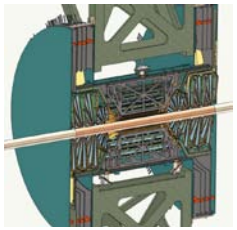


FVTX Mechanical Status: Collaboration Meeting

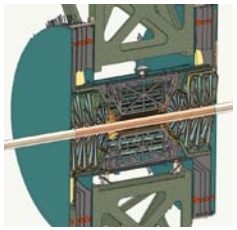
University of New Mexico

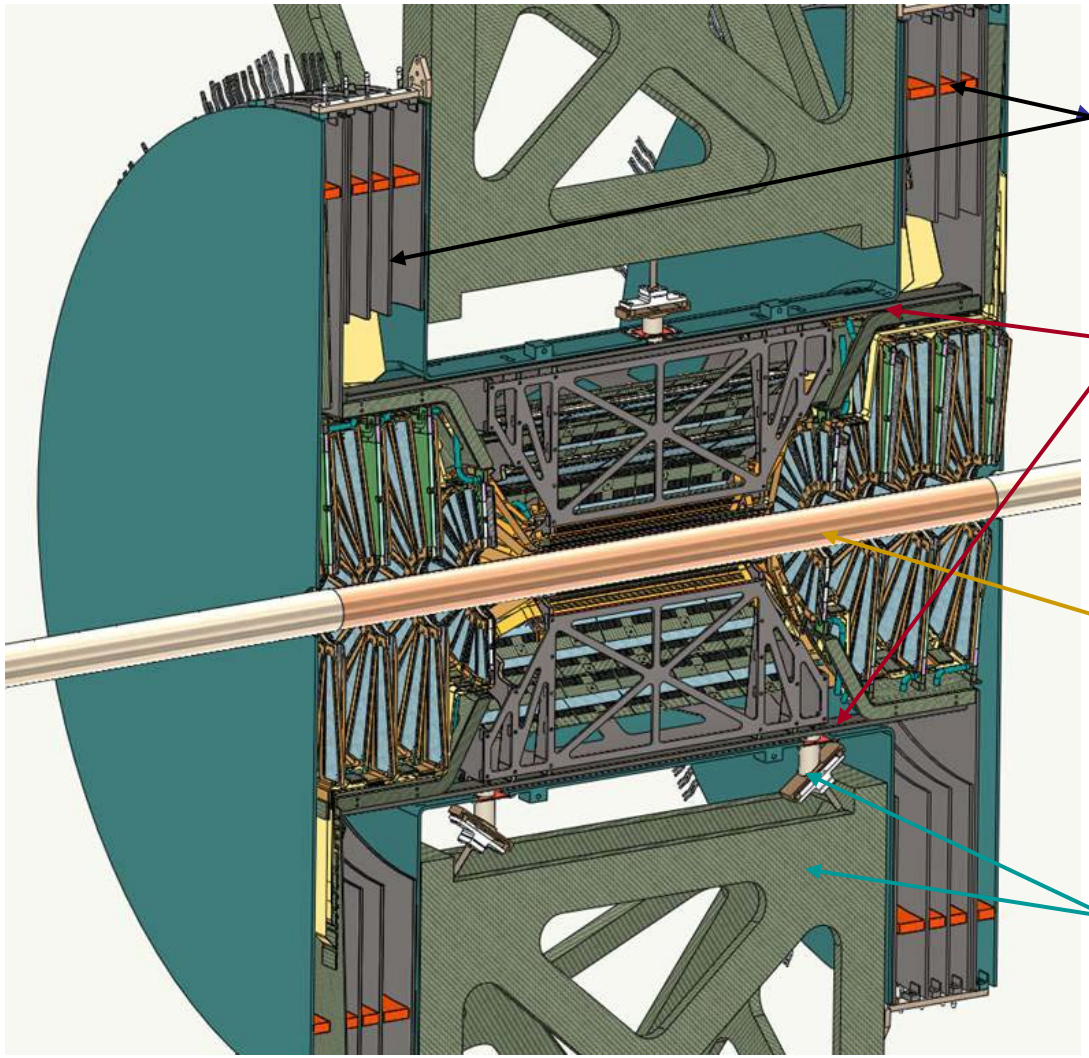
July 15th, 2009

Walter Sondheim - *LANL*

Mechanical Project Engineer; VTX & FVTX

VTX-FVTX Half Assembly for Introduction:





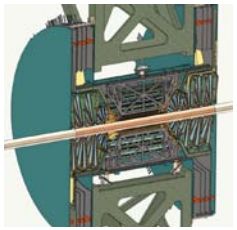
Big Wheel region; read-out electronics for VTX&FVTX, mounts directly to support frame

Each FVTX half is mounted off the space frame horizontal beams

Beryllium beam-pipe, 41.021 mm OD X 800.0 mm long

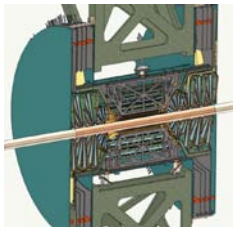
Support structure and isolation mounts attached to central magnet

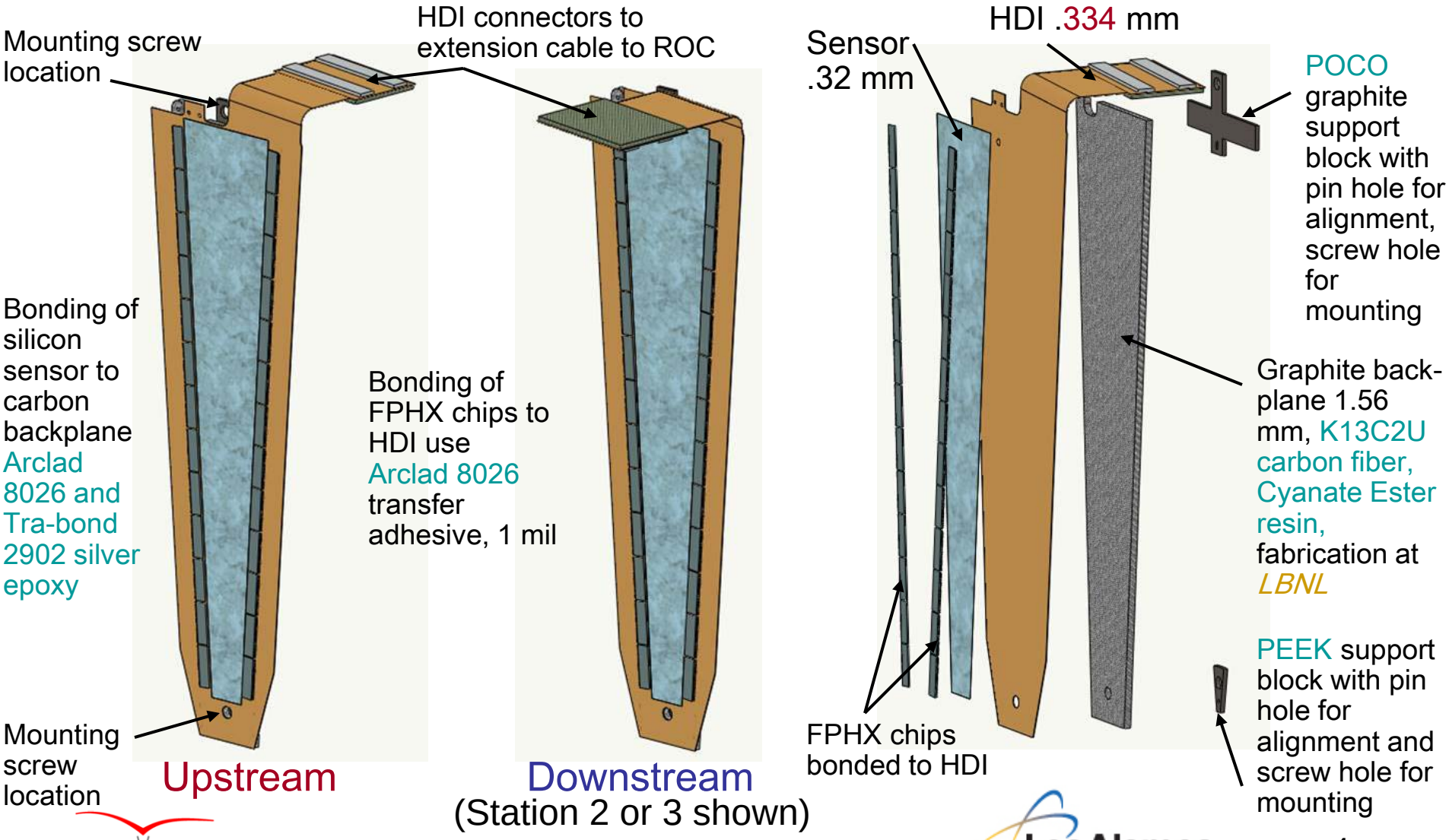
Talk Outline:



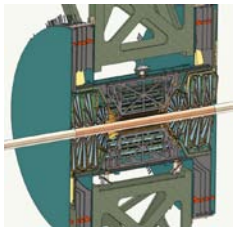
- Sensor module “wedge”
  - Design
  - Analysis
- Station assembly “half disk”
  - Design
- Support structure “cage”
  - Design, staggered stations
- Electronics support “big wheel”
  - Design
  - Thermal studies

