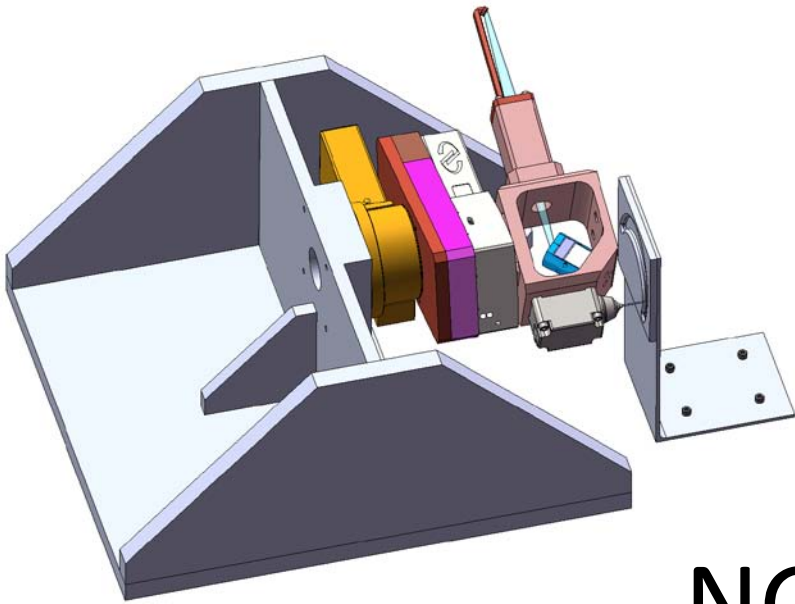




NGAO OSM

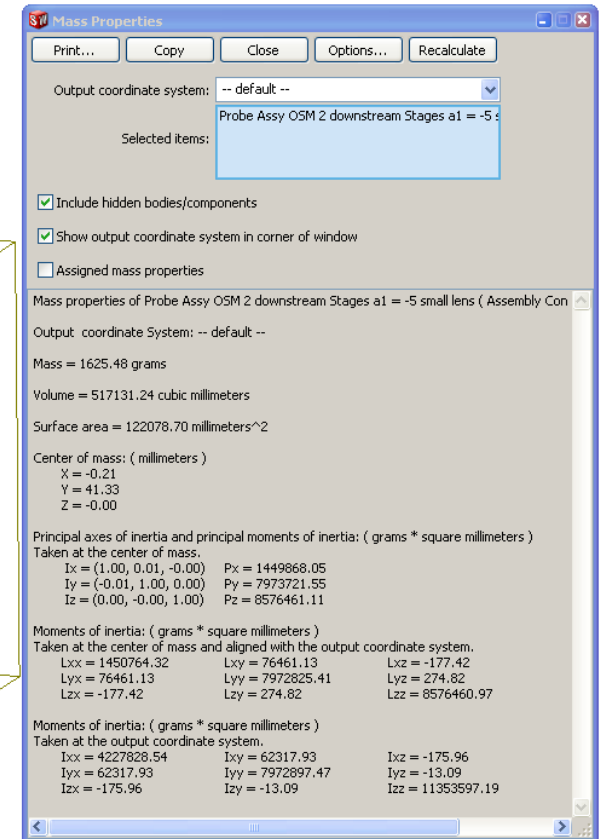
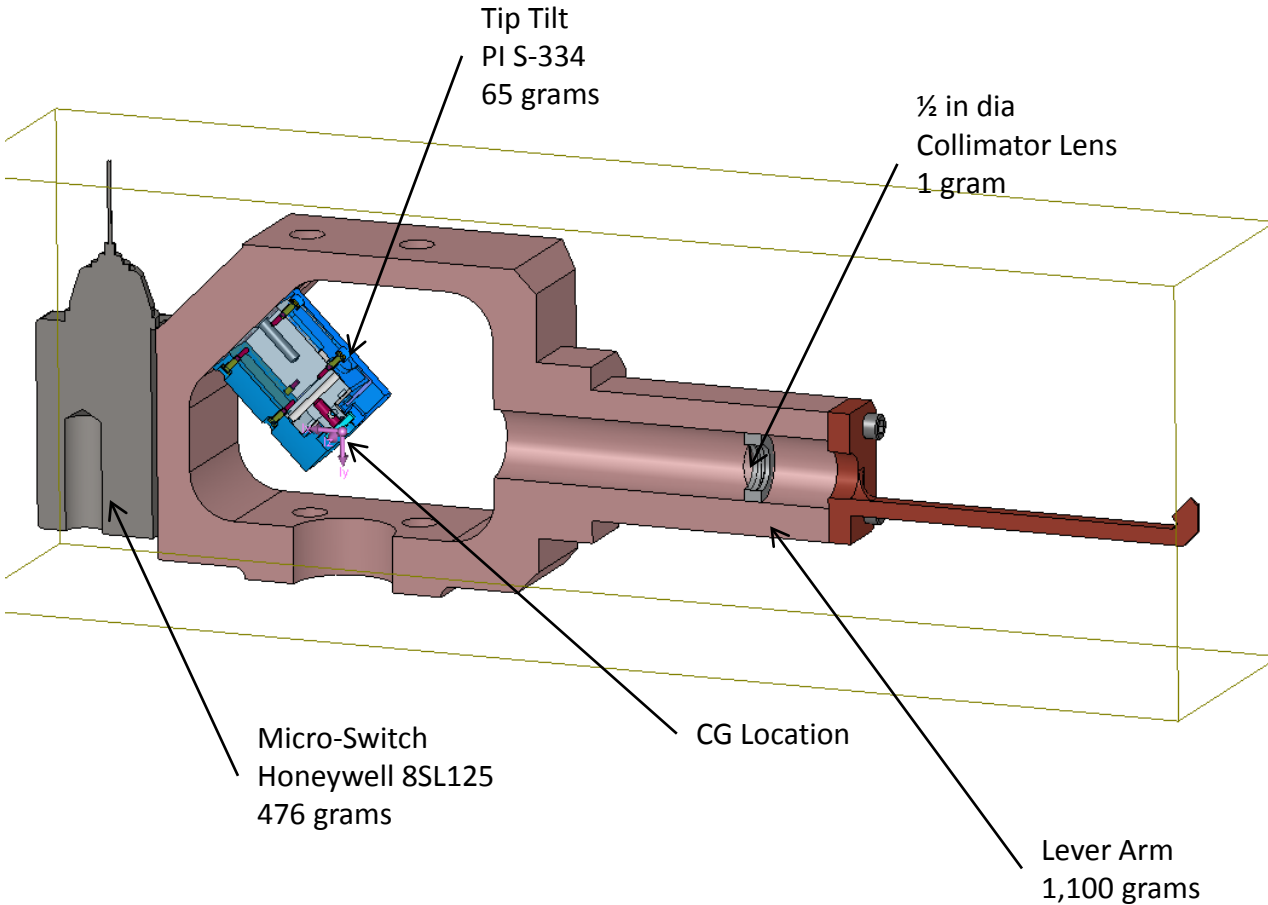
Design Study Update

