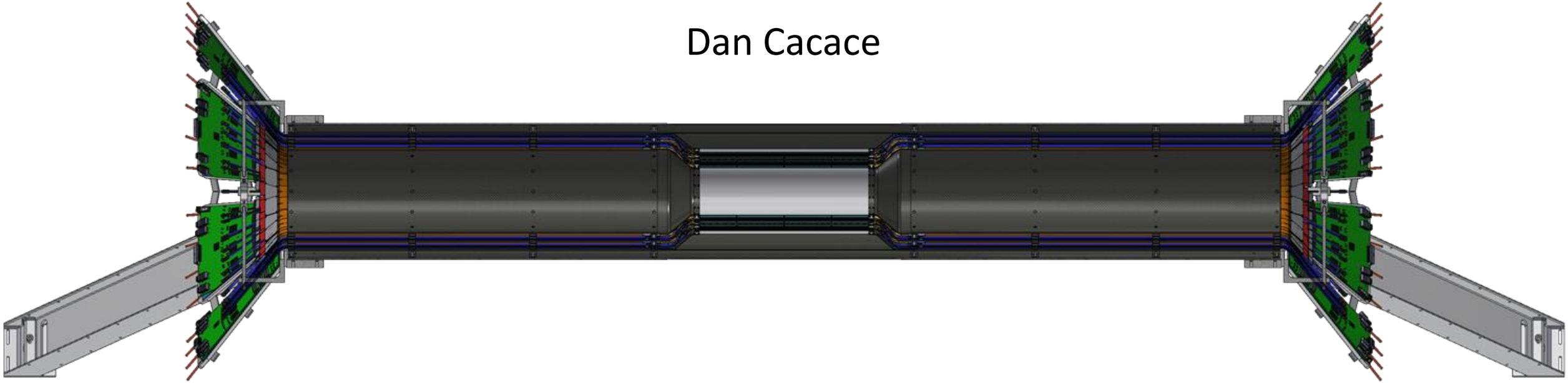
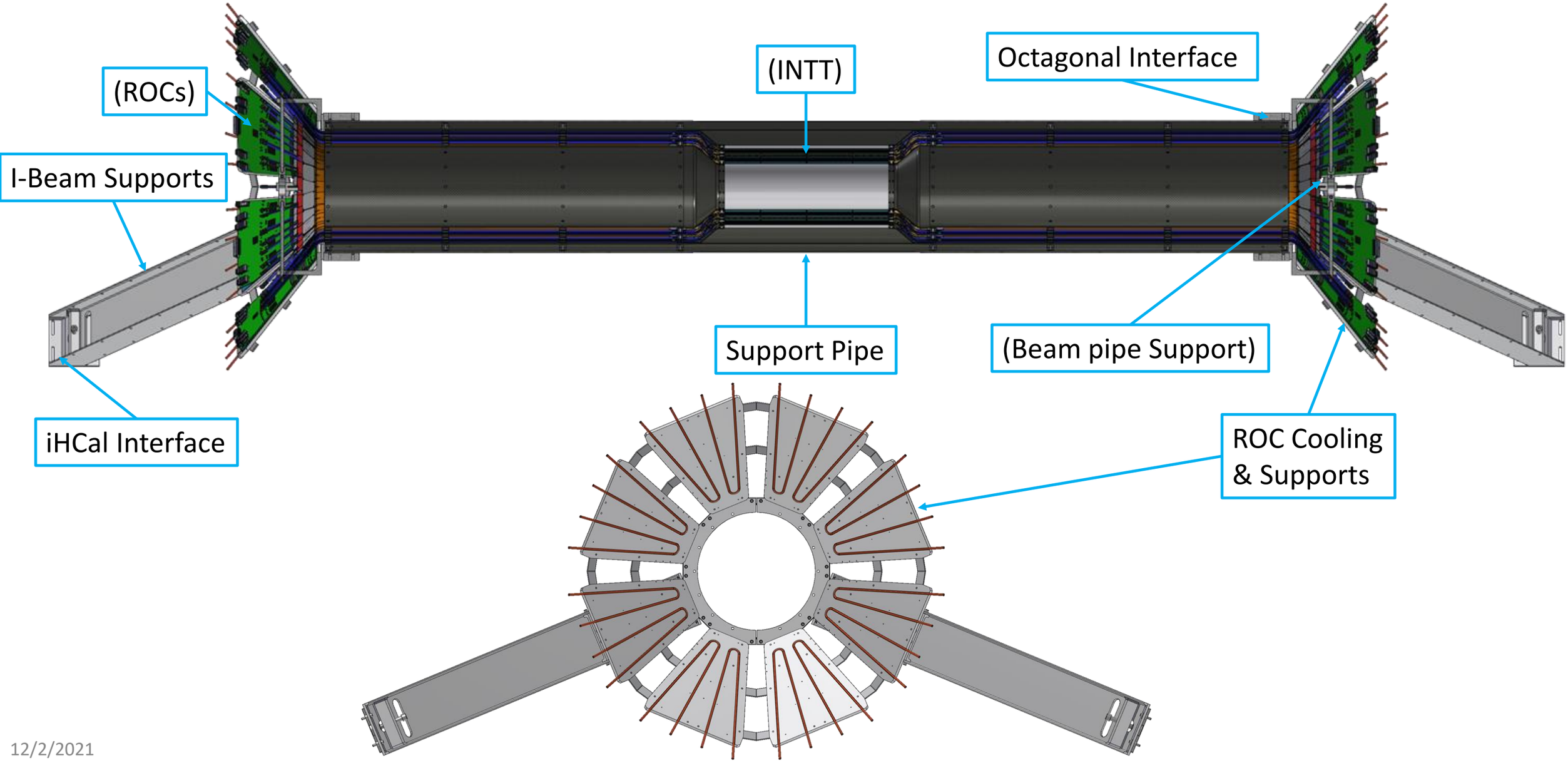
INTT Installation Fixture FDR

Dan Cacace

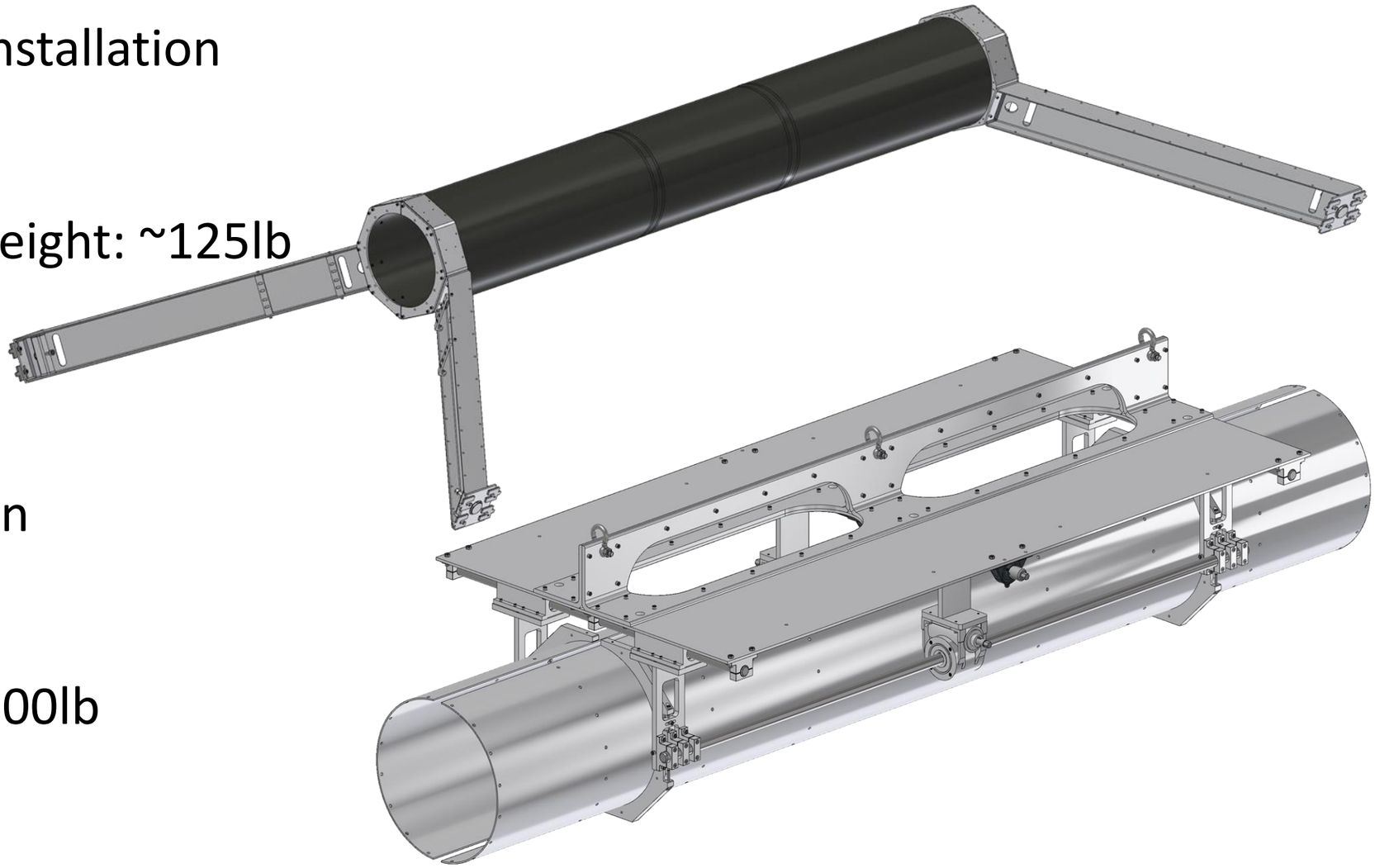


Design Components

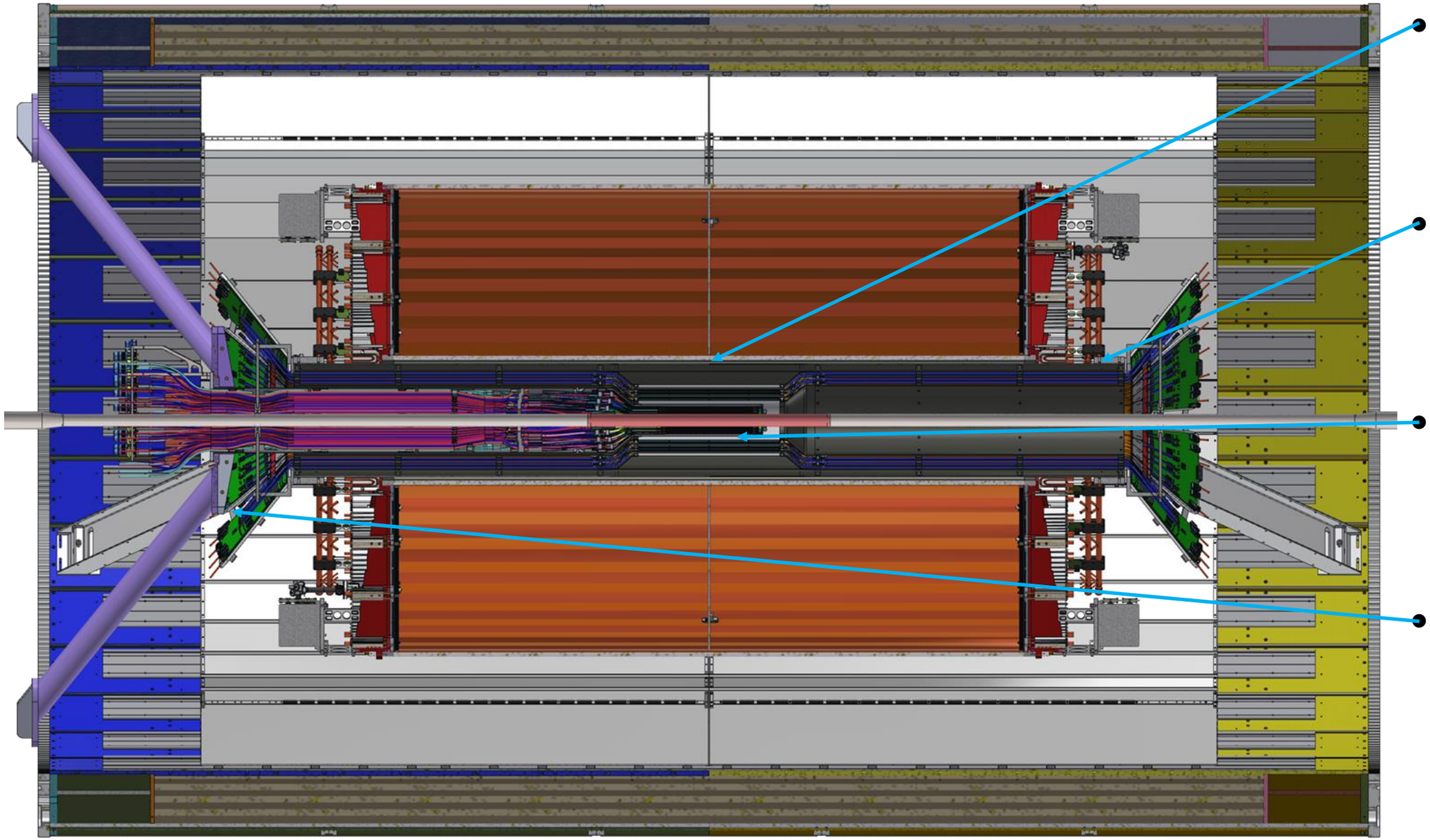


Design Requirements

- INTT Support Structure
  - Facilitate INTT Support Installation
  - Install without crane
  - Tested in silicon lab
  - Support INTT Support Weight: ~125lb
  - Position INTT: +/- 0.125”
- INTT
  - Facilitate INTT Installation
  - Install without crane
  - Tested in silicon lab
  - Support INTT Weight: ~100lb
  - Position INTT: +/- 0.125”

