

NSLS-II BMA & 3PW Diagnostic Beamlines



Prepared by: Muhammad Aftab Hussain

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Outline

- BMA & 3PW Diagnostic Beamline Specifications
- BMA & 3PW Diagnostic Beamline Layout
- BMA & 3PW Diagnostic Beamline Ray Tracing.
- BMA & 3PW Diagnostic Beamline Components Design
- Survey & Alignment
- Summary and Conclusion.

Acknowledgments

- Bernard Kosciuk
- Paul Schneider
- Angelo Caruso
- Lewis Doom
- Charles Hetzel
- Dick Hseuh
- Om Singh
- Petr Illinski
- Sushil Sharma

BMA Diagnostic Beamline Specifications

BMA Source Point:

BMA Beamline uses the Cell-22 BM-A (first bending magnet of Cell-22, which is mounted on Girder-3). The source point is at 48 mrad from the center of BM-A.

BMA Crotch Absorber:

The crotch absorber will have 5 mm Horizontal and 5 mm Vertical Aperture. The horizontal and vertical fan size from crotch absorber is 1.91 mrad.

BMA Gate Valve:

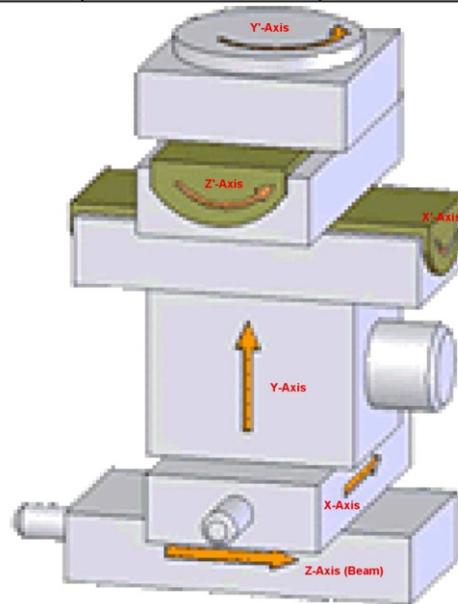
Vacuum Gate valve will be used to isolate X-Ray Exit Window from storage ring during maintenance.

BMA X-Ray Exit Window/Fixed Mask:

X-ray Exit window will have 1 mm horizontal and 5 mm vertical aperture. This will allow only .342 mrad horizontal and 1.691 mrad vertical fan.

BMA Diagnostic Beamline Specifications

Component	Location (m) From Source	Alignment with respect to Beam Centerline (Z-Axis)				
		X (mm) (Transverse)	Y (mm) (Vertical)	X' (Deg.) (Swivel)	Y' (Deg.) (Rotation)	Z' (Deg.) (Swivel)
<i>X-Ray Exit Window</i>	2.91	-	-	-	-	-
<i>Vertical Slit</i>	3	+/-35	+/-12.5	+/-8	-	+/-8
<i>Vertical CRL</i>	3.38	+/-35	+/-12.5	-	+174/-84	+/-8
<i>Horizontal Slit</i>	6	+/-35	+/-12.5	+/-8	+174/-84	-
<i>Horizontal CRL</i>	10.3	+/-35	+/-12.5	-	+174/-84	+/-8
<i>Mirror</i>	10.6	+/-35	+/-12.5	-	+174/-84	-
<i>LR/HR Imaging</i>	15.88	+/-35	+/-35	-	-	-



3PW Diagnostic Beamline Specifications

3PW Source Point:

3PW Beamline uses the Cell-22 3PW (which is mounted on Girder-5). The source point is **366mm** upstream of BM-B upstream lattice point.

3PW Crotch Absorber:

The crotch absorber will have 5 mm Horizontal and 5 mm Vertical Aperture. The horizontal and vertical fan size from crotch absorber is **1.635 mrad**.

3PW Gate Valve:

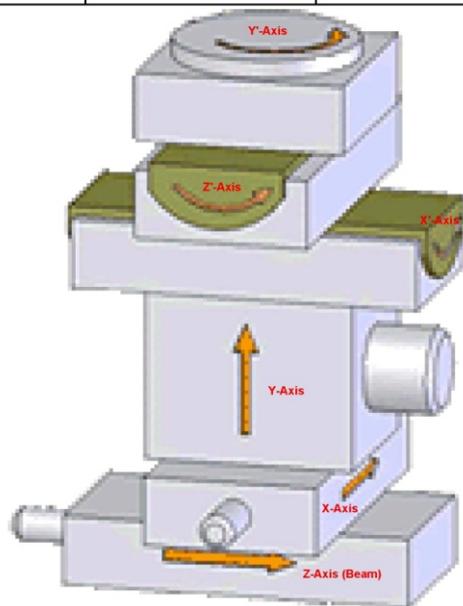
Vacuum Gate valve will be used to isolate X-Ray Exit Window from storage ring during maintenance.

3PW X-Ray Exit Window/Fixed Mask:

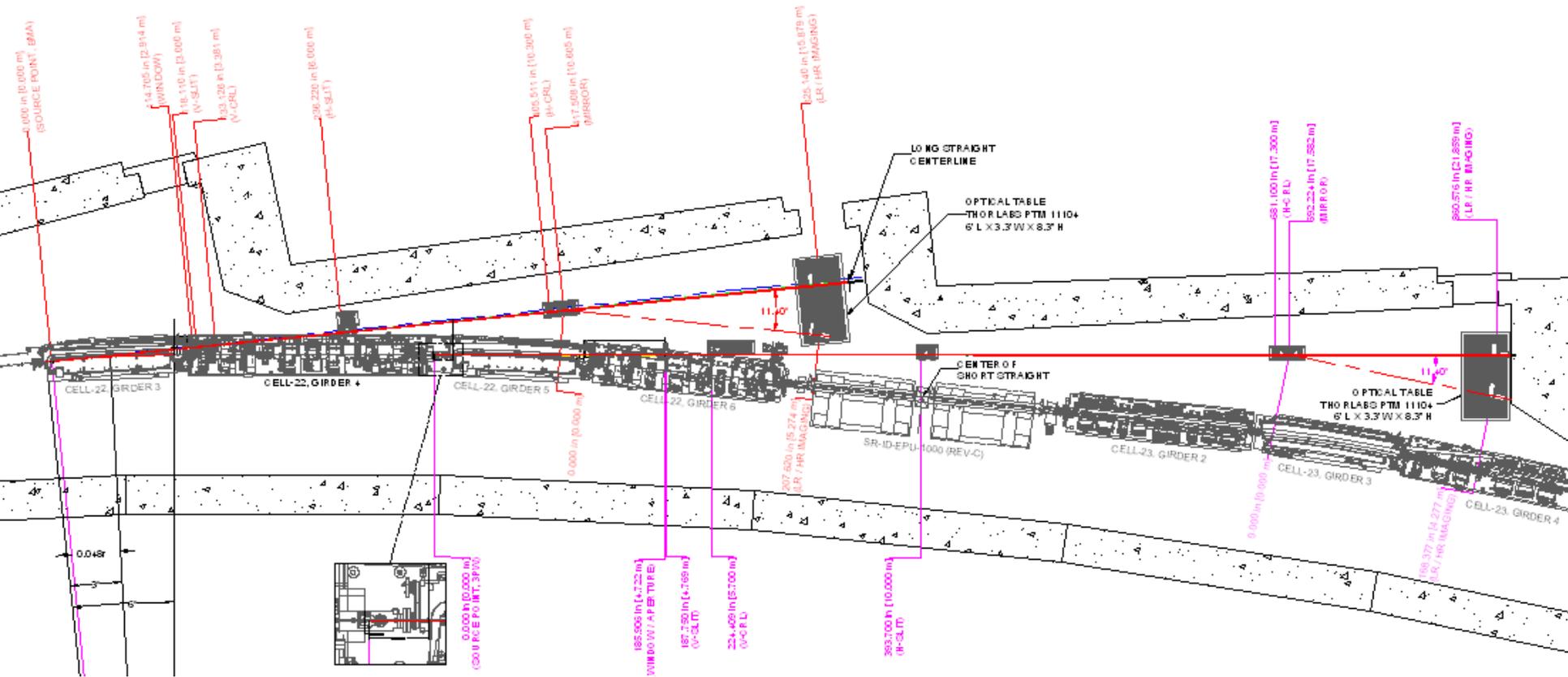
X-ray Exit window will have 1 mm horizontal and 5 mm vertical aperture. This will allow only **.212 mrad** horizontal and **1.059 mrad** vertical fan.

3PW Diagnostic Beamline Specifications

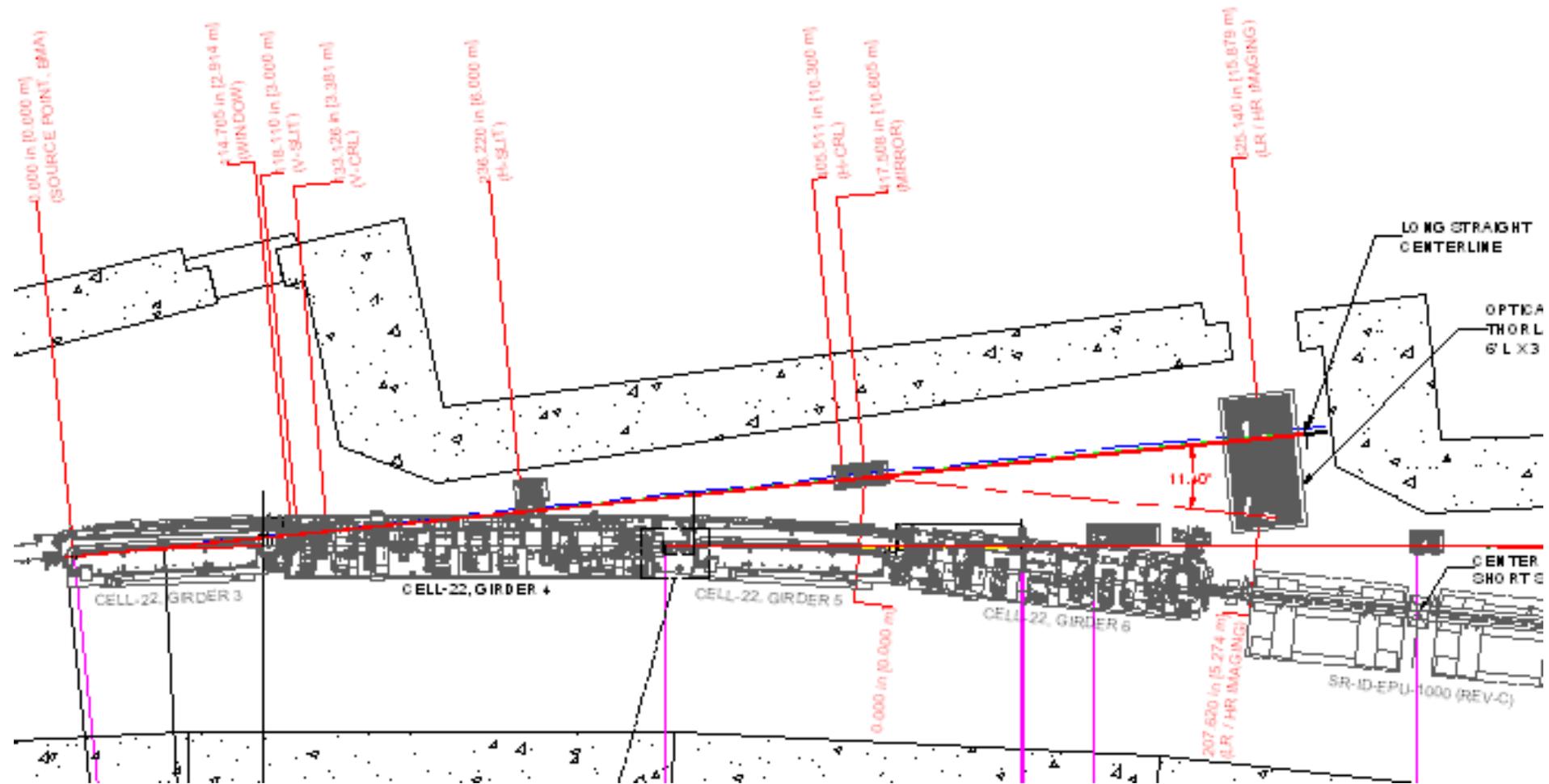
Component	Location (m) From Source	Alignment with respect to Beam Centerline (Z-Axis)				
		X (mm) (Transverse)	Y (mm) (Vertical)	X' (Deg.) (Swivel)	Y' (Deg.) (Rotation)	Z' (Deg.) (Swivel)
<i>X-Ray Exit Window</i>	4.72	-	-	-	-	-
<i>Vertical Slit</i>	4.77	+/-35	+/-12.5	+/-8	-	+/-8
<i>Vertical CRL</i>	5.7	+/-35	+/-12.5	-	+174/-84	+/-8
<i>Horizontal Slit</i>	10	+/-35	+/-12.5	+/-8	+174/-84	-
<i>Horizontal CRL</i>	17.3	+/-35	+/-12.5	-	+174/-84	+/-8
<i>Mirror</i>	17.58	+/-35	+/-12.5	-	+174/-84	-
<i>LR/HR Imaging</i>	21.86	+/-35	+/-35	-	-	-



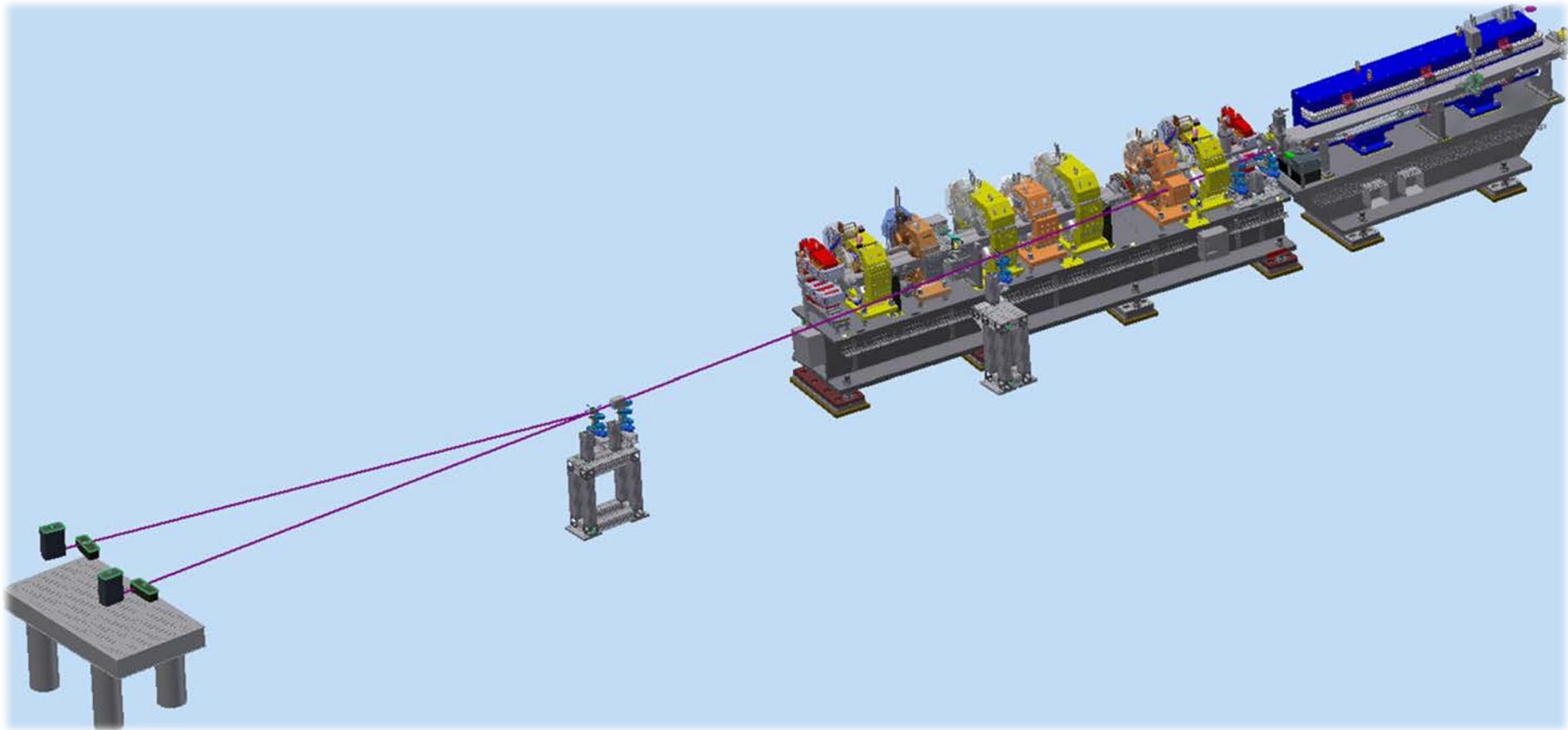
BMA & 3PW Diagnostic Beamline Layout / Ray Tracing