Alex Delacroix
09/22/2009
Version 17

1) Mass and CG

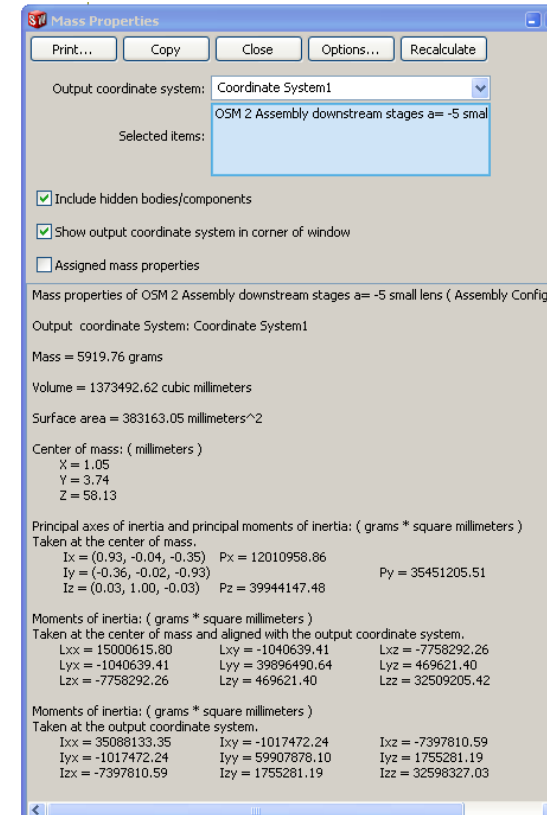
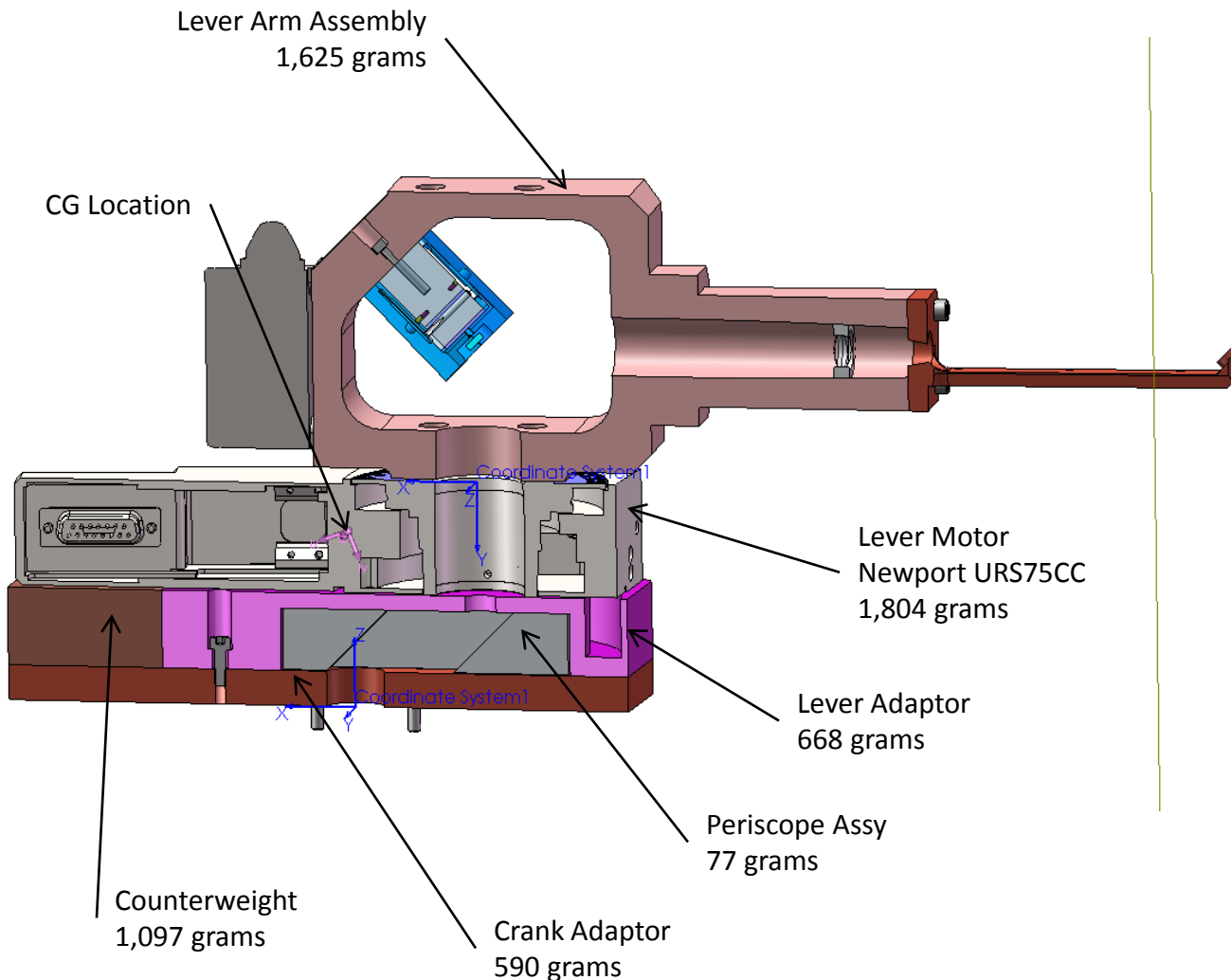
6.1) Lever Arm Assembly