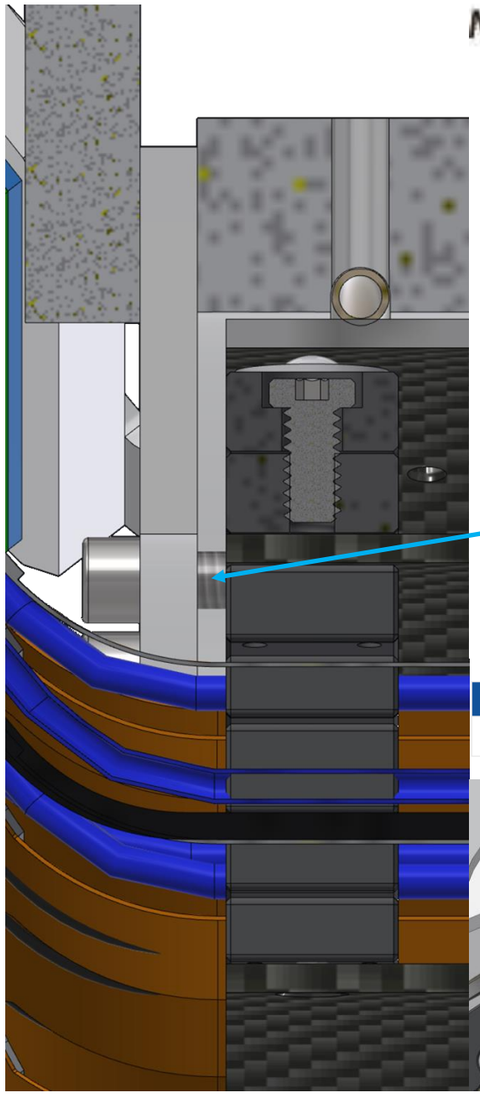


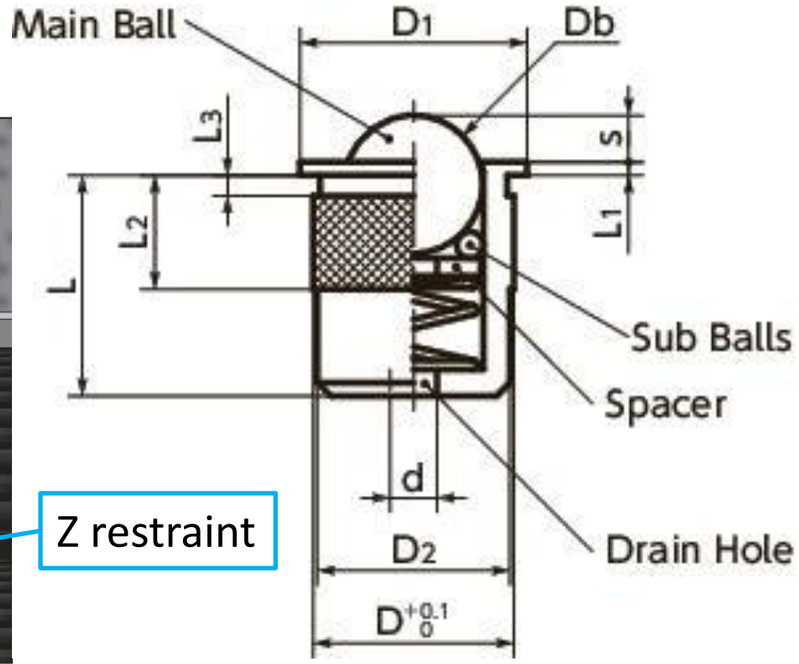
Integration – Installed Position



- 0.375” clearance between TPC ID and INTT Support Tube OD.
- 2” clearance between TPC manifold and INTT octagonal interface.
- 0.2” clearance between MVTX OD and INTT ID.
- 2” clearance between MVTX support and INTT ROC.

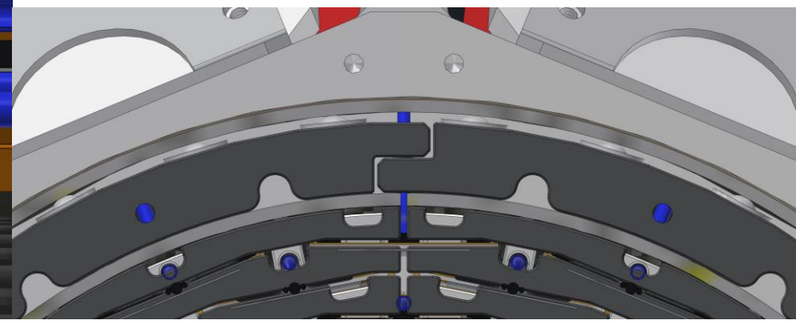
INTT Interface

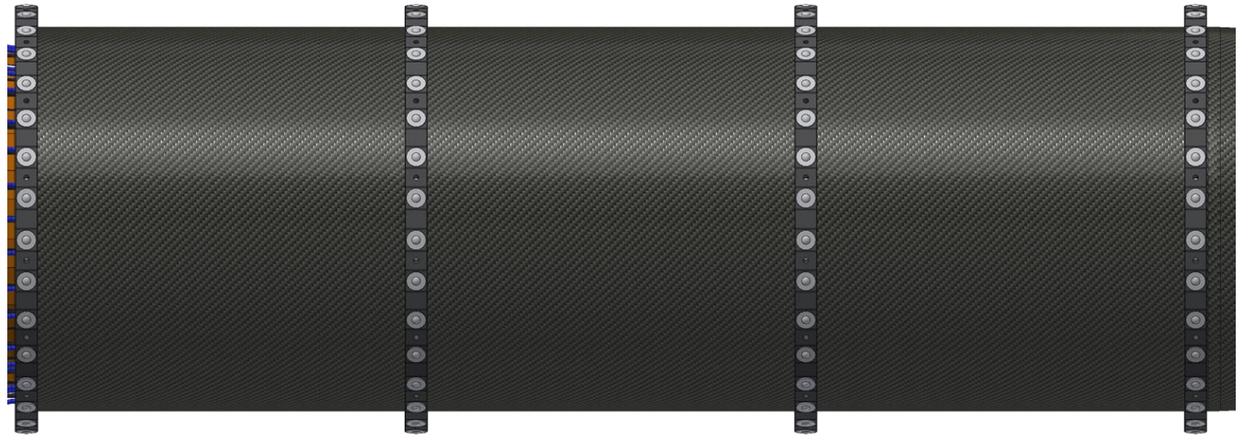




Z restraint

Part Number	D	D_1	D_2	L	s	L_1	L_2	L_3	Db	d	Load (N) Min./Max.	Qty per Pack	Mass (g)
BRPIN-15-N	15	17	14.7	16.5	3.5	1	8.5	1.5	10.32	3.5	0.3 / 11	1	3.9

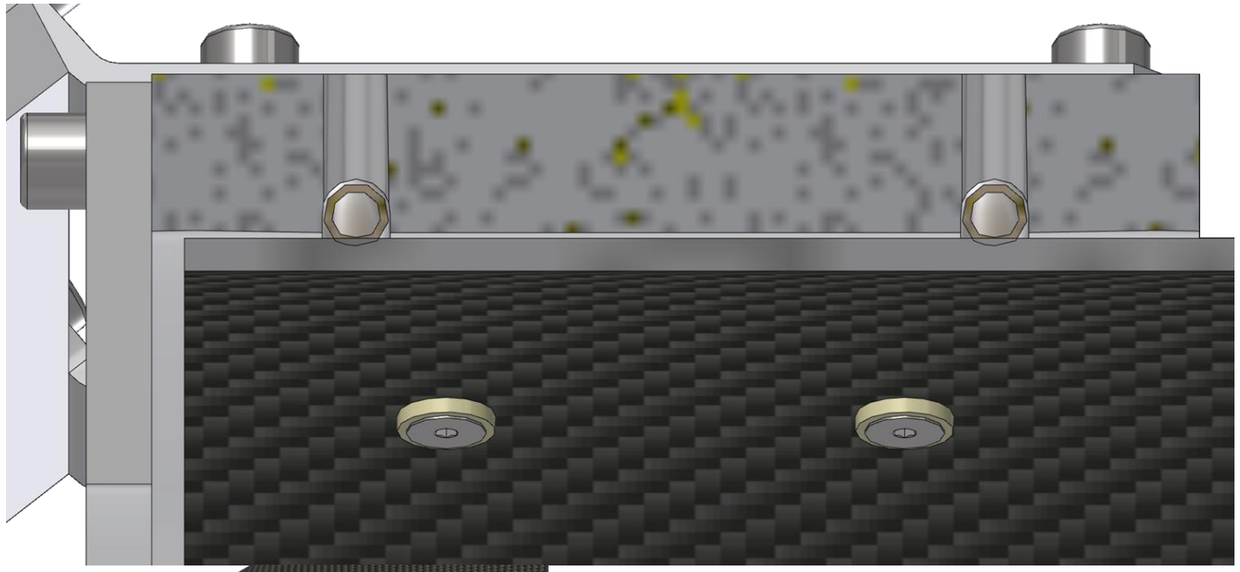


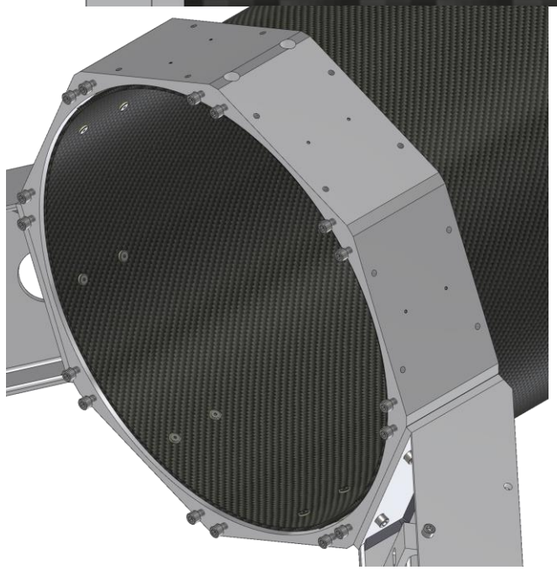


- INTT has 8 rings of 32 spring loaded ball transfers (256 total).
- Each ball transfer is nominally half compressed ~1/16”, 1.25lb.
- INTT roles in on carbon fiber support tube.
- Bolts to aluminum endcaps to allow Z positioning (+/- 0.125”) and prevent undesired movement.

Carbon Fiber Interface

- 16X 6-32 low head with rubber washer per side on ID of carbon fiber tube attaches to the octagon.
- 1/16” clearance radially between carbon fiber tube and aluminum octagon.
- Rubber tube (pulled under vacuum for installation) between carbon fiber tube and aluminum octagon to bank up against.

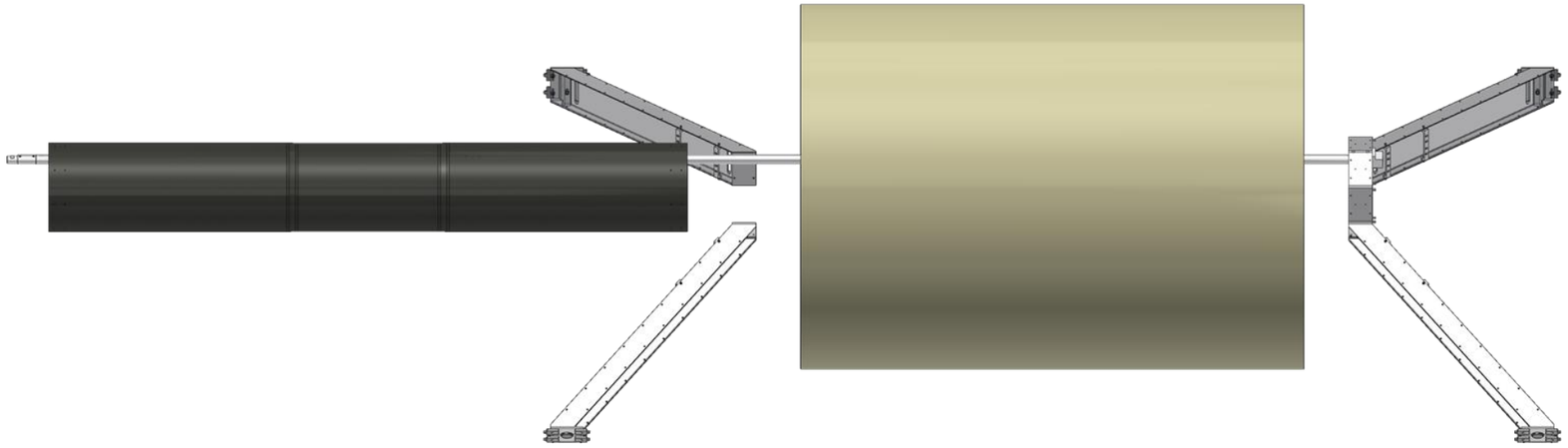




Tube Installation

- Install aluminum parts of support structure by hand.
- Each part is 15lb or less.
- Leave out octagon on one side

- Insert framing through TPC
- Attach framing to octagon.
- Slide tube over framing.
- Tube weighs 35lb.



Tube Installation

- Push tube on framing in to TPC
- Attach tube to octagon on one side.

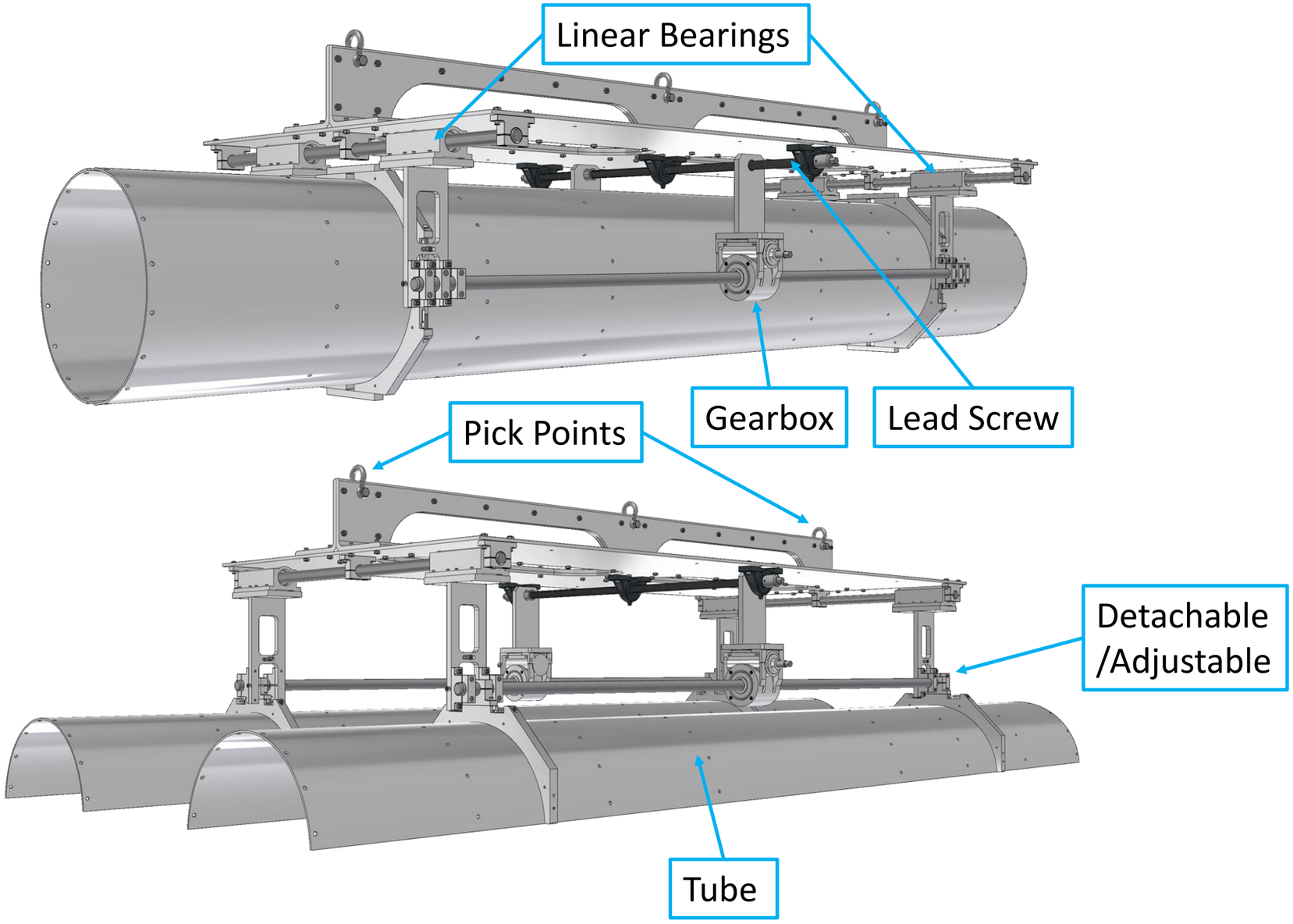
- Add second octagon and attach to tube.
- Remove framing and tread cable though to pull INTT in.