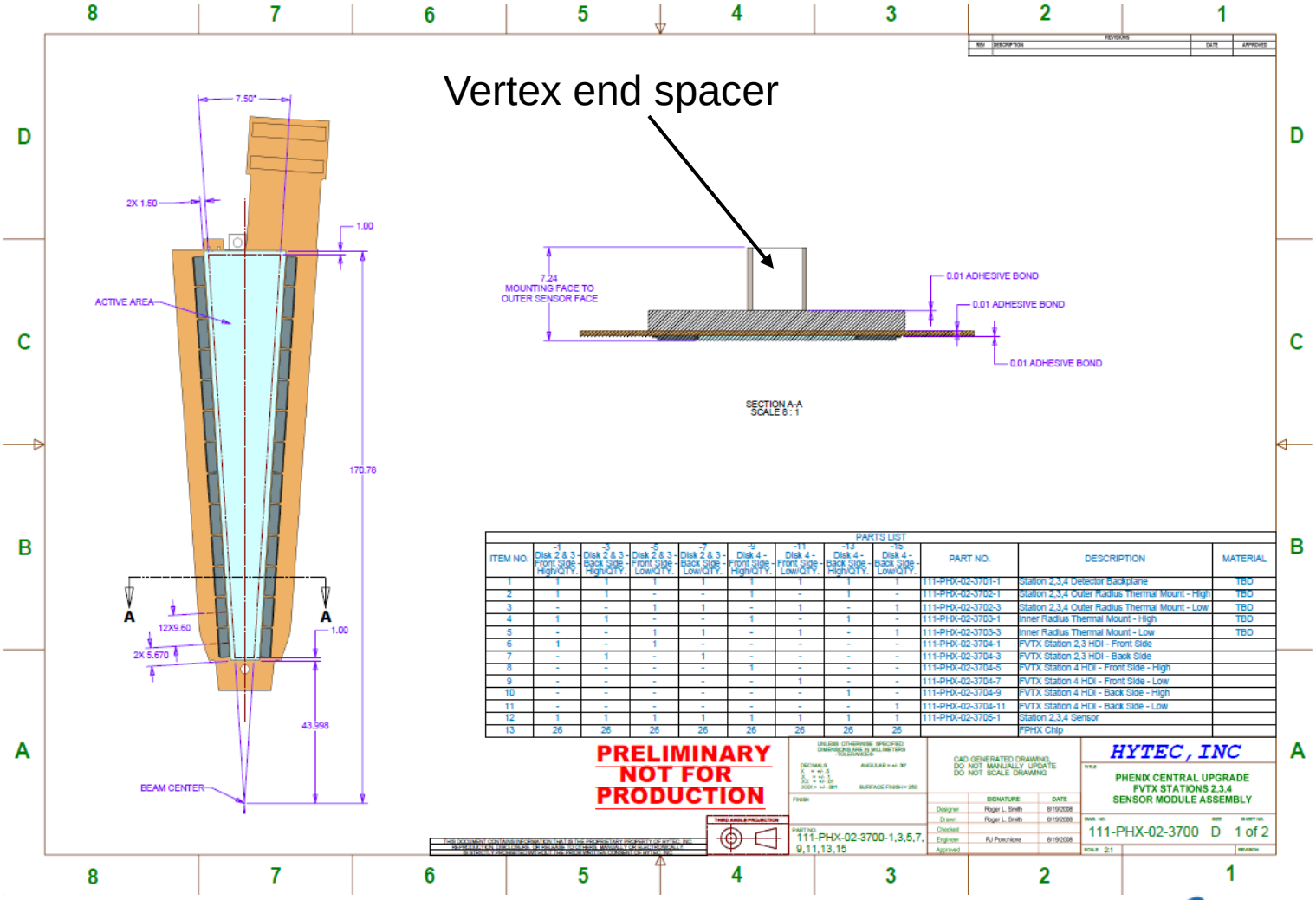
Sensor Module: Two variations for stations 1,2,3 & 4, upstream and downstream:





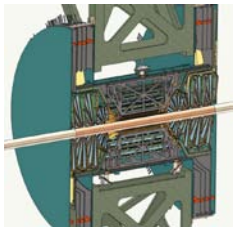
FVTX large wedge “B”:

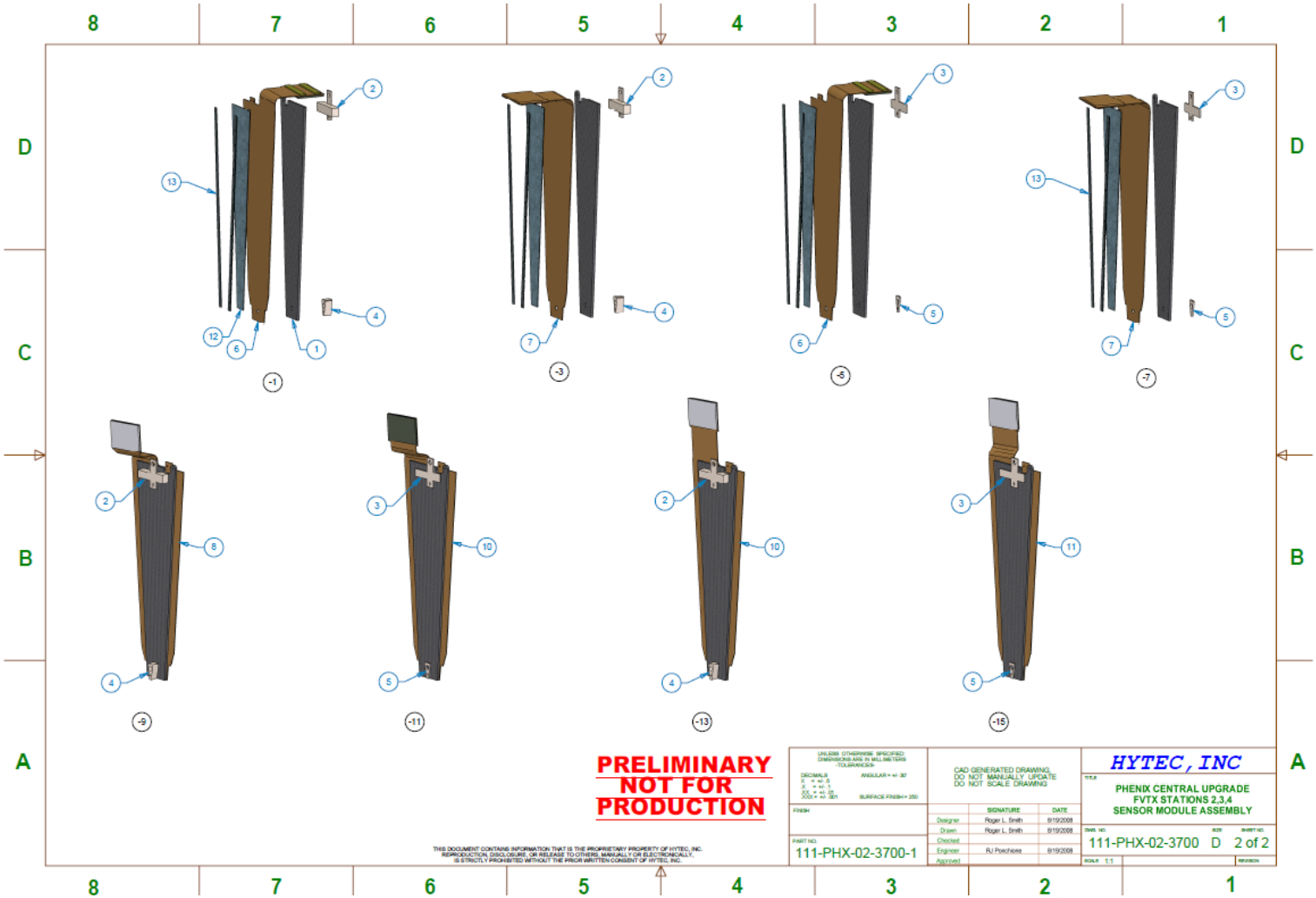




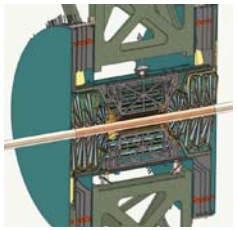
Large wedge currently 12 drawing sheets, 6 different HDI configurations, see next slide.