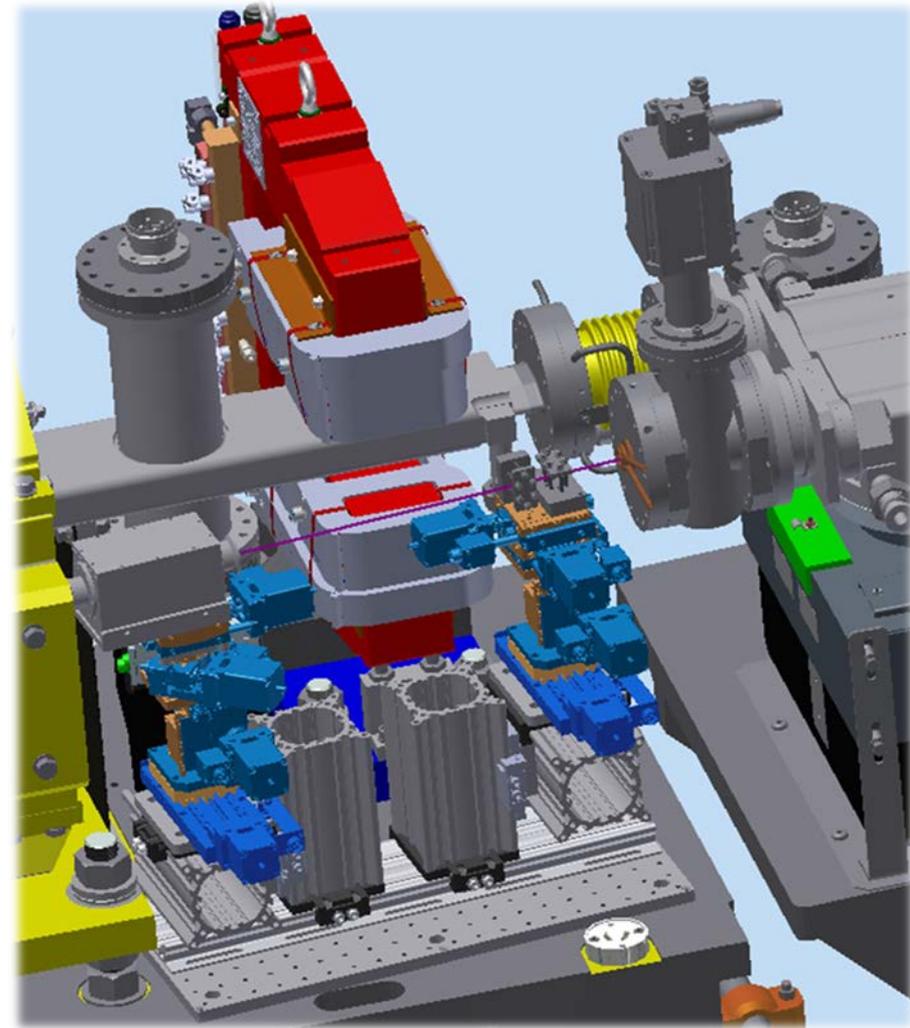
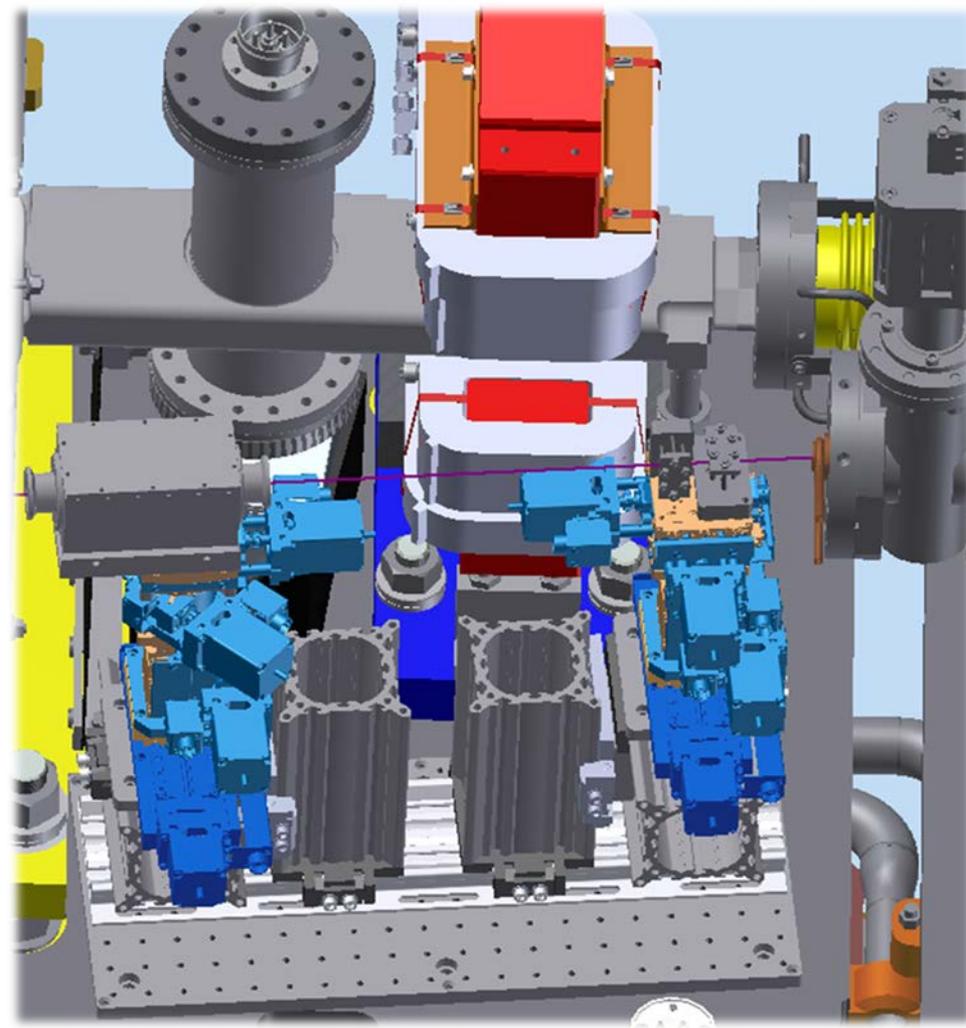
BMA Beamline Layout / Ray Tracing



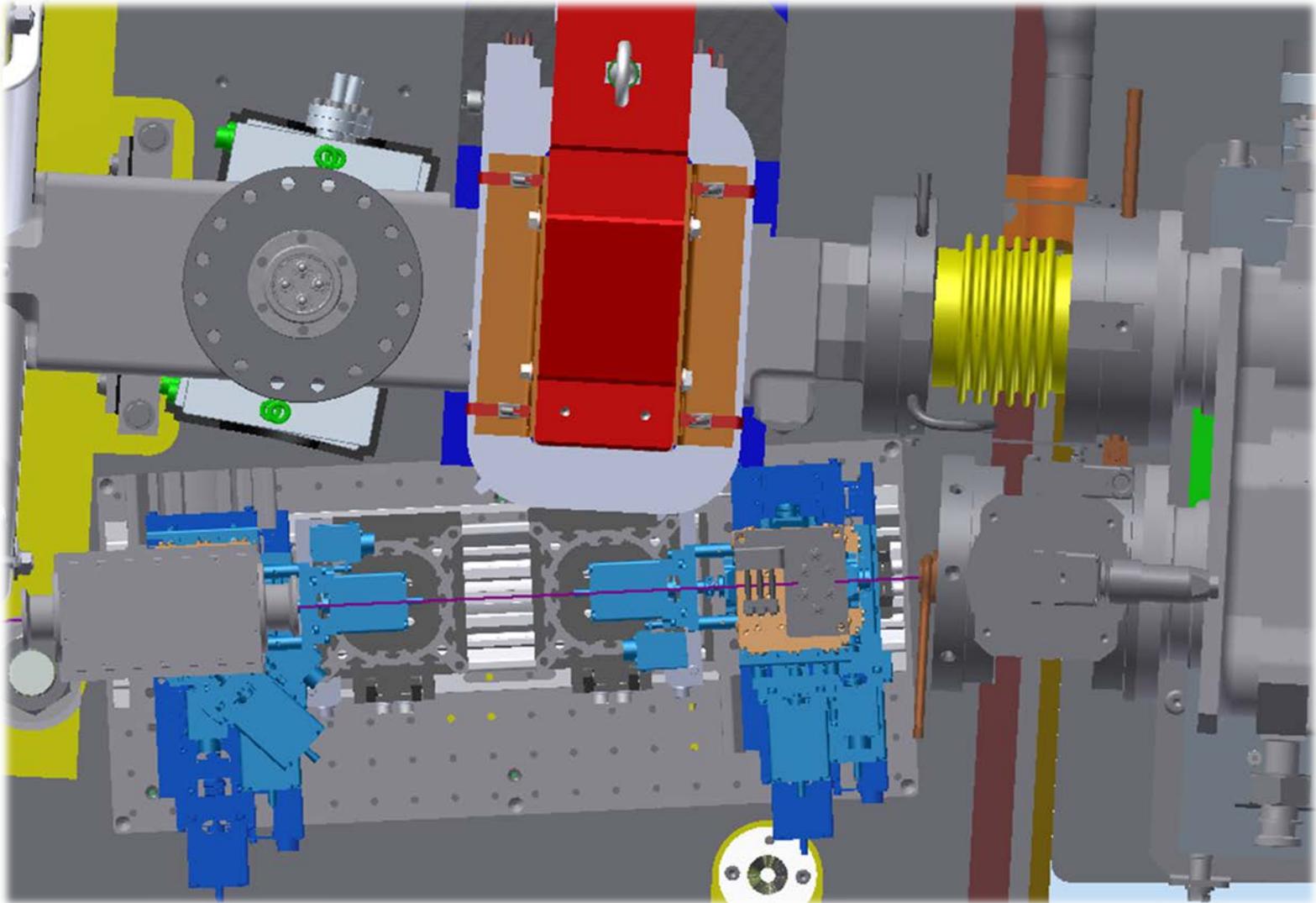
BMA Diagnostic Beamline Layout



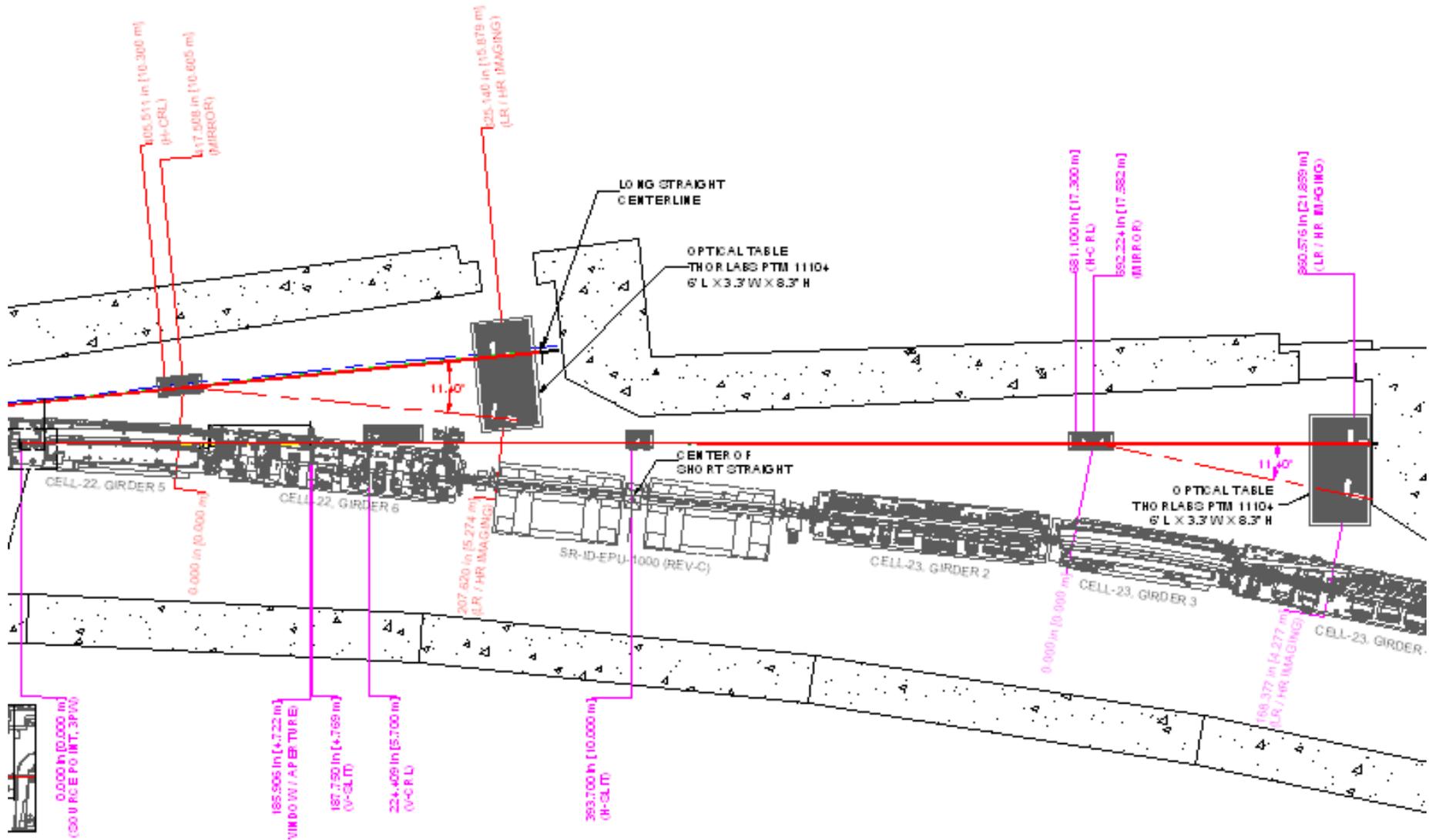
BMA Diagnostic Beamline Layout



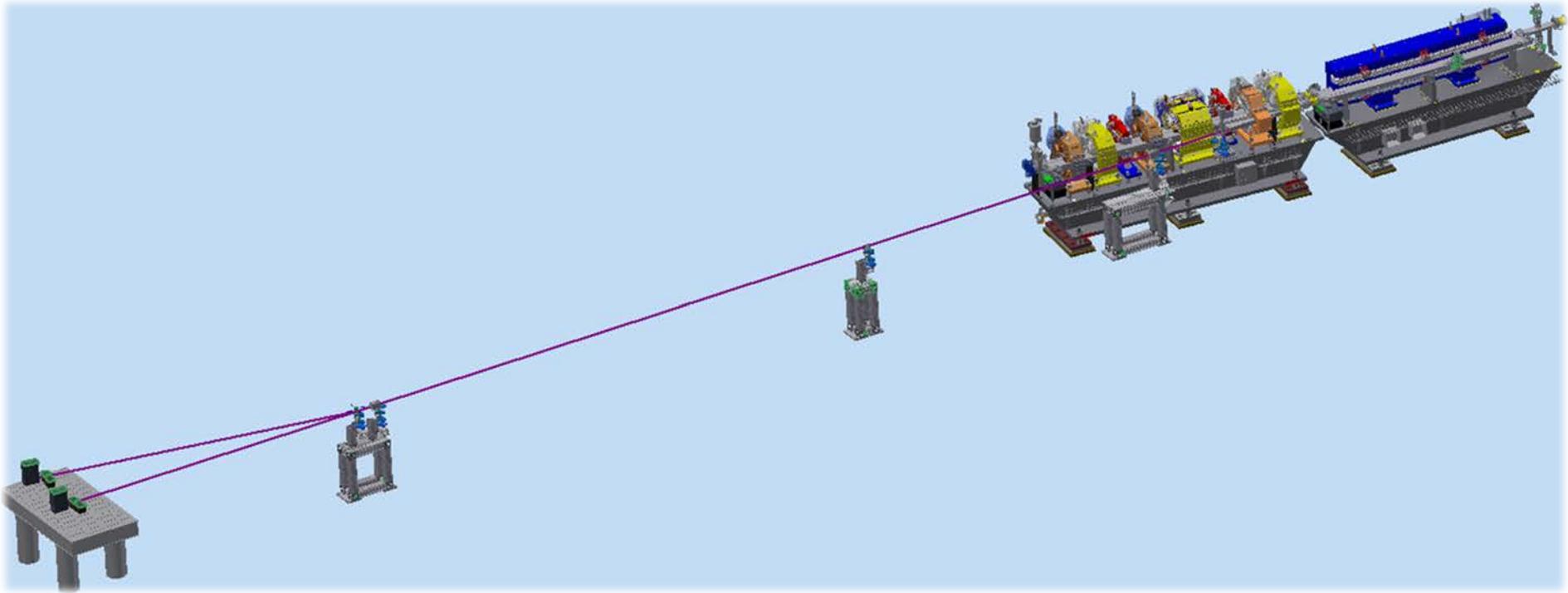
BMA Diagnostic Beamline Layout



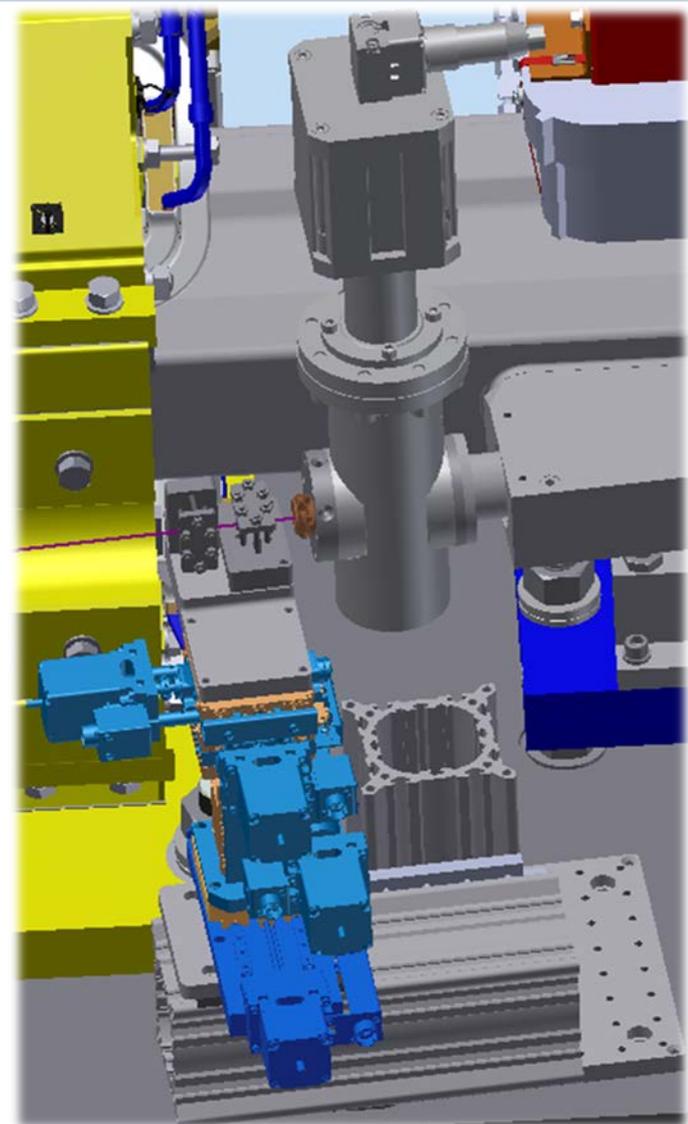
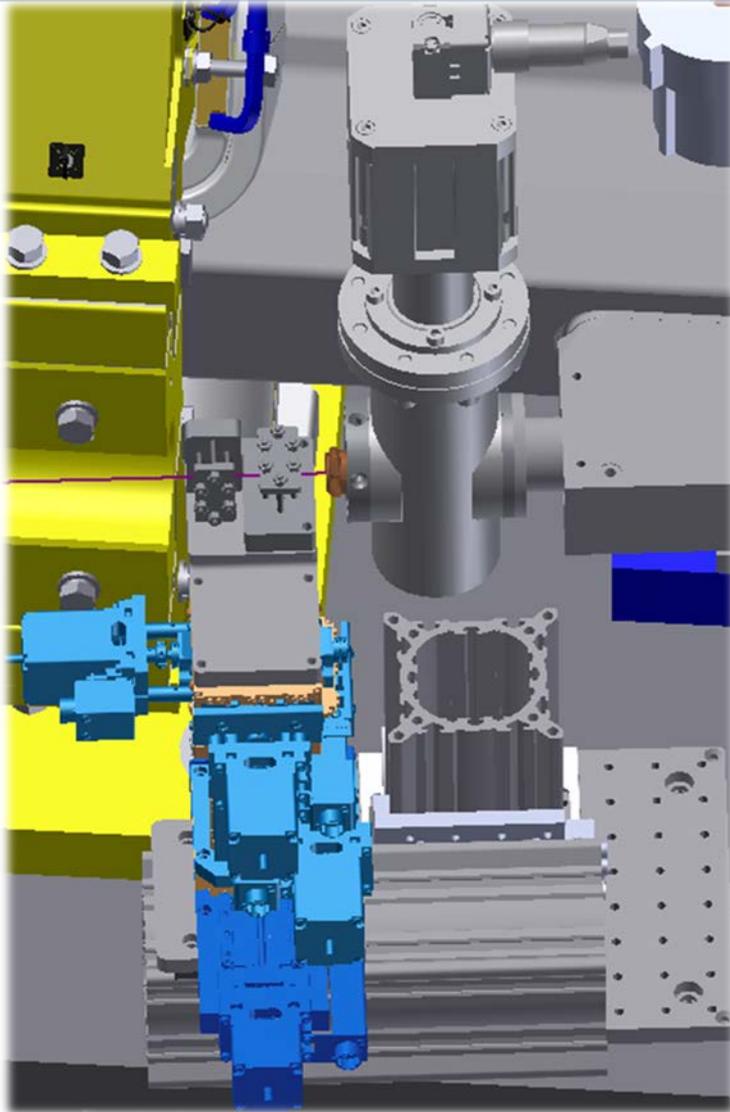
3PW Beamline Layout / Ray Tracing