Installation Fixture

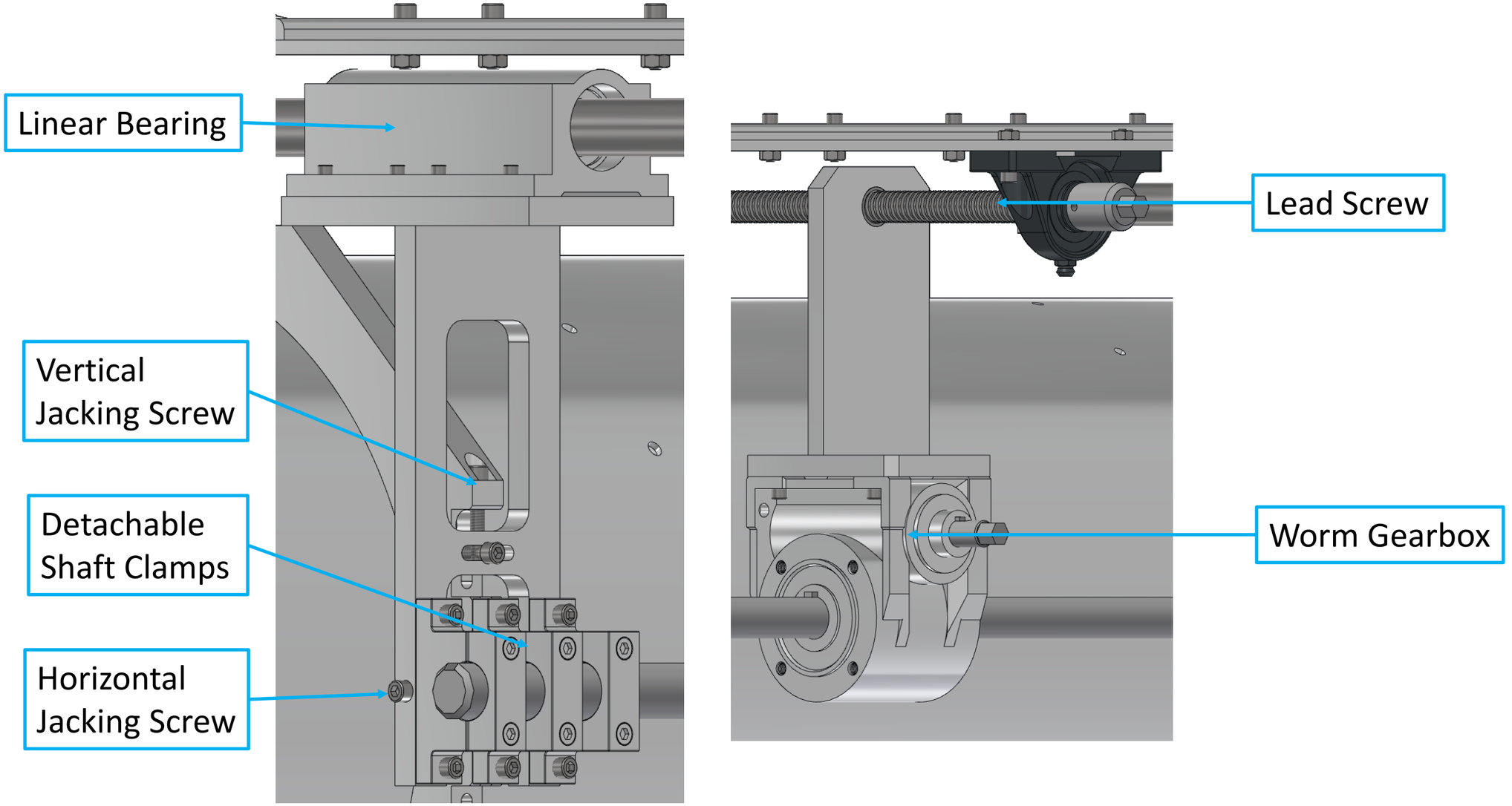
Closed Position

Tested in silicon lab

Open Position

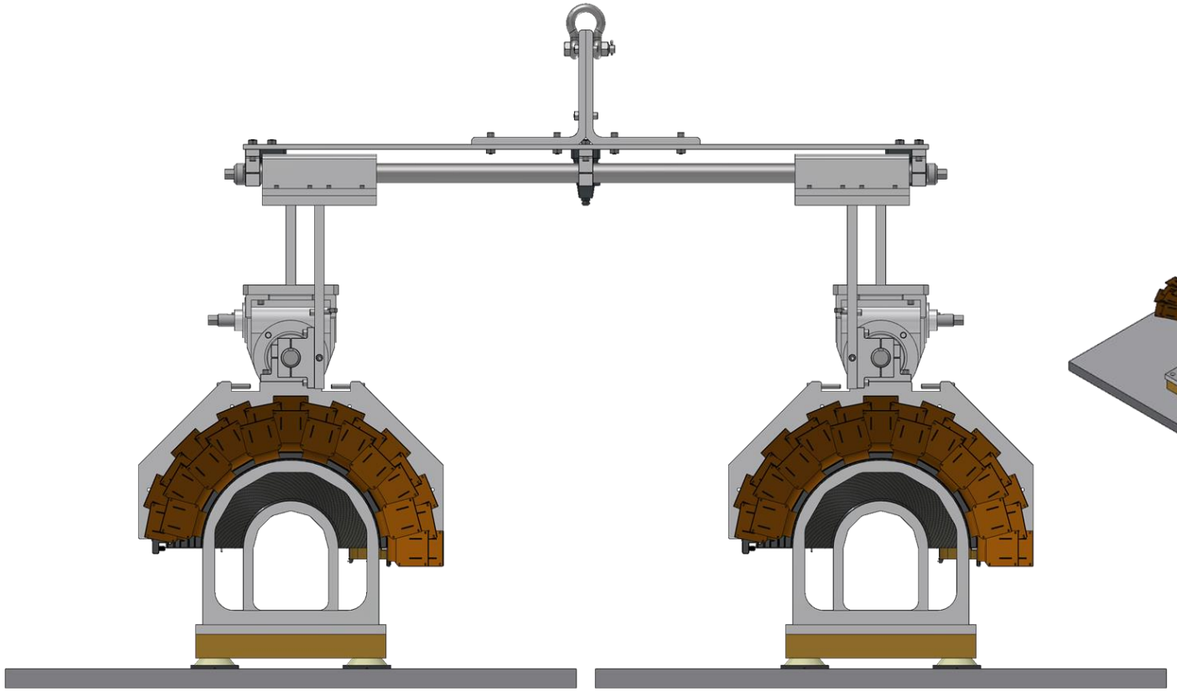


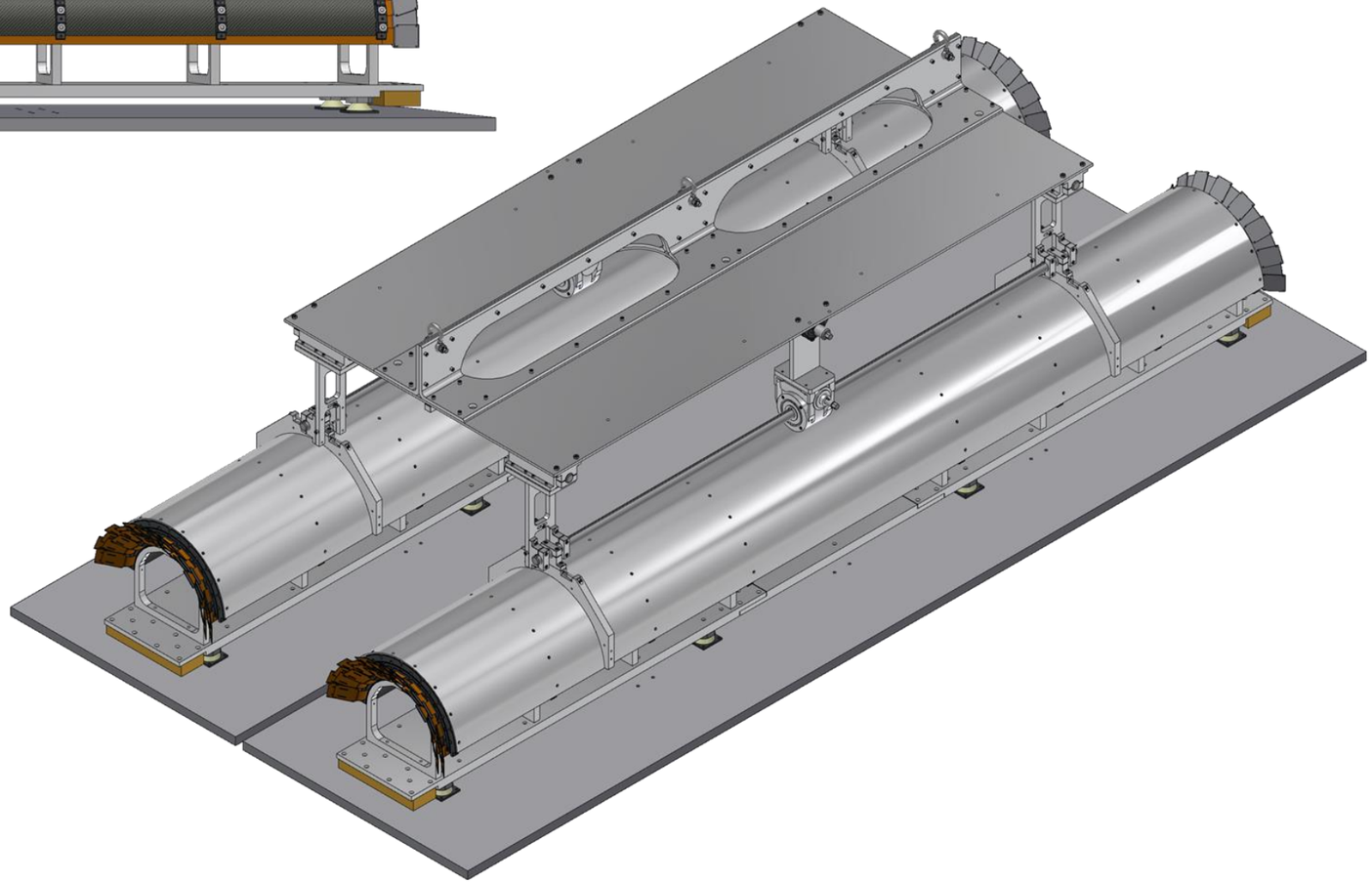
Installation Fixture



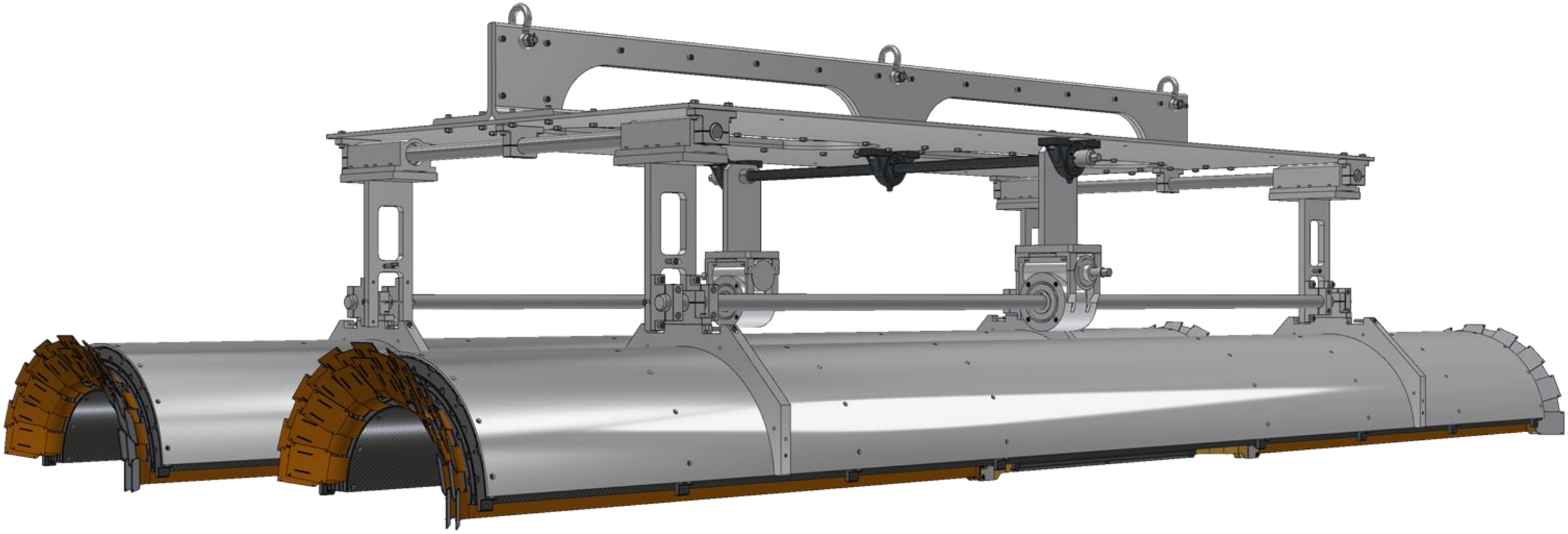
Installation – Attach

Assembly Stand



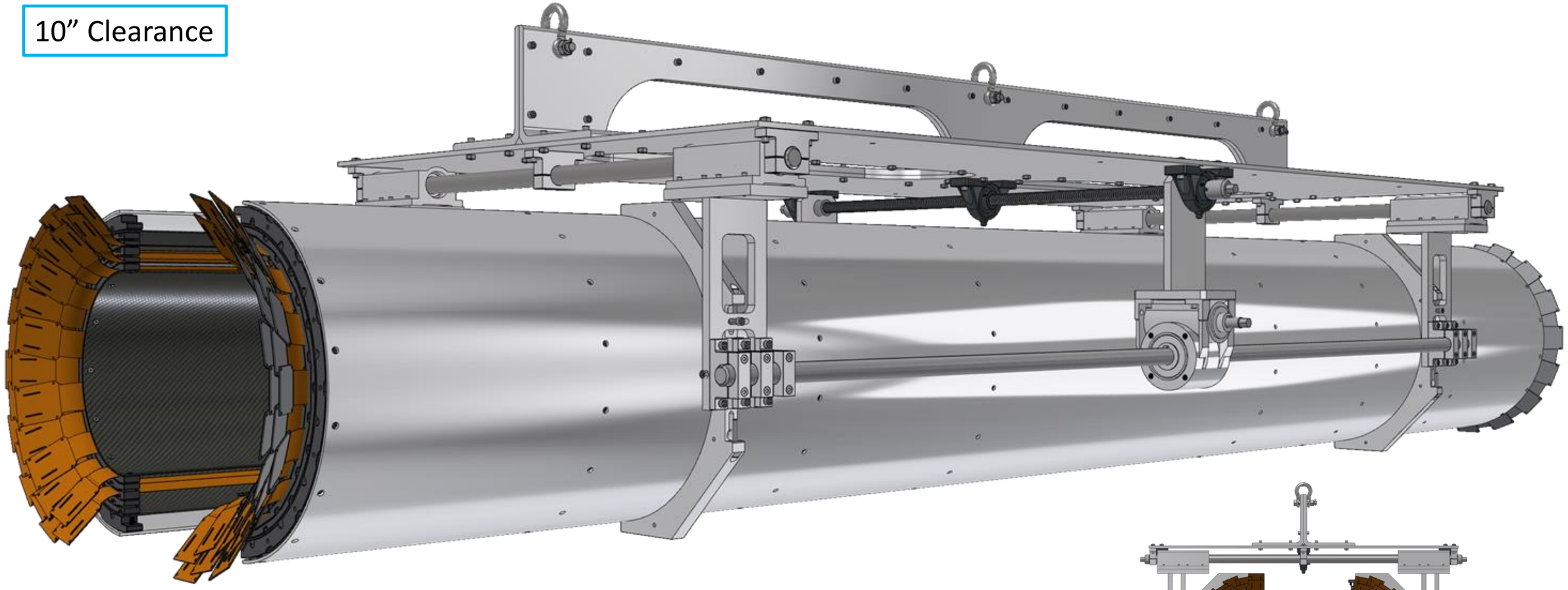


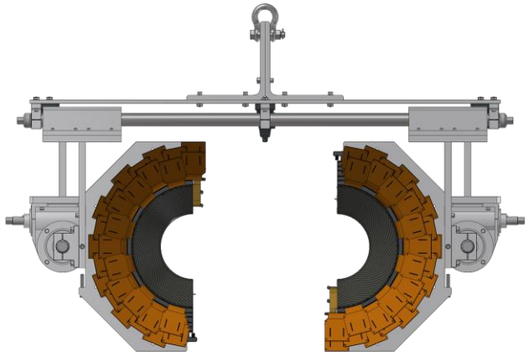
Installation – Pick Up



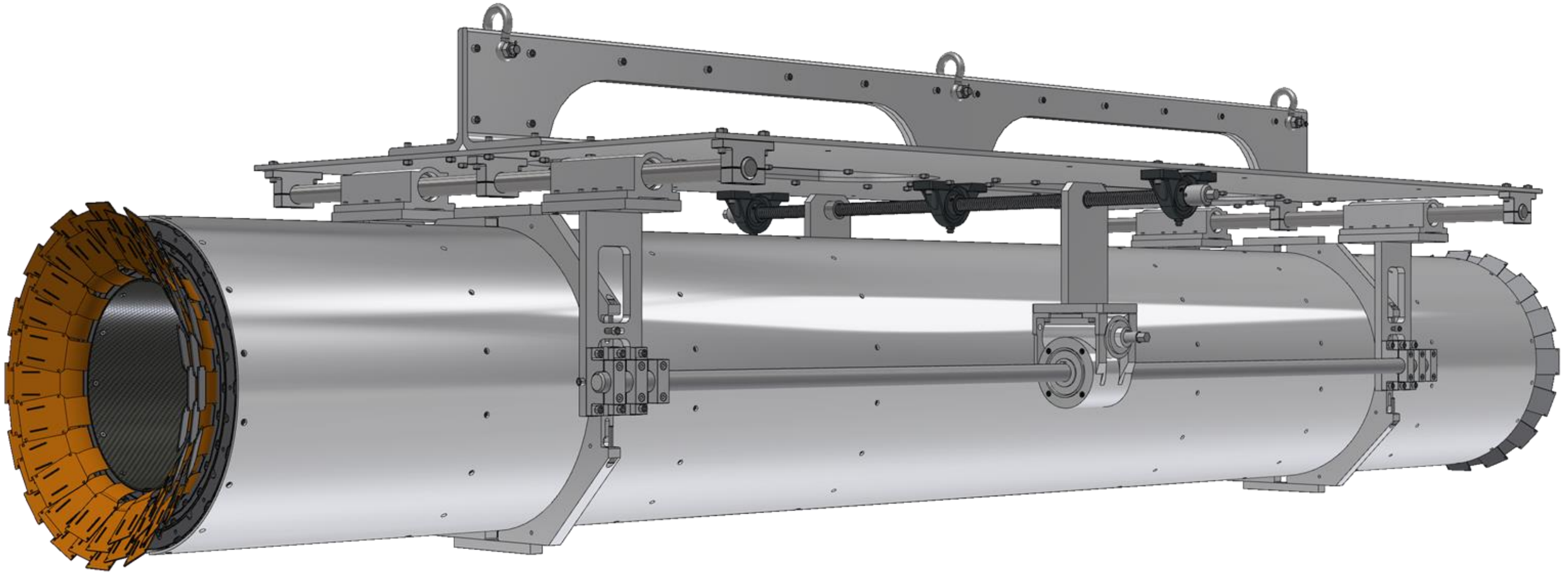
Installation – Rotate

10” Clearance

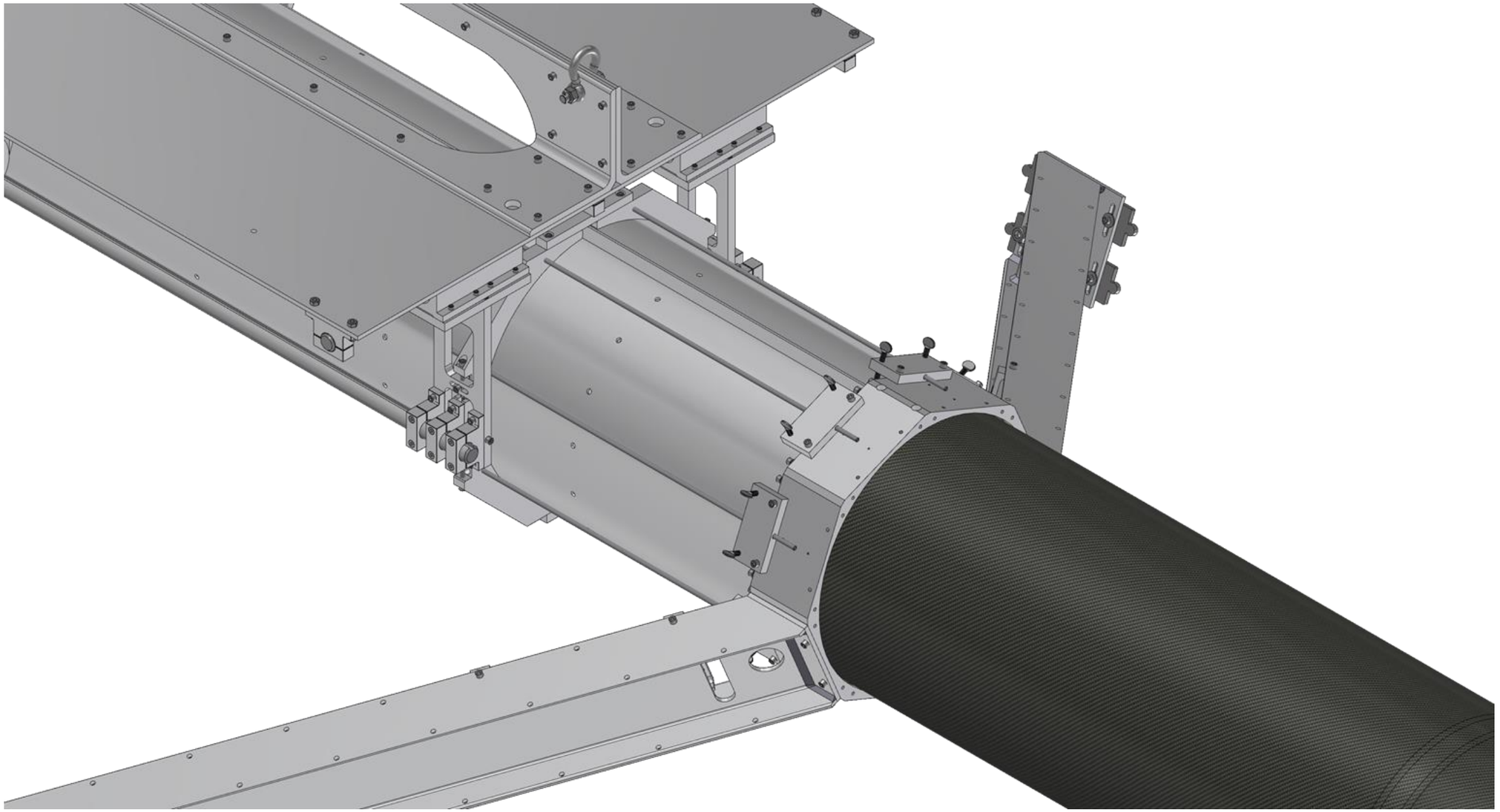




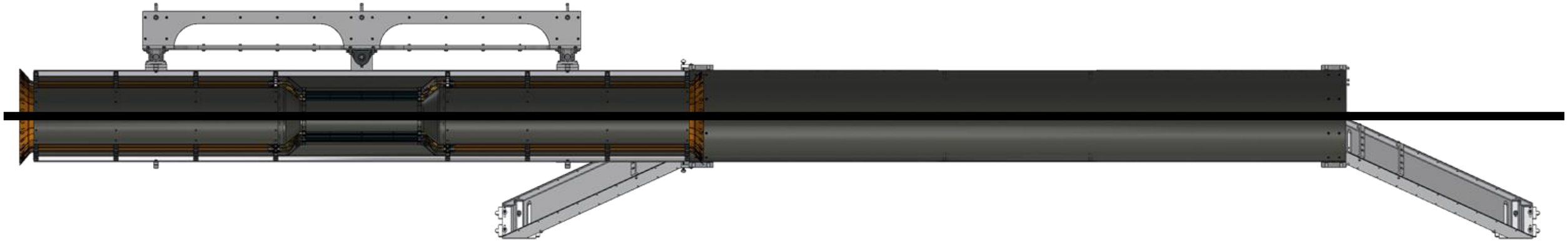
Installation – Clamshell



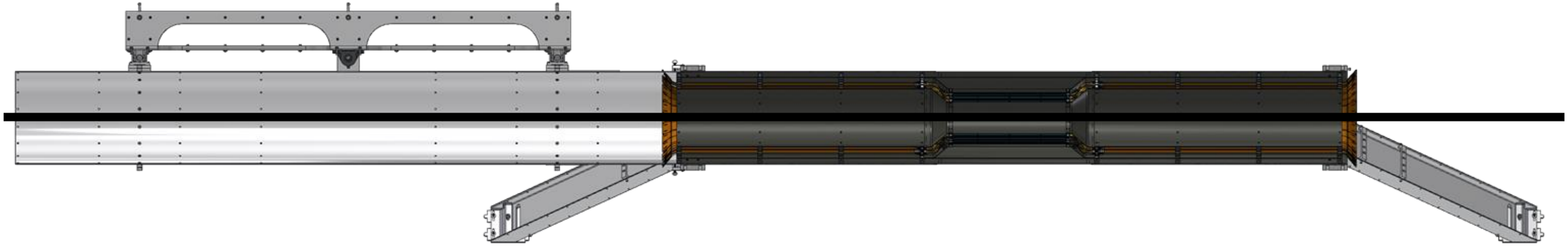
Installation – Tie Down and Align



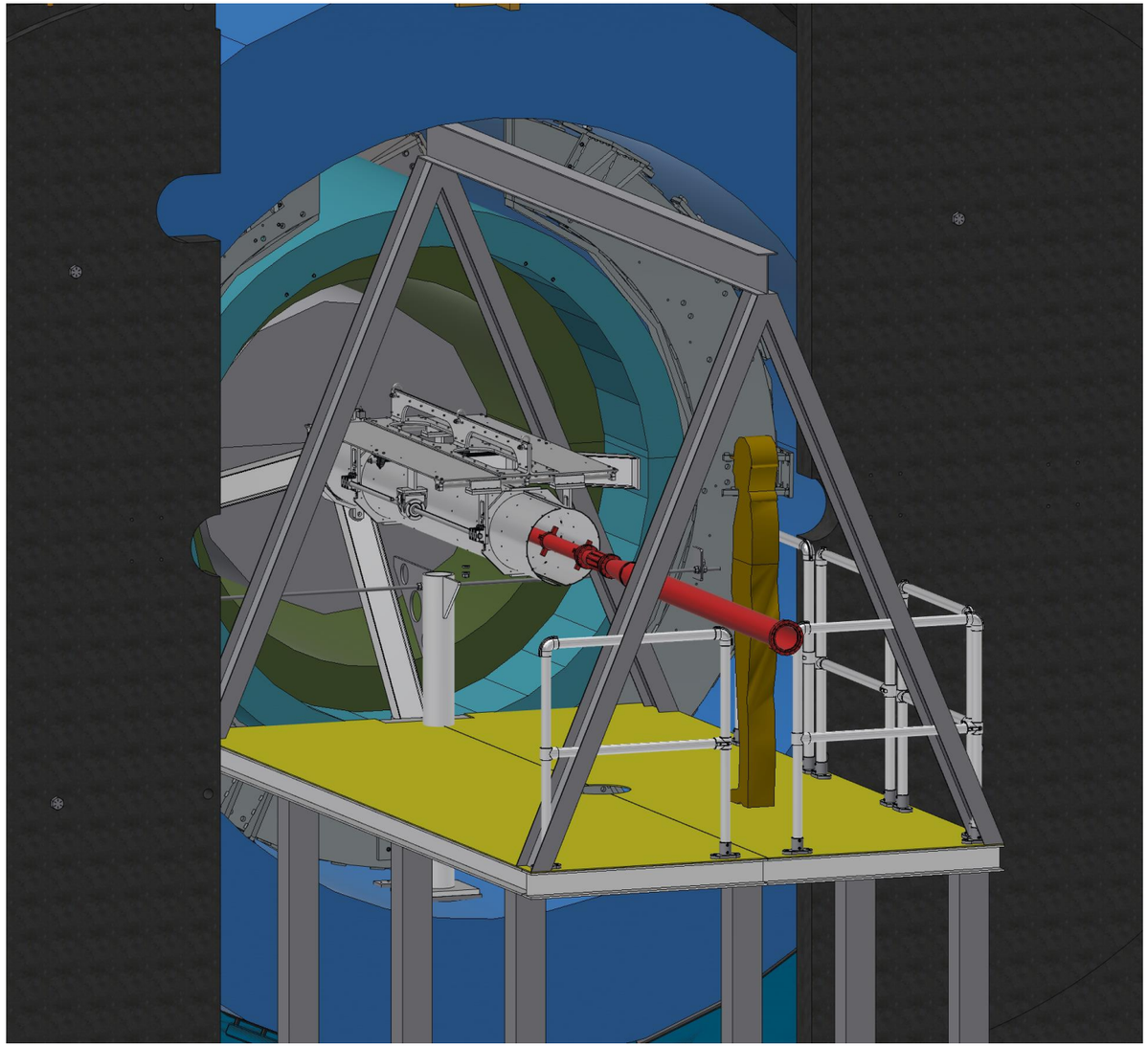
Installation – Cross Section



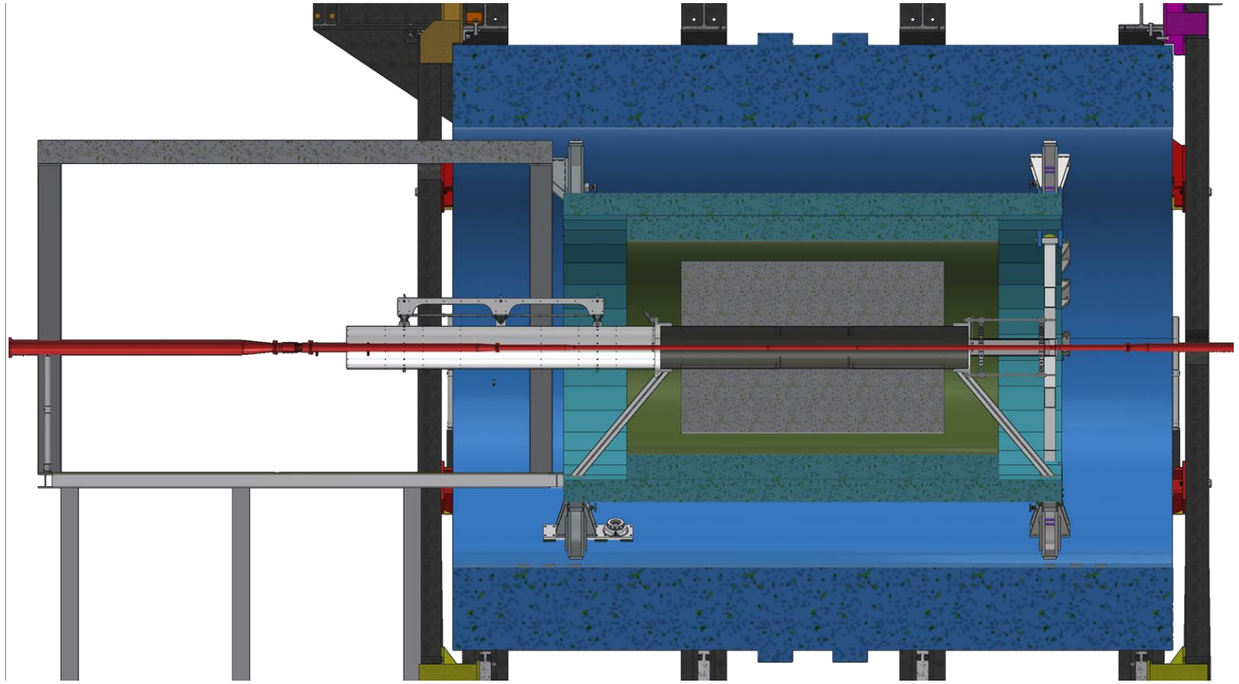
Pulled Through with Cable



Installation – Platform (Concept)

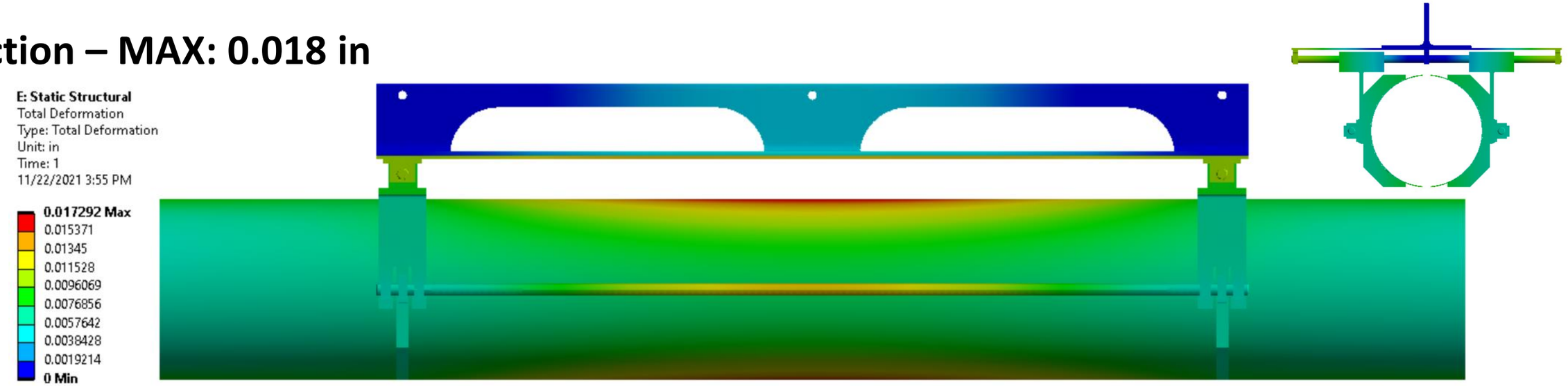


Frame Tested in silicon lab

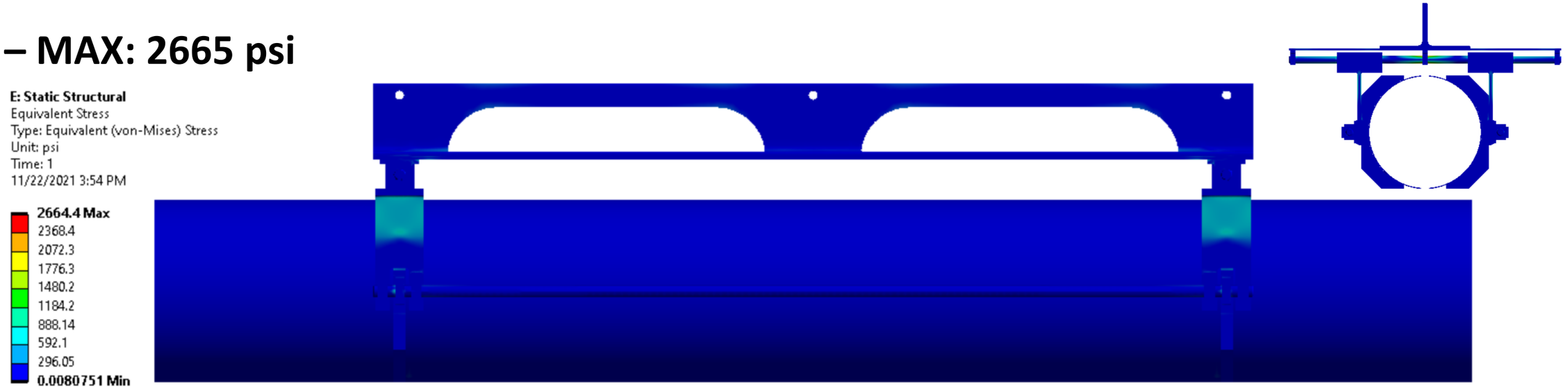


Installation Fixture – FEA

Deflection – MAX: 0.018 in



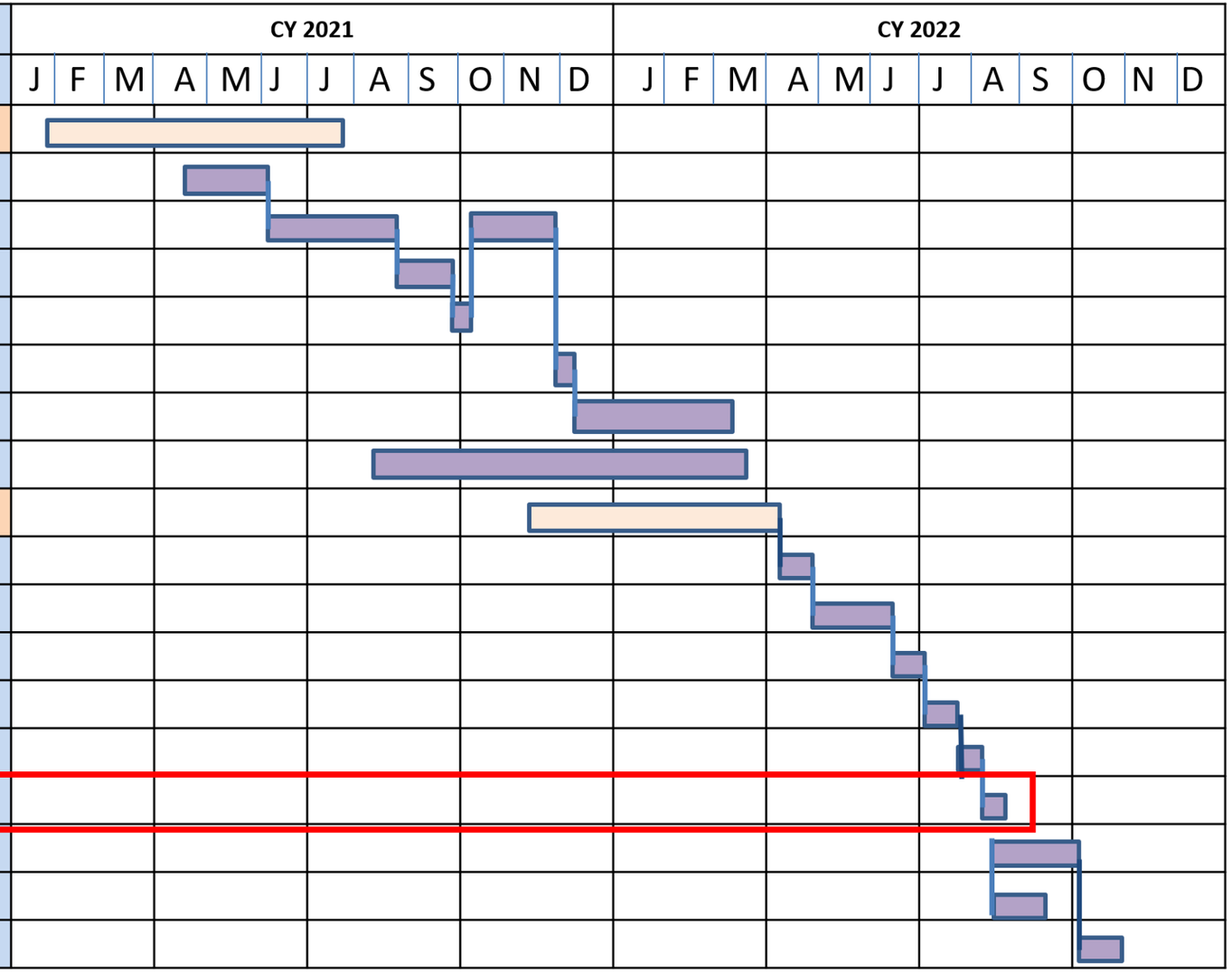
Stress – MAX: 2665 psi



Boundary Conditions: Pick points fixed, gravity, detector weight added

Overall Installation Schedule

Sequential Build Steps	Locate	Start	End
RHIC Run FY21		1/30/21	7/15/21
