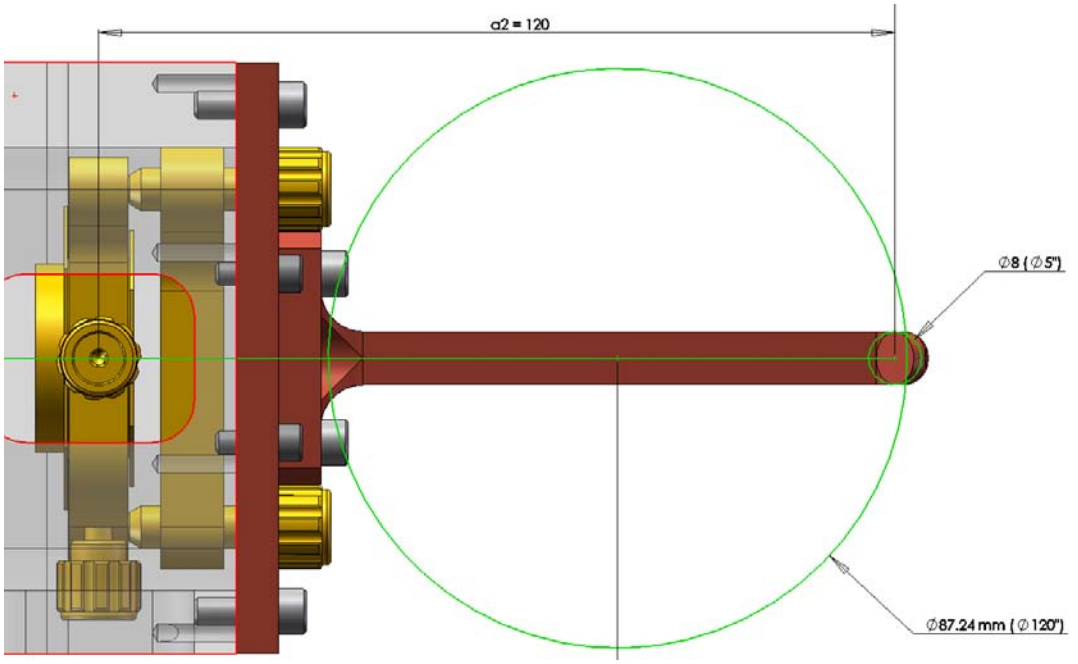
(Eq. 5.3) ➔ $a = a_1 + a_2 = 20 + 120 = 130$
(Eq. 5.1) ➔ $a = b$

With a = b = 130 and:

OSM #1 ➔ a1 = -20 mm ➔ $a_2 = a - a_1 = 130 - -20 = 150$
OSM #2 ➔ a1 = -5 mm ➔ $a_2 = a - a_1 = 130 - -5 = 135$
OSM #3 ➔ a1 = 10 mm ➔ $a_2 = a - a_1 = 130 - 10 = 120$

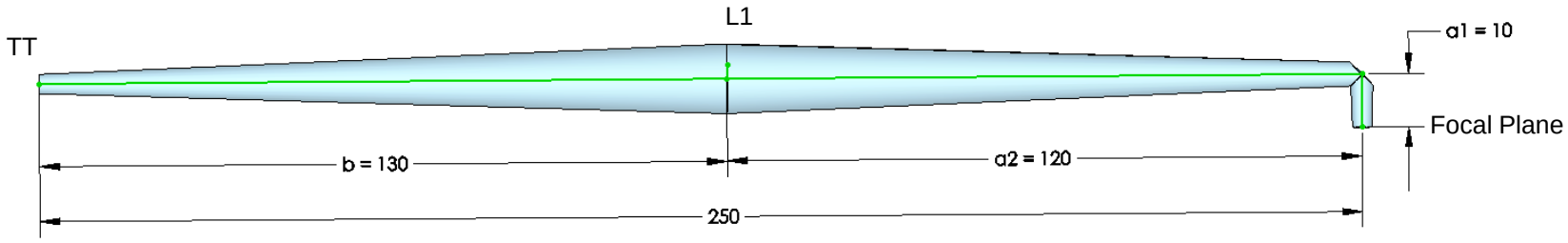
Lever Arm length = $b + a_2$ (Eq. 5.4)

OSM #1 Lever Arm Length = $b + a_2 = 130 + 150 = 280$
OSM #2 Lever Arm Length = $b + a_2 = 130 + 135 = 265$
OSM #3 Lever Arm Length = $b + a_2 = 130 + 120 = 250$