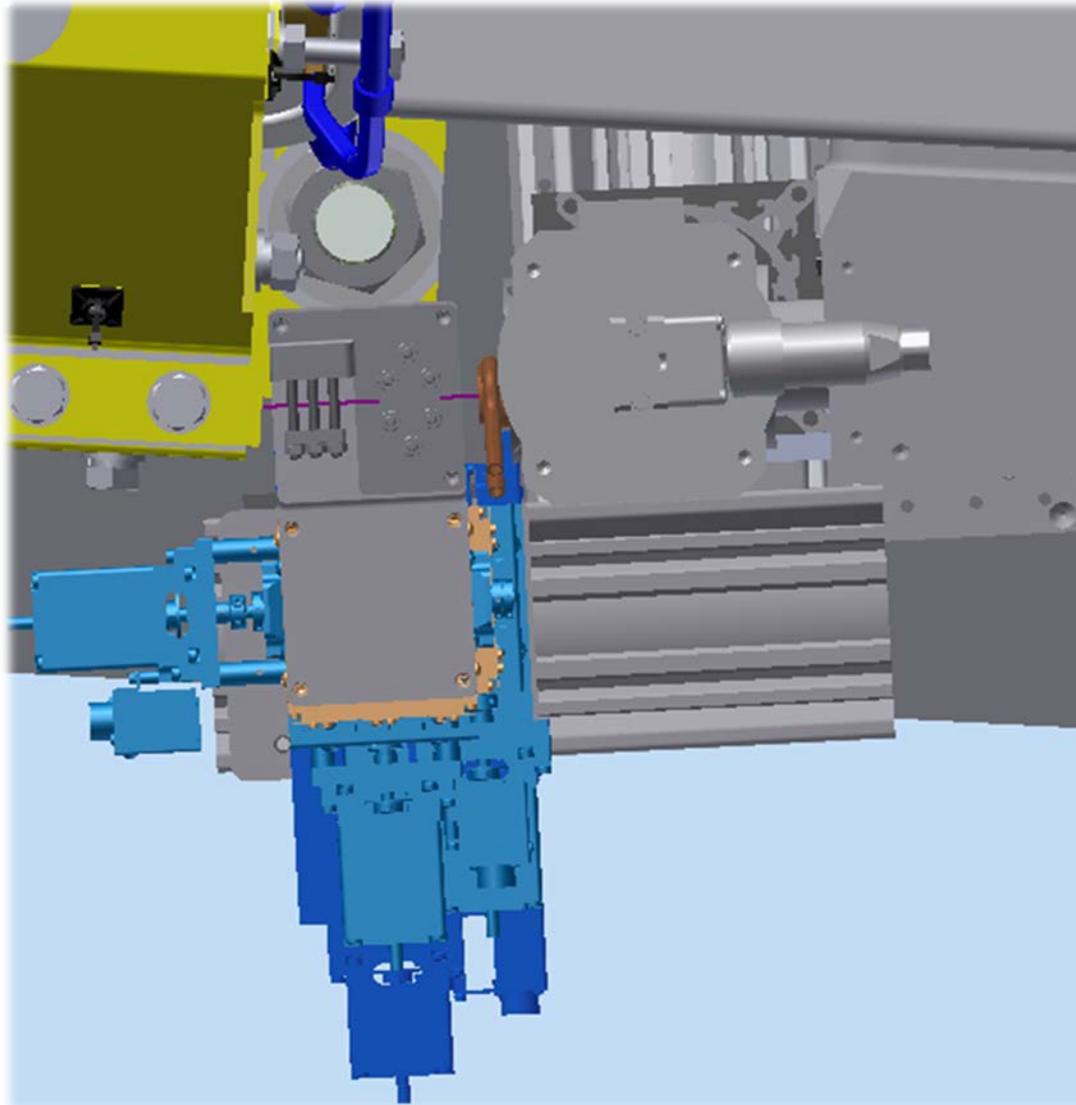
3PW Diagnostic Beamline Layout



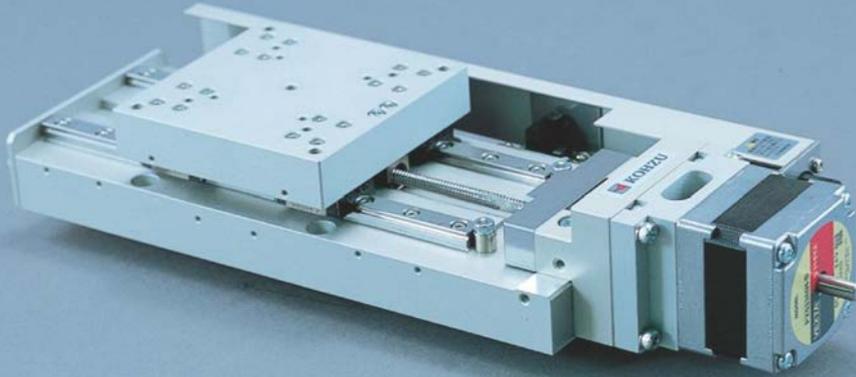
3PW Diagnostic Beamline Layout



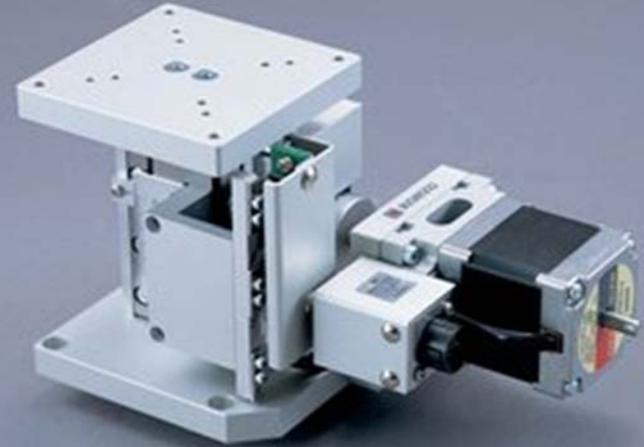
3PW Diagnostic Beamline Layout



Beamline Components (X & Y-Stage)

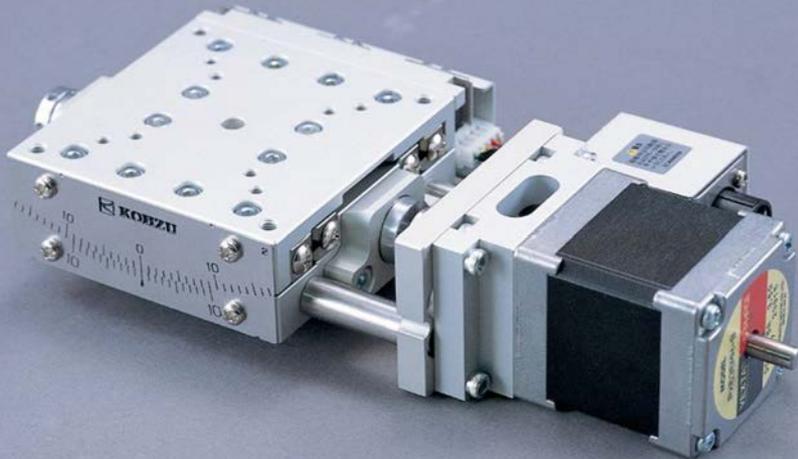


KOHZU X-Stage, Part# XA07A-L2
Motion Range +/-35mm
Resolution 0.5 micron/step
Max. Speed 5mm/sec
Repeatability +/-0.5 micron
Weight 1.3kg (2.8lbs)
Load Capacity 7kg (15.4lbs)

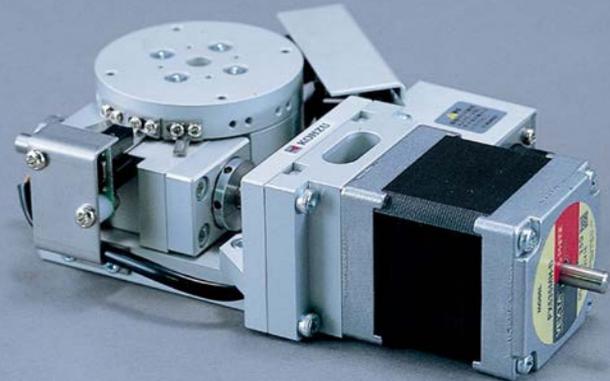


KOHZU Y-Stage, Part# ZA07A-R3
Motion Range +/-12.5MM
Resolution 0.25 micron/step
Max. Speed 2.5mm/sec
Repeatability +/-
Weight 1.8kg (3.9lbs)
Load Capacity 5kg (11lbs)

Beamline Components (X', Z' & Y'-Stage)



KOHZU X' & Z'-Stage, Part# SA07A-RB
Motion Range +/-8 Degree
Resolution 0.00048 Deg./step
Max. Speed 4.8 Deg./sec
Weight 1kg (2.2lbs)
Load Capacity 5kg (11lbs)



KOHZU Y'-Stage, Part# RA05A-W
Motion Range +174Deg., -84Deg.
Resolution 0.002Deg./step
Max. Speed 20Deg./sec
Weight 0.9kg (1.98lbs)
Load Capacity 4kg (8.8lbs)

Beamline Components (Support)