Cradle-Base	AH	4/28/21	6/2/21
Outer HCAL	AH	6/4/21	11/12/21
Secure Magnet in oHCAL	AH	8/26/21	9/29/21
Large Support Rings	AH	9/30/21	10/6/21
Inner HCAL	AH	11/22/21	12/8/21
EMCAL	AH	12/10/21	3/14/22
Upper Platform, Pole Tips	AH	11/15/21	3/28/22
RHIC Run FY22		11/15/21	4/3/22
Open Wall and Move to IR	IR	4/5/22	4/20/22
Magnet Connect	IR	4/5/22	6/13/22
Magnetic field mapping	IR	6/14/22	7/6/22
TPC	IR	7/11/22	7/22/22
Beam Pipe	IR	8/1/22	8/9/22
INTT	IR	8/16/22	8/18/22
MVTX	IR	8/12/22	10/3/22
MBD	IR	8/11/22	8/29/22
ORR	IR	10/4/22	10/31/22



Quality and Safety

- **Quality**
  - sPHENIX project has an overall Quality Assurance Plan
  - All drawings go through a checking process with appropriate sign offs
  - Statement of Work not required, build to print.
  - All parts/assemblies received are inspected/verified

- **Safety**
  - sPHENIX follows all BNL safety guidelines with regards to handling/moving parts
  - Assembly/Installation INTT Barrel
    - Lifting Safety committee
    - Work planning
    - Safety walkdowns of work areas
    - Work procedures

PRR Charges – Management and Fabrication

Management PRR Charges	
Is the schedule for procurement, including internal signatures and approvals, bid duration, material procurement, and fabrication been correctly estimated?	Yes. Our estimates are based on previous experience with sPHENIX procurements, as well as budgetary quotes that included fabrication lead times (early procurment).
Are they consistent with the Resource Loaded Schedule?	Yes. The RLS has the appropriate time estimated for procurement, fabrication, and delivery.
Have all recommendations from prior reviews been properly addressed and approved by sPHENIX Project Management?	N/A (no prior reviews).
Fabrication PRR Charges	
Have potential vendors been identified?	Yes.
Will assembly be required?	Yes.
Who will perform the assembly?	BNL will perform the fixture assembly.
What are the acceptance criteria for parts?	The criteria is defined on the individual drawings.
Is this documented and part of the procurement package?	Yes. It will be documented within the PO as well as the individual specifications noted on the drawings.
Who will do the acceptance inspection and testing?	BNL Technical Representative will work with BNL technical staff as well as the survey group to perform acceptance inspection.
Is shipping included in the procurement?	Yes, shipping costs will be included in the bid process.
Where will equipment be stored upon arrival at BNL?	The current plan is to use lab space at 510 for testing and 912/1008 for storage.