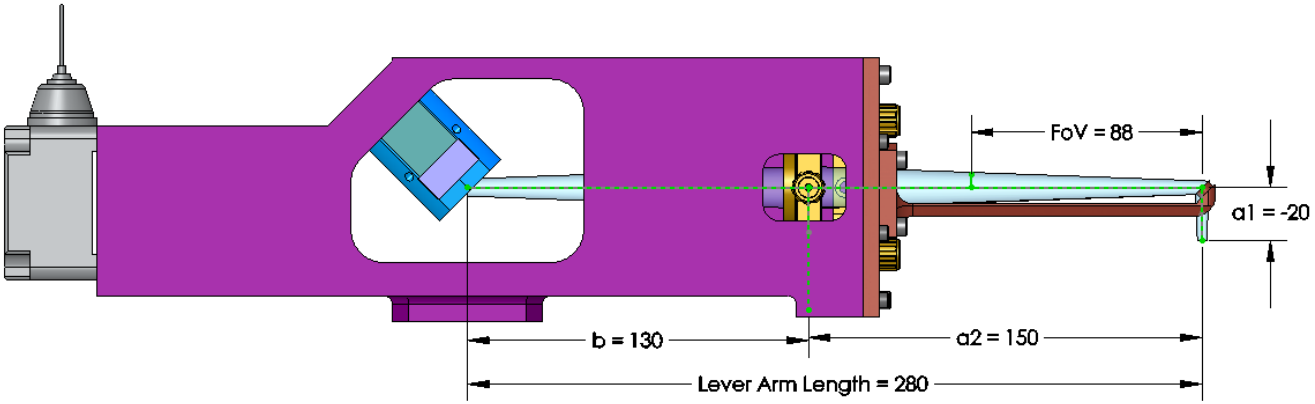
OSM#	a_1	a = b	$a_2 = a - a_1$	Arm = $b + a_2$
I	-20	130	135	280
II	-5	130	142.5	265
III	10	130	150	250