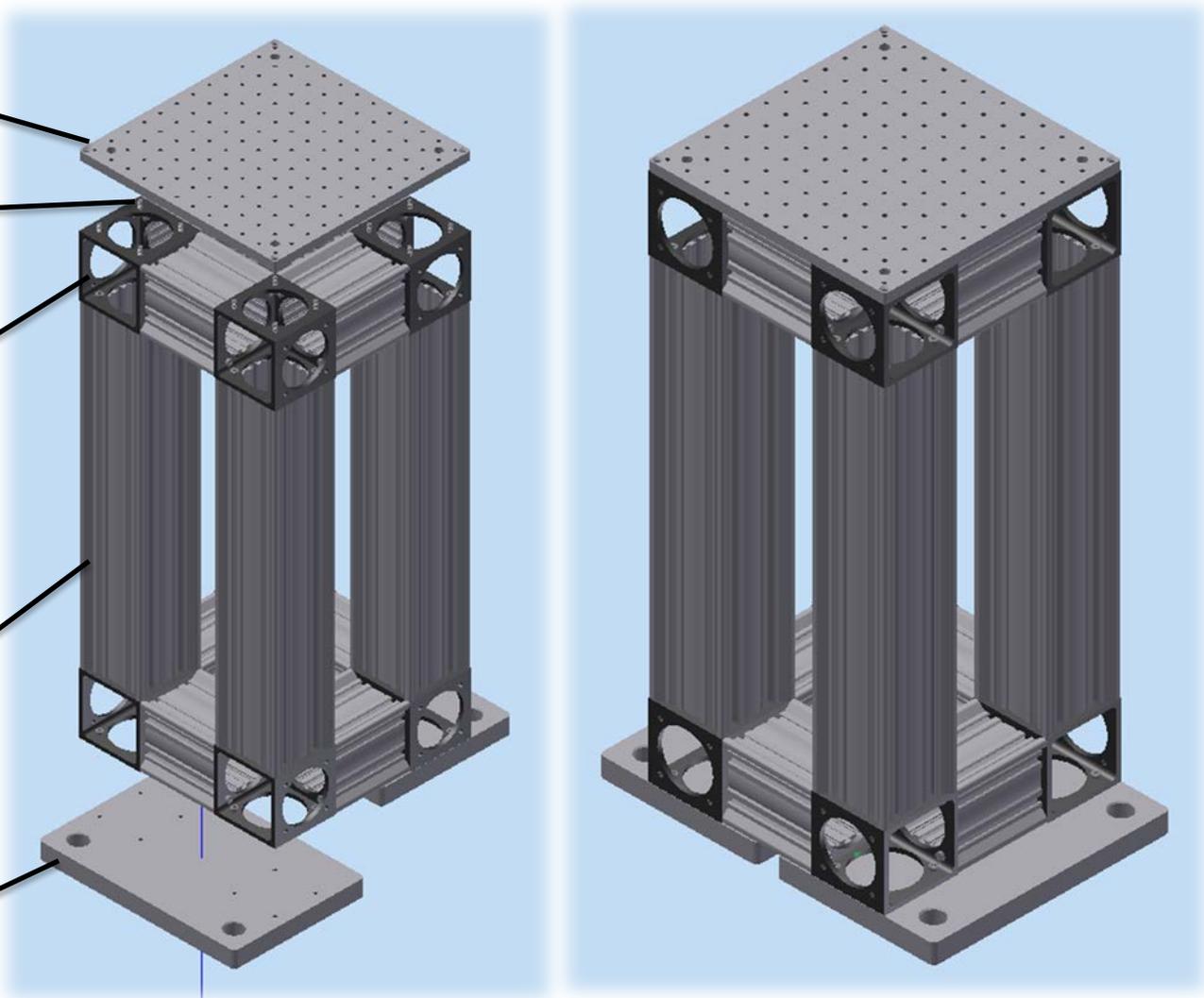
Breadboard

M6 Low Head Screw

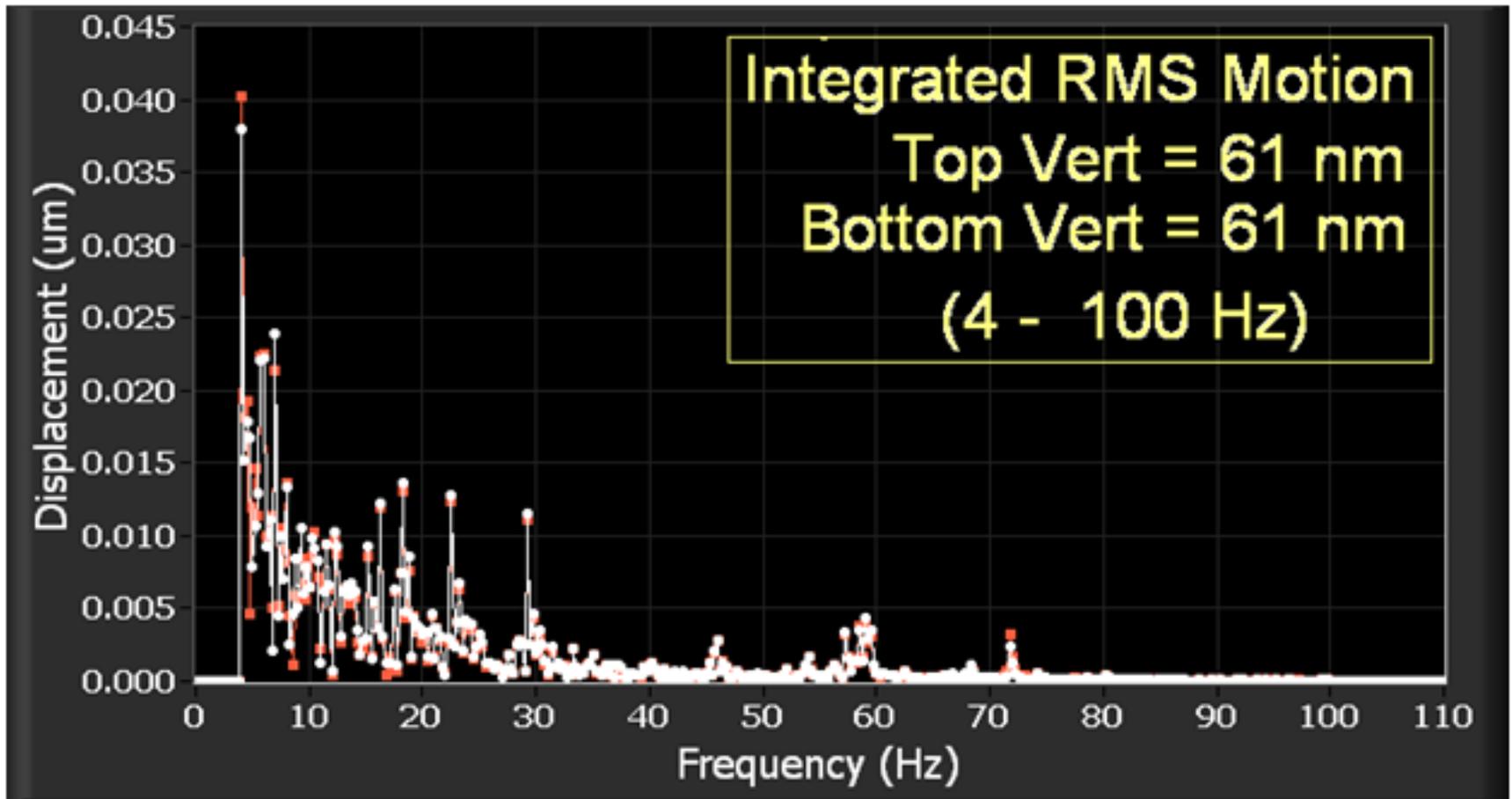
5 Way Corner Cube

95mm Square
Aluminum Extrusion

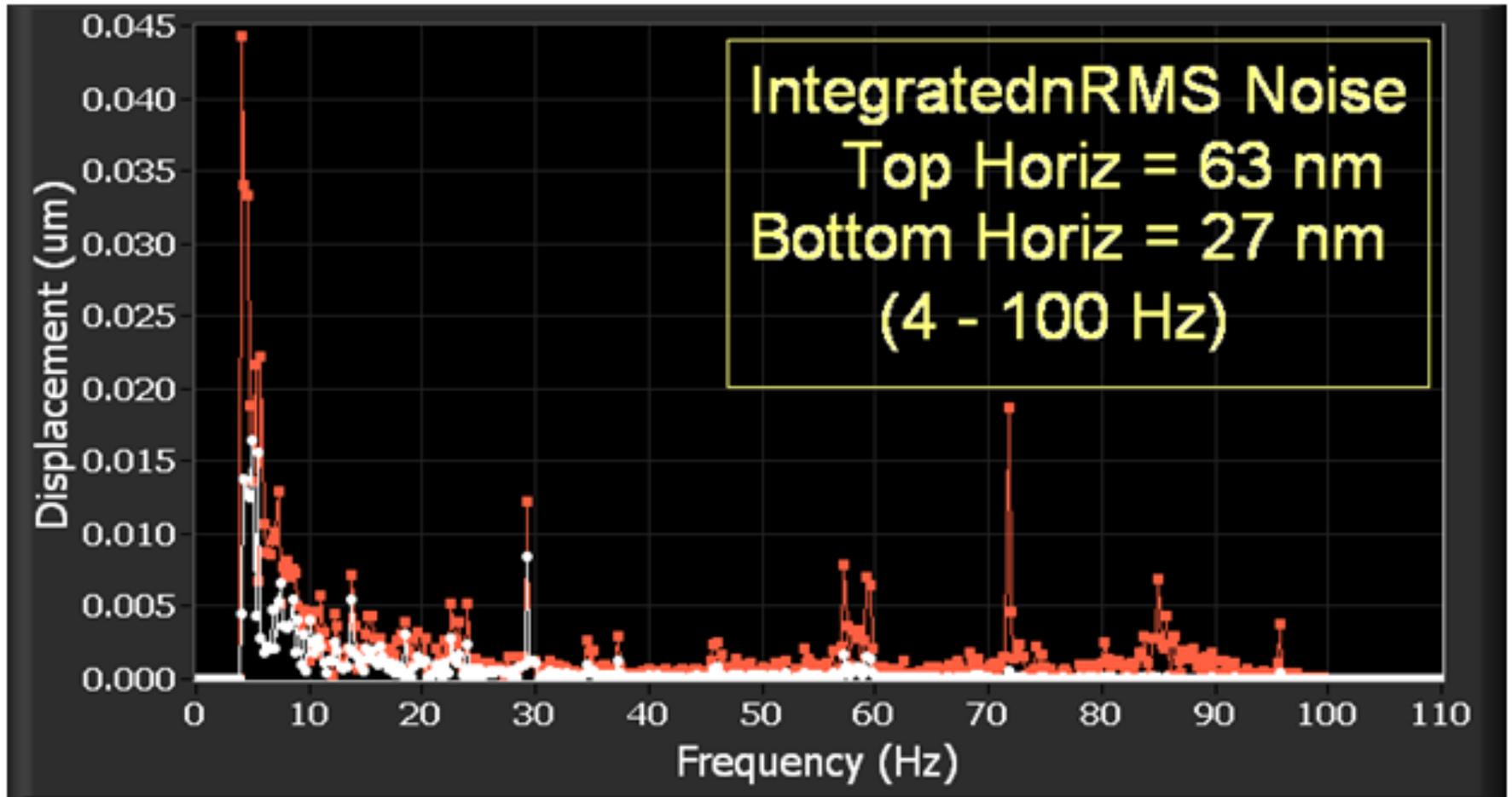
1" Thick
Aluminum Base Plate



Beamline Components (Support, Vibration Test)

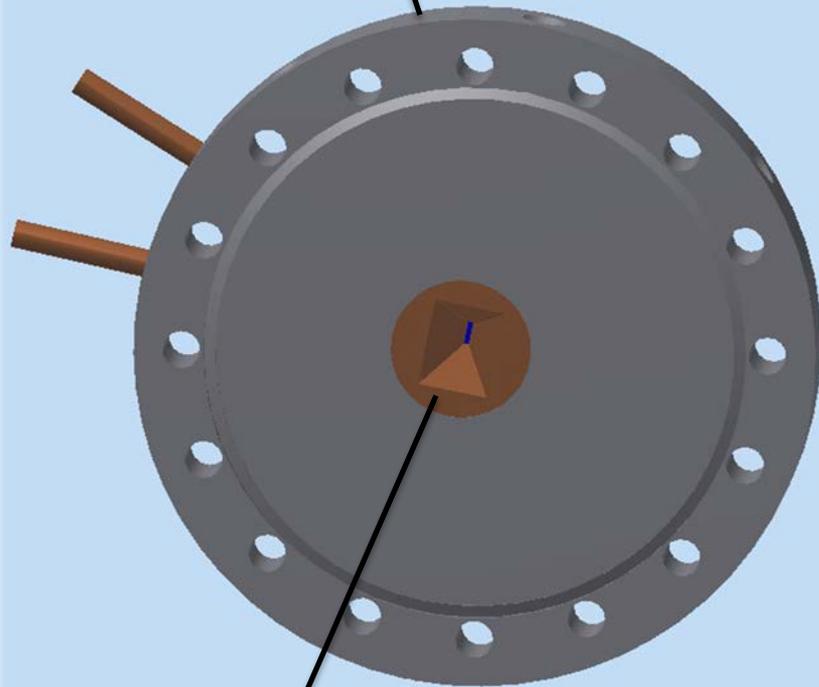


Beamline Components (Support, Vibration Test)

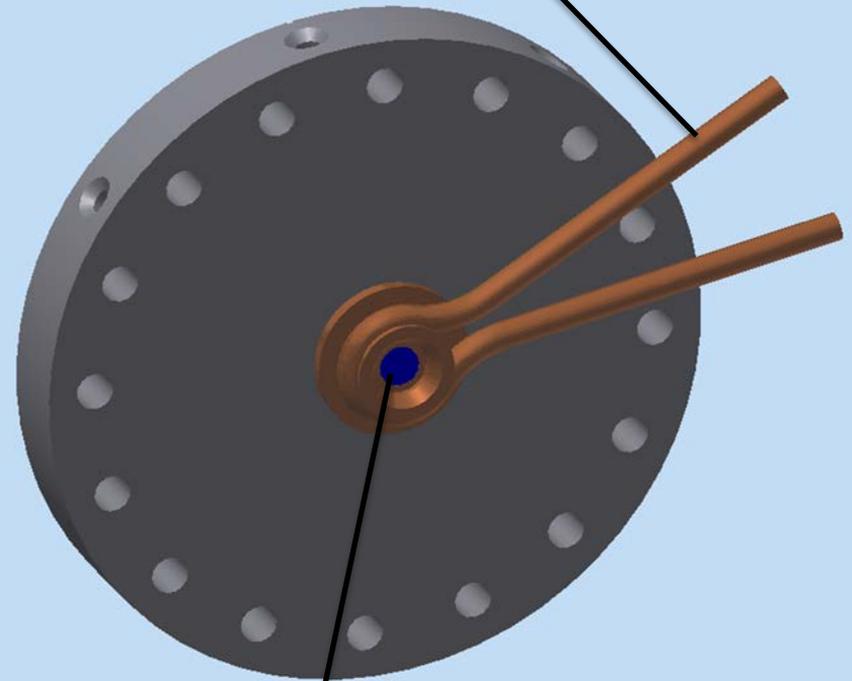


Beamline Components (BMA X-Ray Exit Window)

Stainless Steel $\phi 6''$ Conflat Flange



$\frac{1}{4}''$ OD x $.186''$ ID Copper Tube

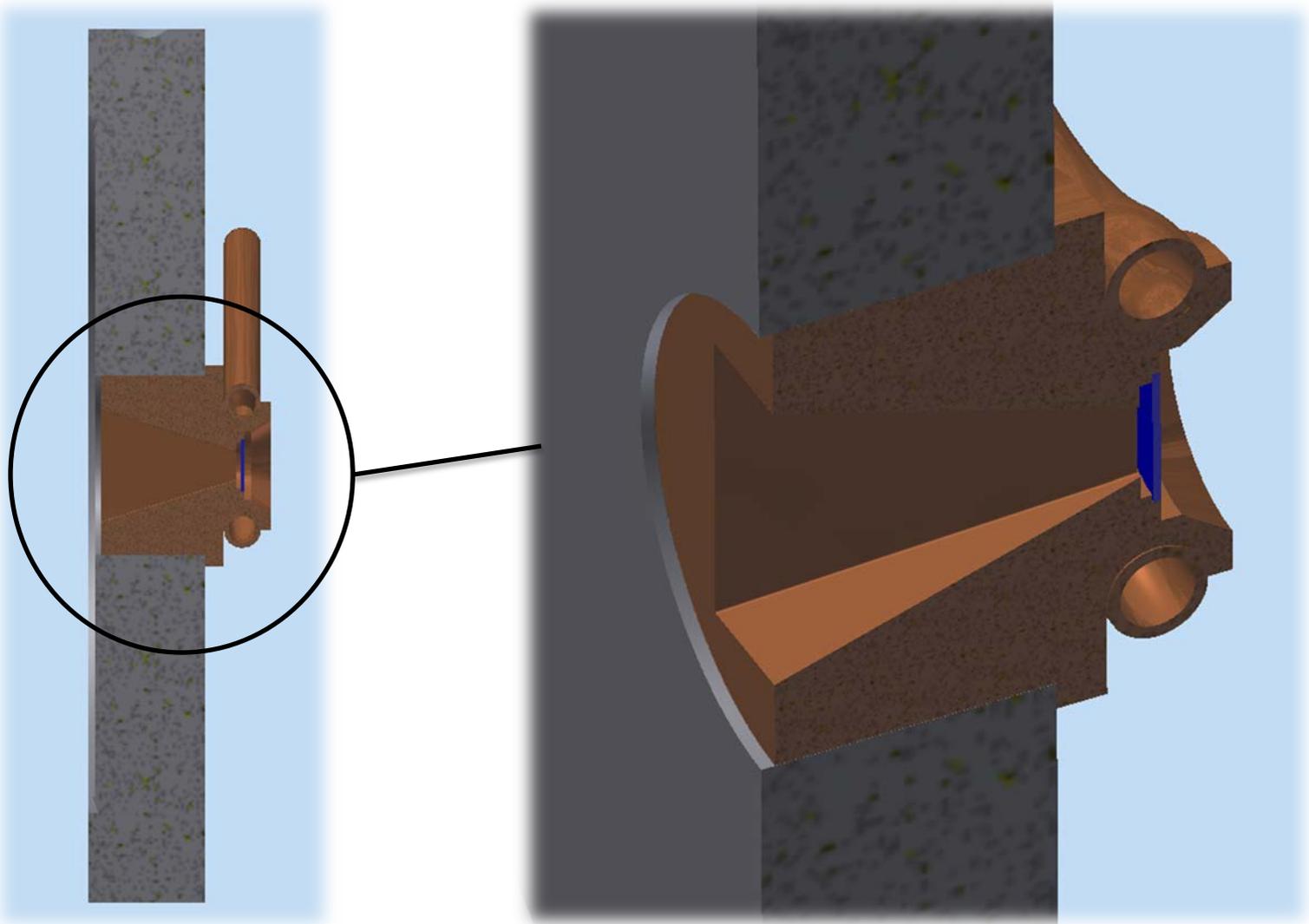


OFE Copper Ring
1mm H X 5mm V Aperture

High Grade CVD Diamond, $\phi .360''$ & $.02''$ Thick
Thermal Conductivity 1800W/mK @ 25°C

Beamline Components (BMA X-Ray Exit Window)

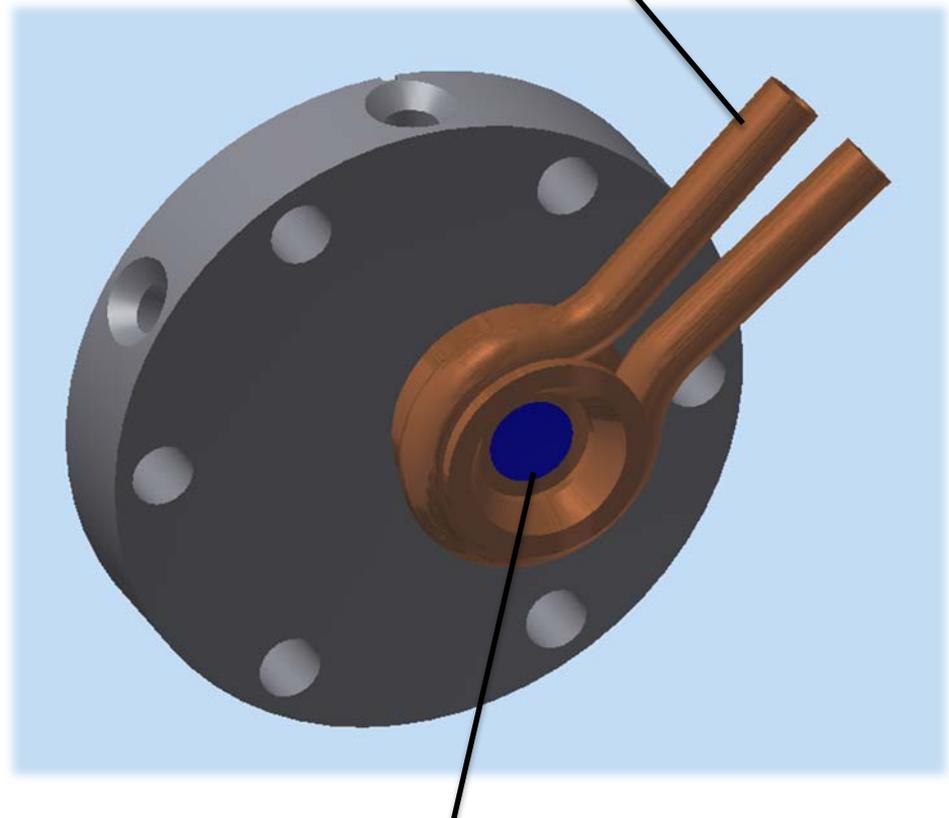
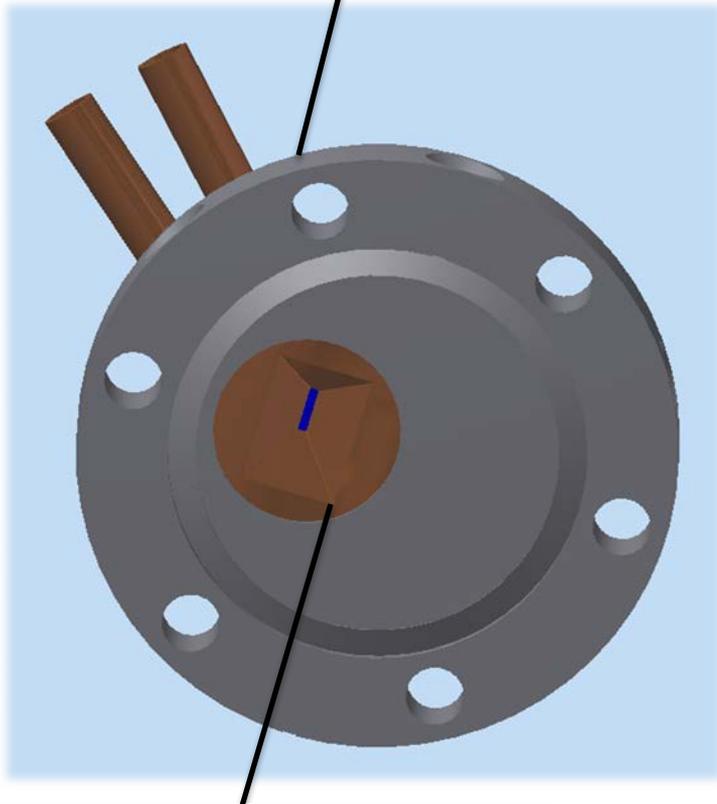
Part# SR-DG-BL-1000



Beamline Components (3PW X-Ray Exit Window)

Stainless Steel $\phi 2.75''$ Conflat Flange

$\frac{1}{4}''$ OD x $.186''$ ID Copper Tube

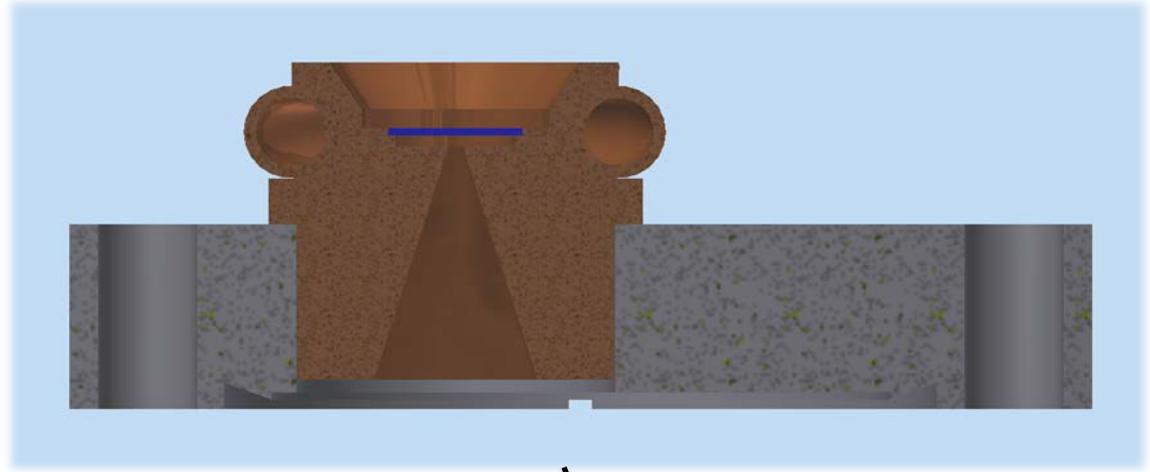
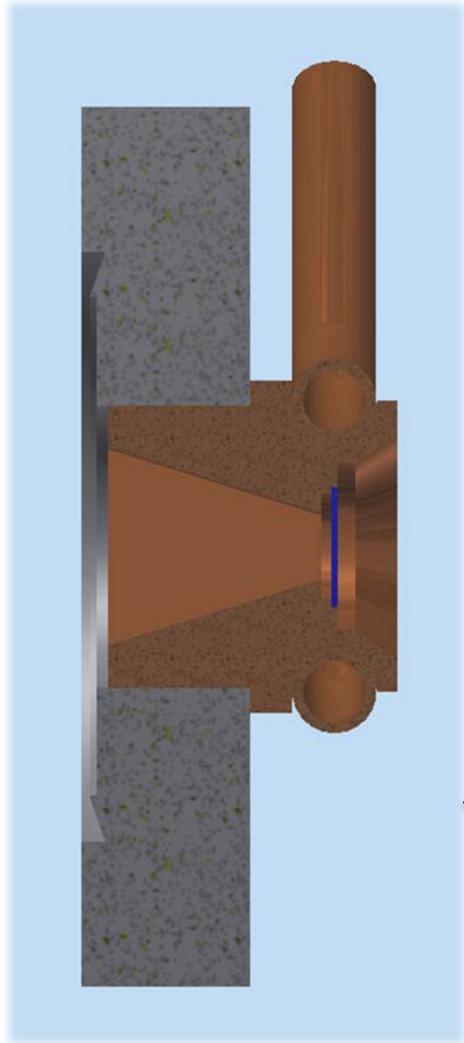