PRR Charges – Quality and Safety

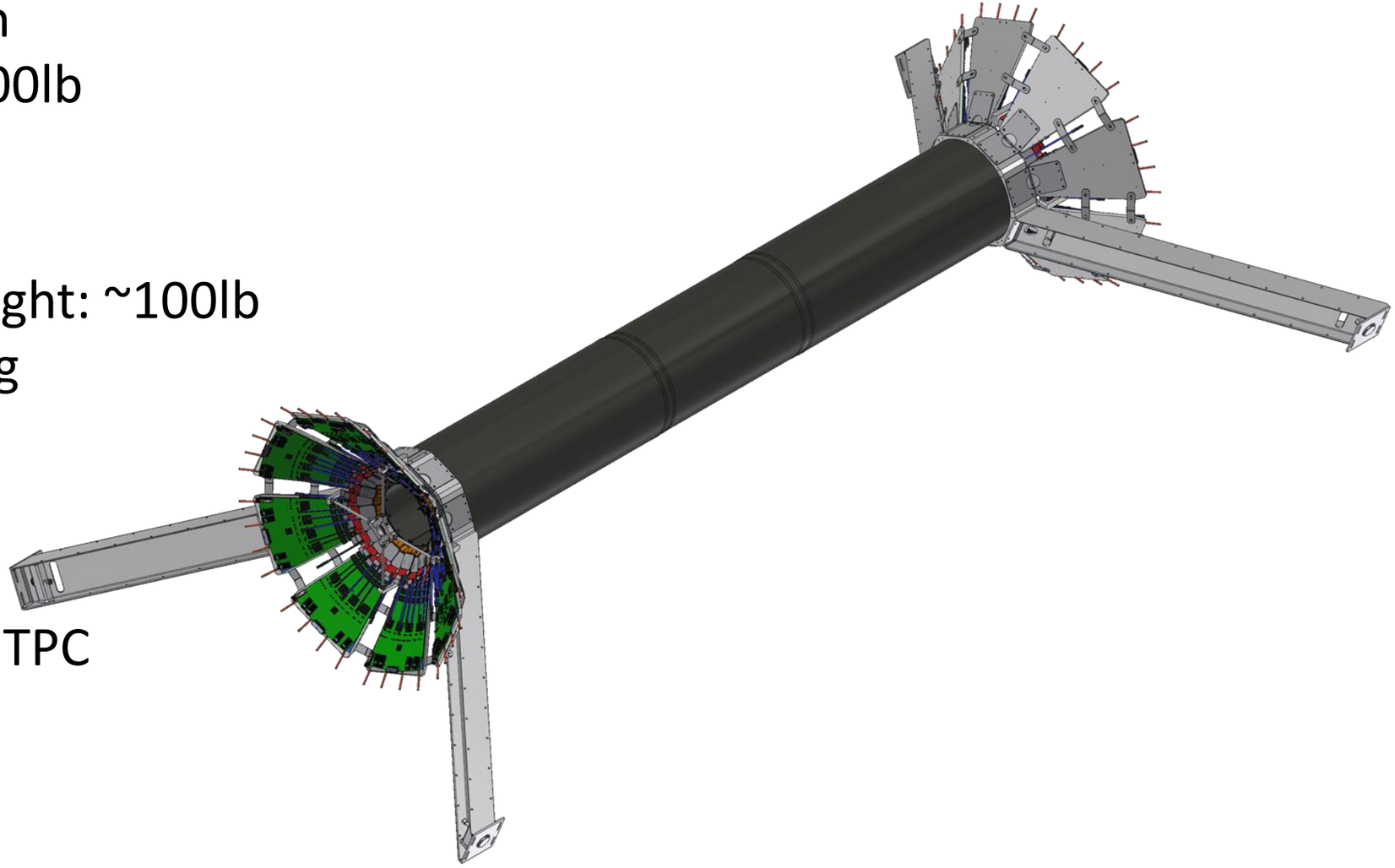
Quality PRR Charges	
What are the quality assurance requirements for this procurement?	Standard build to print.
Are material certifications required?	Yes, we will require certificates for all materials.
Are there intermediate inspection steps required during fabrication that will require BNL involvement?	No.
Are they clearly spelled out in the procurement documentation?	N/A.

Safety PRR Charges	
Have all safety requirements been satisfied and closed out?	No. Need to run it past the Lifting Safety committee.

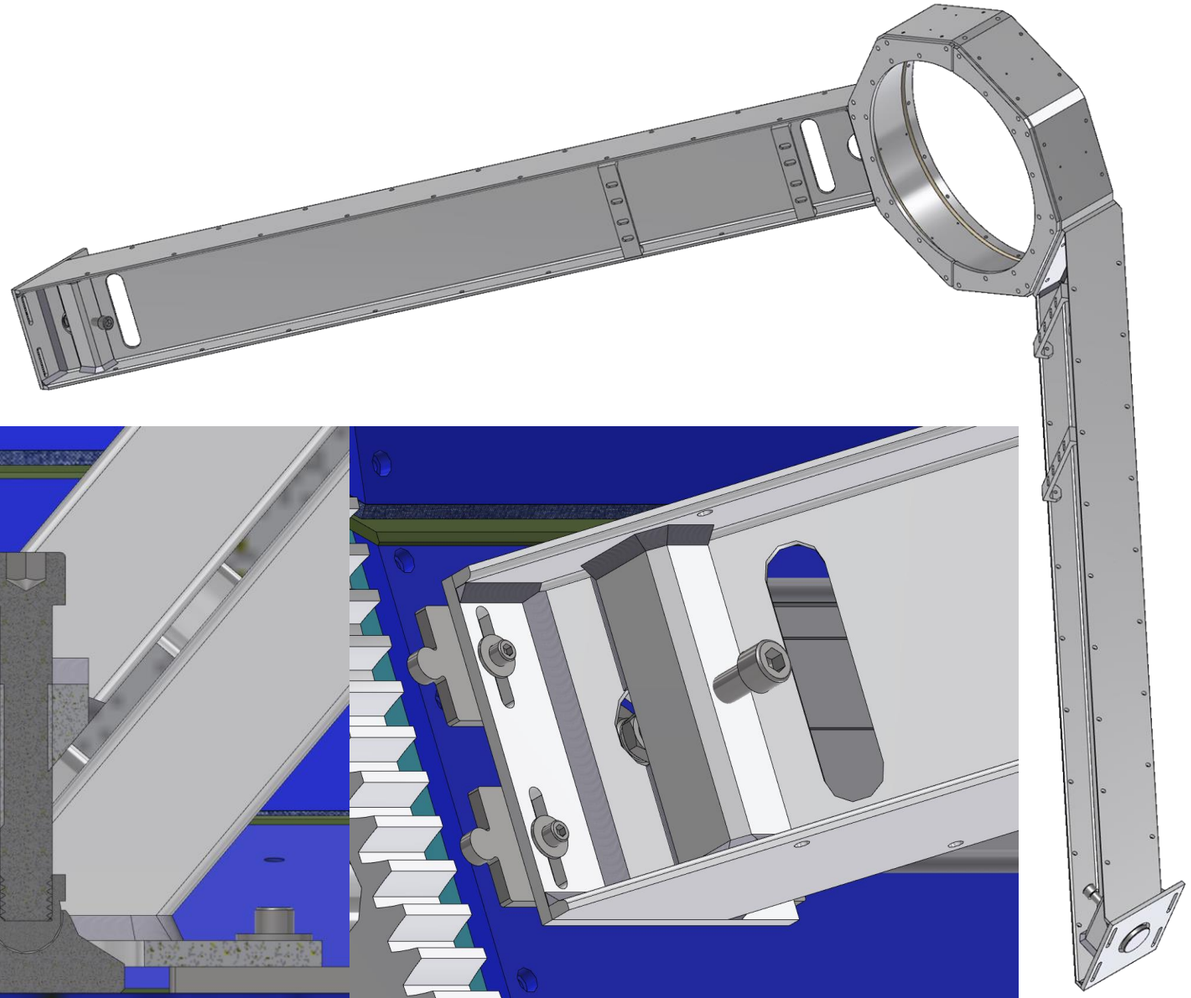
Backup

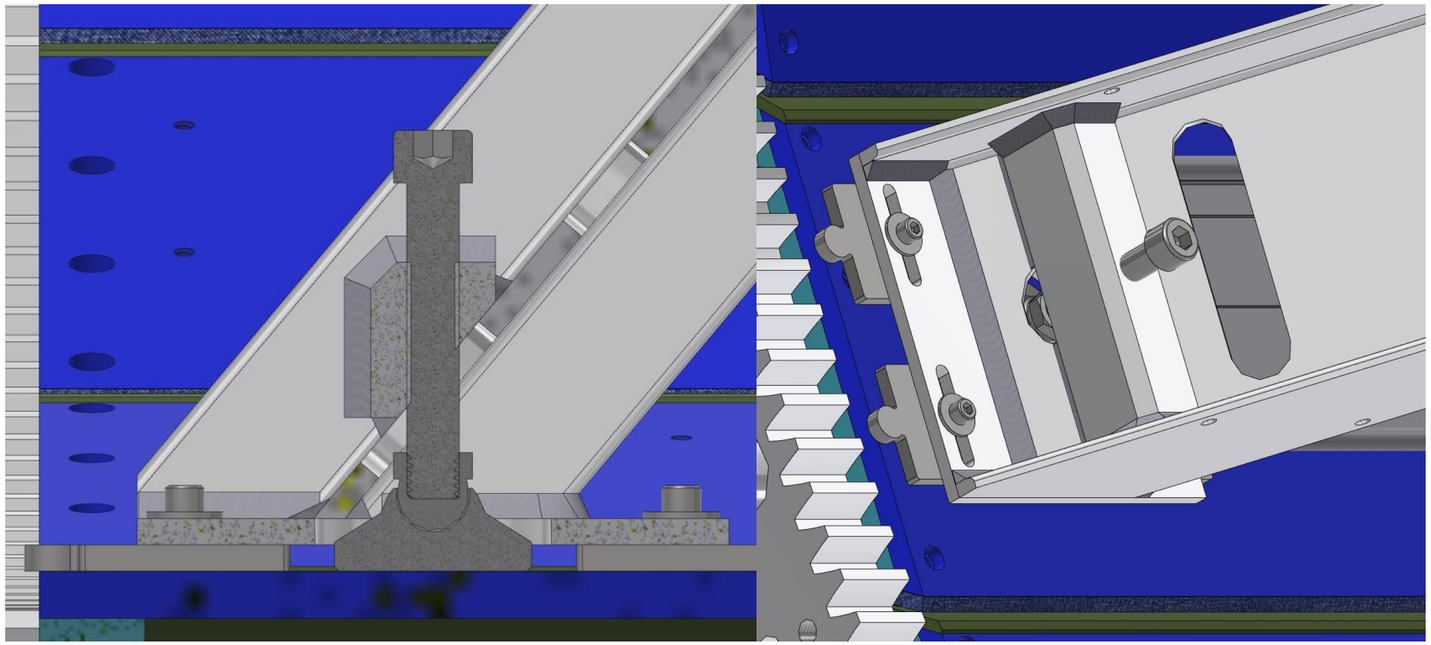
Design Requirements

- INTT
  - Facilitate INTT Installation
  - Support INTT Weight: ~100lb
  - Position INTT: +/- 0.125”
- Services
  - Support ROC/cooling Weight: ~100lb
  - Rout cables/fibers/cooling
- Other
  - Support Beam pipe
  - Withstand bake out
  - Integrate with MVTX and TPC
  - Install without crane



