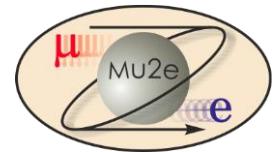




U.S. DEPARTMENT OF  
**ENERGY** Office of  
Science

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# Mu2e Tracker Straw Assemblies



A. Mukherjee

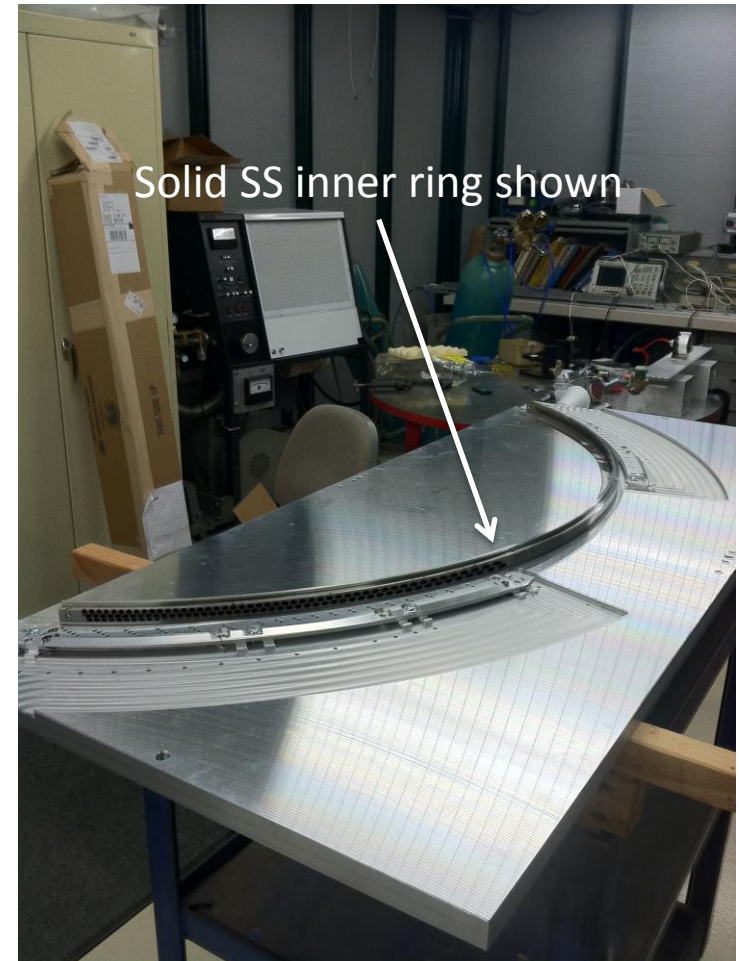
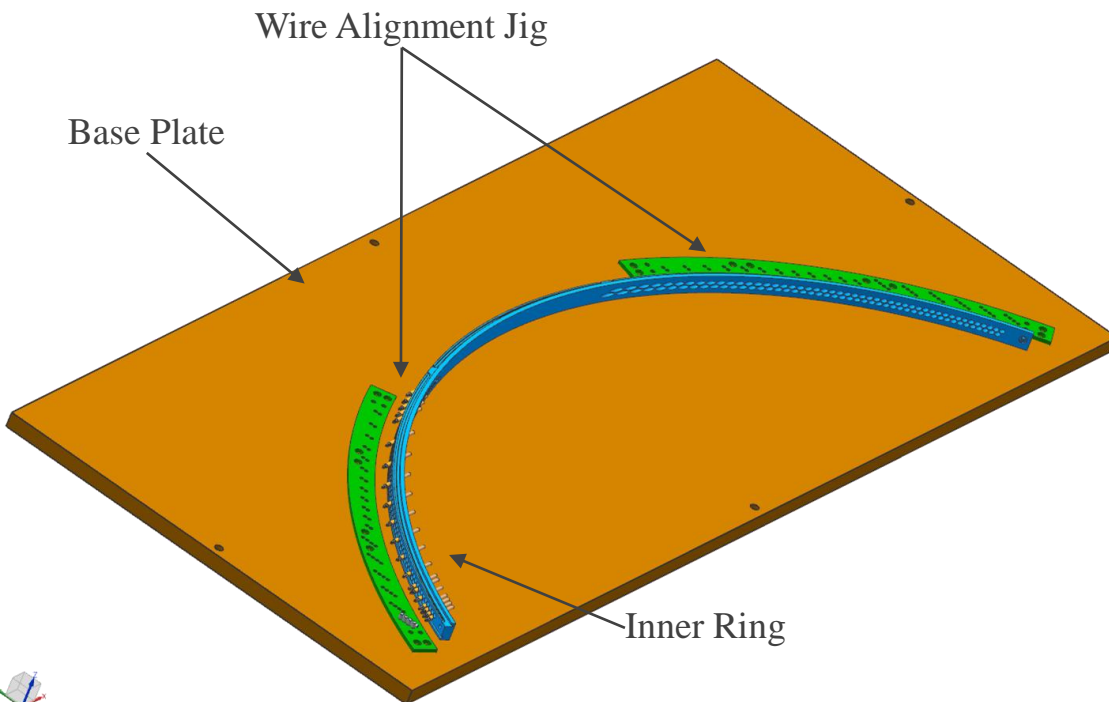
Tracker L2 Manager