OFE Copper Ring
1mm H X 5mm V Aperture

High Grade CVD Diamond, $\phi .360''$ & $.02''$ Thick
Thermal Conductivity 1800W/mK @ 25°C

Beamline Components (3PW X-Ray Exit Window)

Part# SR-DG-BL-1015



Horizontal Section View

Vertical Section View

Beamline Components (3PW Exit Window, FEA)

Analysis Parameters

Fan Source: Three Pole Wiggler (3PW)

Crotch Absorber:

- Distance of Crotch Absorber from source = 3.1m Approx.
- Crotch Absorber Horizontal Aperture = 5mm
- Horizontal Fan through Crotch Absorber = 1.63 mrad
- Vertical Divergence = 0.2 mrad

Window:

- Distance of Window from source = 4.65m Approx.
- Horizontal Aperture of Window = 1mm
- Vertical Aperture of Window = 5mm

Beamline Components (3PW Exit Window, FEA)

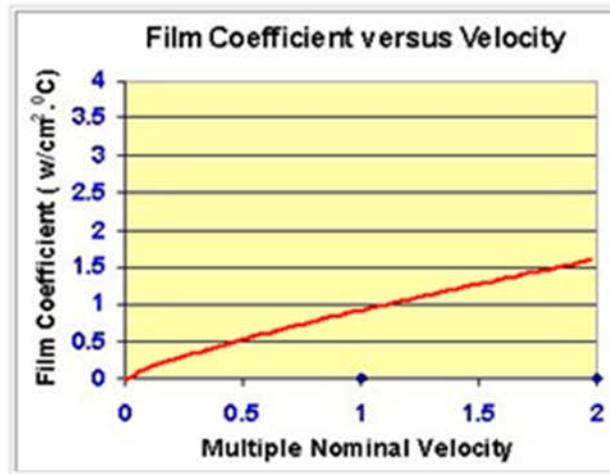
Analysis Parameters

Total Intercepted Power (W):

	<i>Peak Power Density (W/mrad)</i>	<i>Horizontal Fan Angle (mrad)</i>	<i>Total Intercepted Power (W)</i>
<i>Flange at Inclined Incidence</i>	65	0.71	46.2
<i>Window at Normal Incidence</i>	65	0.21	14
<i>Flange at Inclined Incidence</i>	65	0.71	46.2

Film Co-efficient:

A film co-efficient of $1 \text{ W/cm}^2\text{ }^\circ\text{C}$ is assumed for a flow rate of 1GPM through 0.187 in. diameter cooling channel.



Beamline Components (3PW Exit Window, FEA)

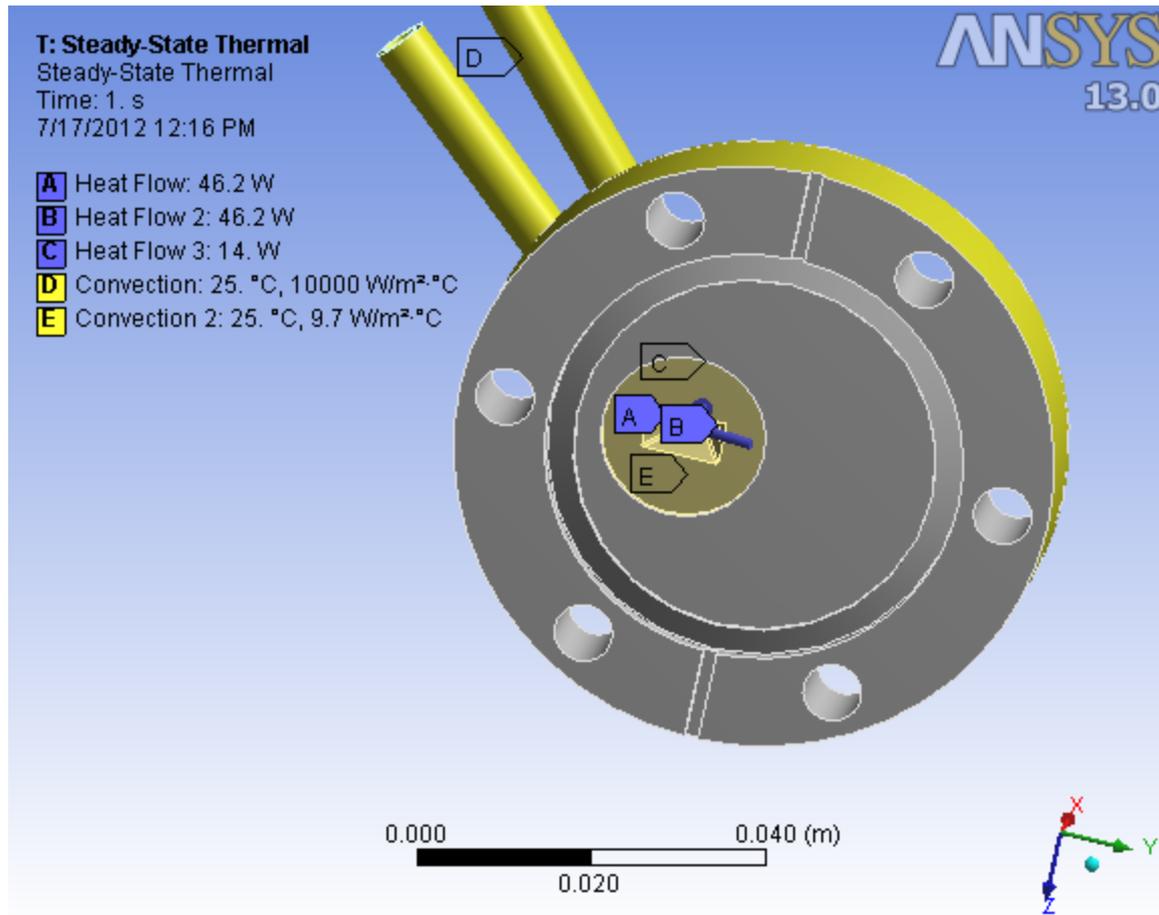
Analysis Parameters

Material Properties:

Material	Thermal Conductivity (K) (W/m°C)	Co-efficient of Thermal Expansion (α) (1/°C)	Young's Modulus (E) (MPa)	Yield Strength (MPa)
OFE Copper	391	17×10^{-6}	115.3×10^3	365
CVD Diamond	1800	1×10^{-6}	1050×10^3	1000
304 Stainless Steel	16.2	17×10^{-6}	193×10^3	207

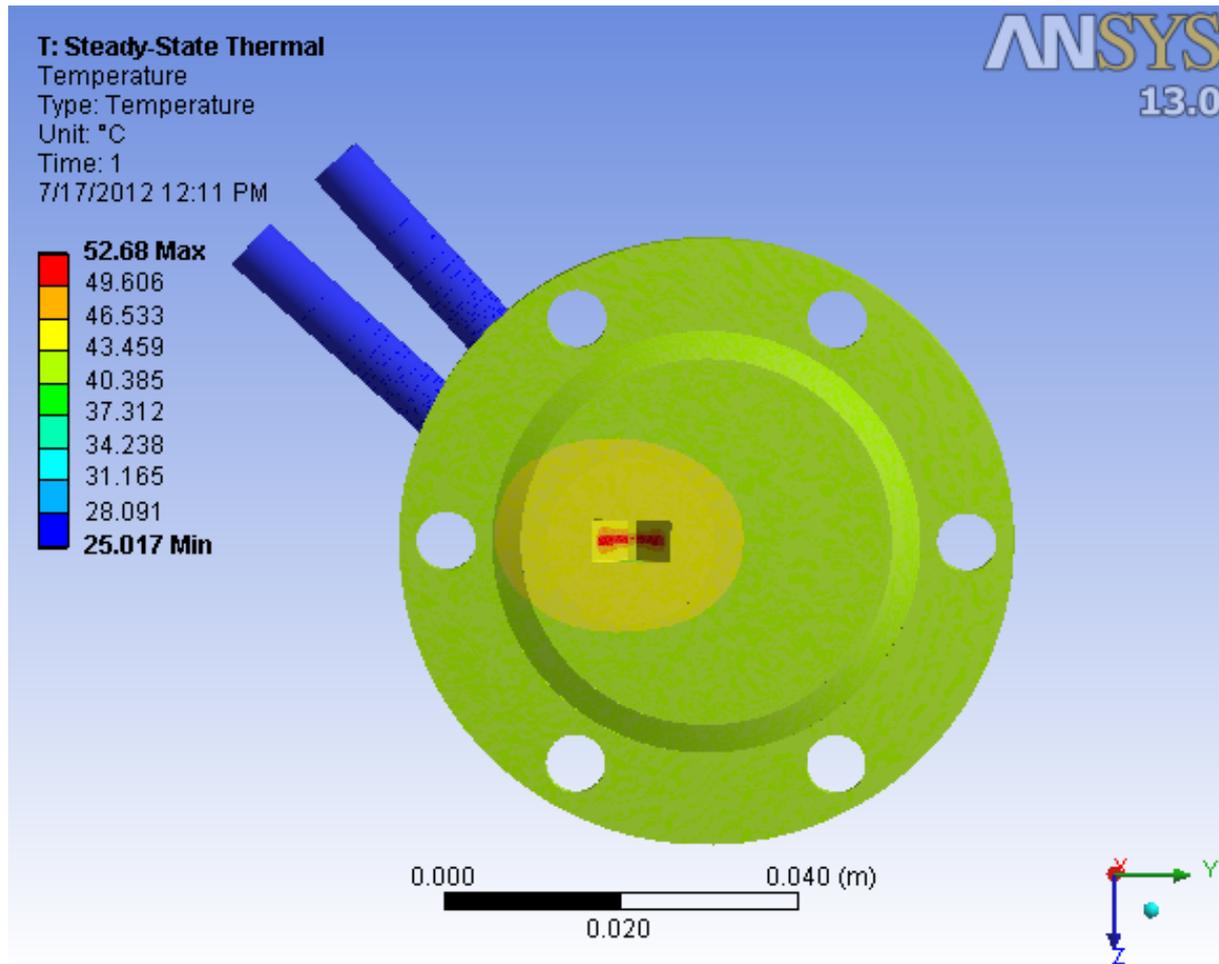
Beamline Components (3PW Exit Window, FEA)

Boundary Conditions, Steady-State Thermal



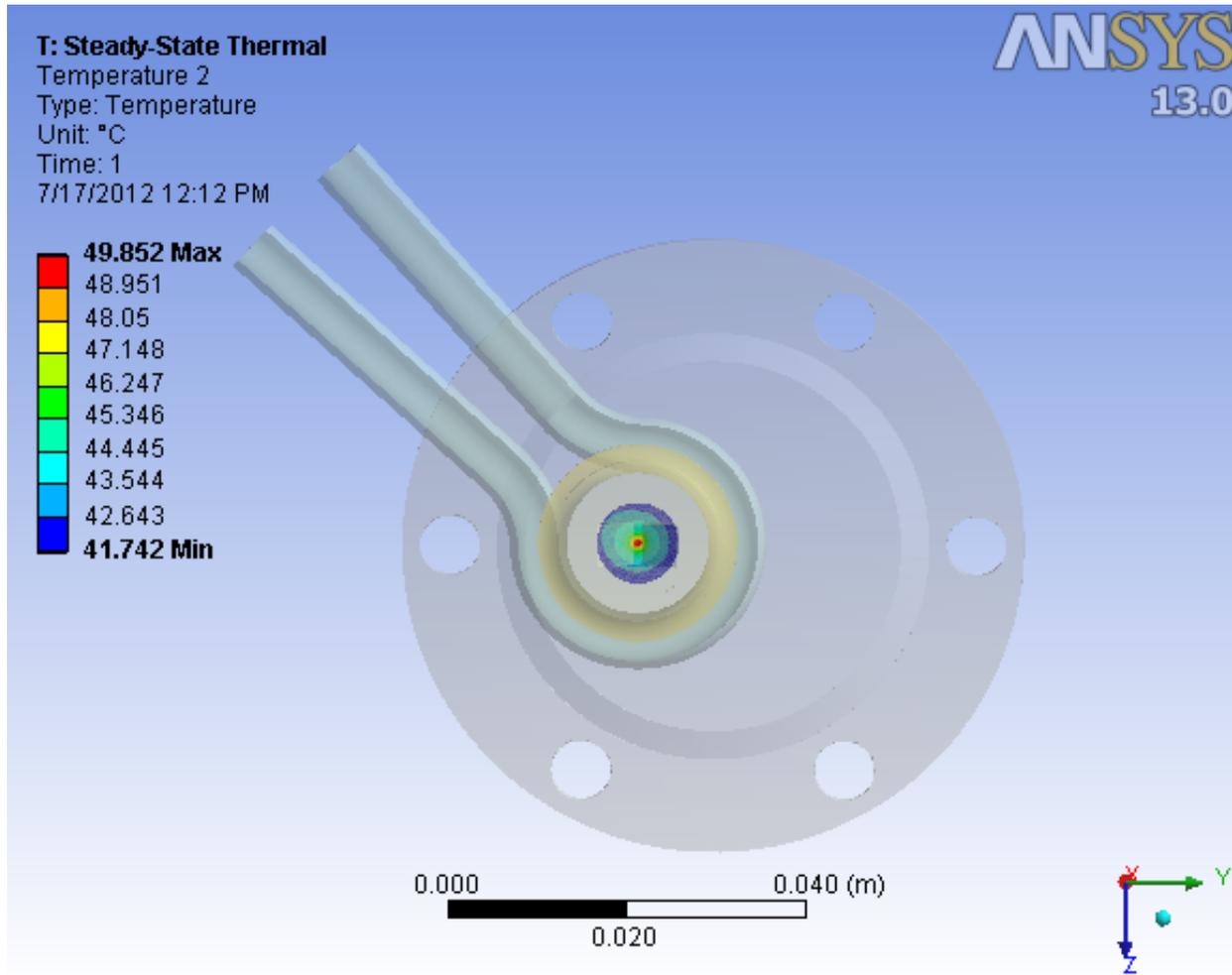
Beamline Components (3PW Exit Window, FEA)

OFE Copper Ring, Max. Temp. = 52.7°C



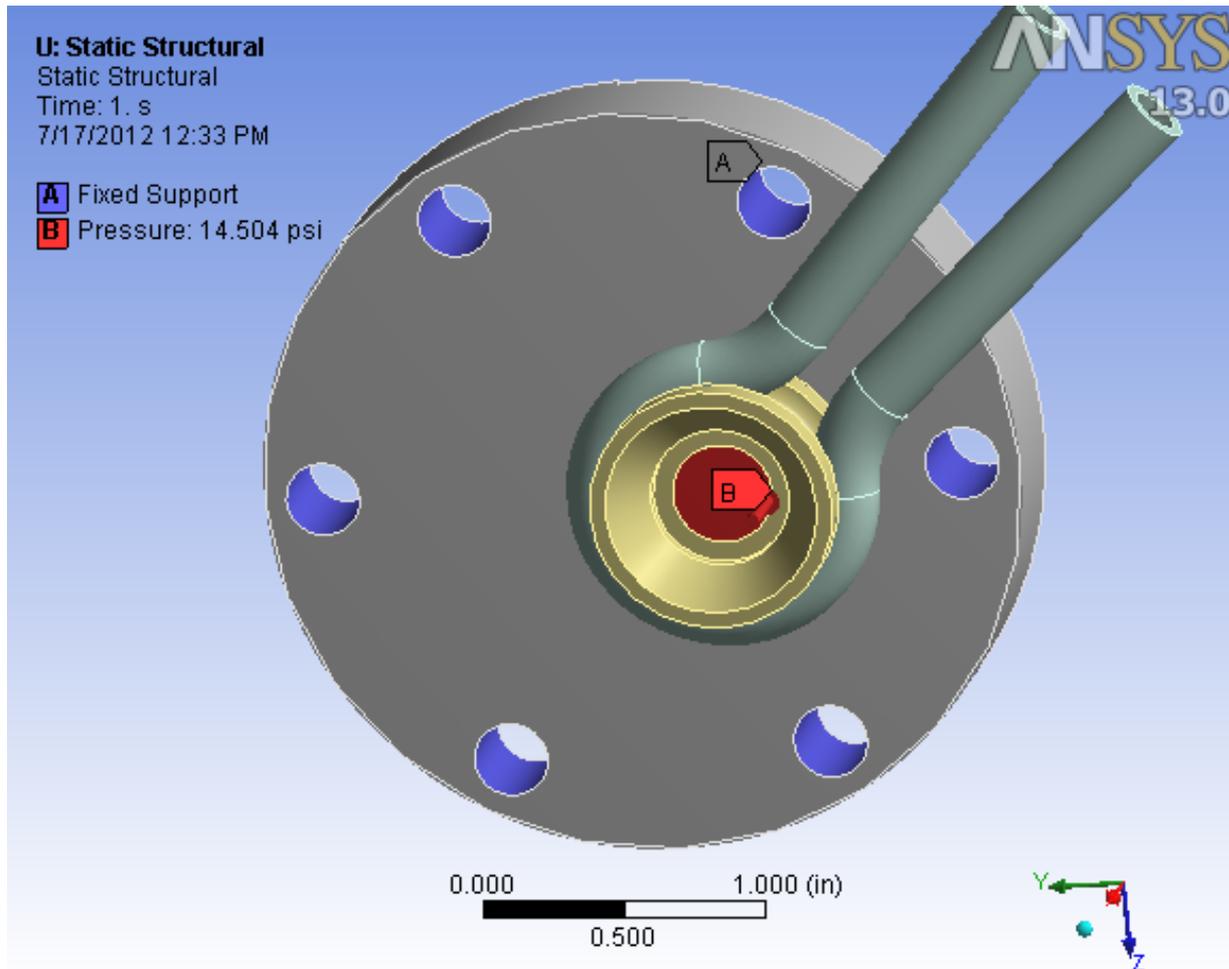
Beamline Components (3PW Exit Window, FEA)