Aluminum Ends

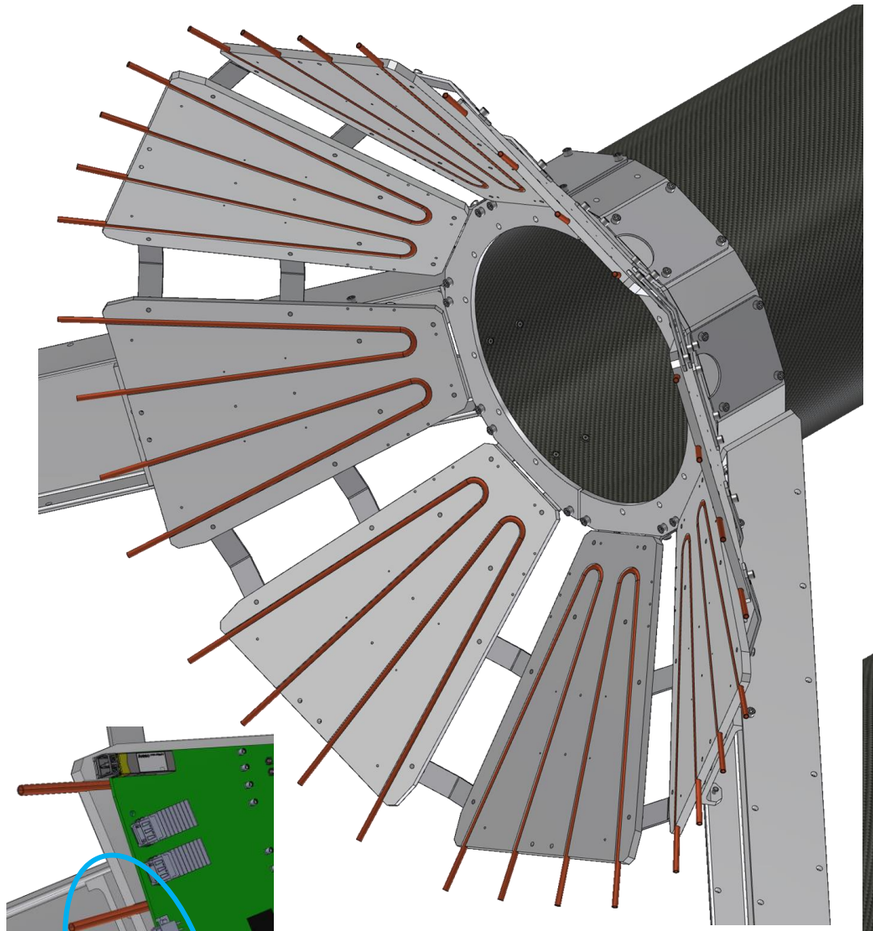


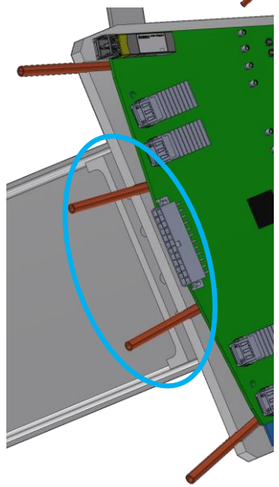


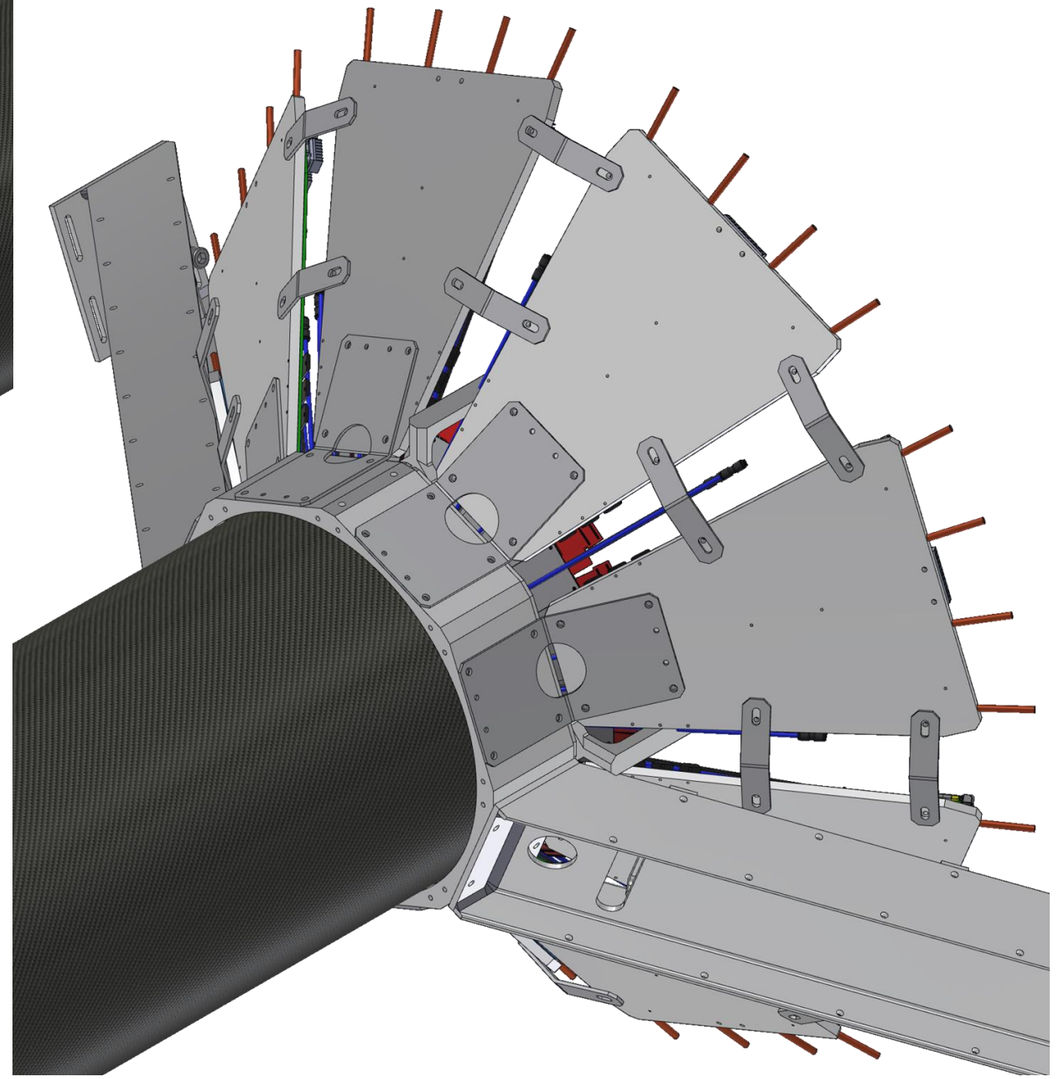
- Bolted assembly (a couple welded plates to I-Beams).
- Each section (two I-beams and octagonal interface) <15lb (could be installed assembled at about 45lb).
- iHCal interface ½-13 jacking screw has X/Y +/- 0.25” adjustment (can shim too).
- 4X ¼-20s per interface plate to attach to iHCal.

ROC Attachment

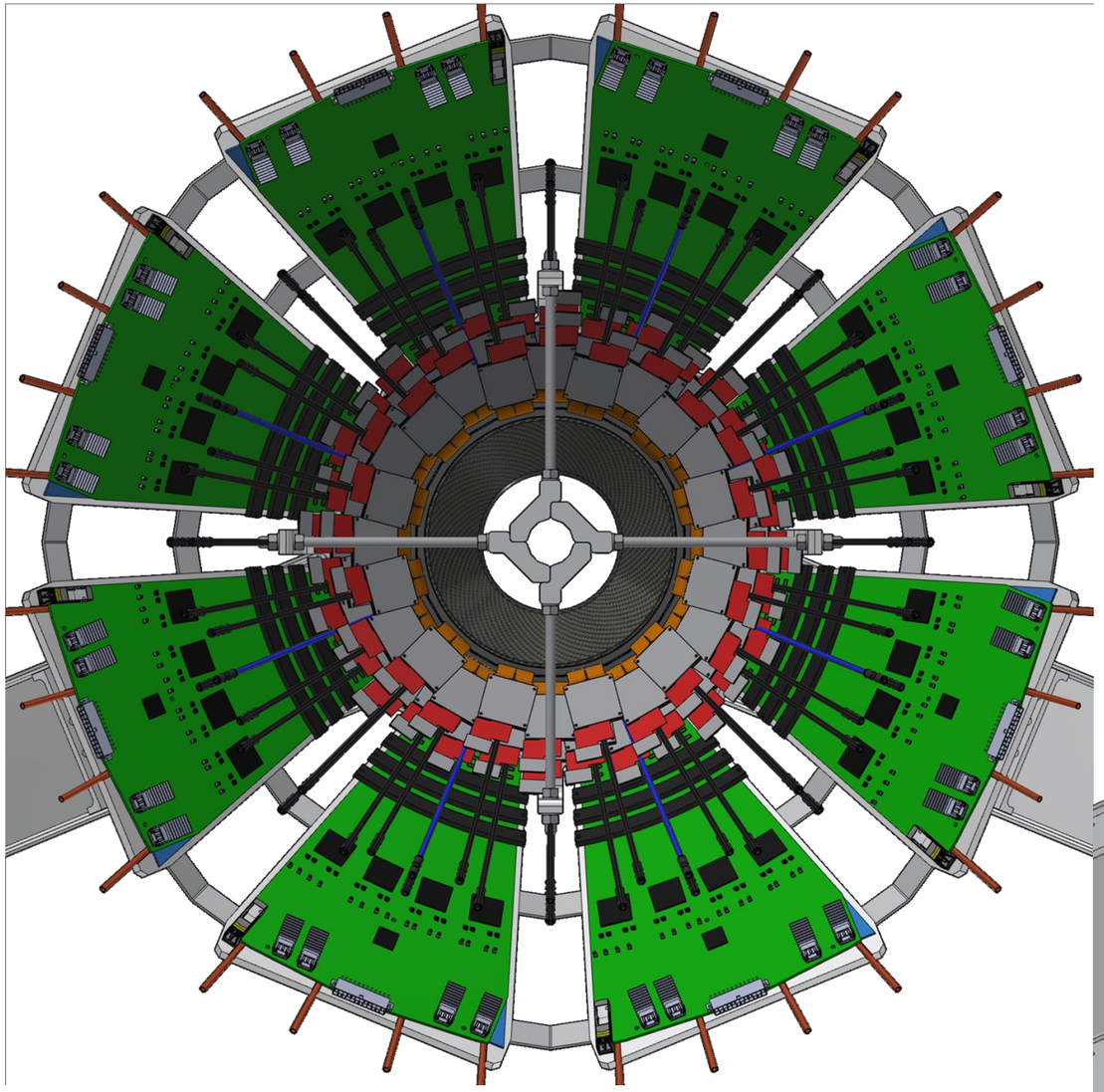
- Sheet metal L-bracket attaches octagonal interface to ROC cooling plate.
- Additional L-bracket attaches adjacent ROC cooling plates.
- Specific brackets attach ROCs to I-beam supports.

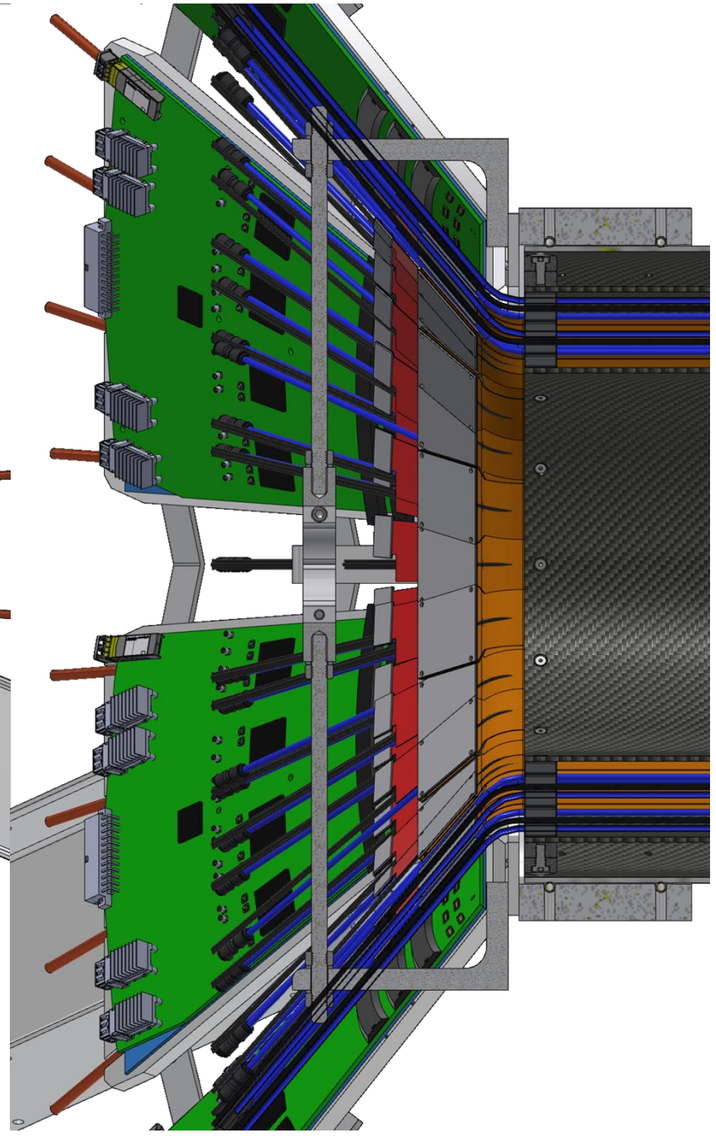






Beam Pipe Supports

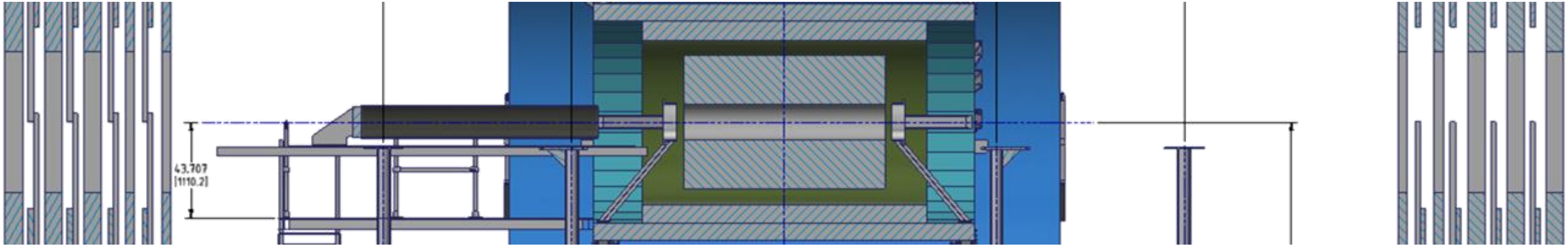




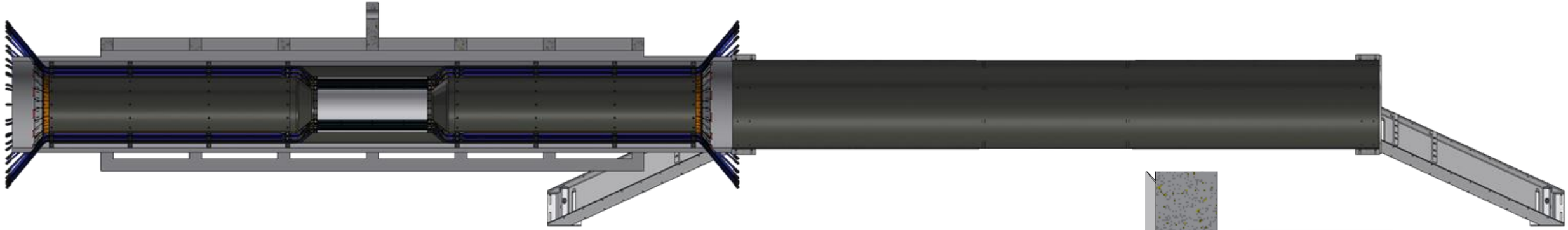
- L-Brackets reach round the INTT services from the aluminum endcaps to the beam pipe support tie rods.
- Beam pipe weight is less than 10lb (negligible).
- Insulation is being chosen to accommodate INTT structure during bakeout.