Total Mass: 1,625 grams, CG located at the Axis of rotation, 41 mm above the Lever motor Interface.



6.2) OSM #1 Assembly

Total Mass: 5,920 grams, CG located at the Crank Axis of rotation, 58 mm above the Lever motor Interface.



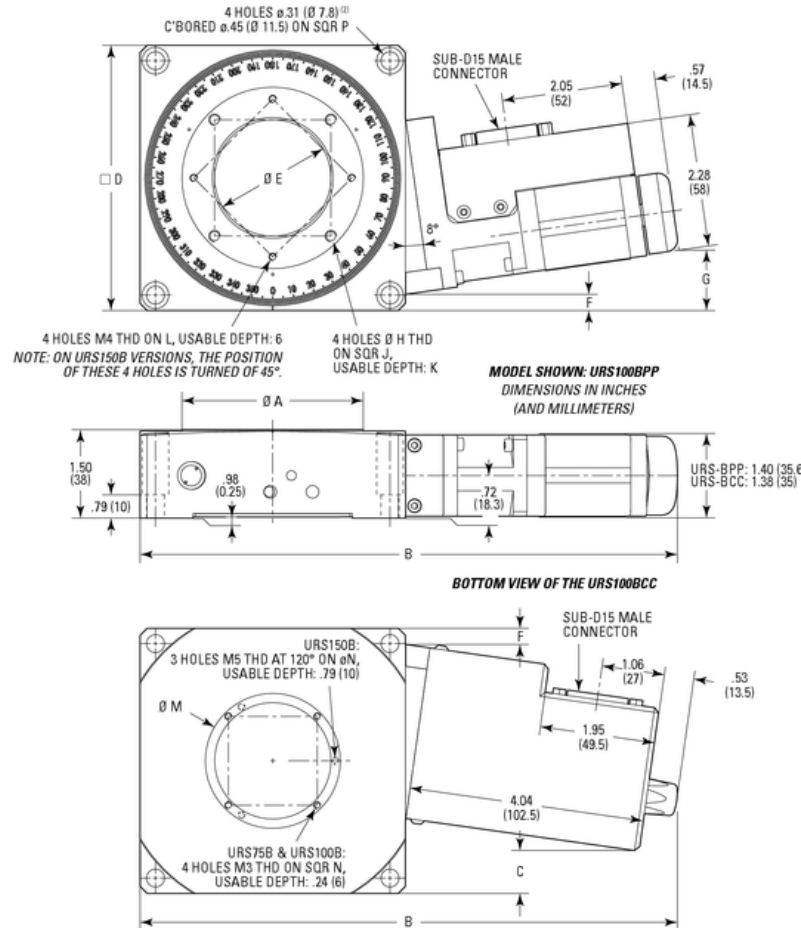
2)Newport Stage Specifications

Newport URS Series Precision Rotation Stages

Dimensions

Dimensions in inches (millimeters)