CVD Diamond, Max. Temp. = 49.8°C



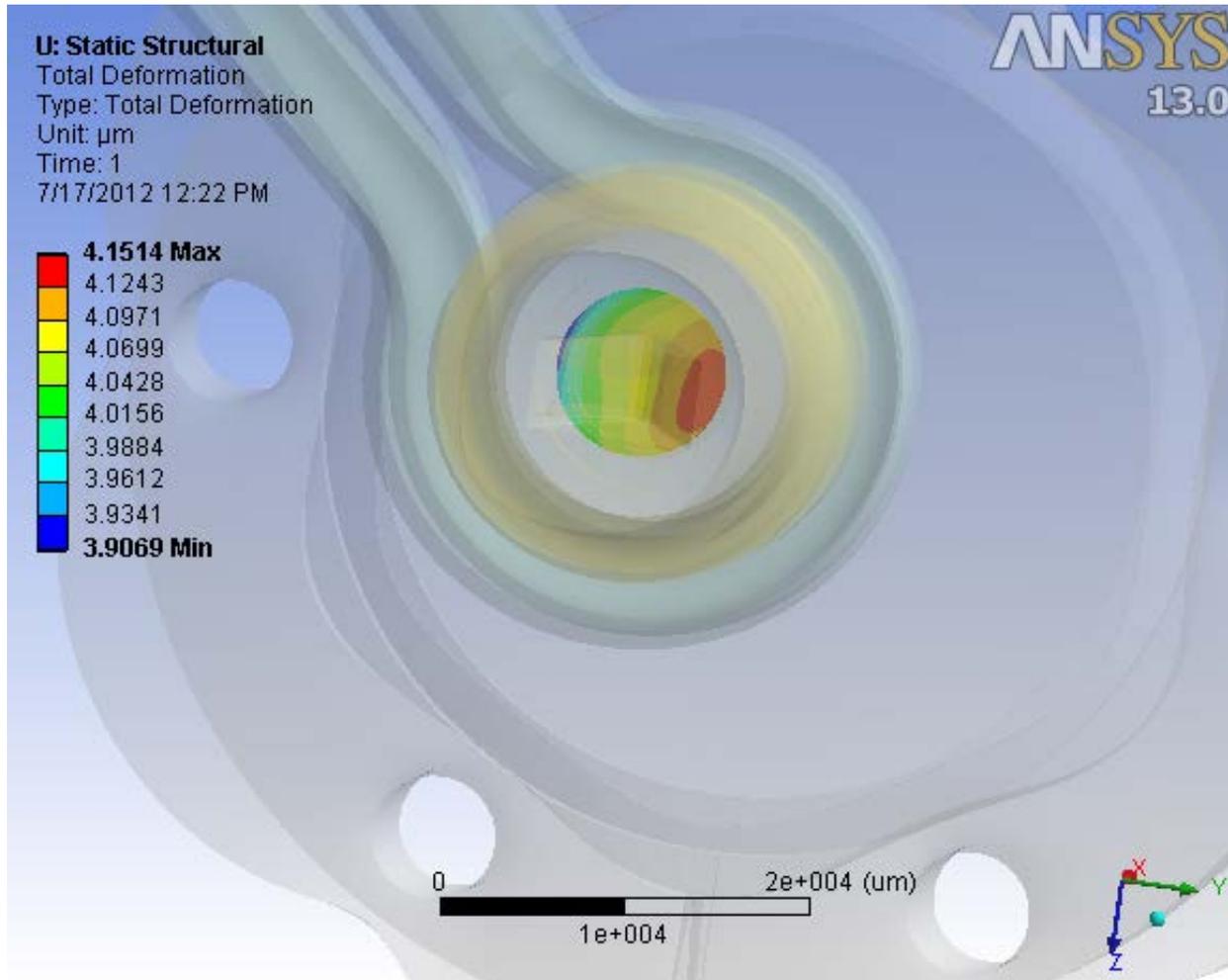
Beamline Components (3PW Exit Window, FEA)

Boundary Conditions, Static Structural



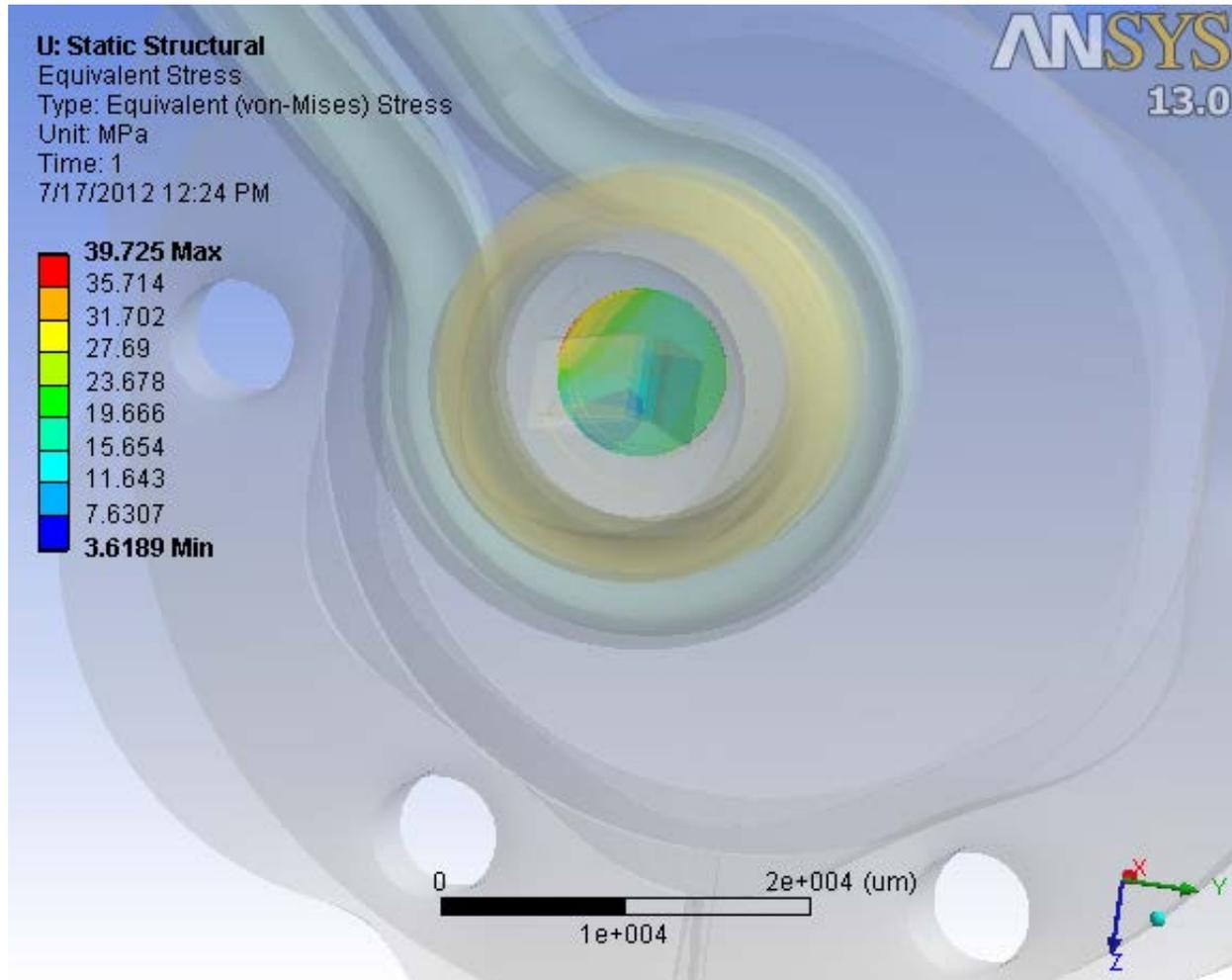
Beamline Components (3PW Exit Window, FEA)

CVD Diamond, Max. Deformation = 4.2 μm



Beamline Components (3PW Exit Window, FEA)

CVD Diamond, Max. Stress (Von-Mises) = 39.7 Mpa

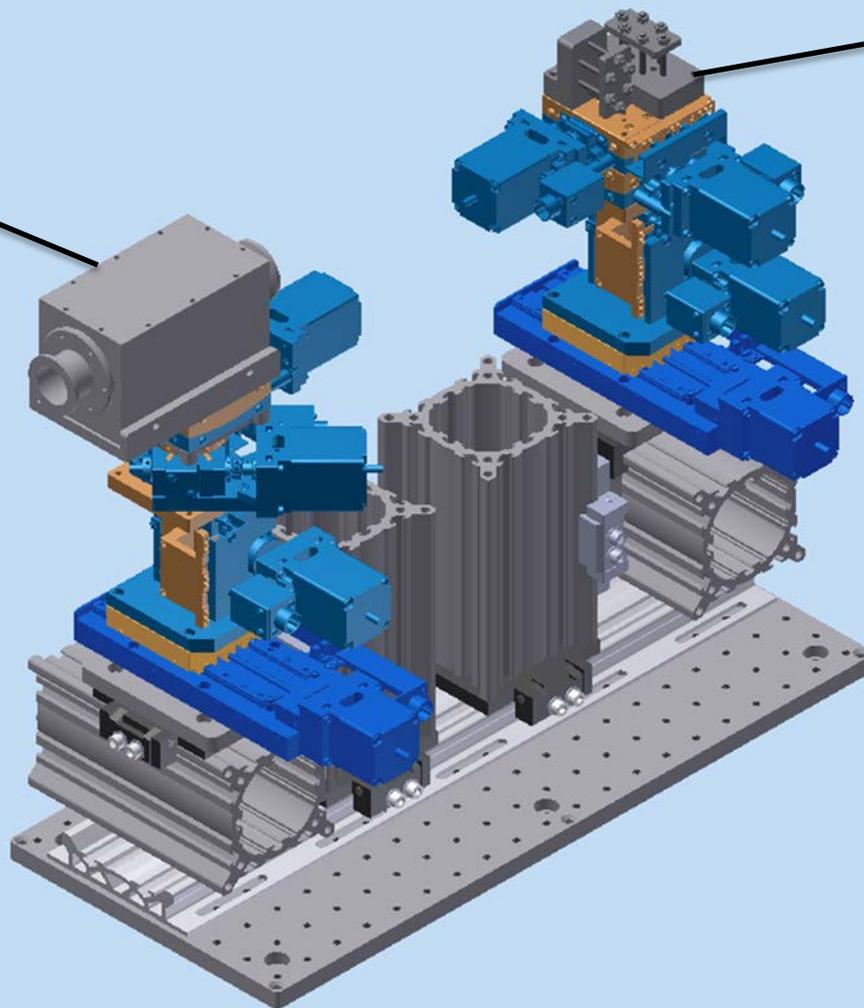


Beamline Components (BMA V-Slit & V-CRL)

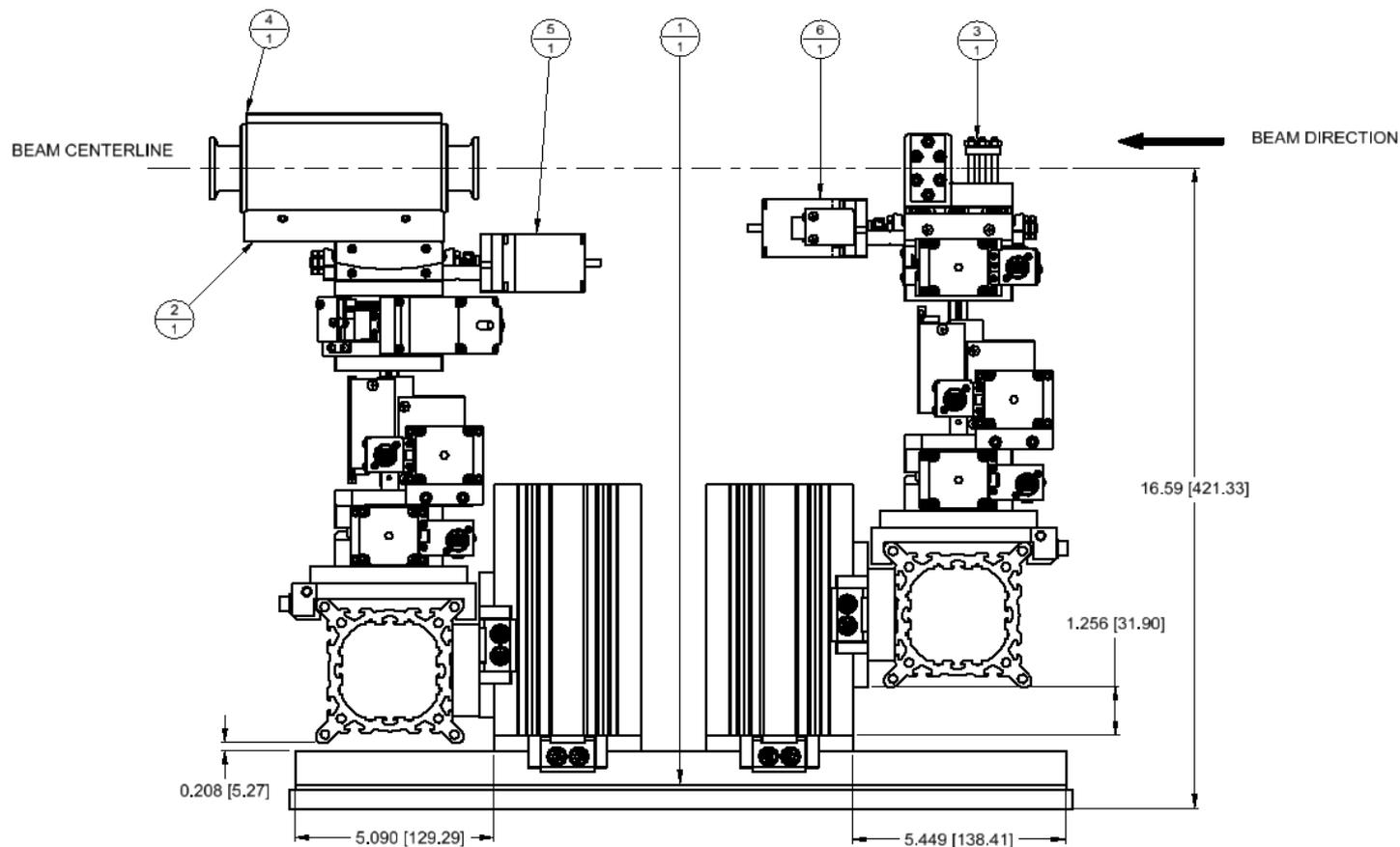
BMA V-Slit

BMA V-CRL

Part# SR-DG-BL-5078



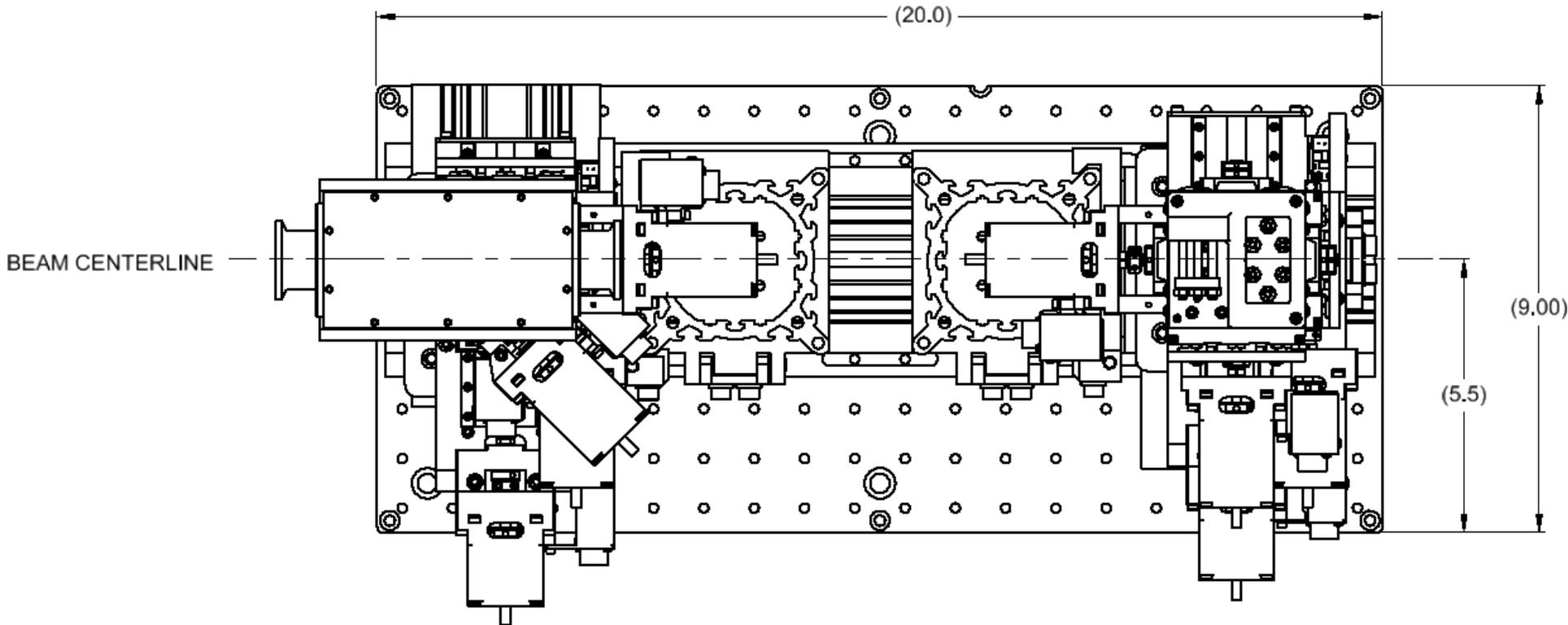
Beamline Components (BMA V-Slit & V-CRL)