Installation – Support Structure

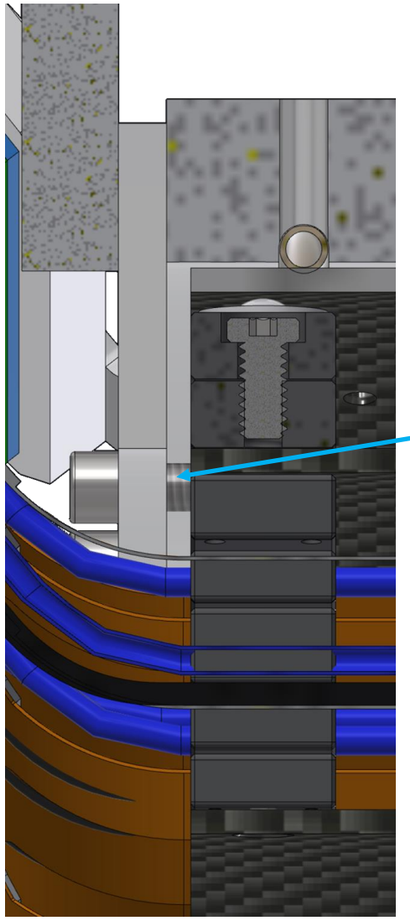
- Aluminum end (I-beams and octagon) installed on the north.
- Carbon fiber pipe cantilevered from the south and installed in the TPC with the octagon pre attached on the south side of the pipe.
- Once tube is in position, it is attached on the north and I-beams are attached on south both to octagon and iHCal.
- Installation fixturing removed.



Installation – INTT

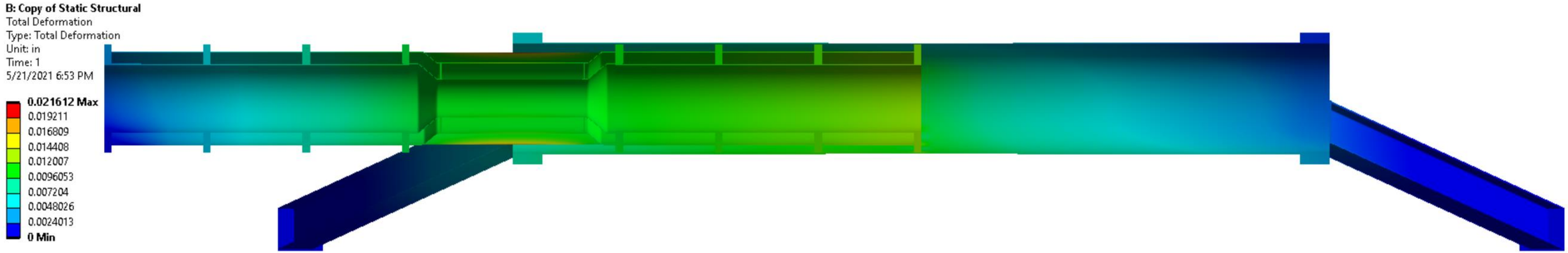


- The support structure allows for an INTT installation fixture to aligned with the carbon fiber tube and adjusted as needed.
- The INTT will be pulled in with a winch.
- Once installed the INTT will be secured at both ends.

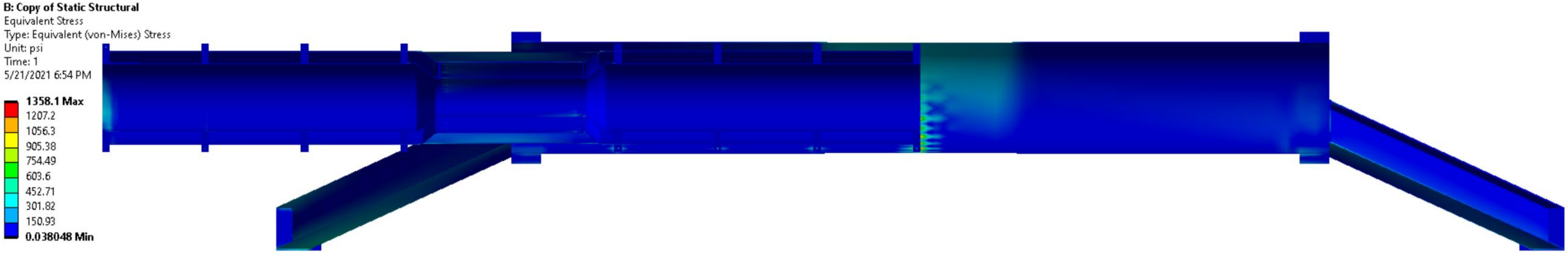


Support Structure FEA – Installing

Deflection – MAX: 0.022 in



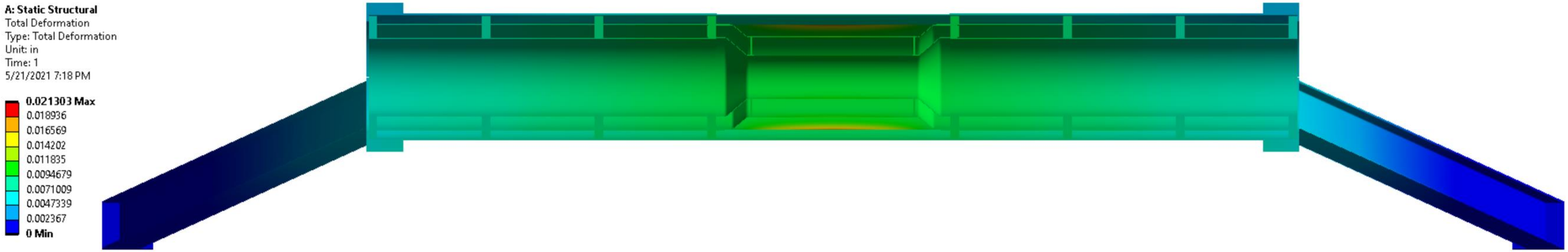
Stress – MAX: 1360 psi



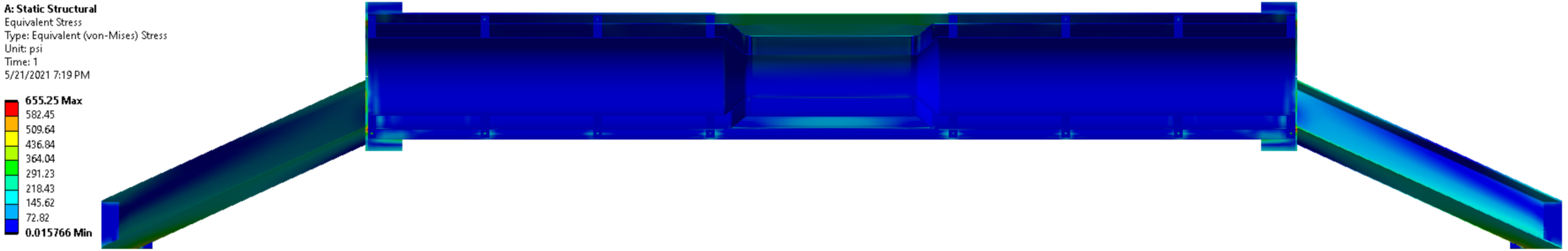
Boundary Conditions: Support tabs fixed, far left fixed, ladder and services weight added

Support Structure FEA – Installed

Deflection – MAX: 0.022 in



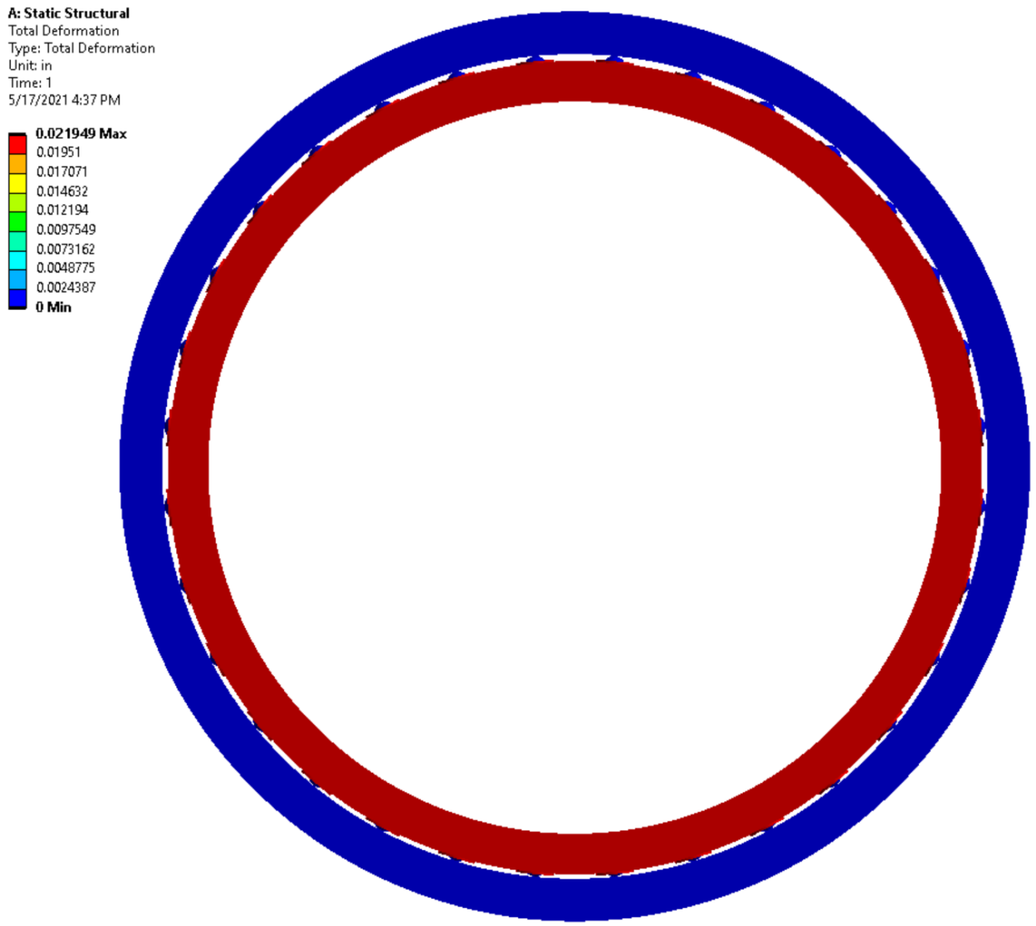
Stress – MAX: 660 psi



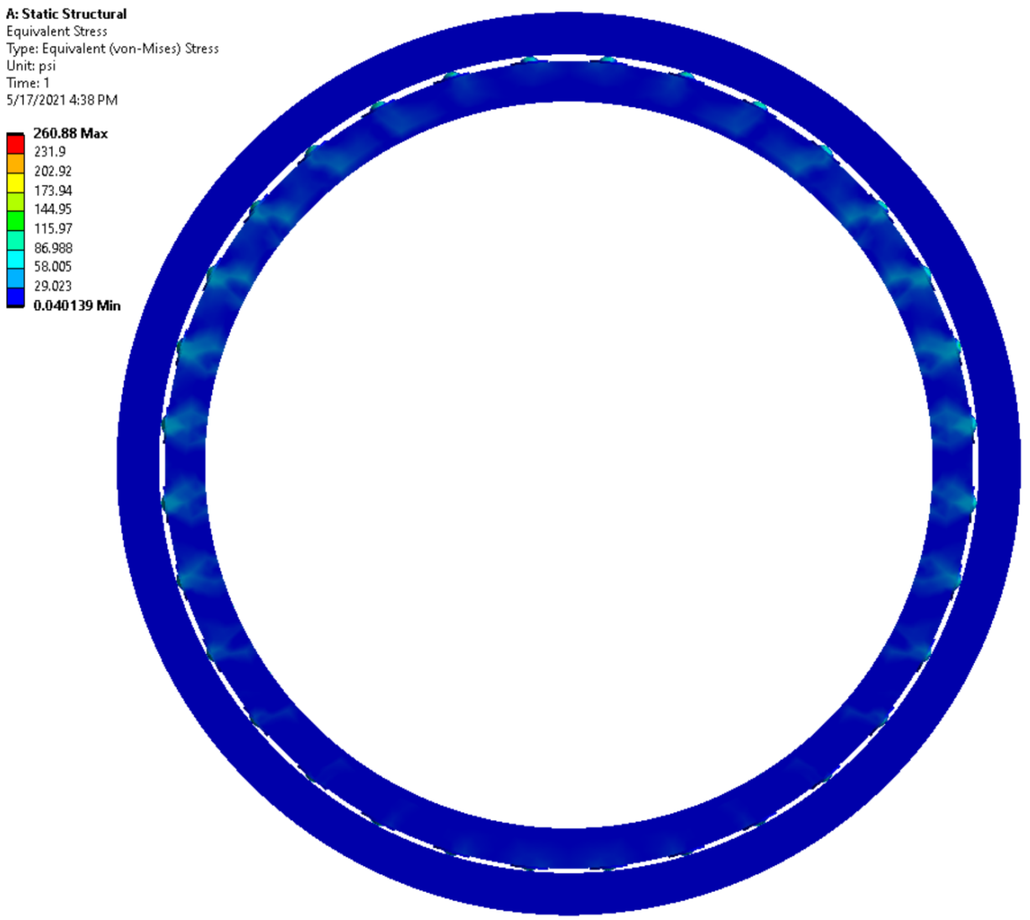
Boundary Conditions: Support tabs fixed, ladder and services weight added

Support Structure FEA – Spring Loaded Rollers

Deflection – MAX: 0.025 in



Stress – MAX: 260 psi



Boundary Conditions: Support fixed, services weight added

Procurment

- Carbon fiber support tube will be procured with other INTT carbon fiber components.
- Getting quotes from Rockwest, Asuka (made INTT staves) and others.

- Aluminum parts are weldments, sheet metal and CNC machined.
- Getting quote from SBU. Others?

Summary

- The design of the INTT support structure meets all requirements for:
  - Radiation Length ✓
  - Rigidity ✓
  - Stress ✓
  - Geometry ✓
  - Clearances ✓
  - Tolerances ✓
  - Installation✓
  - Integration ✓