For M. Corcoran, Straw Assemblies L3 Manager

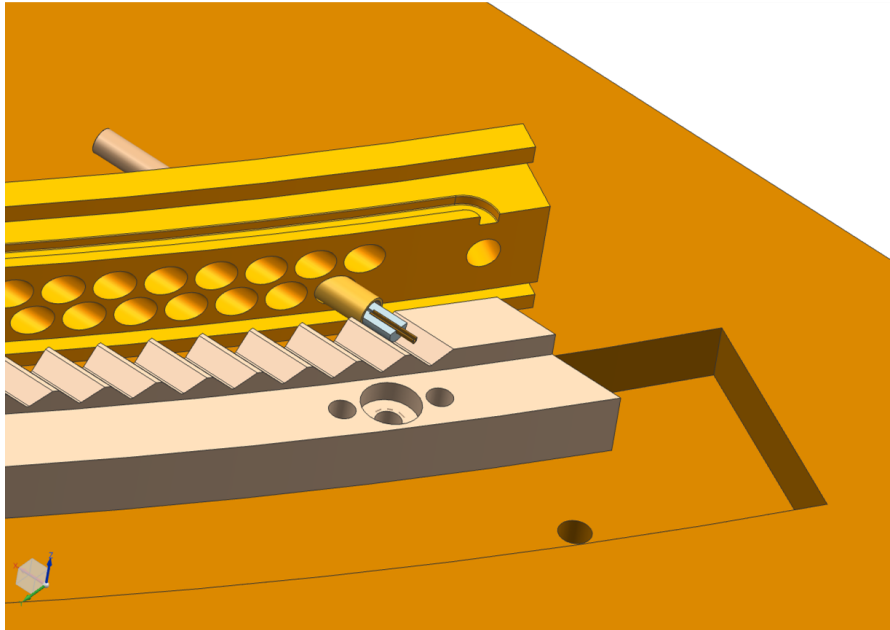
7/8/2014

# Panel Assembly Jig

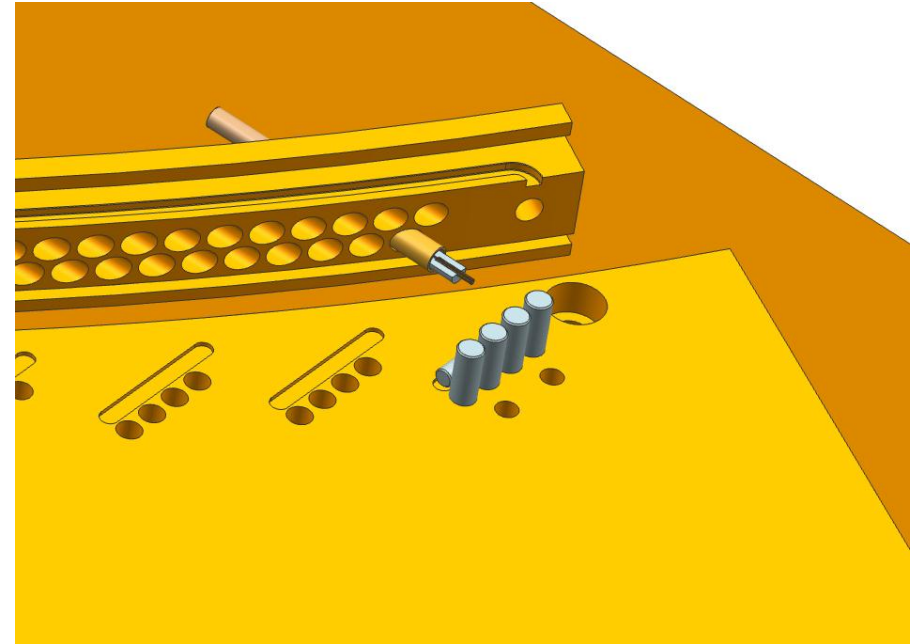
- Align parts for inner ring
- Align straws
- Align wires



# Panel Assembly Jig



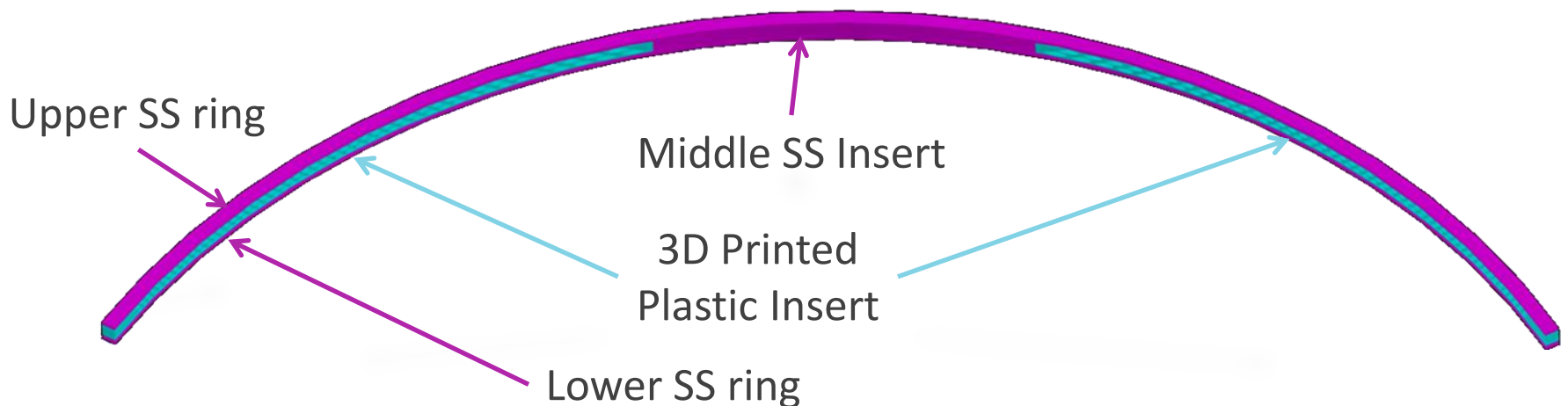
- Straw end alignment
- Position straw end to  $\sim 100\mu\text{m}$
- Sufficient to ensure wire fits in pin



- Wire aligned
- Independent of straw position
- Use dowel pins to form "comb"

# Panel Assembly Inner Ring

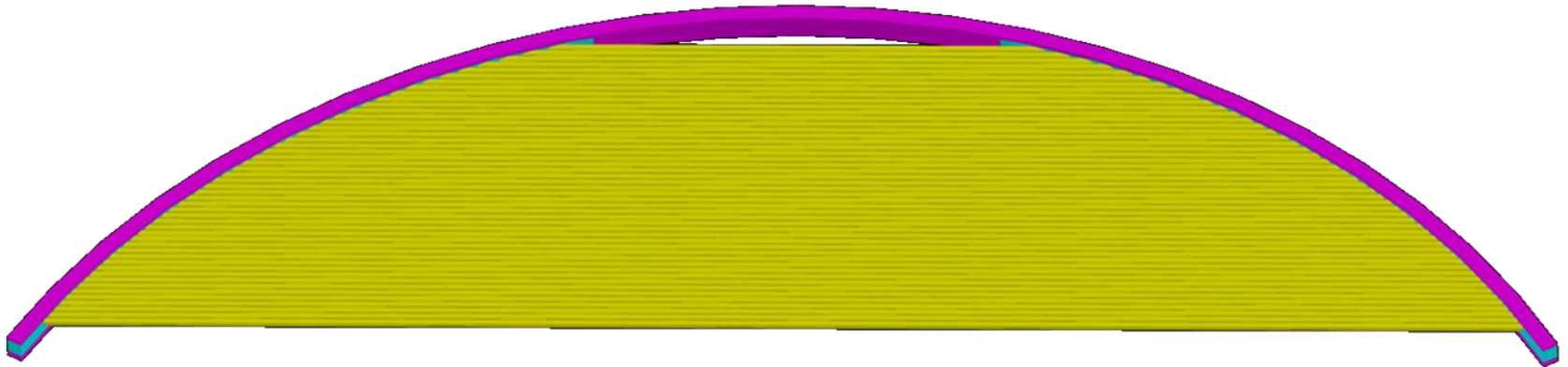
- Assemble inner ring from 5 parts
  - Lower SS ring and plastic inserts include alignment holes to engage on alignment jig
  - Epoxy plastic inserts and middle SS insert together with lower SS ring
  - Epoxy on upper SS ring