6	1	SR-DG-BL-1045	STAGE ASSEMBLY, X, Y, X' AND Z'	ALUMINUM ALLOY
5	1	SR-DG-BL-1043	STAGE ASSEMBLY, X, Y, Y', AND Z'	ALUMINUM ALLOY
4	1	SR-DG-BL-5200	COMPOUND REFLECTIVE LENS HOUSING	ALUMINUM 6061-T6511 PER ASTM B221
3	1	SR-DG-BL-5045	SLIT ASSEMBLY	304 STAINLESS STEEL PER ASTM A 276/479
2	1	SR-DG-BL-5031	PLATE, ADAPTER, CRL	ALUMINUM 6061-T6511 PER ASTM B221
1	1	SR-DG-BL-5040	SUPPORT, OPTICAL ELEMENT	6000 SERIES ALUMINUM
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL

PARTS LIST

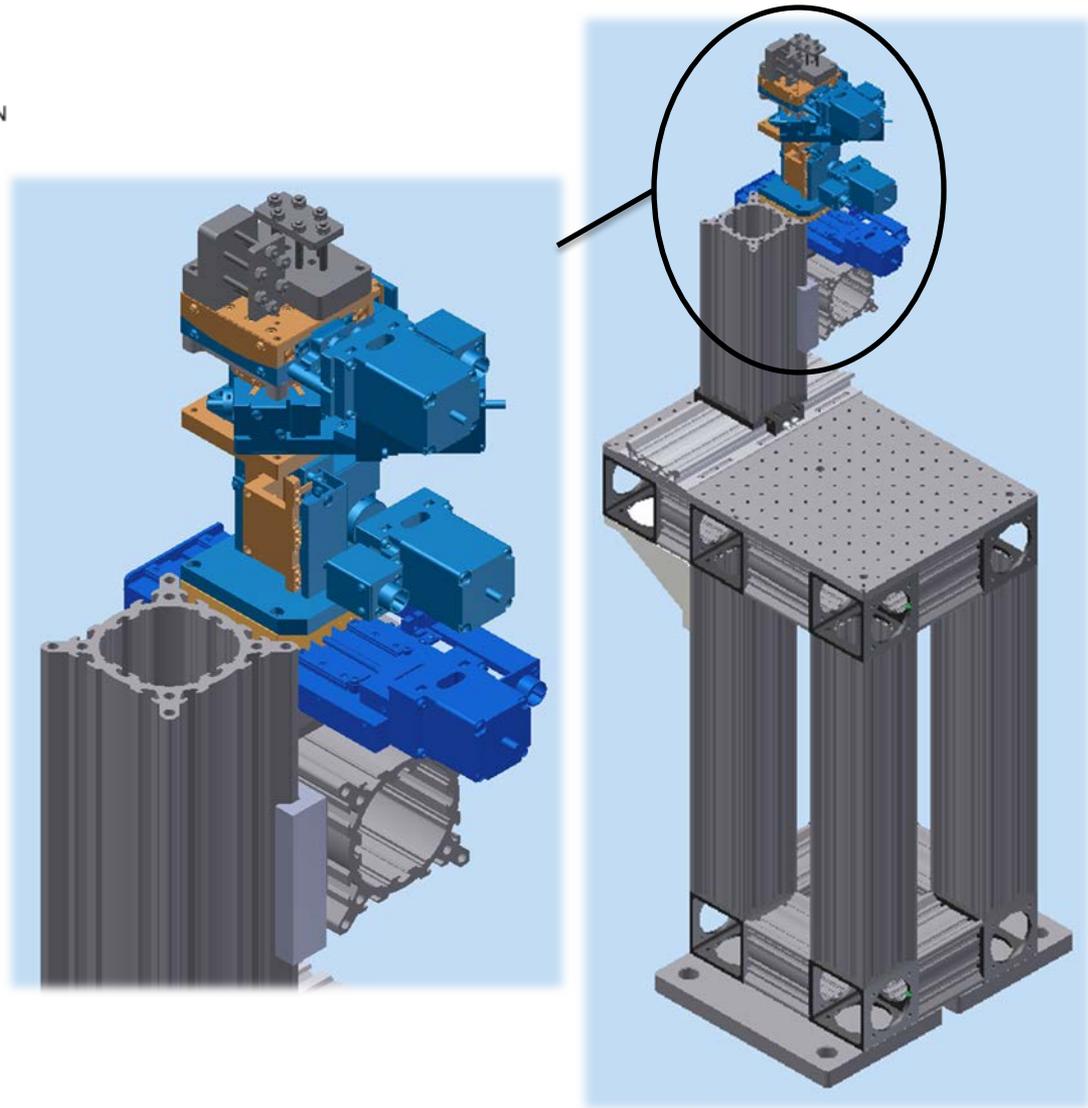
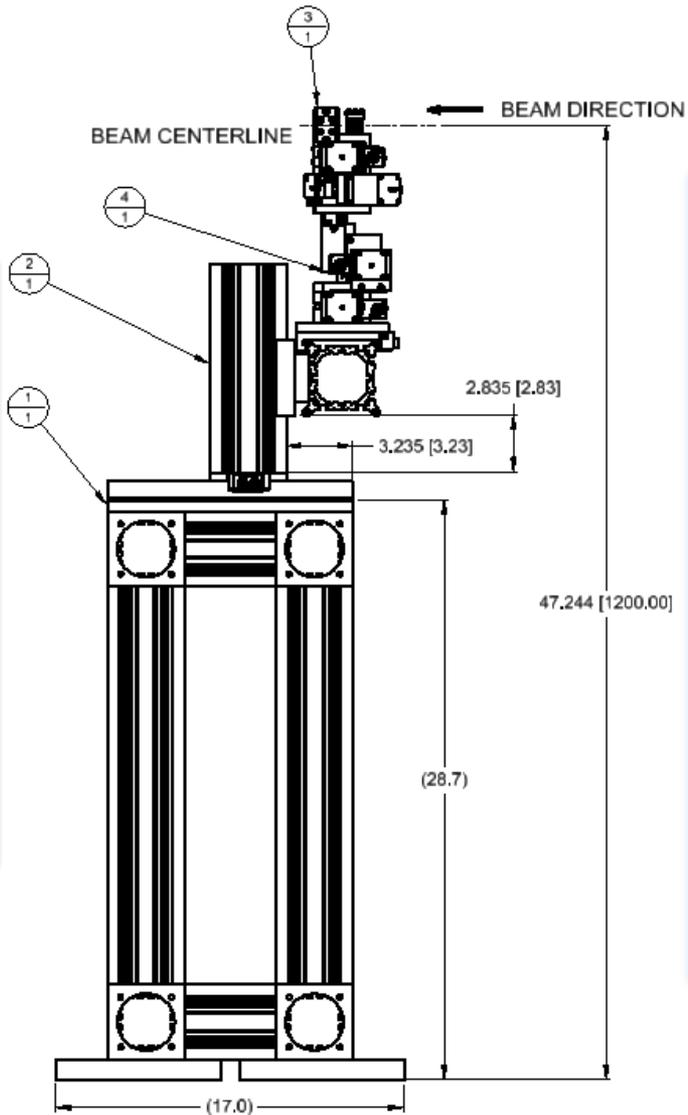
Beamline Components (BMA V-Slit & V-CRL)



Top View

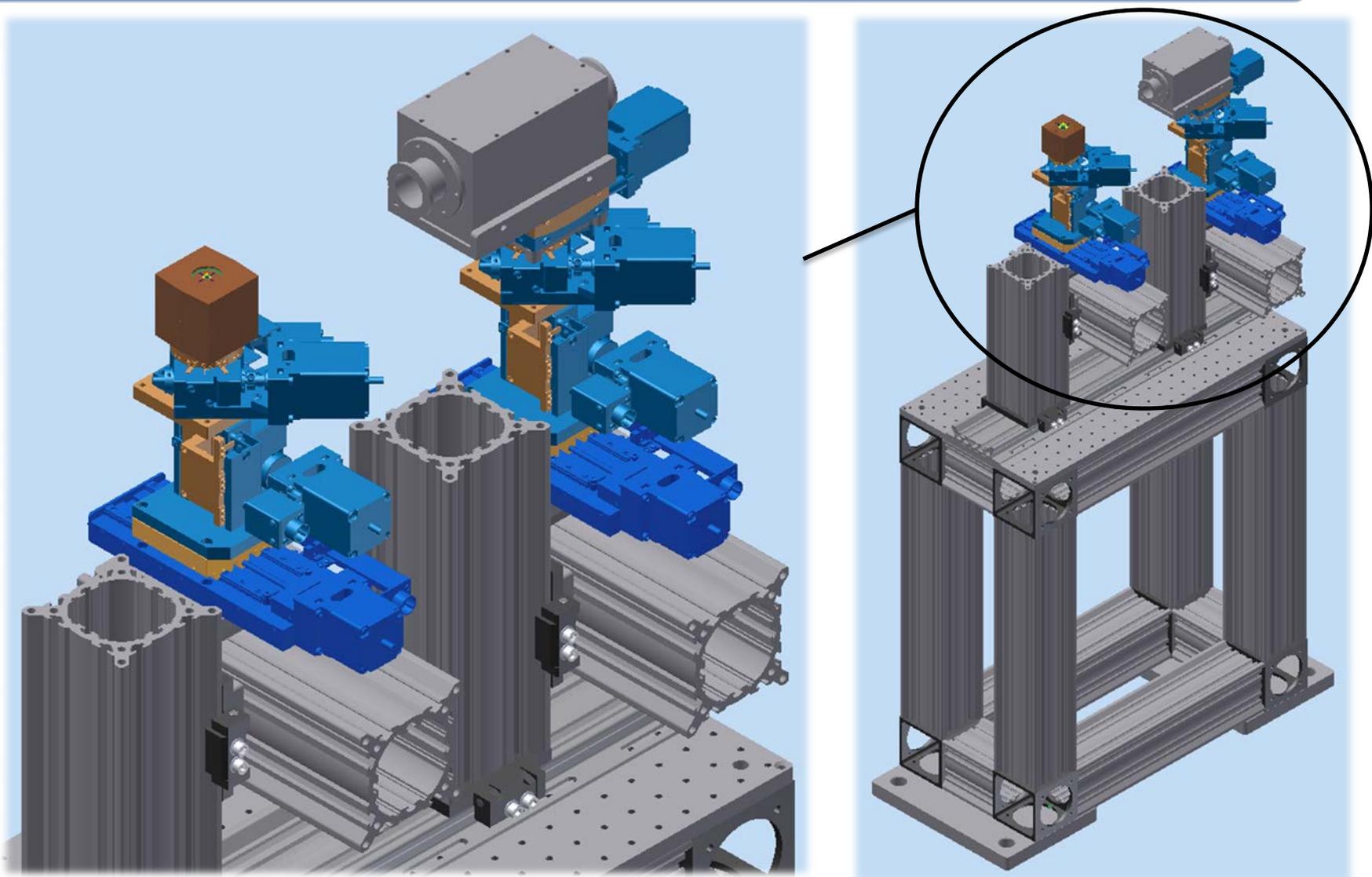
Beamline Components (BMA H-Slit)

Part# SR-DG-BL-5079

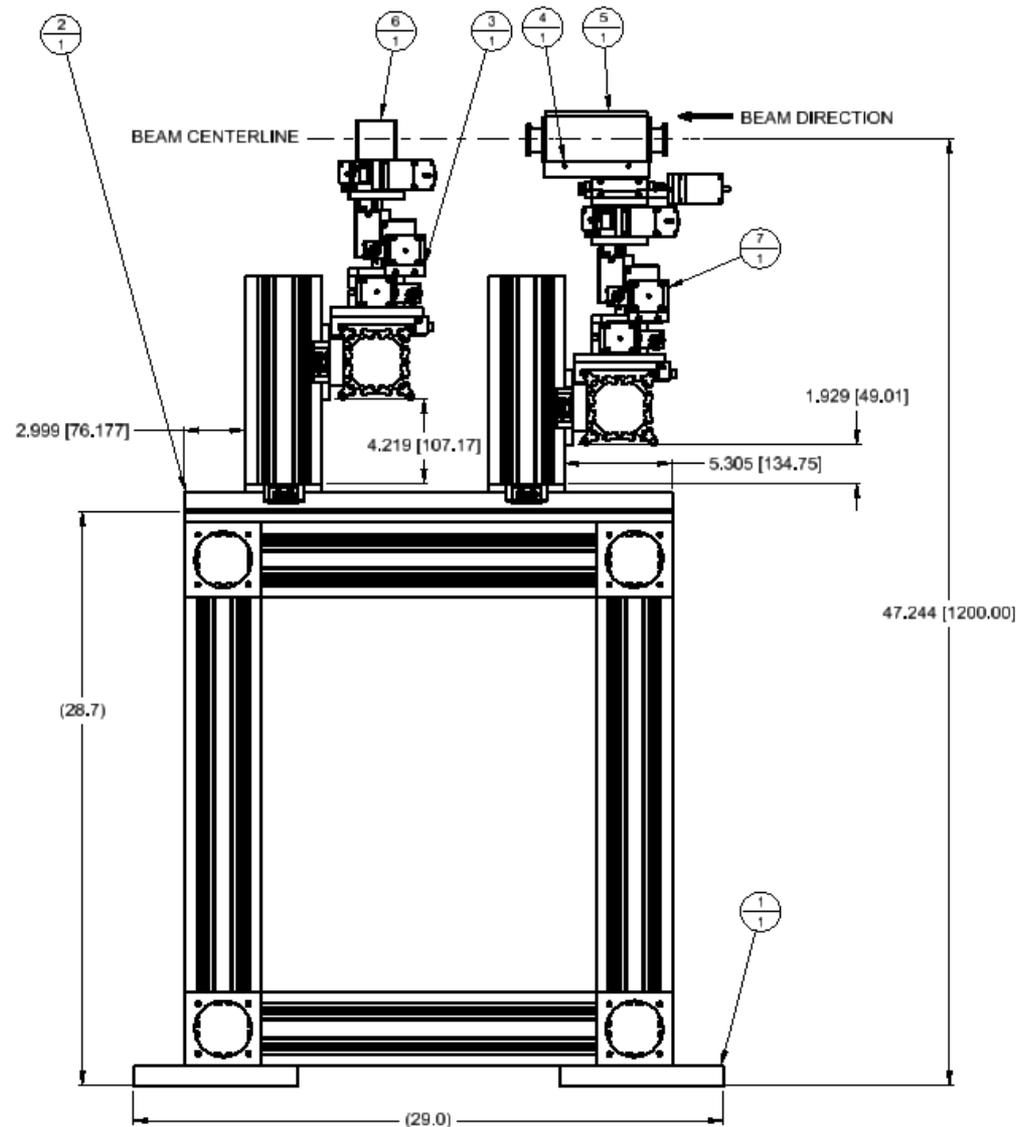


Beamline Components (BMA/3PW H-CRL & Mirror)

Part# SR-DG-BL-5087

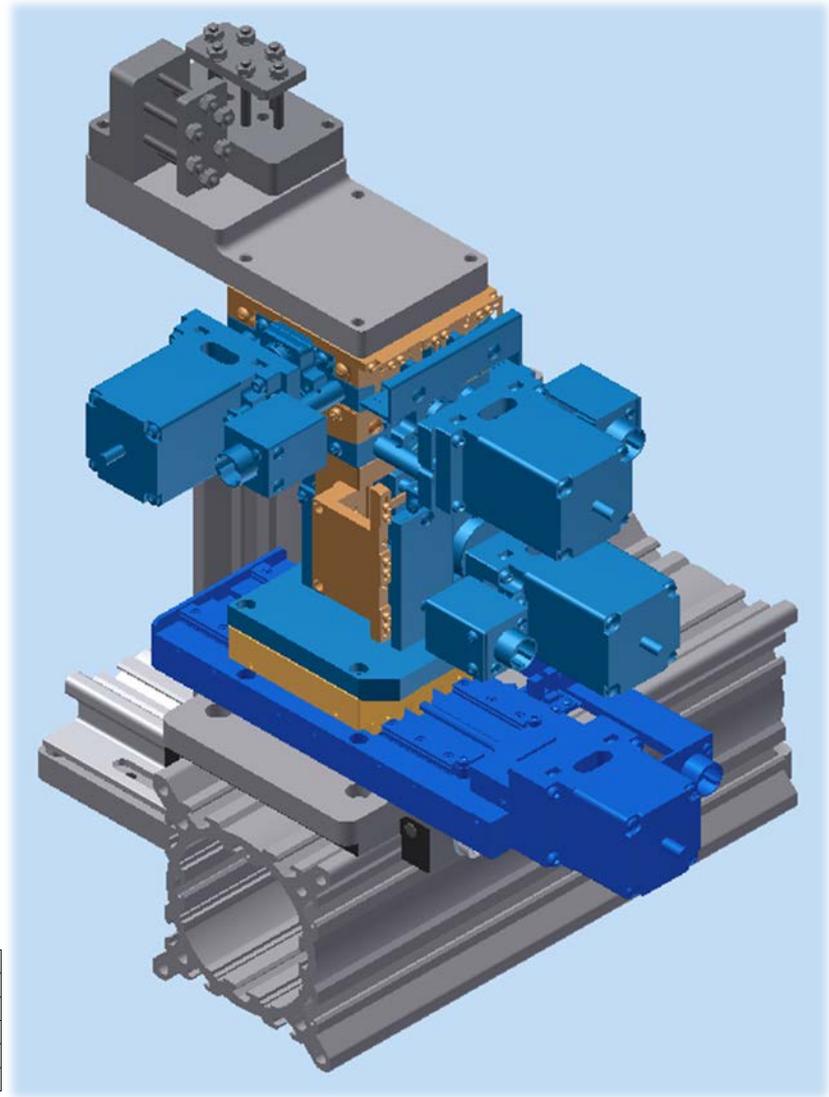
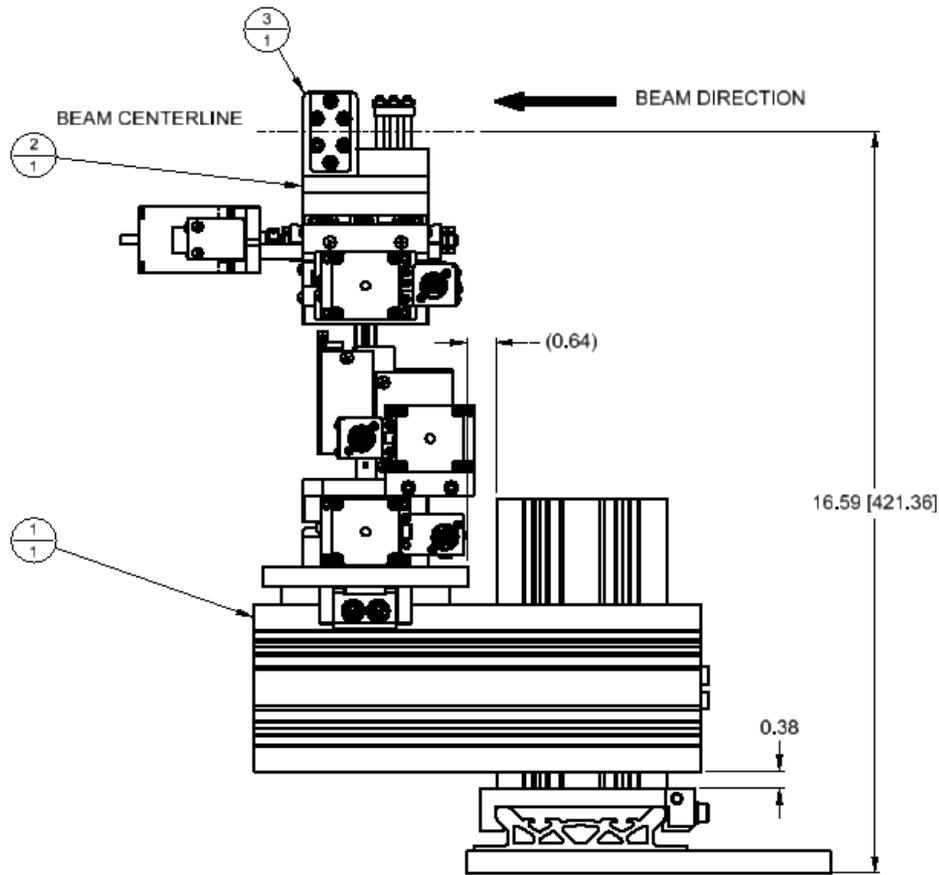