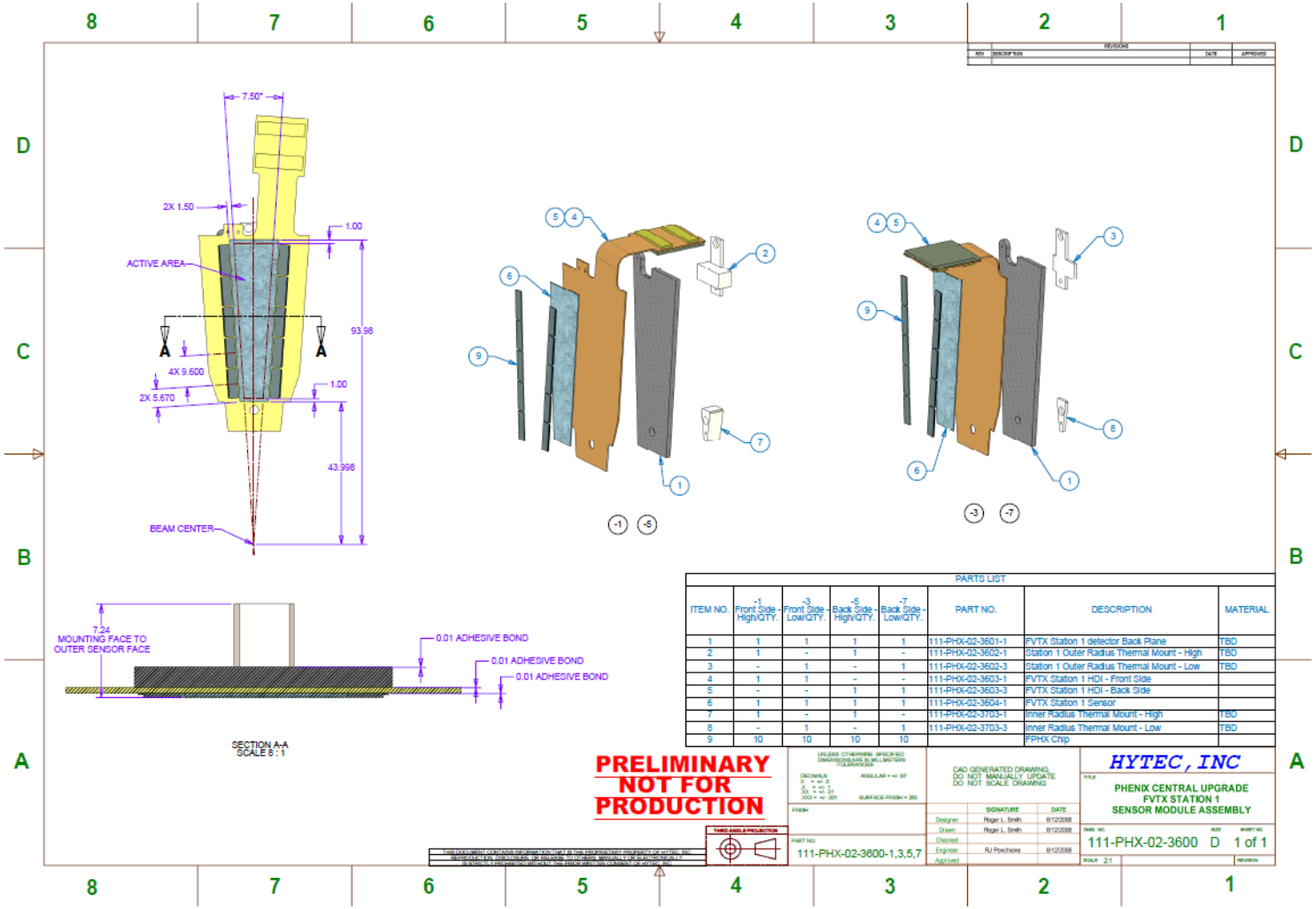
FVTX large wedge “B”:





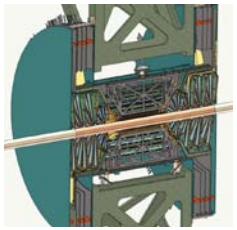
FVTX small wedge “A”:





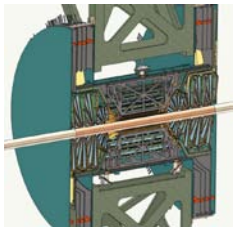
Small wedge has 6 drawing sheets, 2 HDI configurations.

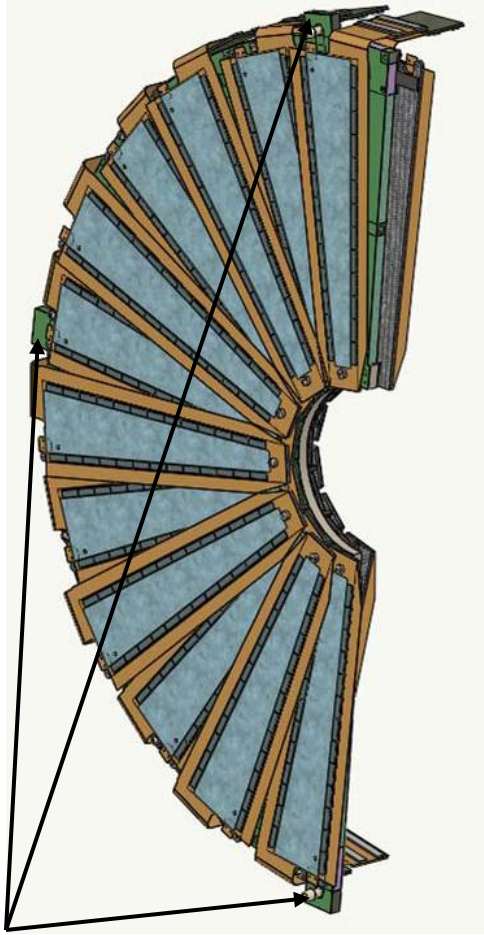
FVTX wedge module status:



- Sensor modules A & B design is complete with the exception of defining the K13C2U Carbon layup. This layup will be defined based on the thermal and mechanical analysis currently being completed.
- A production quotation has been received from Eric Anderssen at LBNL. A SOW has been generated and the paperwork to put in place an order through BNL is in process. There is a proposal to combine this order with the order for the FVTX cages – under discussion, waiting on cage cost estimate from LBNL.
- Spacer blocks, outer POCO Graphite, inner PEEK, being estimated in Albuquerque shops.
- Wedge assembly, using jigs designed by HYTEC, has been demonstrated successfully at SIDET (Fermilab).

Half-Station sub-assembly, stations 2, 3 or 4: (stations 2 & 3 shown)

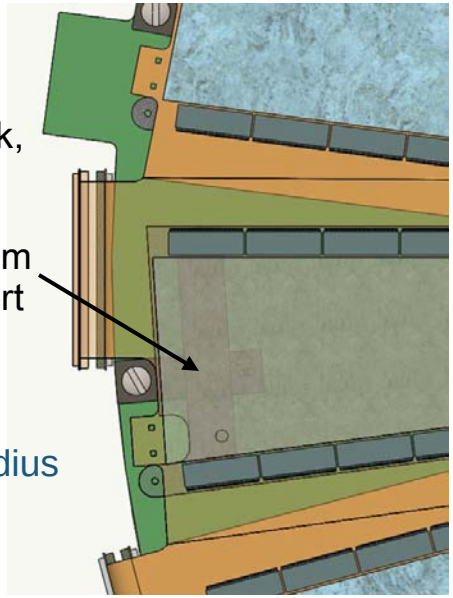


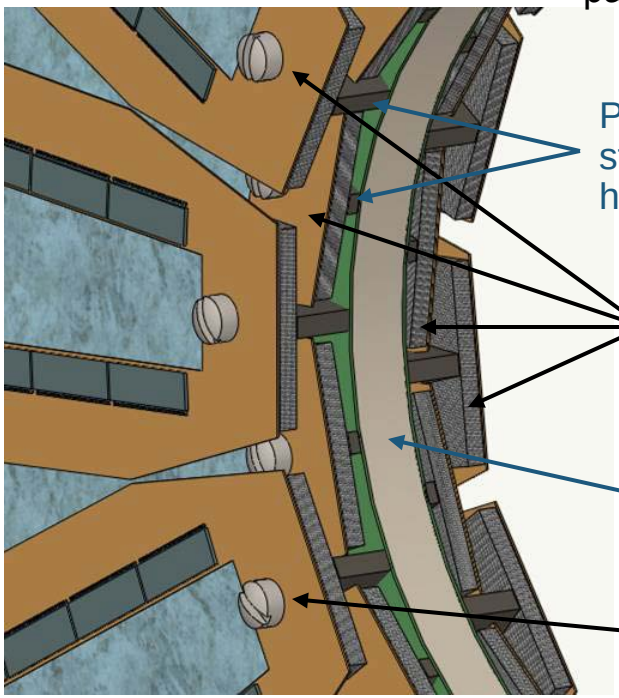


Mounting and alignment pins in tabs, 3 per station half disk, along with cooling barbs.

Two layers of wedges on each side of a support disk. Each wedge offset in phi from its neighbor by 7.5 degrees. Two layers of wedges on upstream side offset from two layers on downstream side by 3.75 degrees.

Thermally conductive block, POCO Graphite AXM5Q, to transfer heat from wedge to support panel.





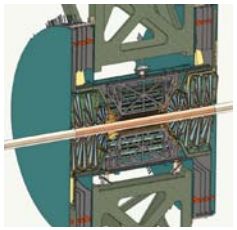
PEEK inner radius stand-offs, two heights.