# Panel Assembly Straws

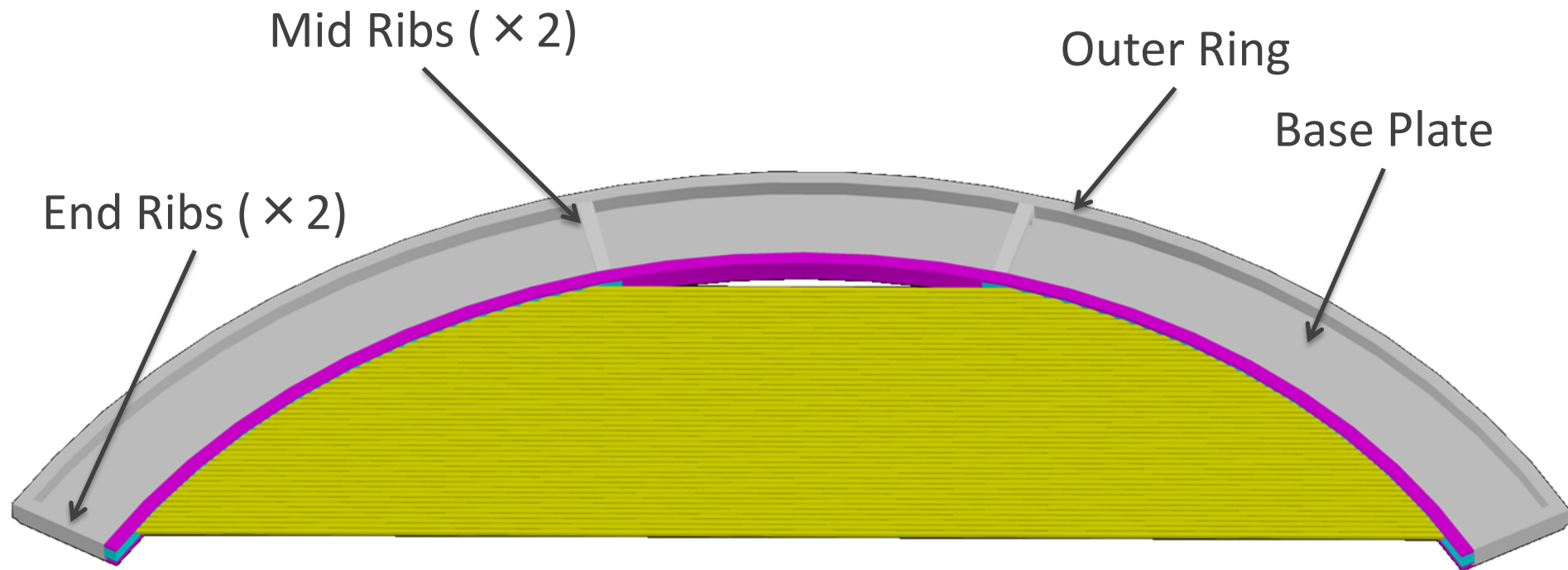
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- Insert, tension, and epoxy straws
  - Jig includes guides to align straw ends
- Install, tension, epoxy and solder wires
  - Jig includes “combs” to align wires



# Panel Assembly Gas Manifold

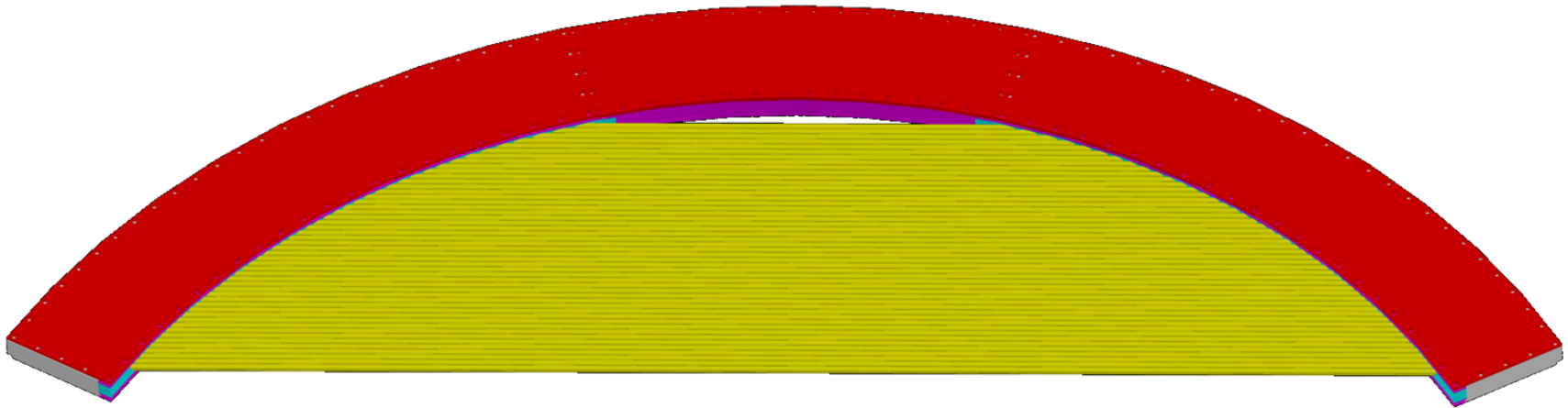
- Epoxy on remainder of gas manifold
  - 6 pieces, all aluminum
  - Penetrations in outer ring not shown



# Panel Assembly Covers

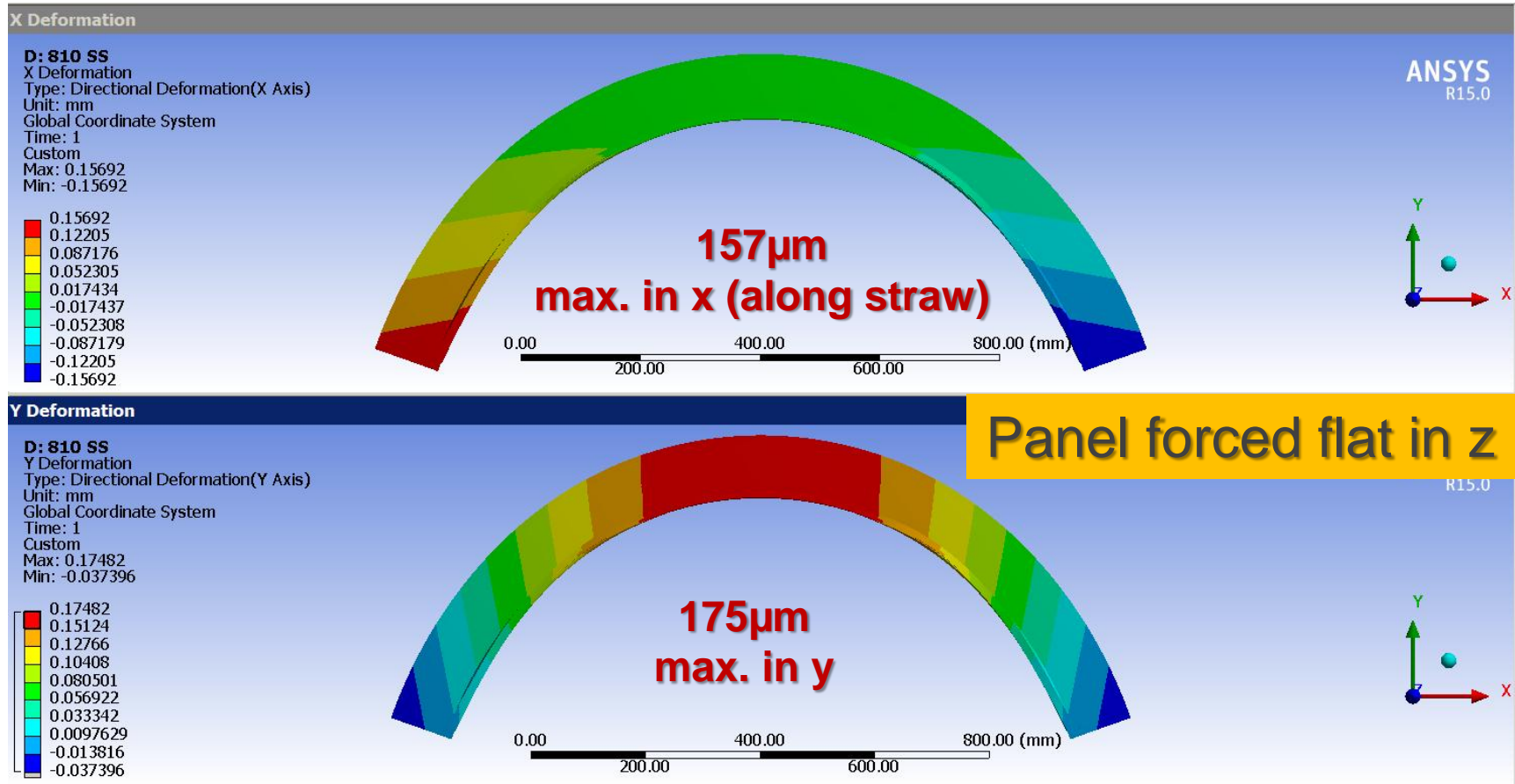
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- Screw on cover plates
  - 3 pieces, all aluminum
  - Gas seal is with o-ring on covers