MODEL URS100B



	A	B	C	D	E	F	G	H	J	K	L	M	N	P
URS75B	1.97 (50)	8.19 (208)	~20 ⁽¹⁾ (511)	3.54 (90)	1.18 ⁽¹⁰⁰⁾ (30)	.08 (2)	.83 (21)	M3	1.26 (32)	.24 (6)	—	1.50 (38)	1.34 (34)	2.98 (75.6)
URS100B	3.07 (78)	9.13 (232)	.71 (18)	4.49 (114)	1.97 ⁽⁵⁰⁾ (50)	.26 (6.5)	1.02 (26)	M6	1.97 (50)	.24 (6)	SQR 1.89 (48)	2.28 (58)	2.13 (54)	3.97 (100.8)
URS150B	5.18 (131.5)	11.14 (283)	2.56 (65)	6.50 (165)	3.54 ⁽⁹⁰⁾ (90)	.41 (10.5)	1.14 (29)	M6	2.95 (75)	.31 (8)	ø4.92 (Ø 125)	4.13 (105)	3.86 (98)	5.91 and 6 ⁽¹⁰⁾ (150 and 152.4) ⁽¹⁰⁾

Notes:

⁽¹⁾ The drive box of the URS75BCC exceeds .20 in. (5 mm) from the body.

⁽²⁾ URS150B: 4 slots counterbored.

Design Details

Base Material	Hardened steel with aluminum body
Bearings	
Drive Mechanism	Ground worm gear with self-compensating preload. Additional 1:2.75 drive belt with URS-CC versions (no belt on URS-PP versions)
Worm Gear Ratio	1:90
Feedback	CC: Worm mounted rotary encoder, 8,000 cts/rev, index pulse. PP: None
Limit Switches	Two independently adjustable optical limit switches
Origin	Optical, fixed at position 0°. Typical 0.0005° repeatability for URS-CC and 0.04° repeatability for URS-PP
Manual Adjustment	Via allen wrench at the end of the worm screw. Allen wrench is included.
Motor	CC: UE34CC DC servo motor PP: UE34PP Two phase stepper motor, 1 full step = 0.02°
Cable	

Specifications

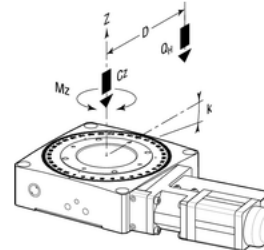
	PP		CC	
	Typical	Guaranteed	Typical	Guaranteed
Travel Range (°)	360 continuous ⁽¹⁾			
Resolution (°)	0.0002 ⁽²⁾		0.0005	
Minimum Incremental Motion (°)	0.0002		0.002	
Uni-directional Repeatability (°)	0.001	0.002	0.001	0.002
Reversal Value (Hysteresis) (°)	0.006	0.01	0.002	0.004
Absolute Accuracy (°)	0.016	0.030	0.012	0.023
Maximum Speed (°/s)	40		80	
Wobble (µrad)	20	50	20	50
Eccentricity (µm)	3		3	
MTBF	20,000 h at 25% load and with a 30% duty cycle			

1) With disabled limit switches

2) Equal to 1/100 of a full step

See the Motion Control Metrology Primer section (see [Motion Control Metrology Primer](#)) for more information on typical and guaranteed values.

Load Characteristics



	URS75	URS100	URS150
Cz, Normal centered load capacity (N)	200	300	300
a, Construction parameter (mm)	25	5	55
ka, Transversal compliance (µrad/Nm)	30	0	5
Mz, Nominal Torque (Nm)	+/- 0.5	+/- 1	+/- 2
Q, Off-center load	$Q \leq C_z / (1 + D/a)$		
D, Cantilever distance in mm			
Weight [lb (kg)]	3.7 (1.7)	4 (2)	7.5 (3.4)

STATIC LOAD ON CRANK MOTOR

3) Static Load Analysis on Crank Motor URS75

3.1) Load (Qh):

$$Q_h = 5.920\text{Kg} = 59.2\text{N}$$

3.2) Cantilever Torque:

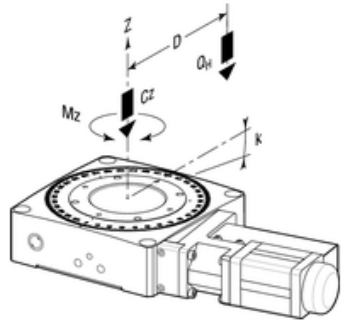
Distance between Crank Motor and center of Mass: $D = 58\text{mm}$

Cantilever Torque at Crank motor: $0.058\text{m} \times 59.2 = 3.4\text{ Nm}$

Off Center Load Requirement: $Q < 200 / (2 / (1 + 58/25)) = 30\text{ N}$

59N > 30N → THE LOAD IS TOO HIGH FOR THIS STAGE

Load Characteristics



	URS75	URS100	URS150
Cz, Normal centered load capacity (N)	200	300	300
a, Construction parameter (mm)	25	35	55
kα, Transversal compliance (μrad/Nm)	30	10	5
Mz, Nominal Torque (Nm)	+/- 0.5	+/- 1	+/- 2
Q, Off-center load	$Q \leq C_z / (1 + D/a)$		
D, Cantilever distance in mm			
Weight [lb (kg)]	3.7 (1.7)	4.4 (2)	7.5 (3.4)