6.3) Light Beam Dimension

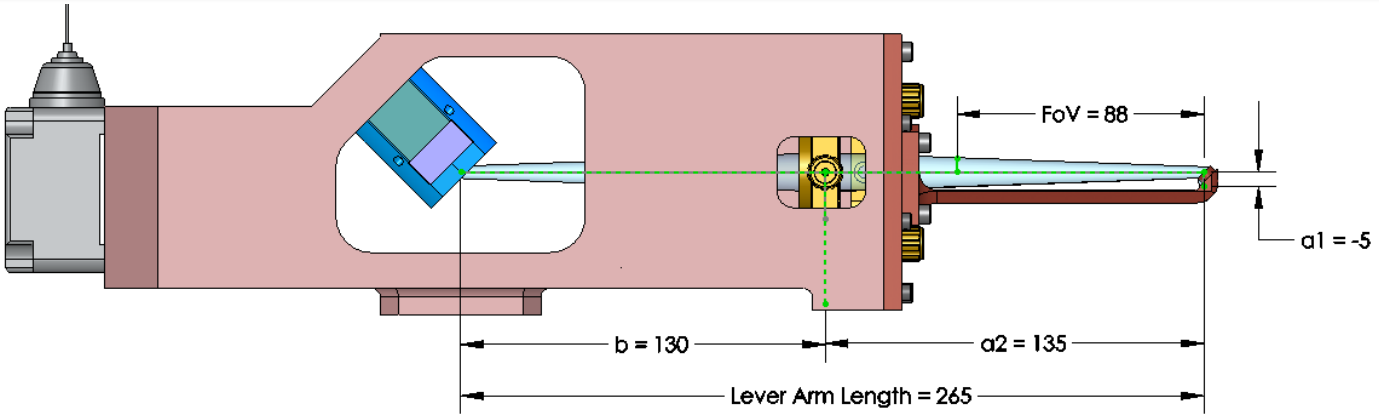


6.4) Probe Arm Length

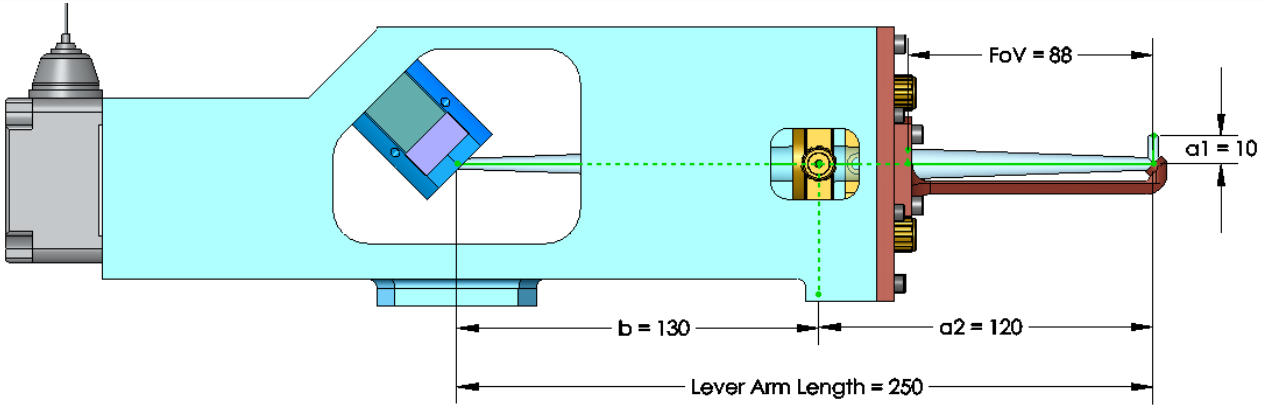
OSM #1



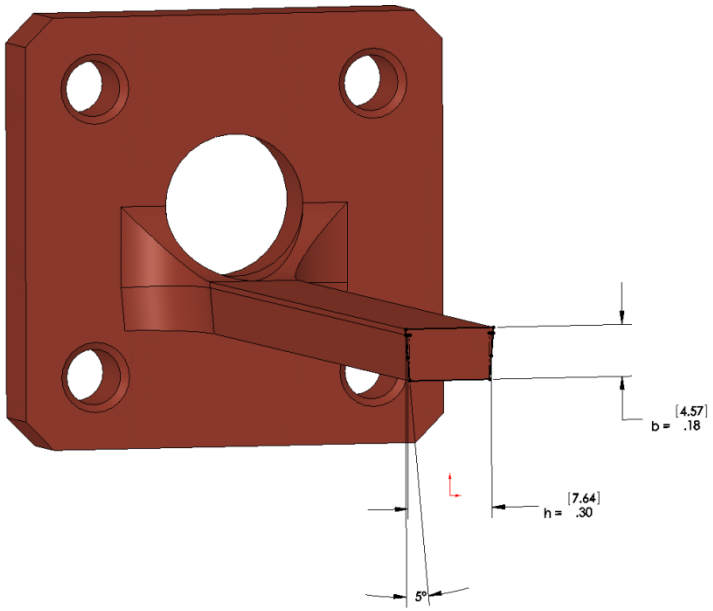
OSM #2



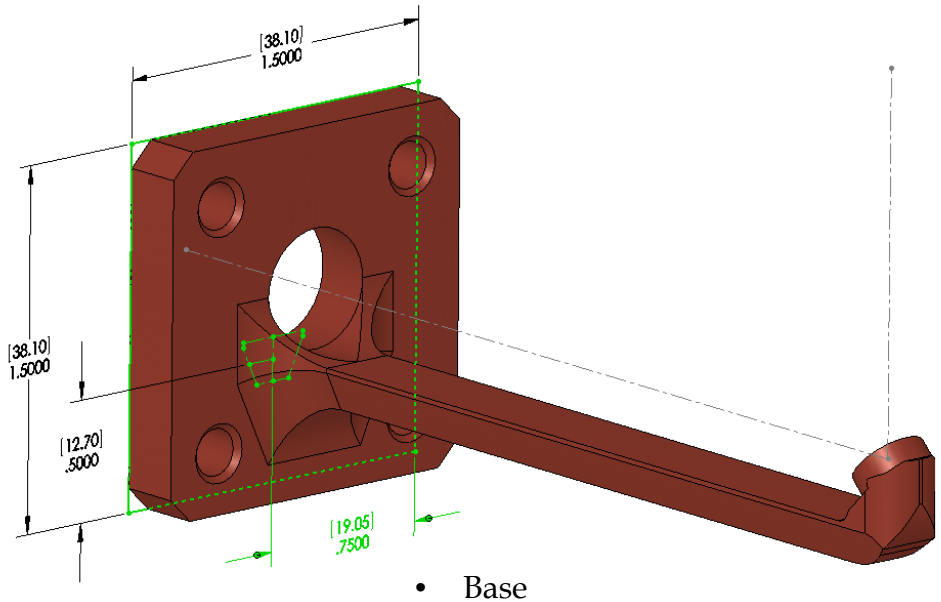
OSM #3



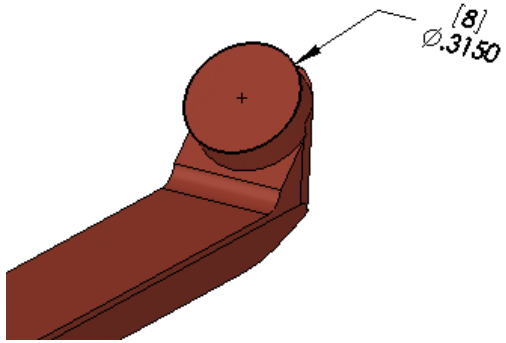
6.4) Design Features Common to all Probes