# Panel Rigidity

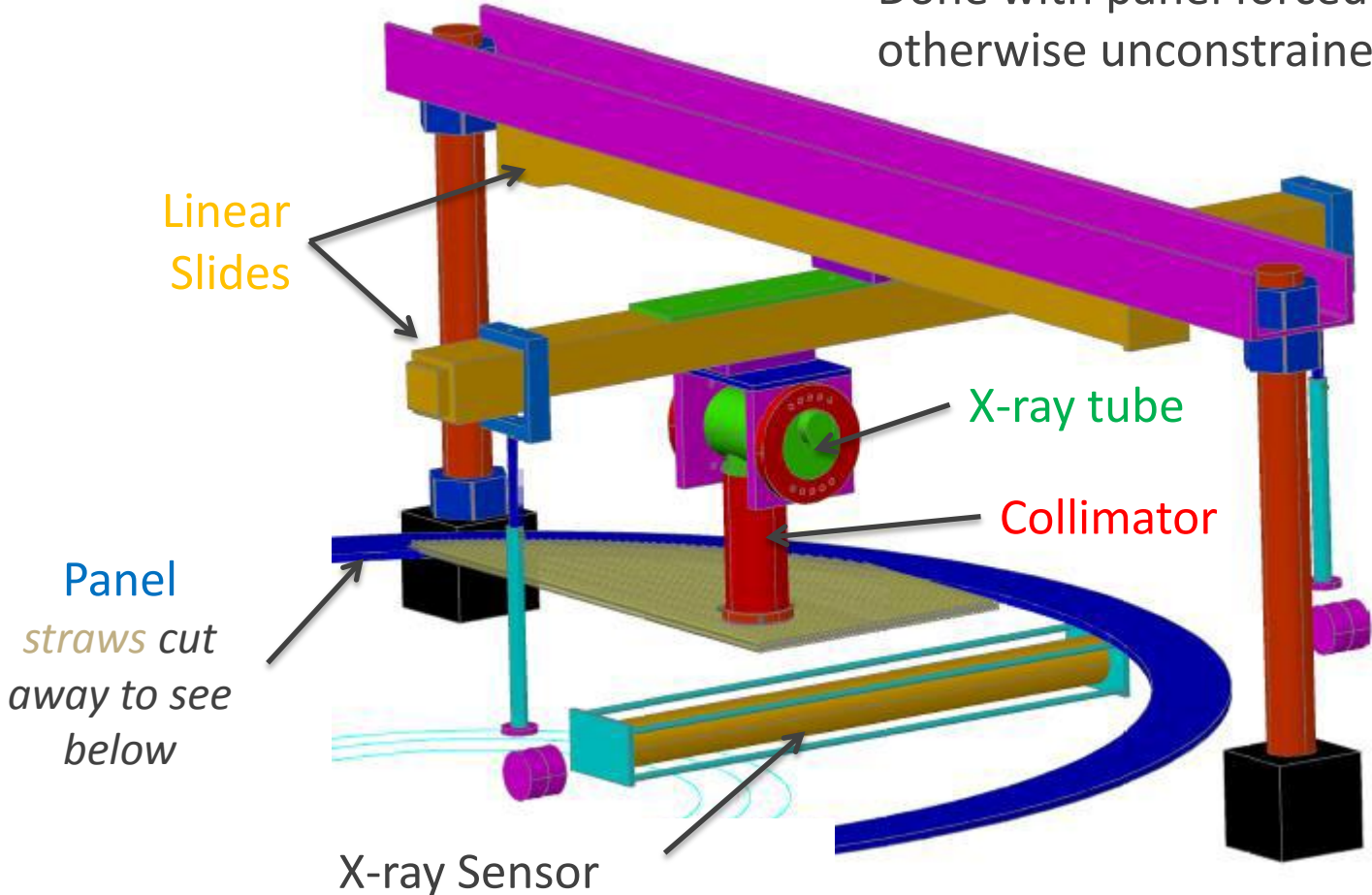
- Panel deformation due to straw tension
- Significant, but acceptable