4) Static Load Analysis on Crank Motor URS150

4.1) Load (Qh): $Q_h = 5.920\text{Kg} = 59.2\text{N}$

4.2) Cantilever Torque:

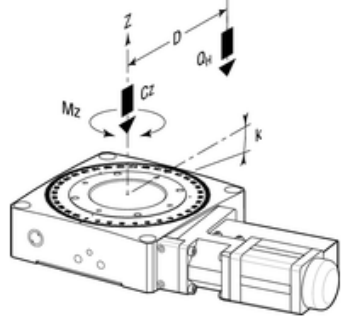
Distance between Crank Motor and center of Mass: $D = 58\text{mm}$

Cantilever Torque at Crank motor: $0.058\text{m} \times 59.2 = 3.4\text{ Nm}$

Max Off Center Load: $300 / 2 / (1 + 58/55) = 73\text{ N}$

$59\text{N} < 73\text{N} \rightarrow \text{FS} = 1.2$

Load Characteristics



Component	Manufacturer	P/N	Weight (Kg)	Mass (N)
TT Mirror	PI	S-334	0.065	
Lens Holder	Newport	LPV-1	0.001	
Microswitch	Honeywell	8SL125	0.476	
Lever Arm	Caltech	XXX	1.083	
Lever Arm Assy			1.625	
Rotation Stage	Newport	URS75CC	1.804	
Lever Adaptor	Caltech	XXX	0.668	
Periscope Assy	Caltech	XXX	0.136	
Crank Adaptor	Caltech	XXX	0.59	
Counterweight	Caltech	XXX	1.097	
Total Mass			5.92	58.08
D	58			
Cz	300			
a	55			
Max Off center load				73
K(urad/Nm)	5			
Torque (Nm)	3.37			
Deflection (urad) (rad)	16.84	1.68418E-05		
Proj Distance (mm)	130			
Deflection at tip (mm)	0.0022			
Tip Horiz disp (mm)	0.0022			
Tip Vert disp (mm)	0.0000			

	URS75	URS100	URS150
Cz, Normal centered load capacity (N)	200	300	300
a, Construction parameter (mm)	25	35	55
kα, Transversal compliance (μrad/Nm)	30	10	5
Mz, Nominal Torque (Nm)	+/- 0.5	+/- 1	+/- 2
Q, Off-center load	$Q \leq C_z / (1 + D/a)$		
D, Cantilever distance in mm			
Weight [lb (kg)]	3.7 (1.7)	4.4 (2)	7.5 (3.4)

5) Static Load Analysis on Crank Motor RVS80CC

5.1) Load $Q_v = 5.920\text{Kg} = 59.2\text{N}$

Distance between Crank Motor and center of Mass: $D = 58 + 32 = 90\text{ mm}$

Cantilever Torque at Crank motor: $0.090\text{m} \times 59\text{N} = 5.3\text{ Nm}$

Max Off Center Load: $900/2 / (1 + 90/30) = 112\text{ N}$

$$59\text{N} < 112\text{N} \rightarrow \text{FS} = 1.9$$

Load Characteristics

	RVS80	RV120	RV160	RV240	RV350
Cz, normal centered load capacity (N)	900	1800	2700	4000	6500
a, construction parameter (mm)	30	40	50	70	100
b*, (mm) except HAT & HAHLT	39	53	57	59	73
b*, (mm) for HAT & HAHLT		71	75	77	91
k, radial compliance ($\mu\text{rad}/\text{Nm}$)	3.5	1.5	0.6	0.3	0.1
Q_H , Off-center load, vertical rotation axis	$Q_H \text{ Cz} / (1+D/a)$				
Q_V , Off-center load, horizontal rotation axis	$Q_V \text{ Cz} / 2 / (1+D/a)$				

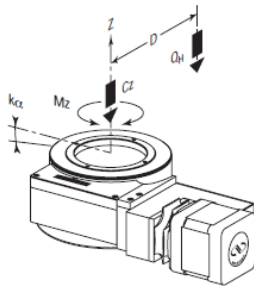
* Construction parameter = Distance between the top surface of the RV stage and the bearing center.

Example:

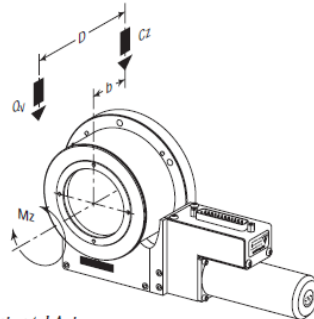
Q_V at a distance of 80 mm from the top surface for a RV160HAT rotation stage,
 $D = 80\text{ mm} + 75\text{ mm} = 155\text{ mm}$:

$$Q_V = 2700\text{ N} / 2 / (1 + 155\text{ mm} / 50\text{ mm}) = 329\text{ N}$$

Load Rotation Axes



Vertical Axis



Horizontal Axis

Component	Manufacturer	P/N	Weight (Kg)	Mass (N)
TT Mirror	PI	S-334	0.065	
Lens Holder	Newport	LPV-1	0.001	
Microswitch	Honeywell	8SL125	0.476	
Lever Arm	Caltech	XXX	1.083	
Lever Arm Assy			1.625	
Rotation Stage	Newport	URS75CC	1.804	
Lever Adaptor	Caltech	XXX	0.668	
Periscope Assy	Caltech	XXX	0.136	
Crank Adaptor	Caltech	XXX	0.59	
Counterweight	Caltech	XXX	1.097	
Total Mass			5.92	58.08
D	90			
Cz	900			
a	30			
Max Off center load				225
K($\mu\text{rad}/\text{Nm}$)	3.5			
Torque (Nm)	5.2			
Deflection (μrad) (rad)	18.29	1.82937E-05		
Proj Distance (mm)	130			
Deflection at tip (mm)	0.0024			
Tip Horiz disp (mm)	0.0024			
Tip Vert disp (mm)	0.0000			

STATIC LOAD ON LEVER MOTOR

6) Static Load Analysis on Lever Motor URS75

6.1) Load (Qh):

$$Q_h = 1.625 \text{ Kg} = 15.9 \text{ N}$$

6.2) Cantilever Torque:

Distance between Lever Motor and center of Mass: $D = 41 \text{ mm}$

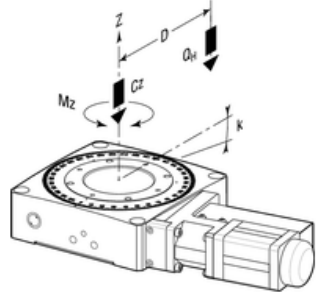
Cantilever Torque at Lever motor: $0.041 \text{ m} \times 15.9 = 0.65 \text{ Nm}$

Off Center Load Requirement: $Q < 200 / 2 / (1 + 41/25) = 38 \text{ N} \rightarrow 16 \text{ N} < 38 \text{ N}$

$$16 \text{ N} < 38 \text{ N} \rightarrow \text{FS} = 2.4$$

Tip deflection angle K (urad) = $30 \times 0.65 = 19.6 \text{ urad}$:

Load Characteristics

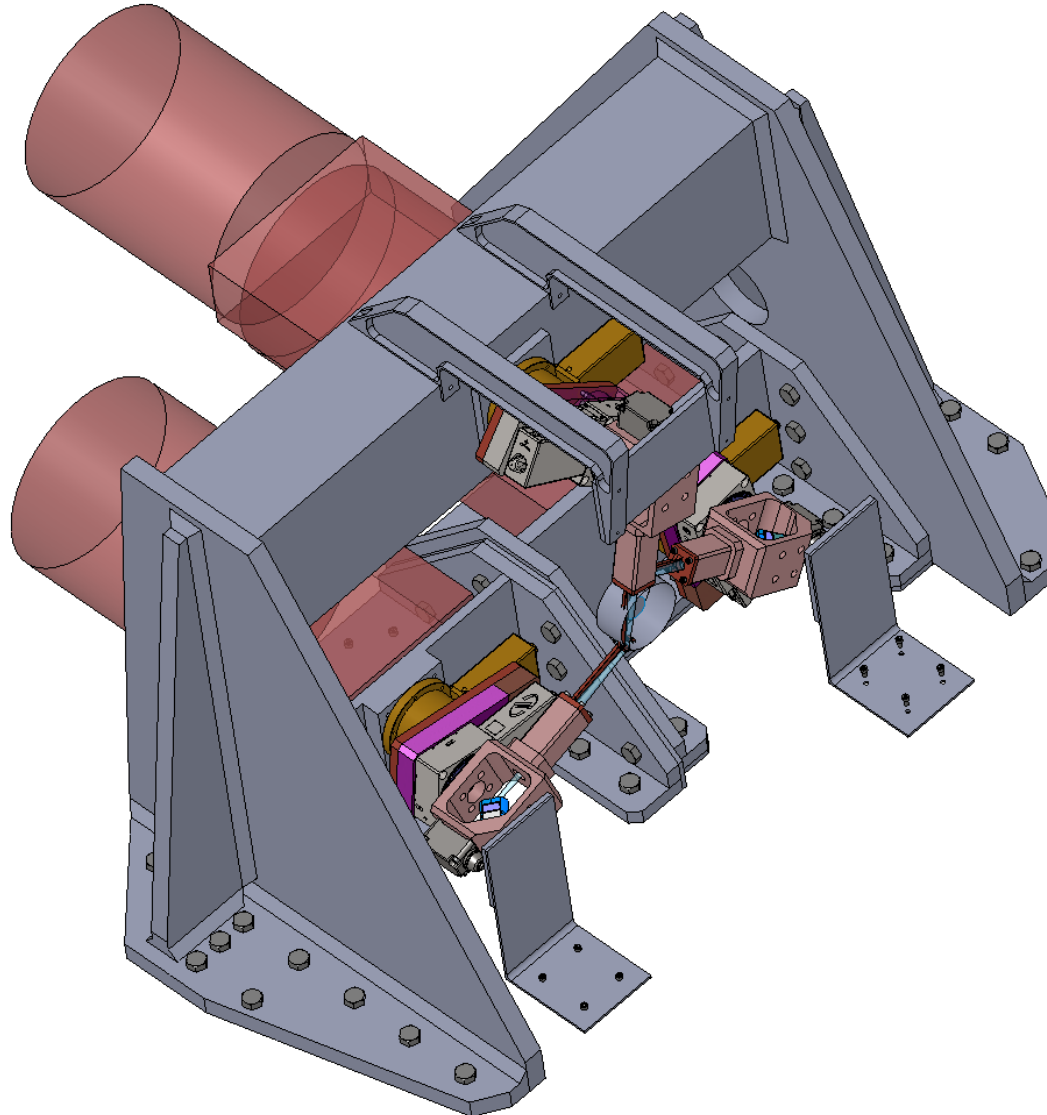


Component	Manufacturer	P/N	Weight (Kg)	Mass (N)
TT Mirror	PI	S-334	0.065	
Lens Holder	Newport	LPV-1	0.001	
Microswitch	Honeywell	8SL125	0.476	
Lever Arm	Caltech	XXX	1.083	
Lever Arm Assy			1.625	
Total Mass			1.625	15.94
D (mm)	41			
Cz (N)	200			
a (mm)	25			
Max Off center load (N)				76
K(urad/Nm)	30			
Torque (Nm)	0.65			
Deflection (urad) (rad)	19.61	1.96077E-05		
Proj Dist (mm)	112			
Twisting of the tip (mm)	0.0022			
Tip Horiz disp (mm)	0.0022			
Tip Vert disp (mm)	0.0000			

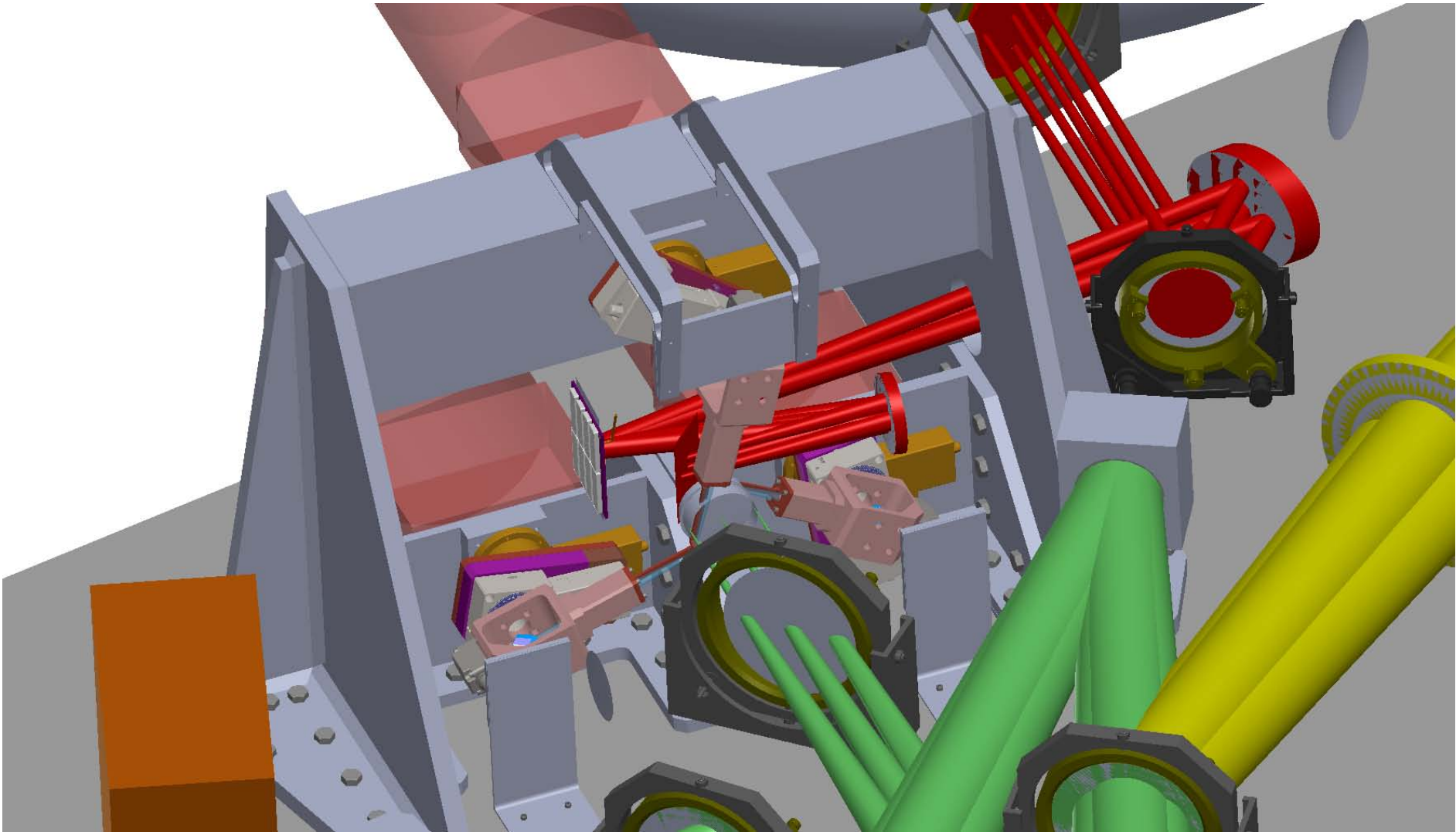
	URS75	URS100	URS150
Cz, Normal centered load capacity (N)	200	300	300
a, Construction parameter (mm)	25	35	55
kα, Transversal compliance (μrad/Nm)	30	10	5
Mz, Nominal Torque (Nm)	+/- 0.5	+/- 1	+/- 2
Q, Off-center load	$Q \leq C_z / (1 + D/a)$		
D, Cantilever distance in mm			
Weight (lb (kg))	3.7 (1.7)	4.4 (2)	7.5 (3.4)