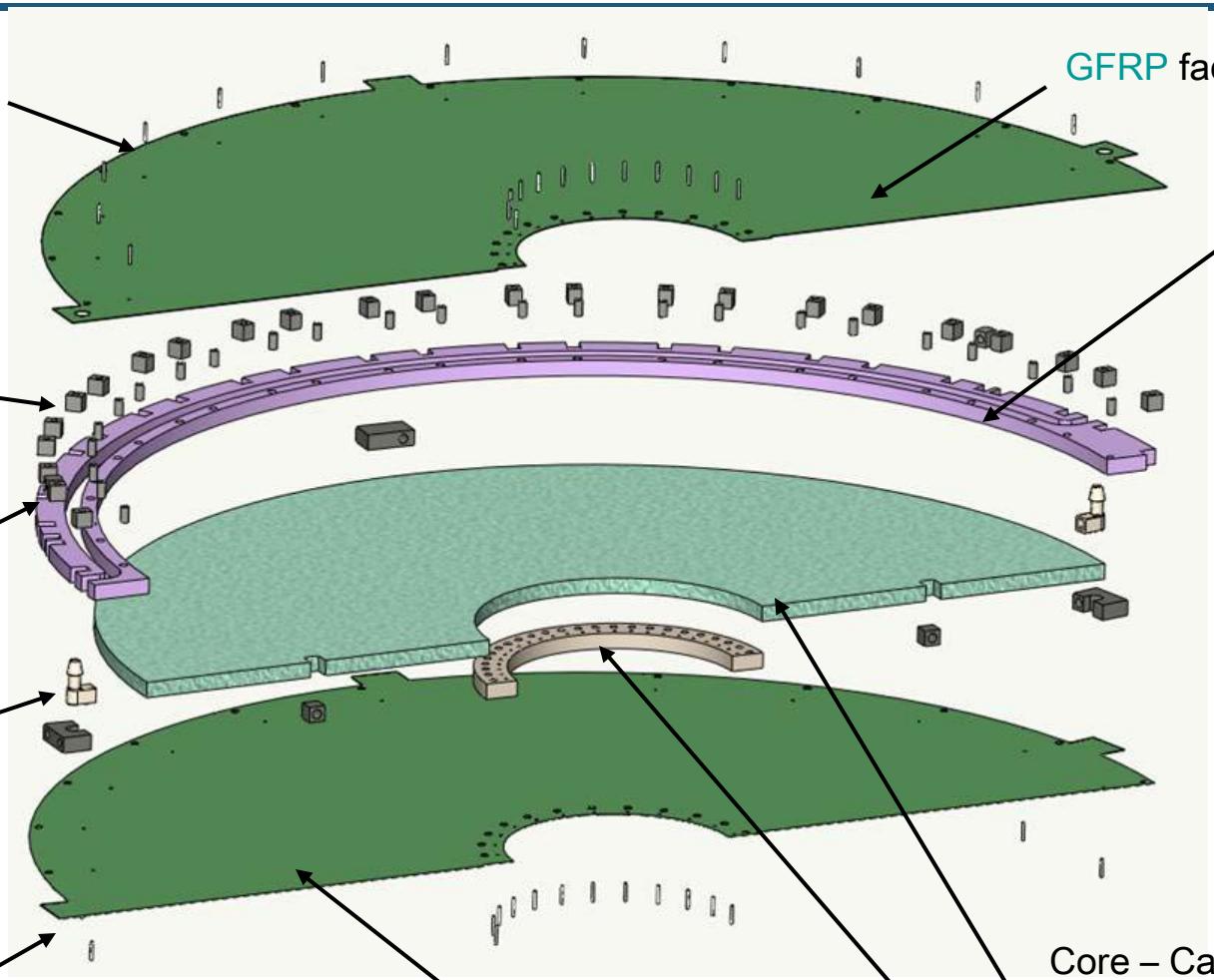
Four layers of 15 degree wedges, 2 layers on each side of support panel

PEEK inner support ring

Nylon mounting screw – (phillips head)

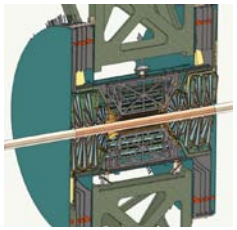
Support Half Station Construction:





Fabrication of disk assembly will take place at *LBNL* composite shop – no cost estimate on these pieces at this time.

Coolant to FPHX Chips Thermal Path – 2007 review – current changes:

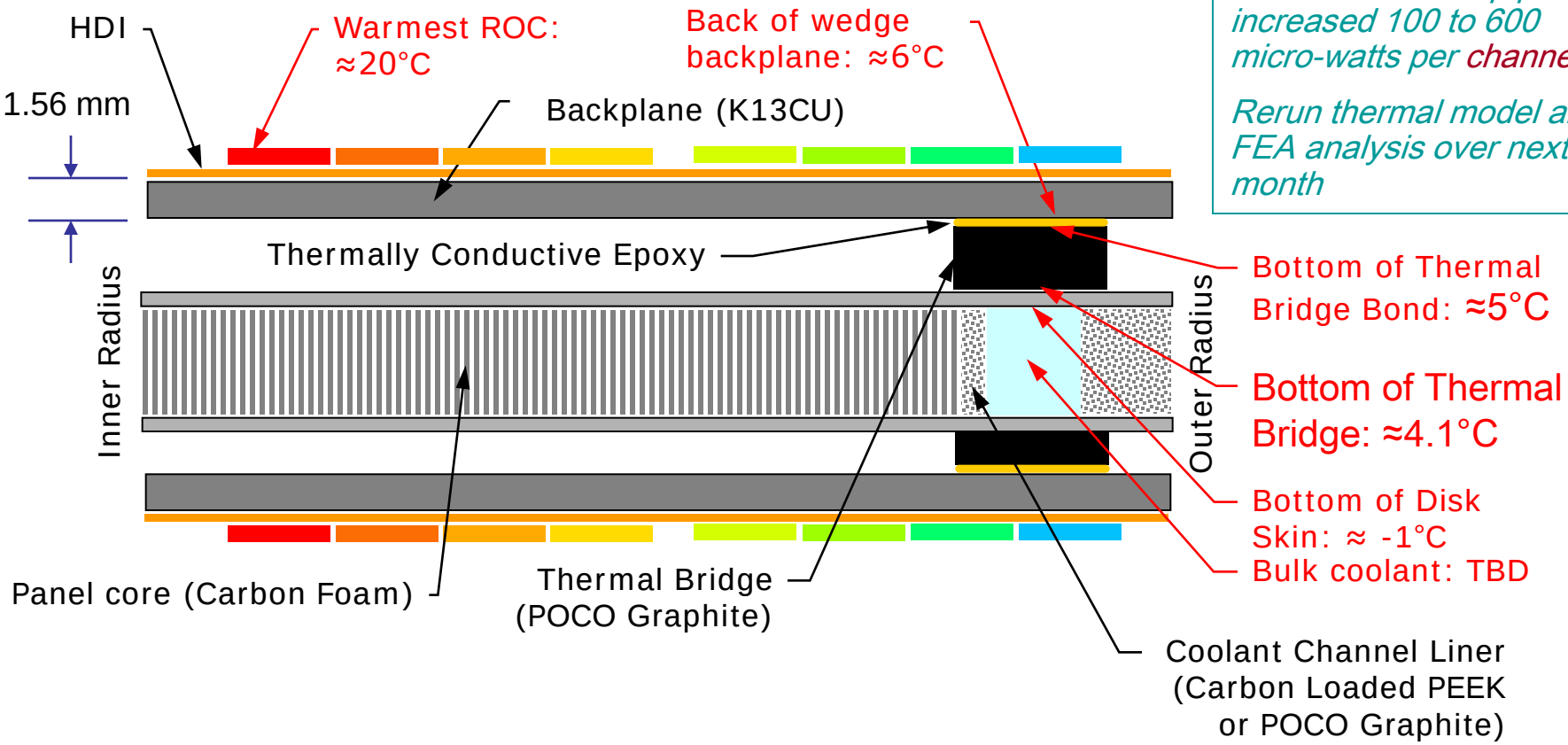


- Use Simple Correlations to Evaluate
  - Pressure drops
  - Temperature drop from fluid to cooling tube

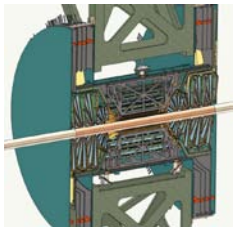
2008 Changes to Wedge:

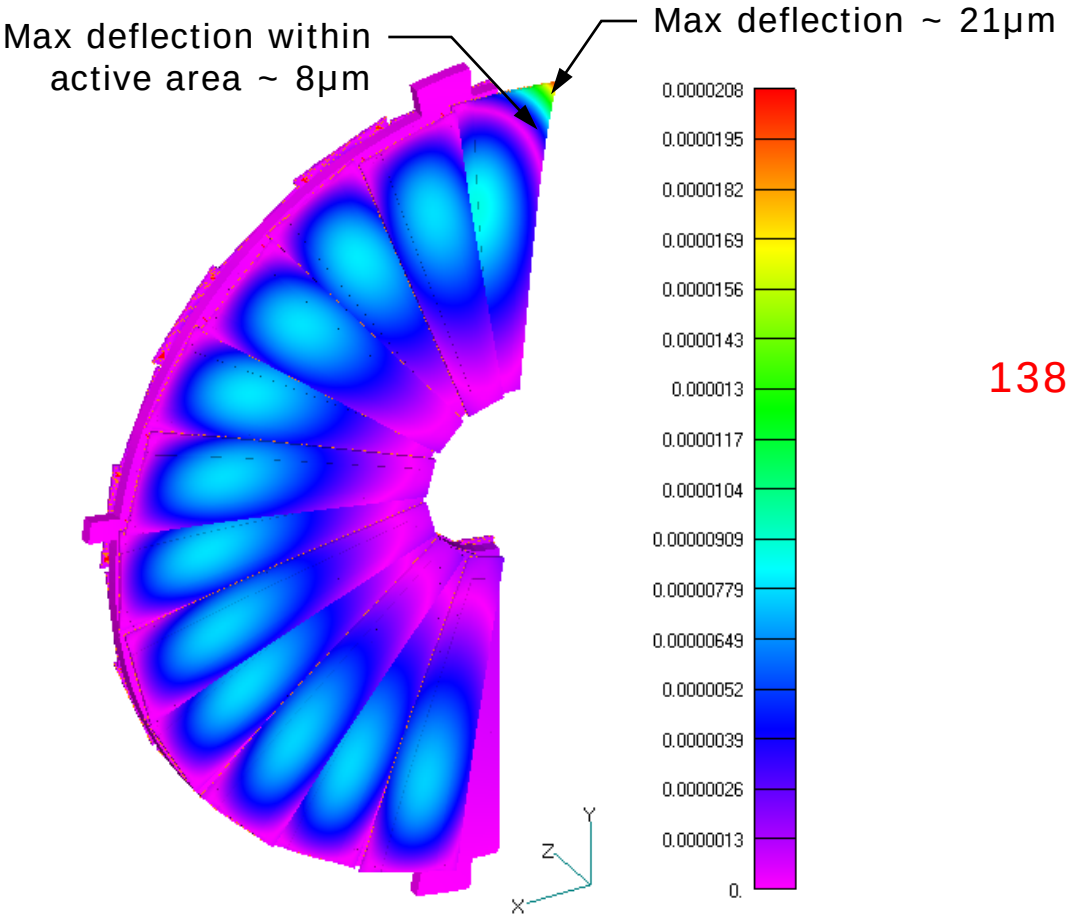
FPHX readout chip power increased 100 to 600 micro-watts per channel.

Rerun thermal model and FEA analysis over next month

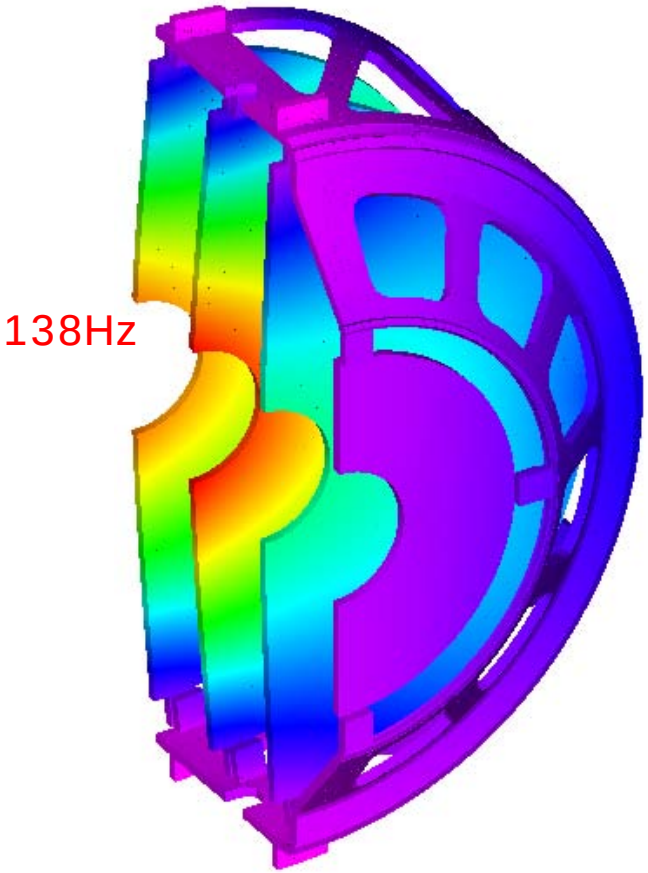


Large Station and Cage-Level Modeling:



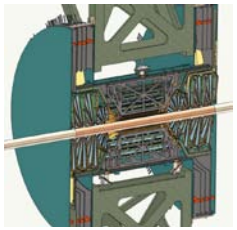


Distortion due to Cooling
(assembled at room temperature)



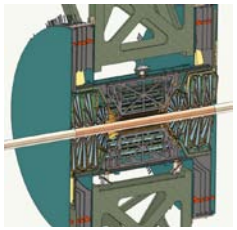
Fundamental Vibration Mode

FVTX station half panel status:



- Preliminary drawings for all four stations have been completed.
- Even with the “staggered” orientation of the stations, there are only two distinct panels – one for station 1 and the second for station 2,3 & 4. The stagger, or phi rotation, is built into the FVTX cage.
- No additional analysis for the station disk has been performed since early 2008.
- The cooling loop around the outer perimeter of the disk is of an enclosed cavity design – solid PEEK material with Carbon face sheets bonded to it as the other two sides for the channel.
- Alignment flag placements have been included at three locations around the outer perimeter of the station half disk. Targets from Hubbs Machine, Cedar Hill, Missouri, will be used.

Half Cage Assembly with Liquid Cooling Circuit:

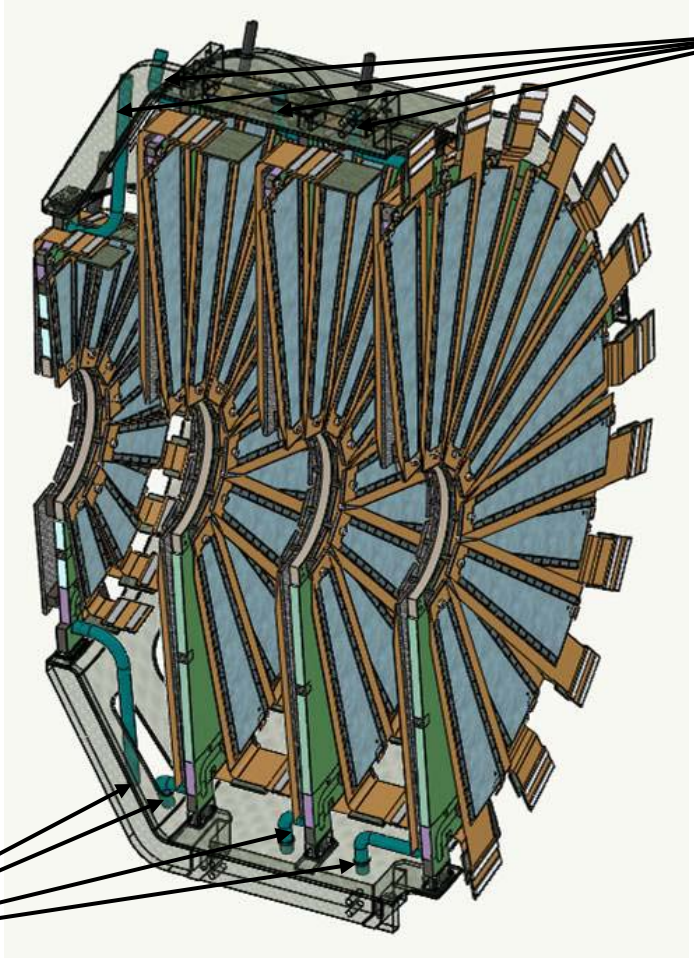


Each station is cooled in parallel with the other stations.

Inlet temperature 0 – 10 degrees C, delivery pressure 5 psi

Delta-T per ½ station 1.8 degrees C, delta p .4 psi

Coolant 3M Novec 7200



Novec 7200:

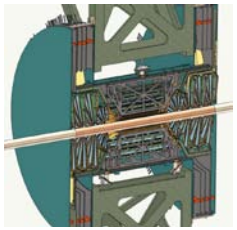
Boiling point 76 degree C

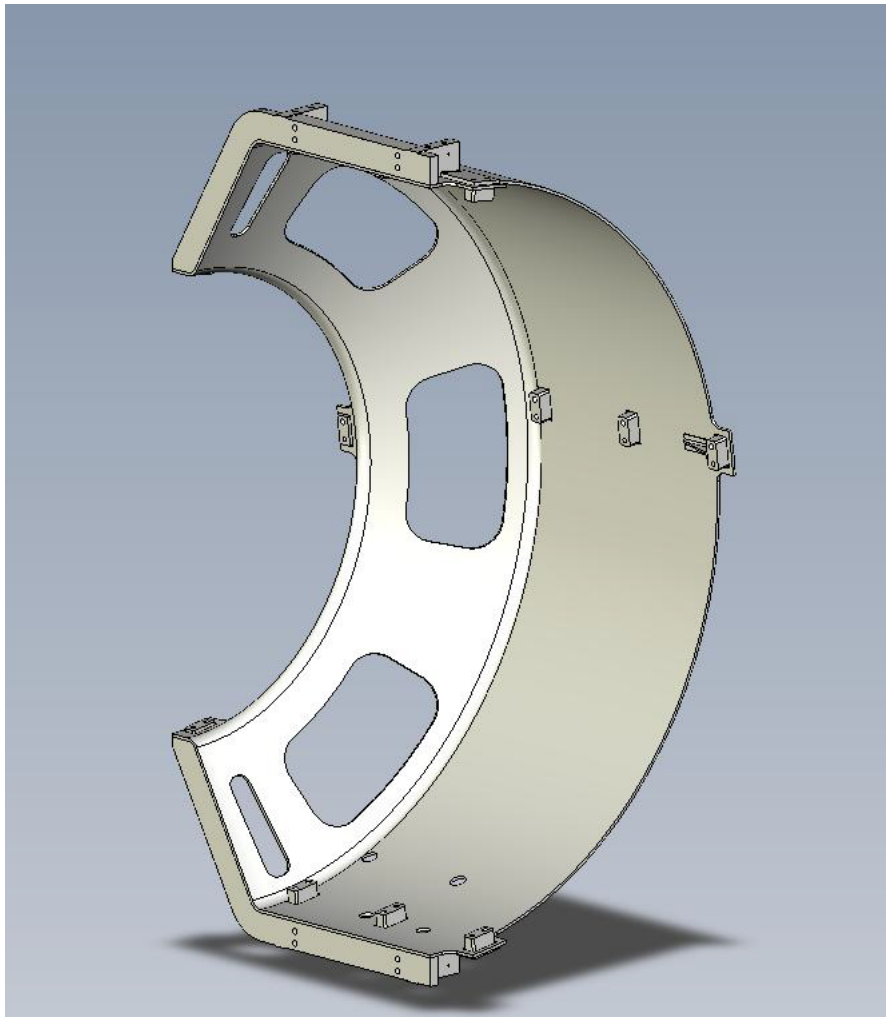
Melting point -138 degree C

Vapor pressure 109 mmHg @ 25 degrees C

Neutron irradiation study at LANL's WNR facility – total dose 6.7 X 10**11 n/cm**2, nominal energy 800 Mev. Samples were sent to 3M for analysis of free Flouride, no indication of significant degradation.

FVTX Cage – non staggered:





Cage design uses CN60 carbon fabric with a EX1515 resin. FEA analysis indicates very rigid structure < 25. microns.

Blocks and flanges POCO graphite ACF-100Q.

Note: the mounting blocks for the 4 stations will be clocked in 1 degree increments.

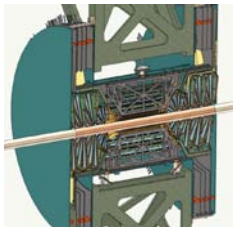
Each FVTX interfaces directly with the VTX space-frame.

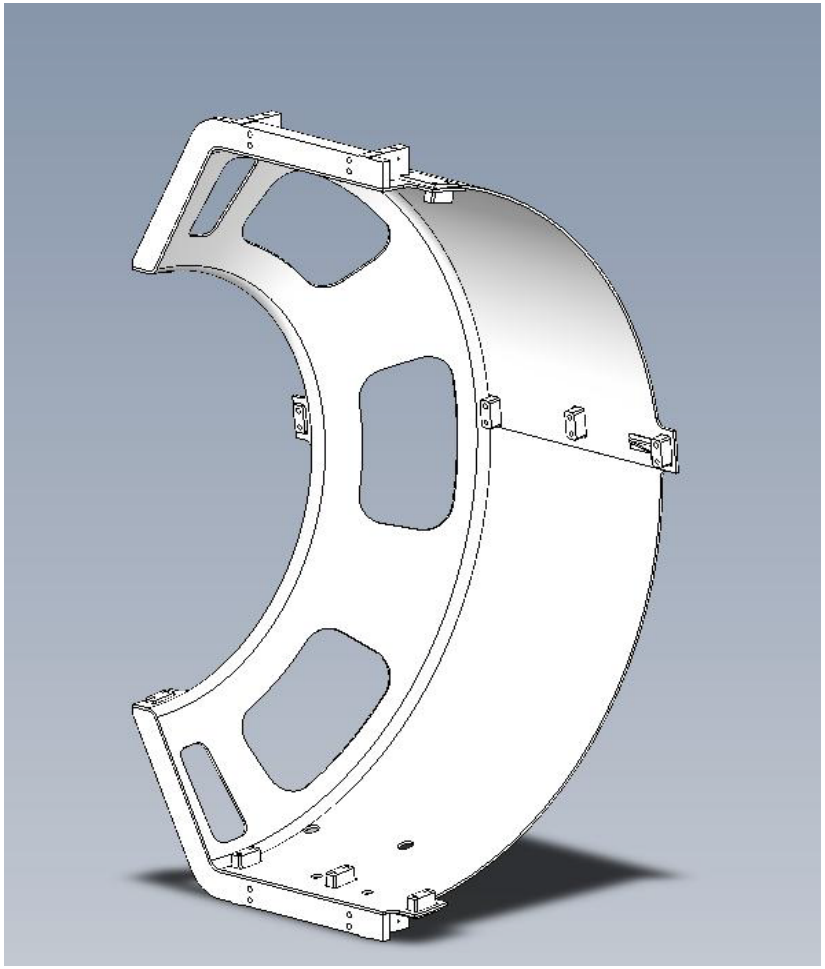
For scale: 400. mm in diameter, 187. mm in length.

Penetrations in shell for survey/alignment flags

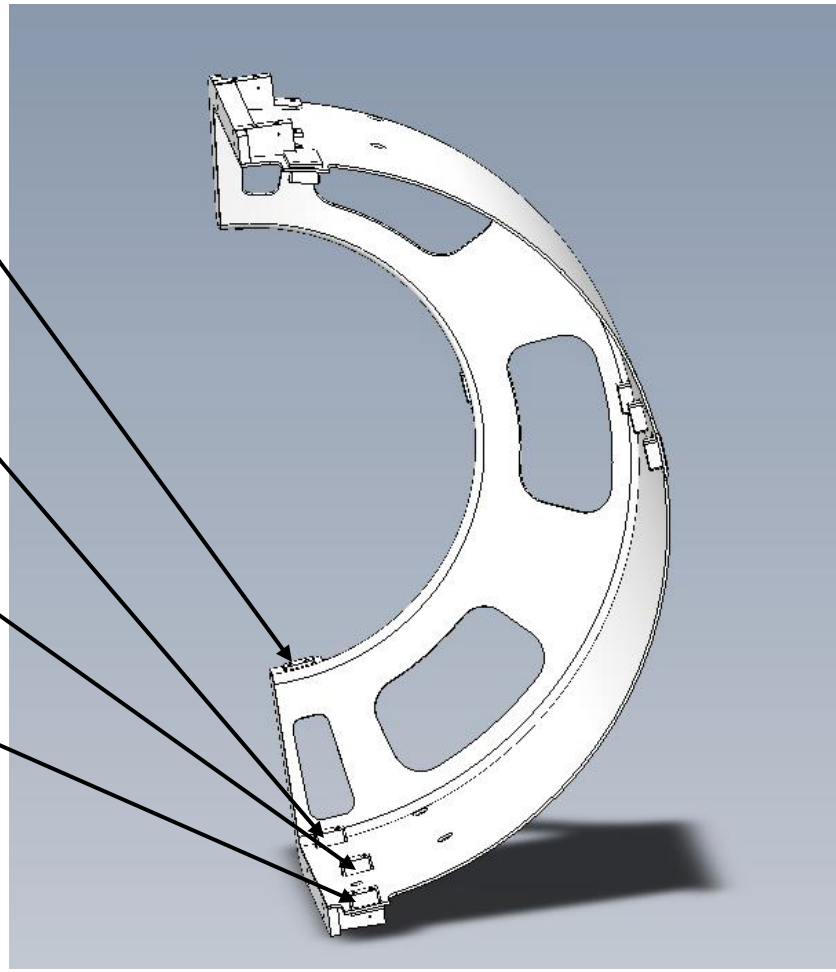
Fabrication will take place at *LBNL* composite shop.

FVTX Cage – staggered:

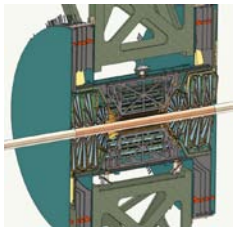




Station 1
0 degree.
Station 2
2.8125
degrees.
Station 3
.9375
degrees.
Station 4
1.8750
degrees.