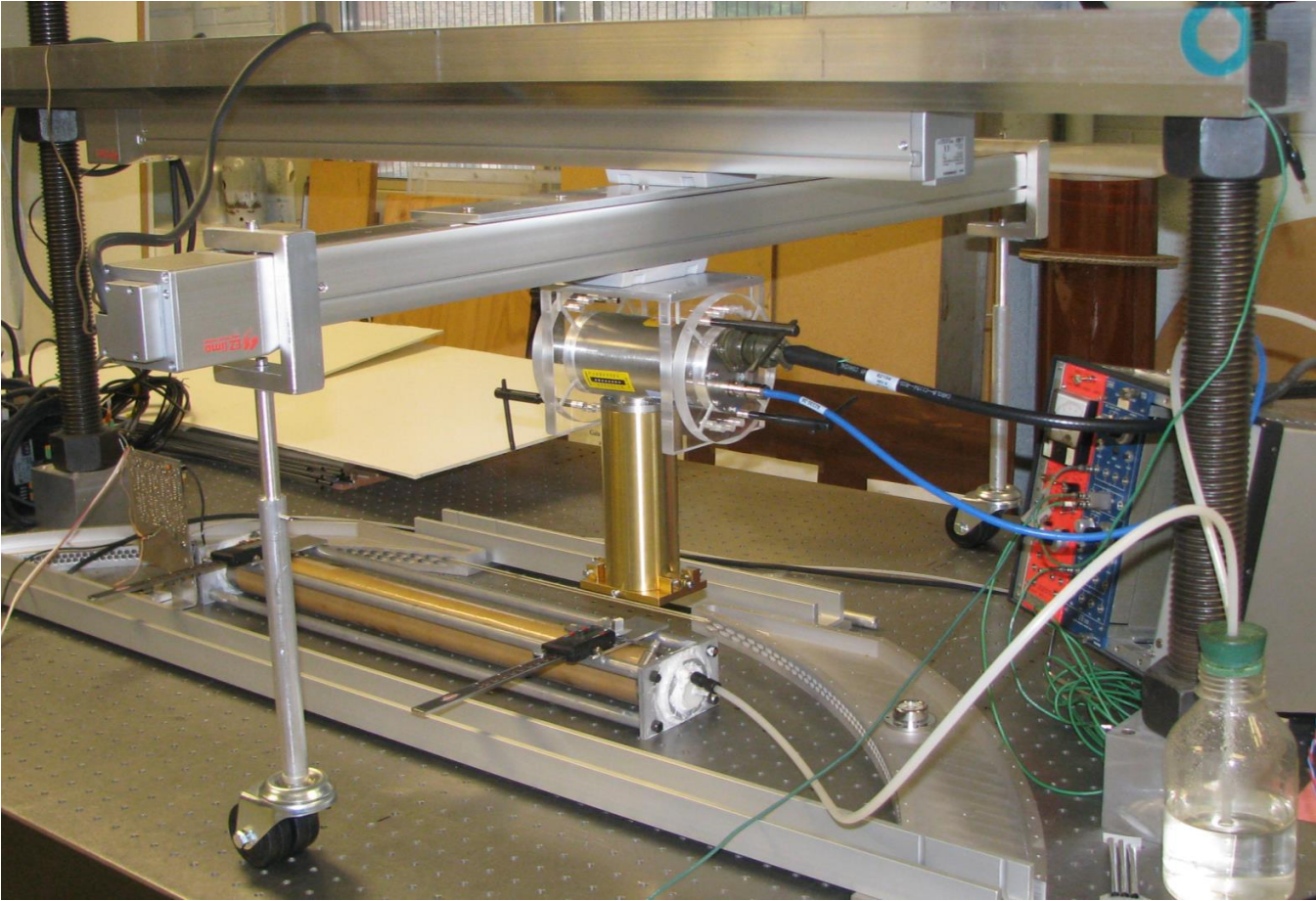


# Wire Position X-ray Scan

- X-ray scan locates wires to  $\sim 25\mu\text{m}$
- Done with panel forced flat but otherwise unconstrained



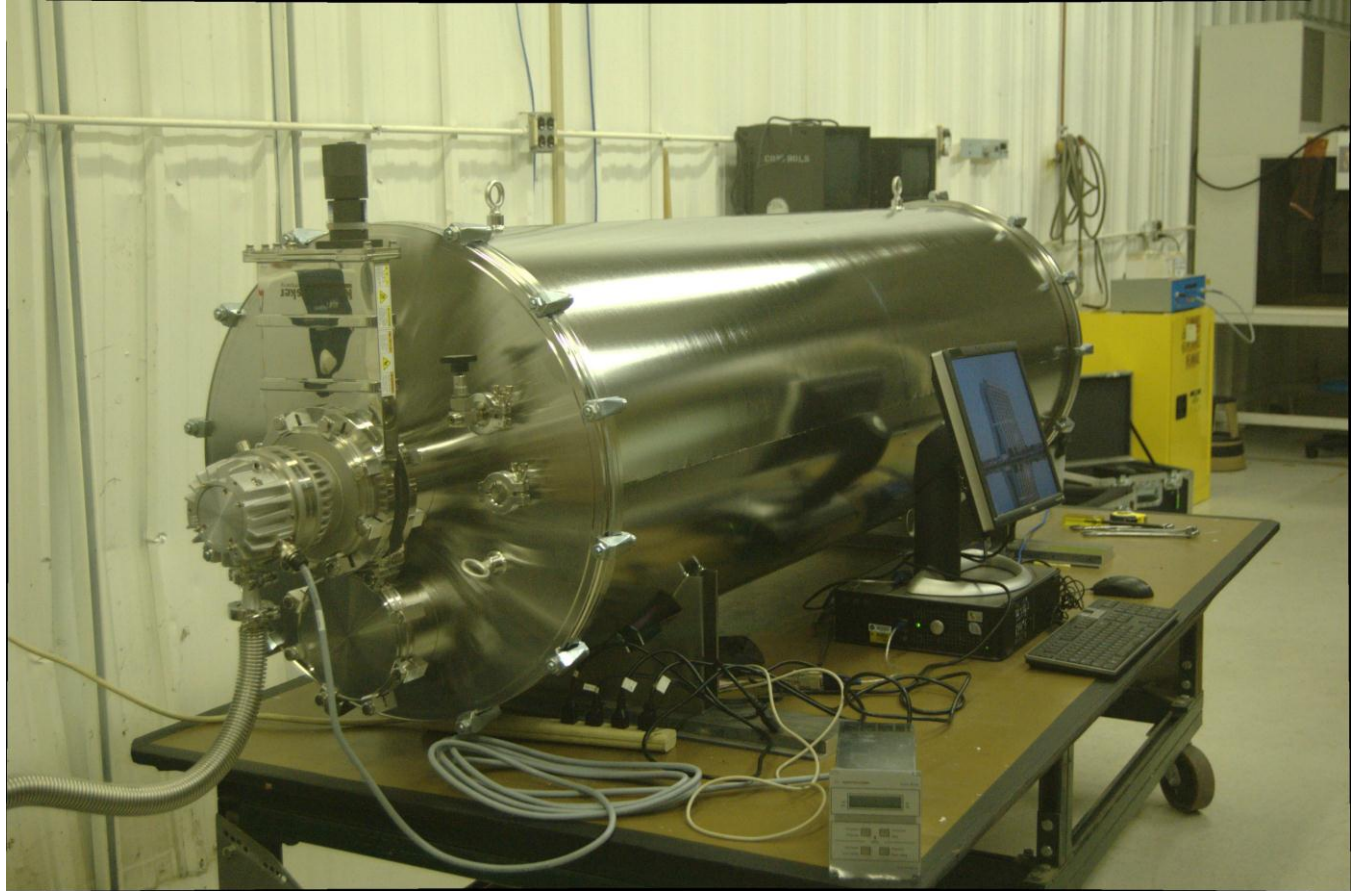
# Wire Position Scan



# Panel Leak Test

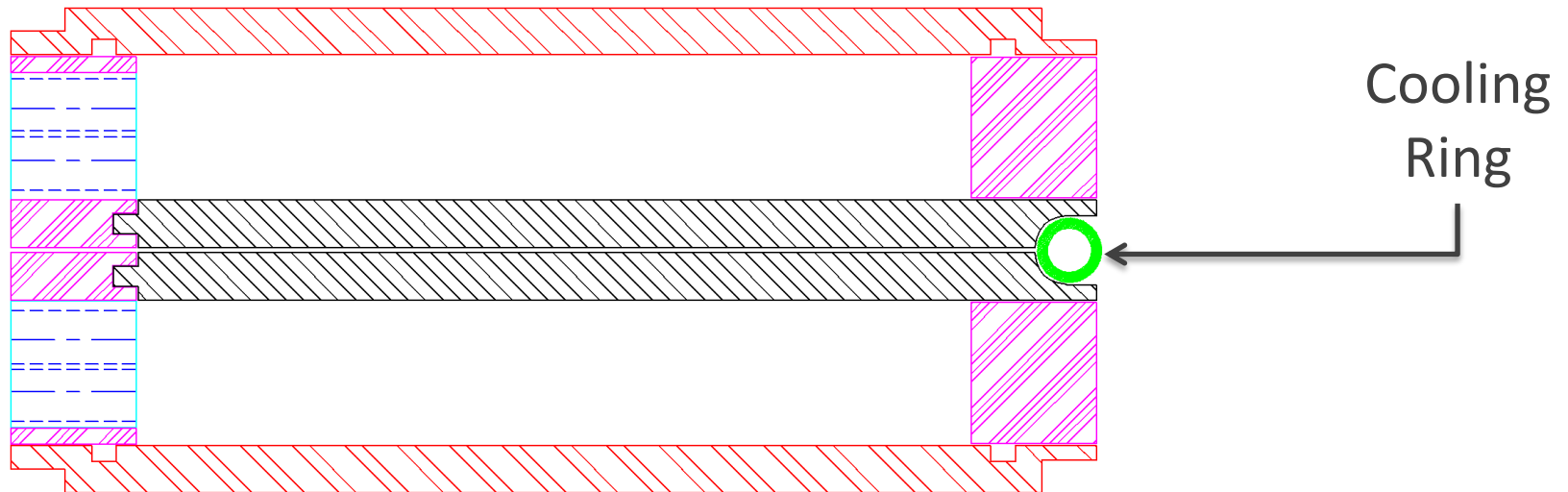
- All panels are leak tested in vacuum before being assembled into planes