- Probe Cross Section



- Base



- Fold Mirror

6.5) Frequency Analysis

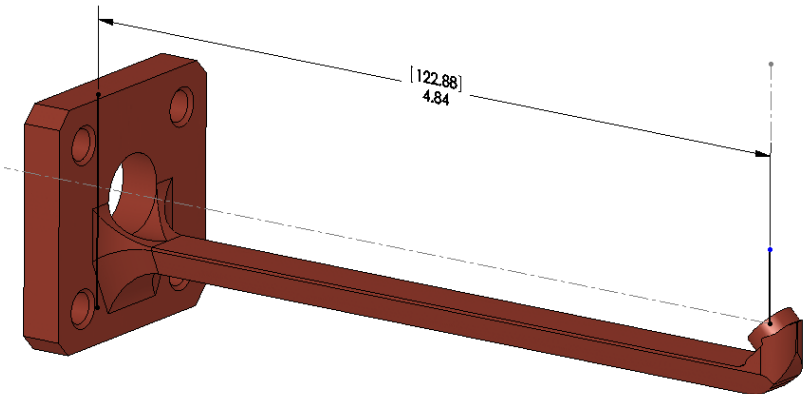
OSM #1

List Modes

Study name: Frequency

Mode No.	Frequency(Rad/sec)	Frequency(Hertz)	Period(Seconds)
1	1480.3	235.59	0.0042446
2	2512	399.79	0.0025013
3	9407	1497.2	0.00066792
4	15592	2481.6	0.00040296
5	25594	4073.5	0.00024549

Close Save Help



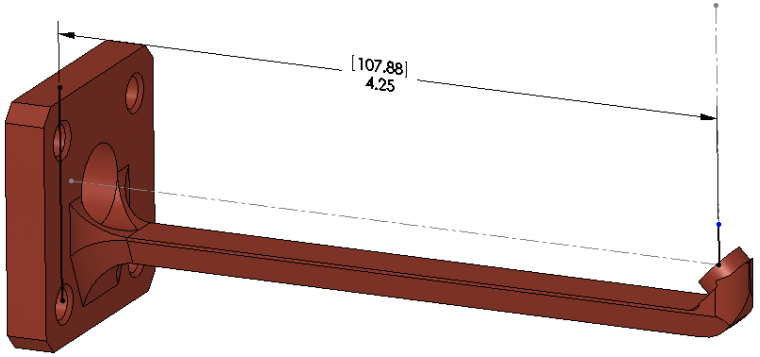
OSM #2

List Modes

Study name: Frequency

Mode No.	Frequency(Rad/sec)	Frequency(Hertz)	Period(Seconds)
1	1911.6	304.24	0.0032869
2	3246.5	516.7	0.0019354
3	12159	1935.1	0.00051677
4	19832	3156.3	0.00031683
5	29325	4667.2	0.00021426