CONCLUSION ON THE STAGES CHOICES

- Newport Stage RVS80CC is more adapted to the imposed Cantilever load on the crank.
- Newport Stage URS75 is suitable as Lever motor.

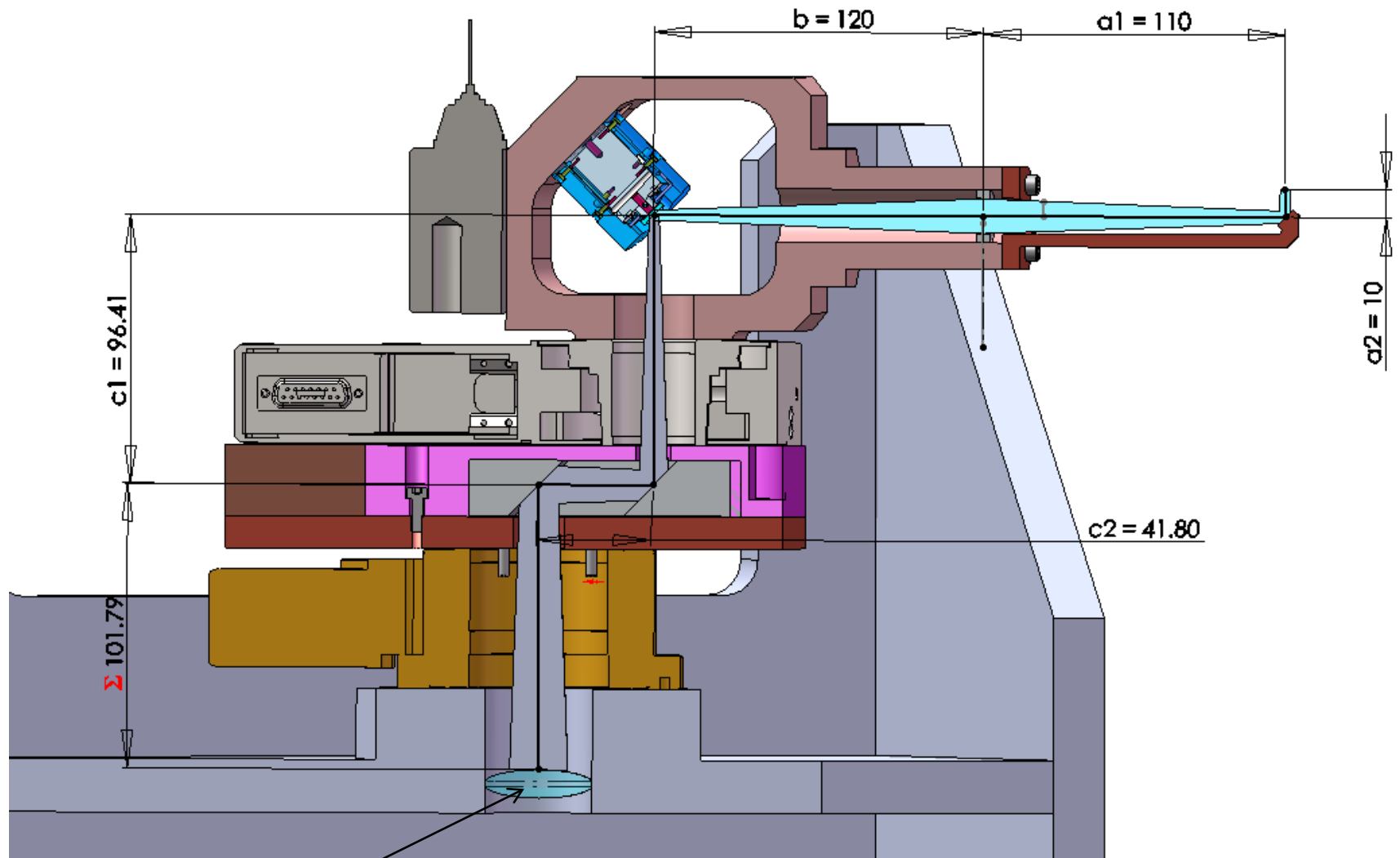


NGAO VIEW



OPTICAL PATH

$$a = b = 120\text{mm} \ \& \ c = d = 240\text{mm}$$



1 in dia Lens

OPEN ISSUES

- 1) The entire 200Kg LOWFS OSM should be installed on linear stages to provide the 5mm focus adjustment necessary to compensate for the Dichroic pickoff motion. (Accuracy TBD)
- 2) The 1mm sag caused by the curved focus around the Probes FM1 is not solved yet.