*Vacuum vessel  
for panel leak  
testing*



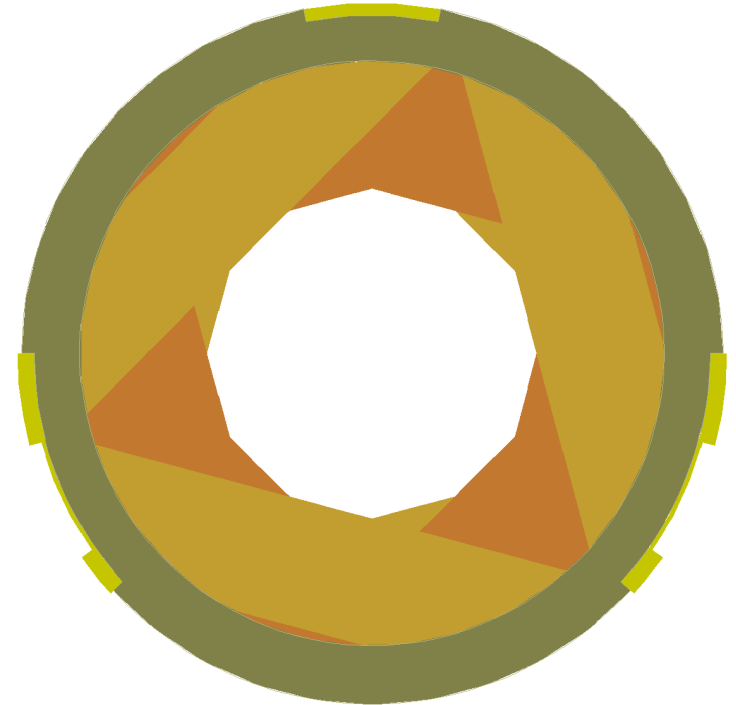
# Plane Assembly

- Inner ring alignment holes at  $15^\circ$  intervals to allow alignment with  $30^\circ$  rotation
- Install cooling ring after assembling plane
- Panels get surveyed (optical) after tracker assembly



# Tracker Assembly Beams

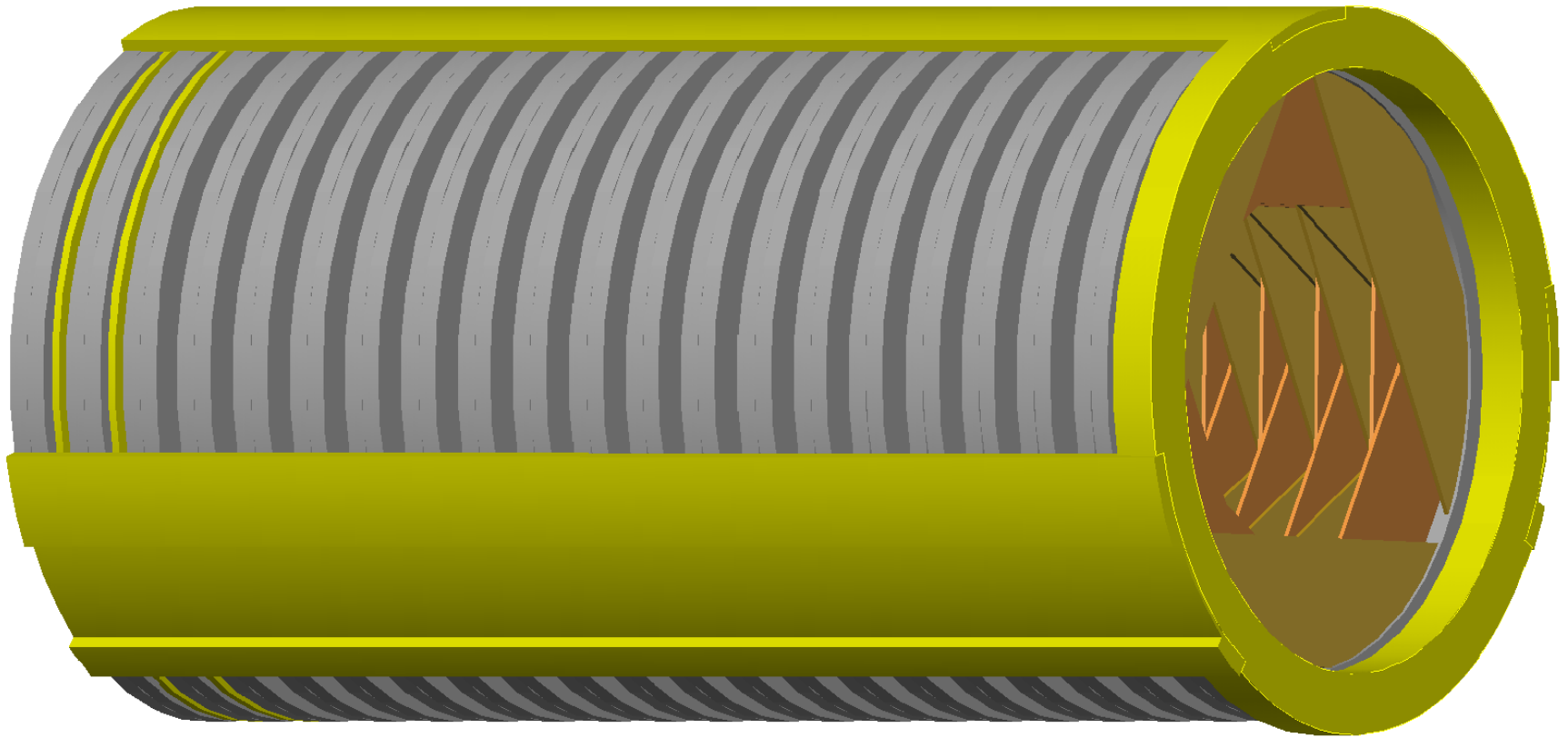
- Horizontal beams to tie planes together
- Top beam just maintains spacing
- Two lower beams support weight (transfer to rails) & act as cable trays
- Asymmetric to place cabling low while maintaining rigidity