Close Save Help



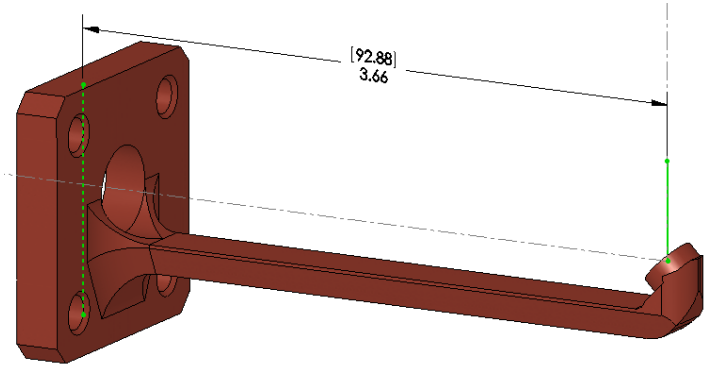
OSM #3

List Modes

Study name: Frequency

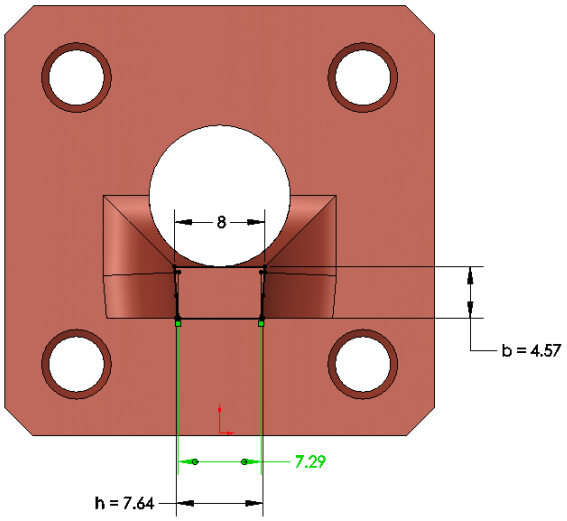
Mode No.	Frequency(Rad/sec)	Frequency(Hertz)	Period(Seconds)
1	2514.5	400.2	0.0024987
2	3706.5	589.9	0.0016952
3	16237	2584.2	0.00038696
4	22491	3579.5	0.00027937
5	32890	5234.6	0.00019103

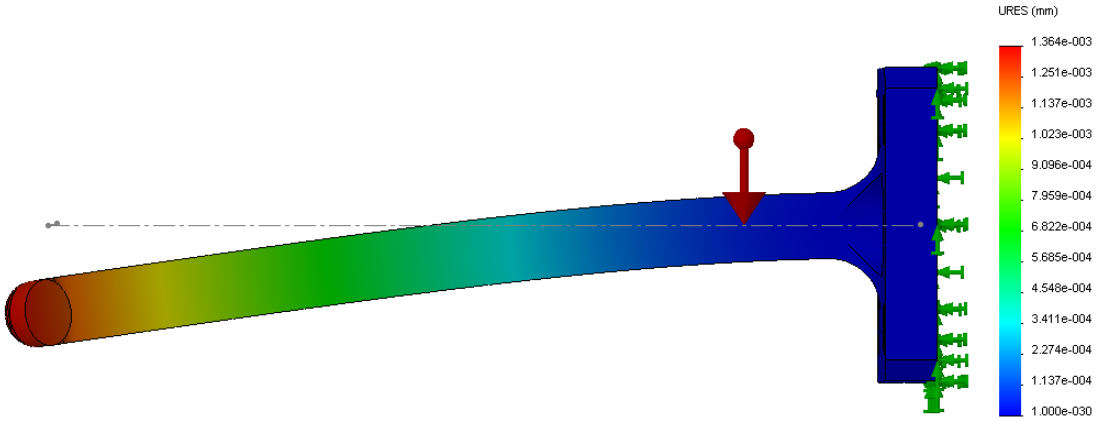
Close Save Help



6.6) Probe Deflection, at rest, under it's own weight:

- Deflection analyzed on the longest Inclined probe (OSM #2)





Probe Deflection

-Mass of the probe w = mg = 0.01 Kg x 9.81 ms^{-2} = 0.098N

-Moment of Inertia: I = $bh^3/12$ = 4.57 x $7.64^3/12$ = 169.8 mm^4

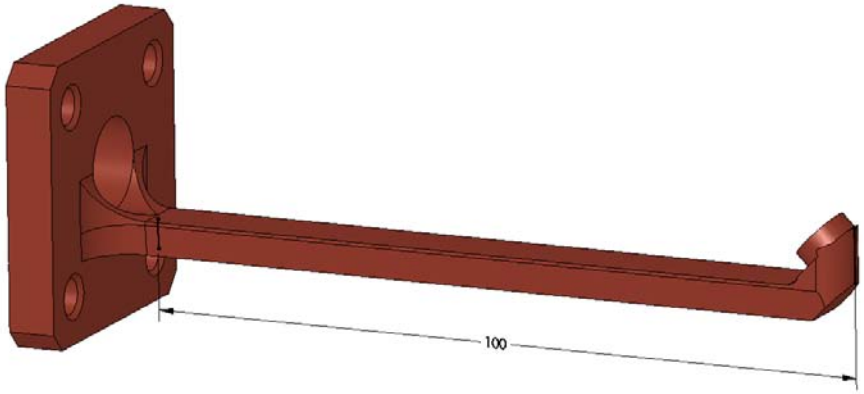
-6061-T6 Module of Elasticity: E = 68,800 N/mm^2

-Max Deflection: v = wL^3 / 8EI

v =0.098 X 100^3 / (8 X 68,800 X 169.8)

v = 98000/ 93457920

v = 0.001mm



Probe Length

Remaining work to be done

-System rigidity Analysis

Questions:

-Probe position Accuracy: 40 (KAON 562) or 70 mas (Contour)
- Minimum Incremental motion ?
- Max Wobble?
- Position Stability (5 mas / 3600 s) TBC
- TT Requirements (Deflection, response, resolution,…)