Beamline Components (BMA/3PW H-CRL & Mirror)



Beamline Components (3PW V-Slit)

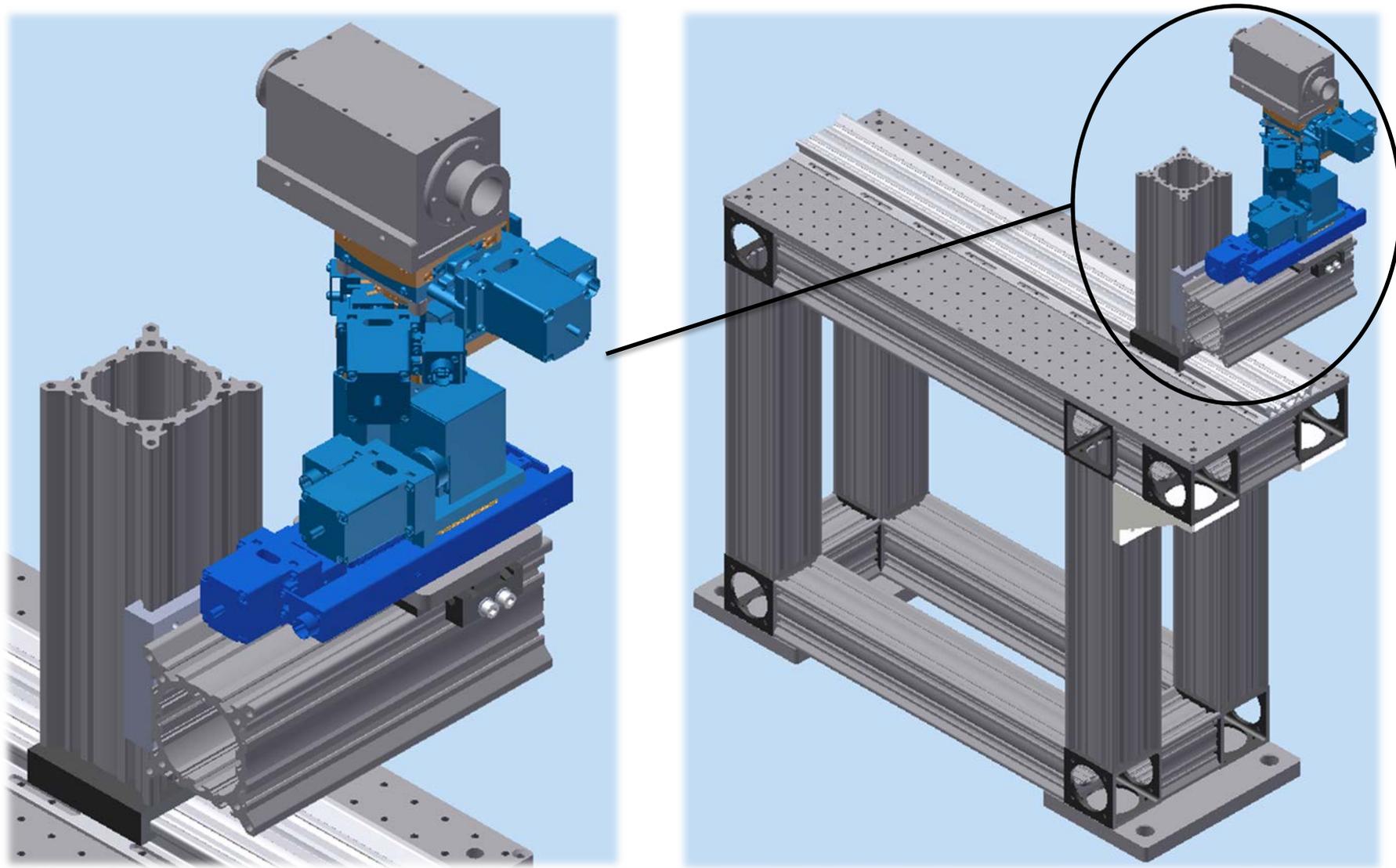
Part# SR-DG-BL-5088



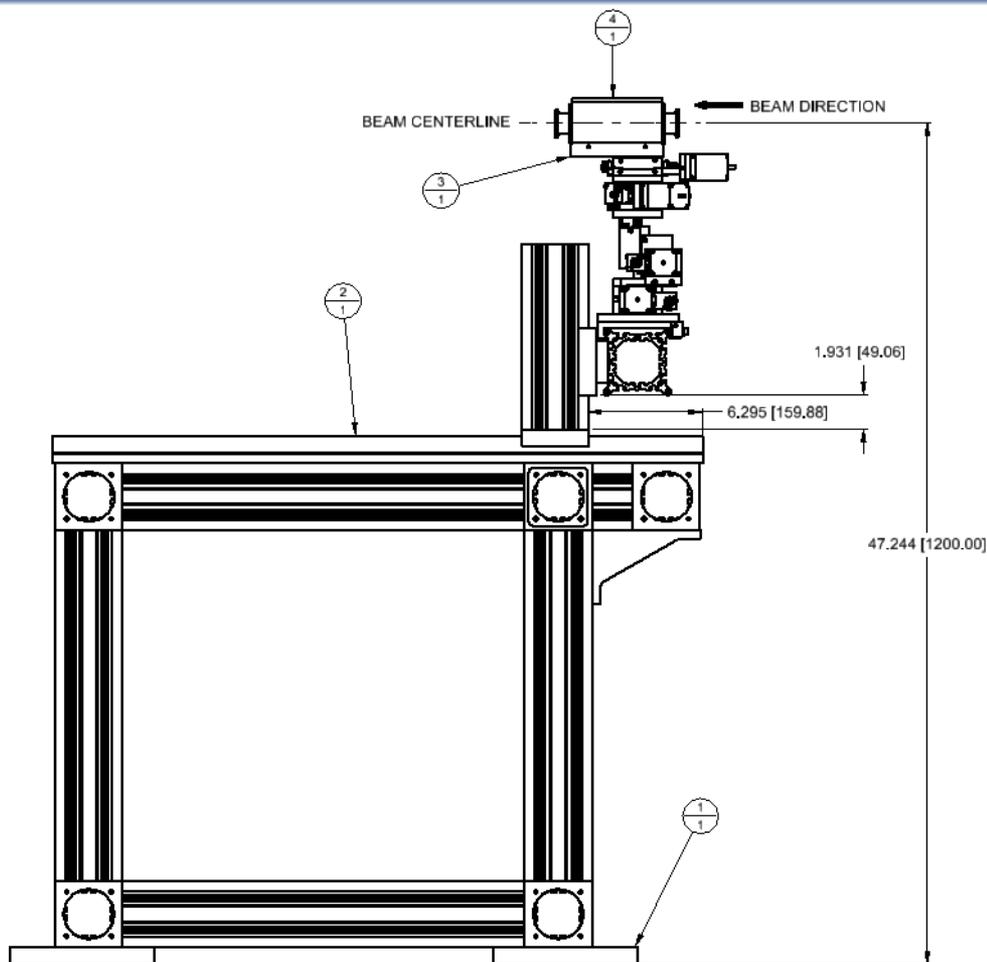
4	1	SR-DG-BL-1045	STAGE ASSEMBLY, X, Y, X' AND Z'	ALUMINUM ALLOY
3	1	SR-DG-BL-5045	SLIT ASSEMBLY	304 STAINLESS STEEL PER ASTM A 276/479
2	1	SR-DG-BL-5038	ADAPTER, V-SLIT	ALUMINUM 6061-T6511 PER ASTM B221
1	1	SR-DG-BL-5037	SUPPORT, O.E.	6000 SERIES ALUMINUM
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
PARTS LIST				

Beamline Components (3PW V-CRL)

Part# SR-DG-BL-5085



Beamline Components (3PW V-CRL)

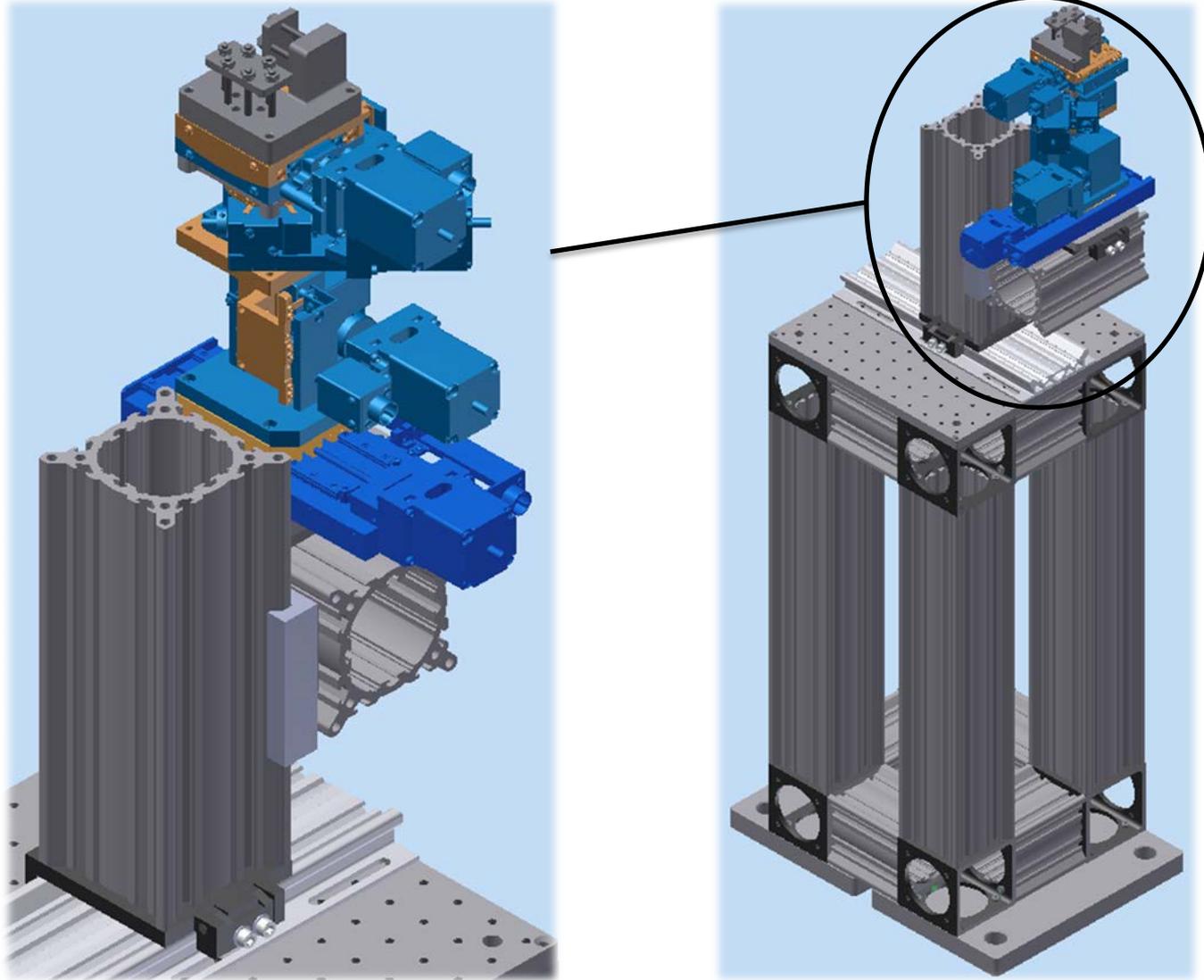


5	1	SR-DG-BL-1043	STAGE ASSEMBLY, X, Y, Y', AND Z'	ALUMINUM ALLOY
4	1	SR-DG-BL-5200	COMPOUND REFLECTIVE LENS HOUSING	ALUMINUM 6061-T6511 PER ASTM B221
3	1	SR-DG-BL-5031	PLATE, ADAPTER, CRL	ALUMINUM 6061-T6511 PER ASTM B221
2	1	SR-DG-BL-5060	O.E. SUPPORT	6000 SERIES ALUMINUM
1	1	SR-DG-BL-5080	SUPPORT, PEDESTAL	6000 SERIES ALUMINUM
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL

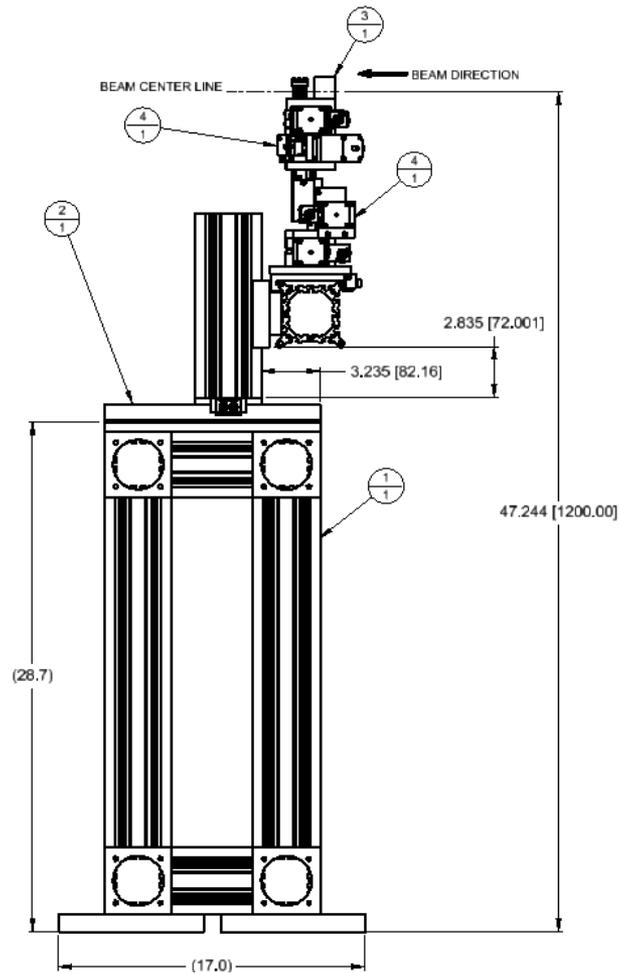
PARTS LIST

Beamline Components (3PW H-Slit)

Part# SR-DG-BL-5086



Beamline Components (3PW H-Slit)



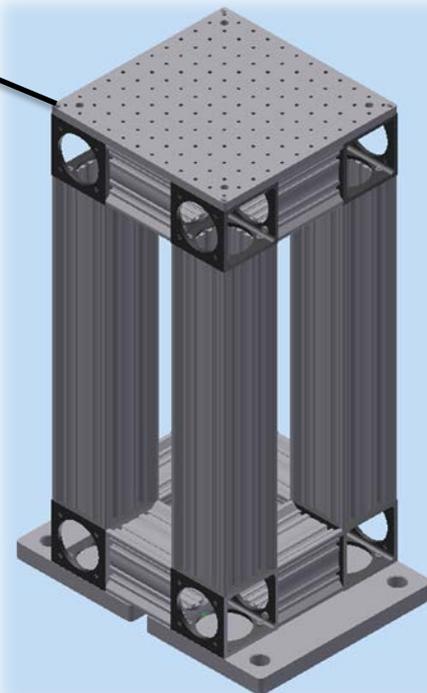
4	1	SR-DG-BL-1044	STAGE ASSEMBLY, X, Y, X' AND Y'	ALUMINUM ALLOY
3	1	SR-DG-BL-5045	SLIT ASSEMBLY	304 STAINLESS STEEL PER ASTM A 276/479
2	1	SR-DG-BL-5020	SUPPORT, O.E.	6000 SERIES ALUMINUM
1	1	SR-DG-BL-5070	SUPPORT, PEDESTAL	6000 SERIES ALUMINUM
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL

PARTS LIST

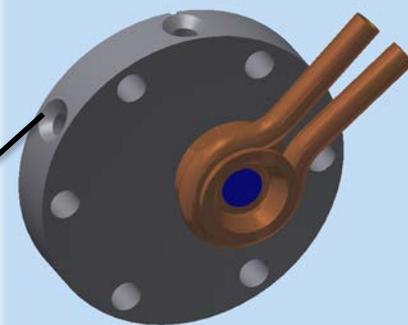
Survey & Alignment

- Min. four fiducial holes are provided on each support for survey and alignment purpose.
- Three fiducial holes are provided on both X-Ray Exit Windows for survey and alignment.
- X-Ray exit window will be installed on exit port of vacuum chamber, it will be surveyed with respect to vacuum chamber fiducial points. Then whole vacuum chamber will be aligned with respect to crotch absorber to find the beam centerline.
- Optical elements assemblies are provided with ample adjustment in each direction.

4X Fiducial Holes



3X Fiducial Holes



Summary & Conclusions

- All the top level assembly drawings have been created.
- All the sub-assembly drawings and parts drawings have been created and ready to be released.
- All the purchased items quotes are available for purchasing.
- Ray Tracing is done for both beamlines to verify the component sizes.
- No problem is anticipated in meeting the costs and schedules for both beamlines.