# Tracker Assembly

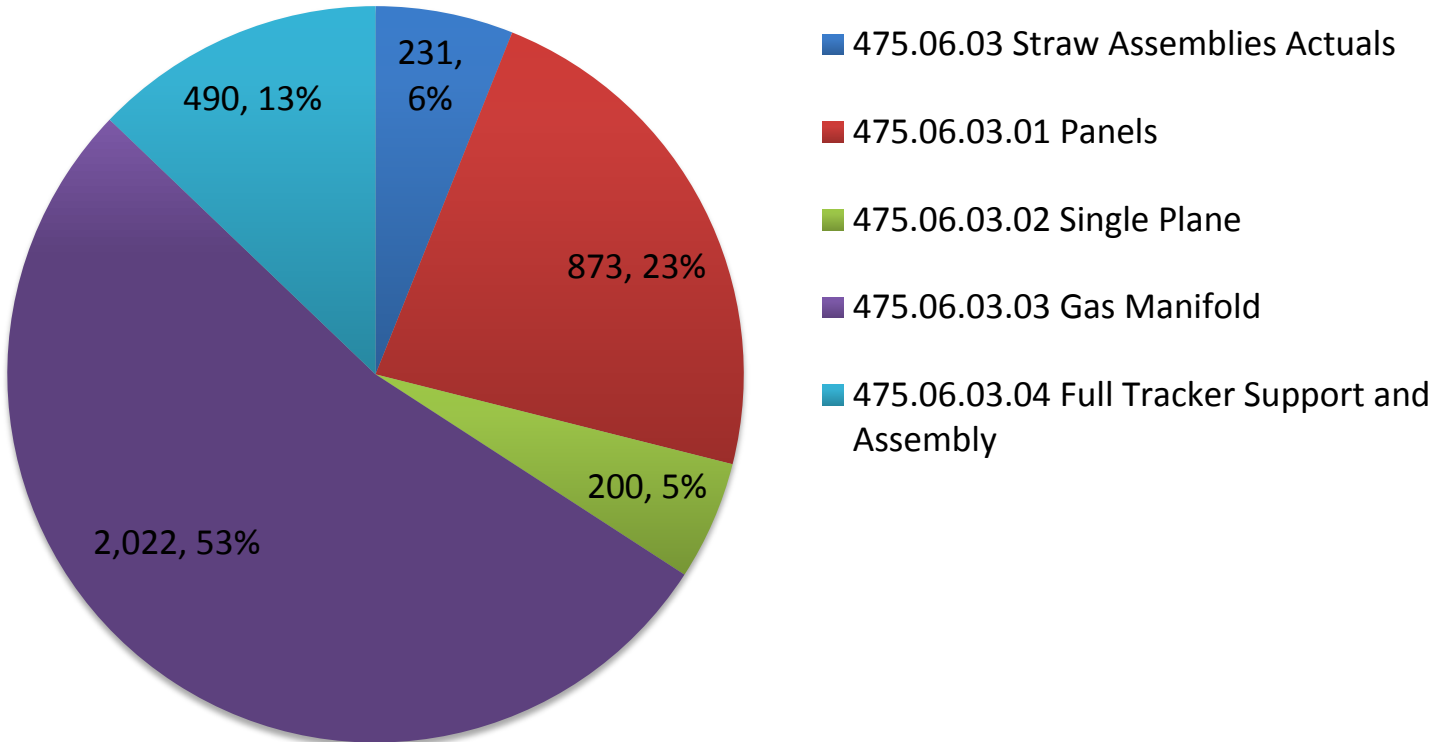
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- Beams include clearance holes (not shown) to sight panel survey monuments



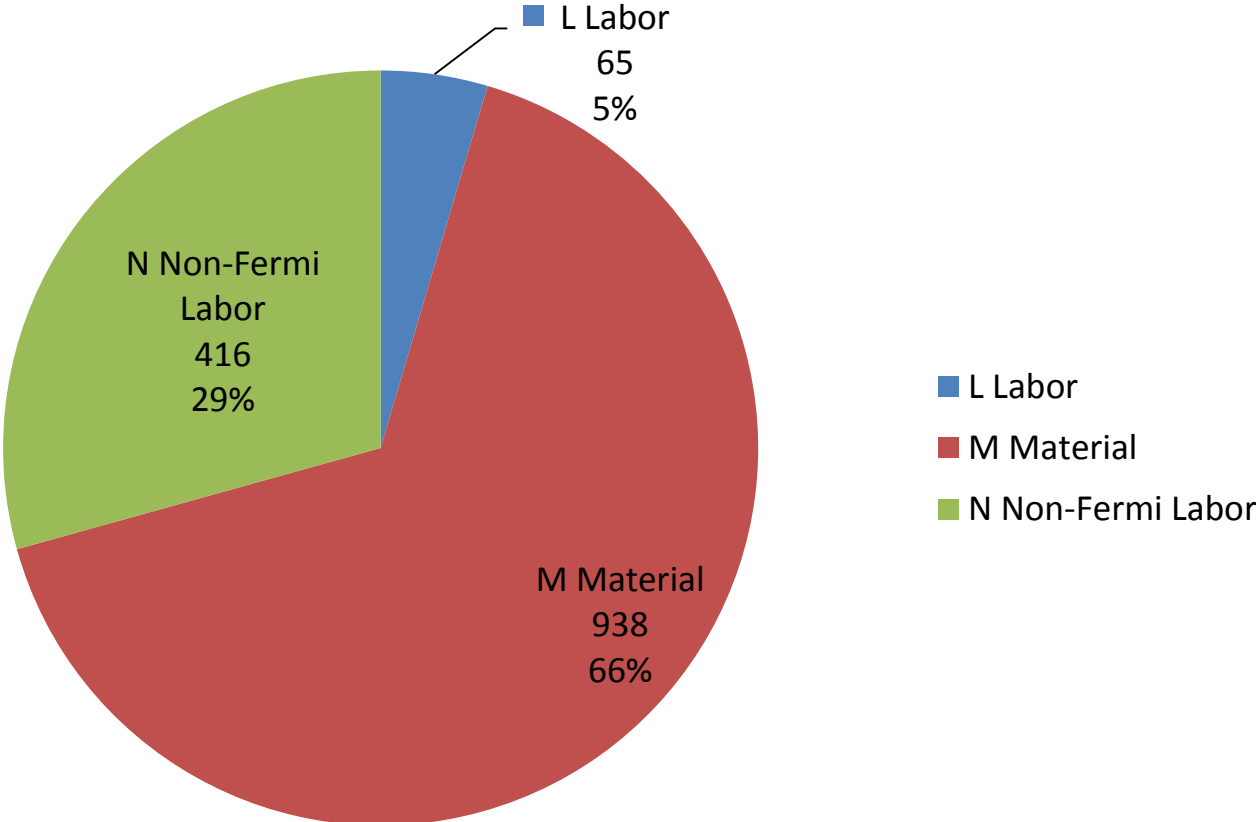
# Cost Distribution by L4

Base Cost by L4 (AY \$k)



# Cost Distribution by Resource Type

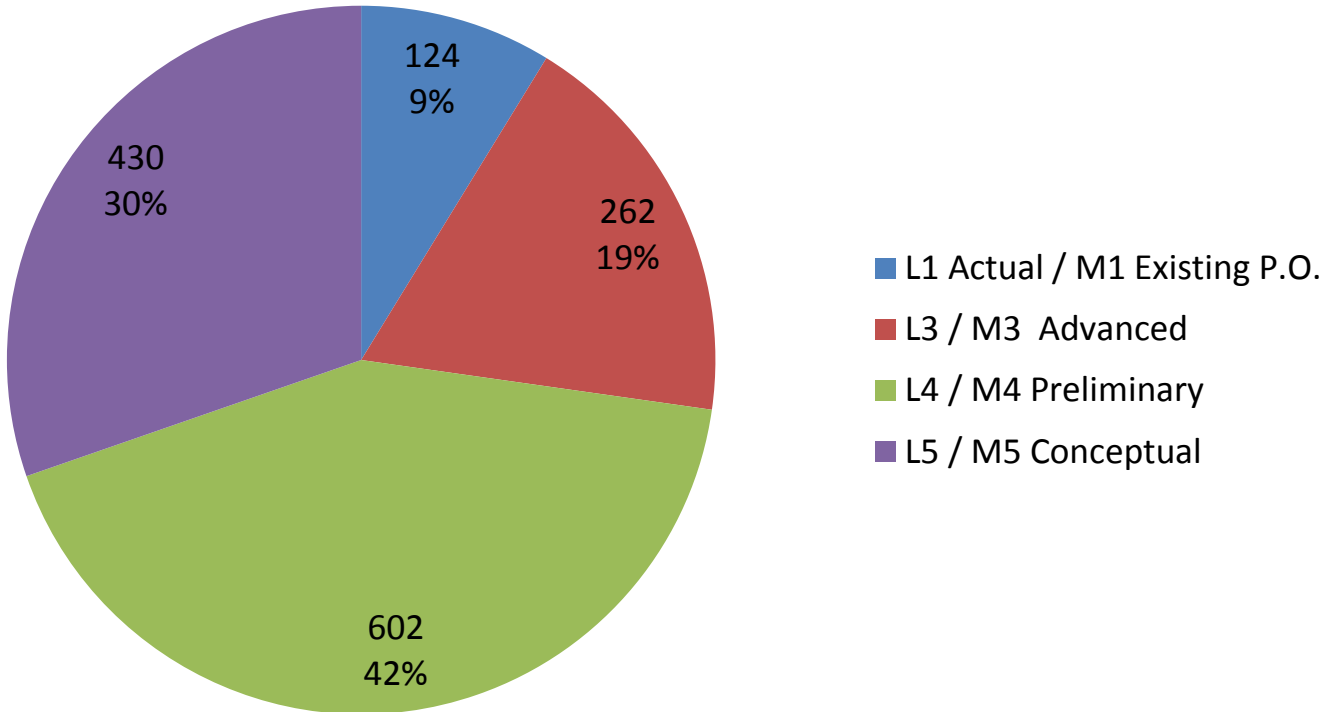
Base Cost (AY \$k)





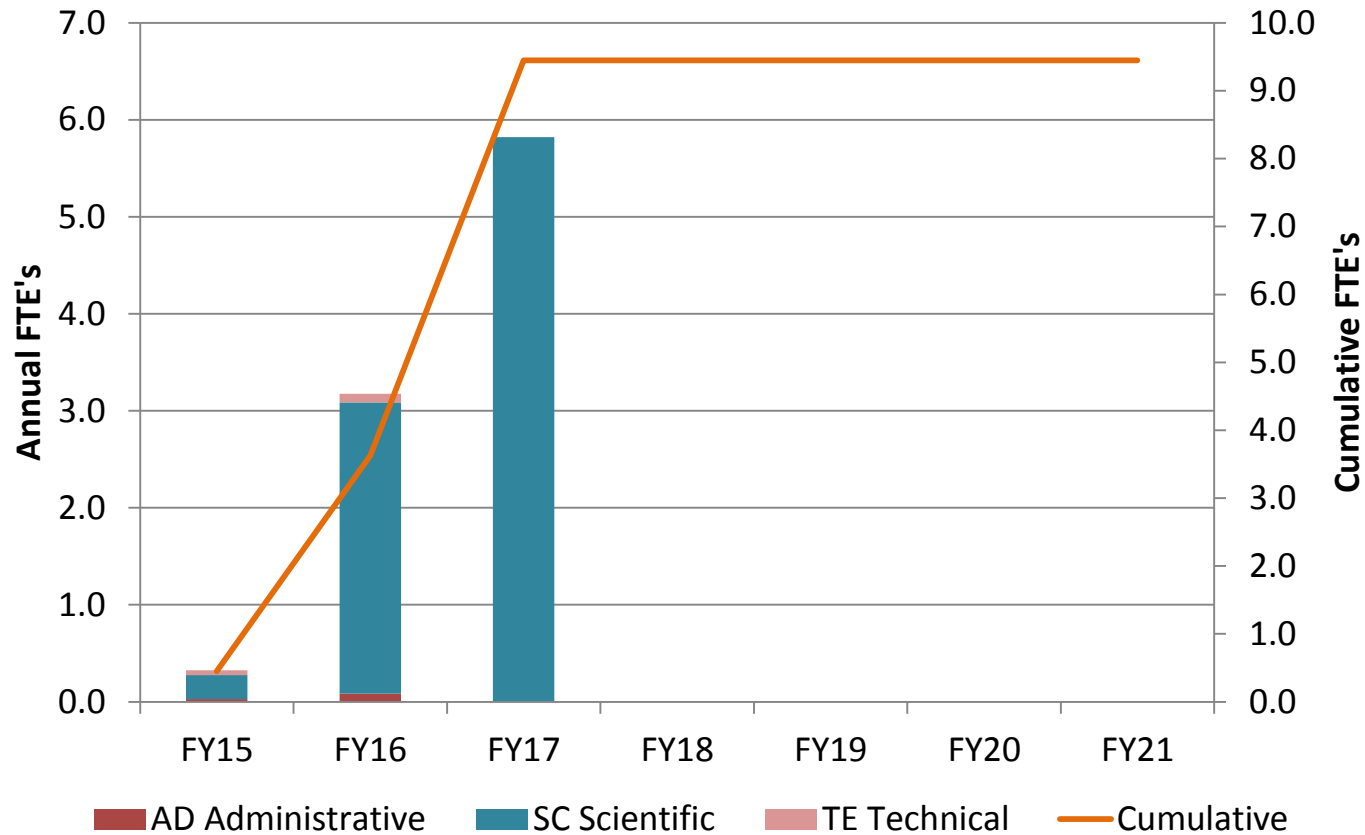
# Quality of Estimate

Base Cost by Estimate Type (AY\$k)



# Labor Resources

## FTEs by Discipline



# Cost Table

Costs are fully burdened in AY \$k

	Base Cost (AY \$)			Estimate Uncertainty (on remaining costs)	% Contingency on ETC	Total Cost
	M&S	Labor	Total			
475.06.03 Straw Assemblies Actuals	85	146	231			231
475.06.03.01 Panels	688	184	873	415	48%	1,288
475.06.03.02 Single Plane	153	46	200	73	37%	273
475.06.03.03 Gas Manifold	1,869	153	2,022	822	41%	2,844
475.06.03.04 Full Tracker Support and Assembly	195	295	490	185	38%	674
Grand Total	2,991	824	3,815	1,495	42%	5,310

# Summary

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- Panel construction fixtures and procedures well defined
  - Starting assembly of first panel, with metal inner ring
  - After completion, this will be the test system for electronics and infrastructure
  - Start assembly of 2<sup>nd</sup> panel, with composite inner ring, immediately after (end of summer)
- Plane and tracker assembly progressing
  - More engineering effort starting this summer