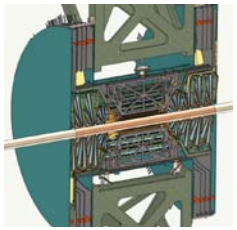


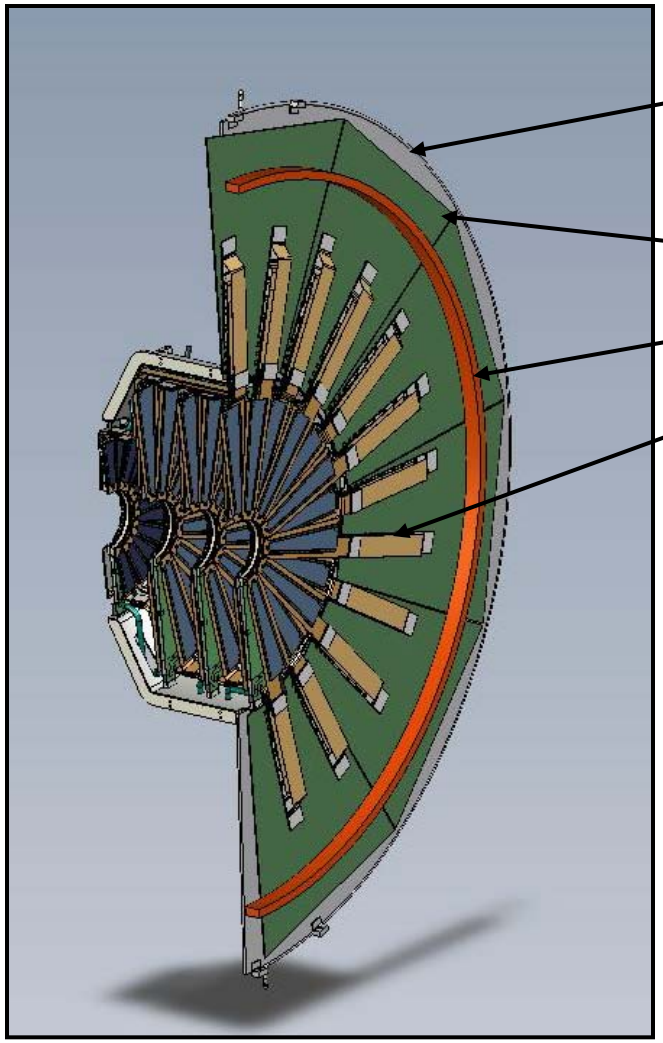
FVTX Cage – question:



- Original staggering angle proposed by Hubert, beginning of June
- Proposed phi angles sent to HYTEC to consider June 9th.
- Last e-mail about DCA resolution improvement with proposed stagger was June 26th – Melynda.
- Is there a confirmation to proceed with the staggered geometry in order for HYTEC to proceed with the cable routing?

Two Independent Halves:





"Big Wheel" cooling plate with coolant channel along perimeter, 3. mm Aluminum

ROC cards, 38. watts/card(?)

Gas seal between layers

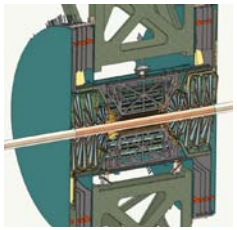
Wedge readout extension cables

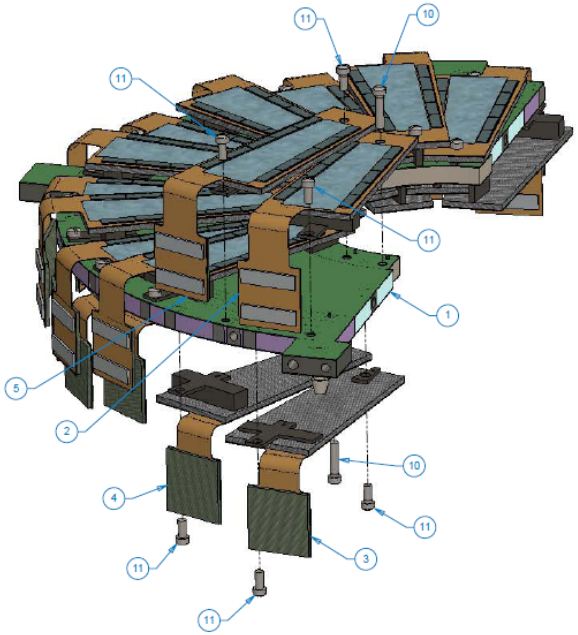
This half FVTX assembly is stand alone, can be tested independently of the rest of the VTX or FVTX detectors, in a lab.

Needed equipment: power supplies, cooling system, dark box.

The FVTX cage, with its' four stations of sensor wedges, is supported off the VTX "space frame" beams – that are at the top and bottom of a half-VTX barrel assembly. The "big wheel" with the ROC cards is supported off the main detector interface "A-Frame" also at the top and bottom, this serves as a "dirty mount" for these plates.

Station 1 Assembly:





PARTS LIST				
ITEM NO.	QTY.	PART NO.	DESCRIPTION	MATERIAL
1	1	111-PHX-02-3200-1	FVTX Half Station 1 Support Panel Assembly	
2	6	111-PHX-02-XXXX-1	Station 1 Front Side Sensor Module Assembly - High	
3	6	111-PHX-02-XXXX-1	Station 1 Back Side Sensor Module Assembly - Low	
4	6	111-PHX-02-XXXX-1	Station 1 Back Side Sensor Module Assembly - High	
5	6	111-PHX-02-XXXX-1	Station 1 Front Side Sensor Module Assembly - Low	
6	6	111-PHX-02-XXXX-1	FVTX Disk 1 Extender 1-A	
7	6	111-PHX-02-XXXX-1	FVTX Disk 1 Extender 1-B	
8	6	111-PHX-02-XXXX-1	FVTX Disk 1 Extender 2-A	
9	6	111-PHX-02-XXXX-1	FVTX Disk 1 Extender 2-B	
10	12		Fillister Hd Screw, #2-56 UNC-2B X 3/8"lg	Nylon
11	36		Fillister Hd Screw, #2-56 UNC-2B X 3/16"lg	Nylon

PRELIMINARY NOT FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
-TOLERANCES-
DECIMALS
.X = +/- .1
.XX = +/- .05
.XXX = +/- .001
ANGULAR = +/- 30'
SURFACE FINISH = 250

FINISH

THIRD ANGLE PROJECTION

PART NO. 111-PHX-02-3010-1

CAD GENERATED DRAWING, DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING

	SIGNATURE	DATE
Designer	Roger L. Smith	9/14/2008
Drawn	Roger L. Smith	9/14/2008
Checked		
Engineer	RJ Ponchione	9/14/2008
Approved		

HYTEC, INC

TITLE: PHENIX CENTRAL UPGRADE FVTX HALF-STATION 1 ASSEMBLY

DWG. NO. 111-PHX-02-3010 SIZE D SHEET NO. 1 of 3

SCALE 2:1 REVISION

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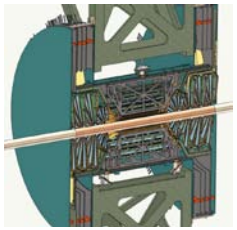
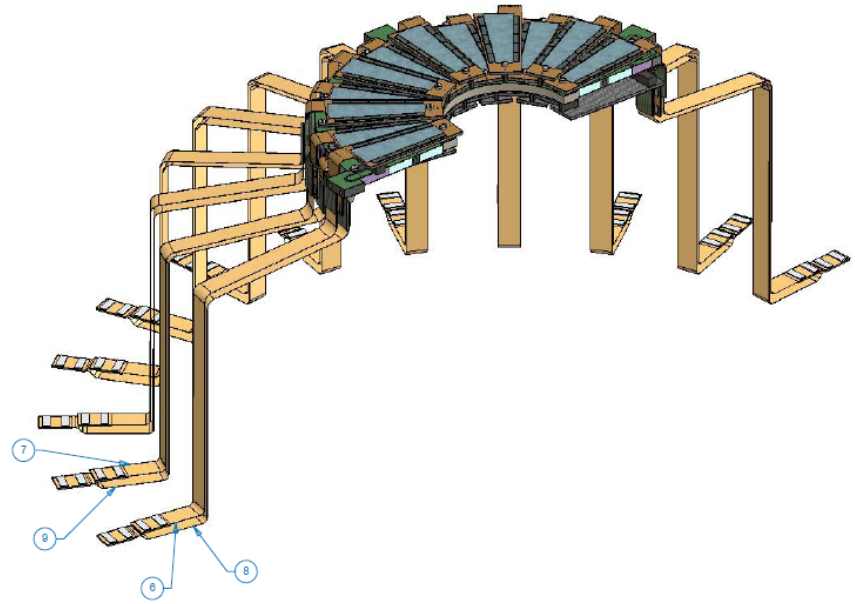
Station 1 Assembly with Ext. Cables:





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PRODUCTION

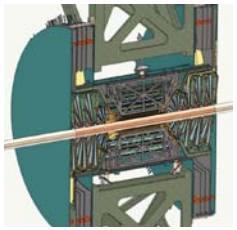
HYTEC, INC

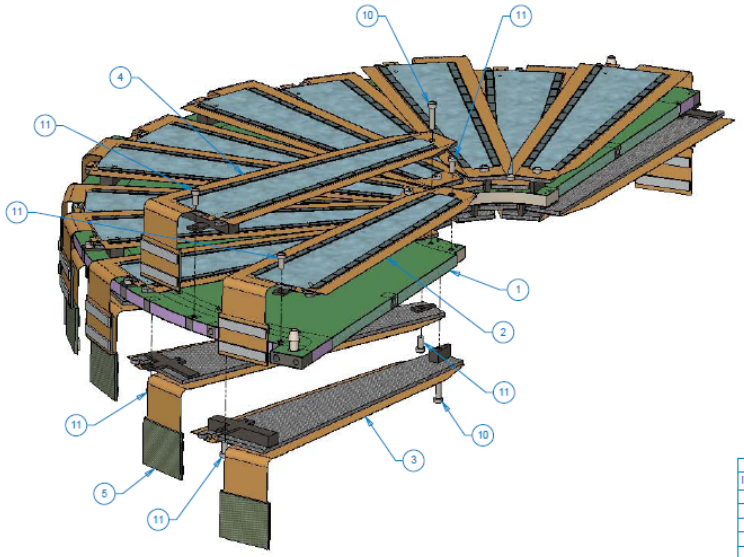
PHENIX CENTRAL UPGRADE
FVTX HALF-STATION 1
ASSEMBLY

111-PHX-02-3010 D 2 of 3

111-PHX-02-3010-1

Station 2 Assembly:





PARTS LIST				
ITEM NO.	QTY.	PART NO.	DESCRIPTION	MATERIAL
1	1	111-PHX-02-3210-1	FVTX Half Station 2-3-4 Support Panel Assembly	
2	6	111-PHX-02-XXXX-1	Station 2-3 Front Side Sensor Module Assembly - Low	
3	6	111-PHX-02-XXXX-1	Station 2-3 Back Side Sensor Module Assembly - High	
4	6	111-PHX-02-XXXX-1	Station 2-3 Front Side Sensor Module Assembly - High	
5	6	111-PHX-02-XXXX-1	Station 2-3 Back Side Sensor Module Assembly - Low	
6	6	111-PHX-02-XXXX-1	FVTX Disk 2 Extender 1-A	
7	6	111-PHX-02-XXXX-1	FVTX Disk 2 Extender 1-B	
8	6	111-PHX-02-XXXX-1	FVTX Disk 2 Extender 2-A	
9	6	111-PHX-02-XXXX-1	FVTX Disk 2 Extender 2-B	
10	12		Fillister Hd Screw, #2-56 UNC-2B X 3/8"lg	Nylon
11	36		Fillister Hd Screw, #2-56 UNC-2B X 3/16"lg	Nylon

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DECIMALS X = +/- .1 X.X = +/- .05 X.XX = +/- .001
ANGULAR = +/- 30'
SURFACE FINISH = 250

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING

HYTEC, INC

TITLE: PHENIX CENTRAL UPGRADE FVTX HALF-STATION 2 ASSEMBLY

	SIGNATURE	DATE
Designer	Roger L. Smith	8/12/2008
Drawn	Roger L. Smith	8/12/2008
Checked		
Engineer	RJ Ponchione	8/12/2008
Approved		

FINISH

THIRD ANGLE PROJECTION

PART NO. 111-PHX-02-3020-1

DWG. NO. 111-PHX-02-3020 SIZE D SHEET NO. 1 of 3

SCALE 4:3 REVISION

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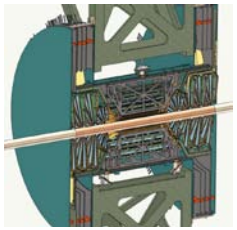
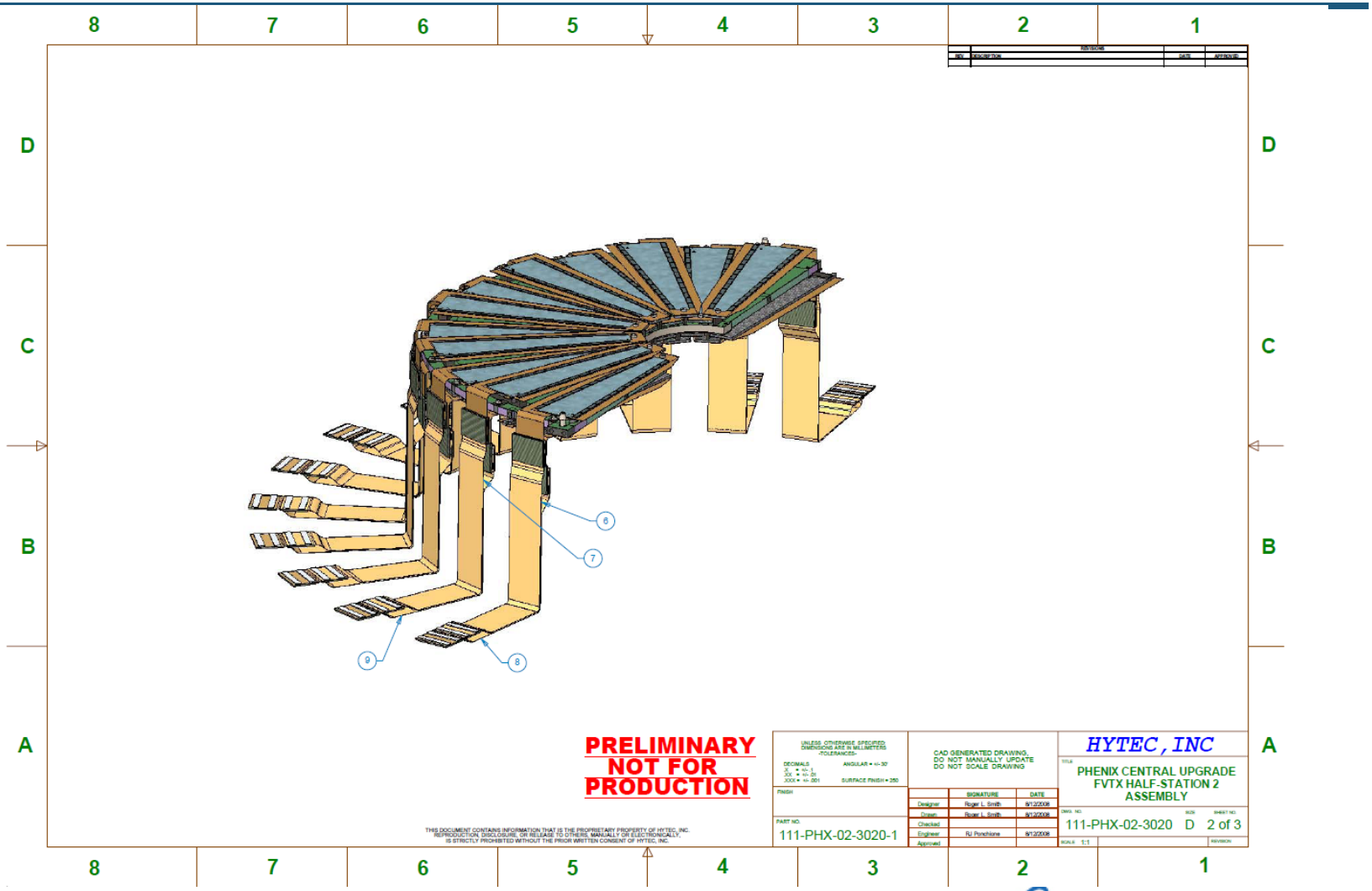
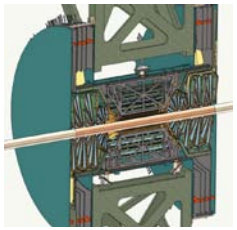
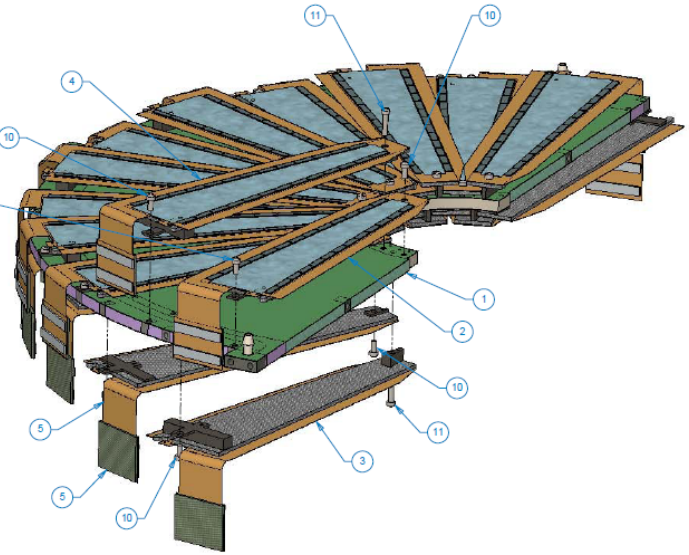
Station 2 Assembly with Ext. Cables:





Station 3 Assembly:





ITEM NO.	Default QTY	PART NO.	DESCRIPTION	MATERIAL
1	1	111-PHX-02-3210-1	FVTX Half Station 2-3-4 Support Panel Assembly	
2	6	111-PHX-02-XXXX-1	Station 2-3 Front Side Sensor Module Assembly - Low	
3	6	111-PHX-02-XXXX-1	Station 2-3 Back Side Sensor Module Assembly - High	
4	6	111-PHX-02-XXXX-1	Station 2-3 Front Side Sensor Module Assembly - High	
5	6	111-PHX-02-XXXX-1	Station 2-3 Back Side Sensor Module Assembly - Low	
6	6	111-PHX-02-XXXX-1	FVTX Disk 3 Extender 1-A	
7	6	111-PHX-02-XXXX-1	FVTX Disk 3 Extender 1-B	
8	6	111-PHX-02-XXXX-1	FVTX Disk 3 Extender 2-A	
9	6	111-PHX-02-XXXX-1	FVTX Disk 3 Extender 2-B	
10	36		Fillister Hd Screw, #2-56 UNC-2B X 3/16"lg	Nylon
11	12		Fillister Hd Screw, #2-56 UNC-2B X 3/8"lg	Nylon

PRELIMINARY NOT FOR PRODUCTION

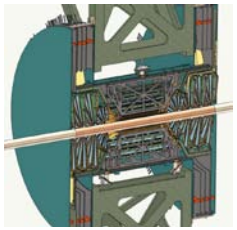
HYTEC, INC

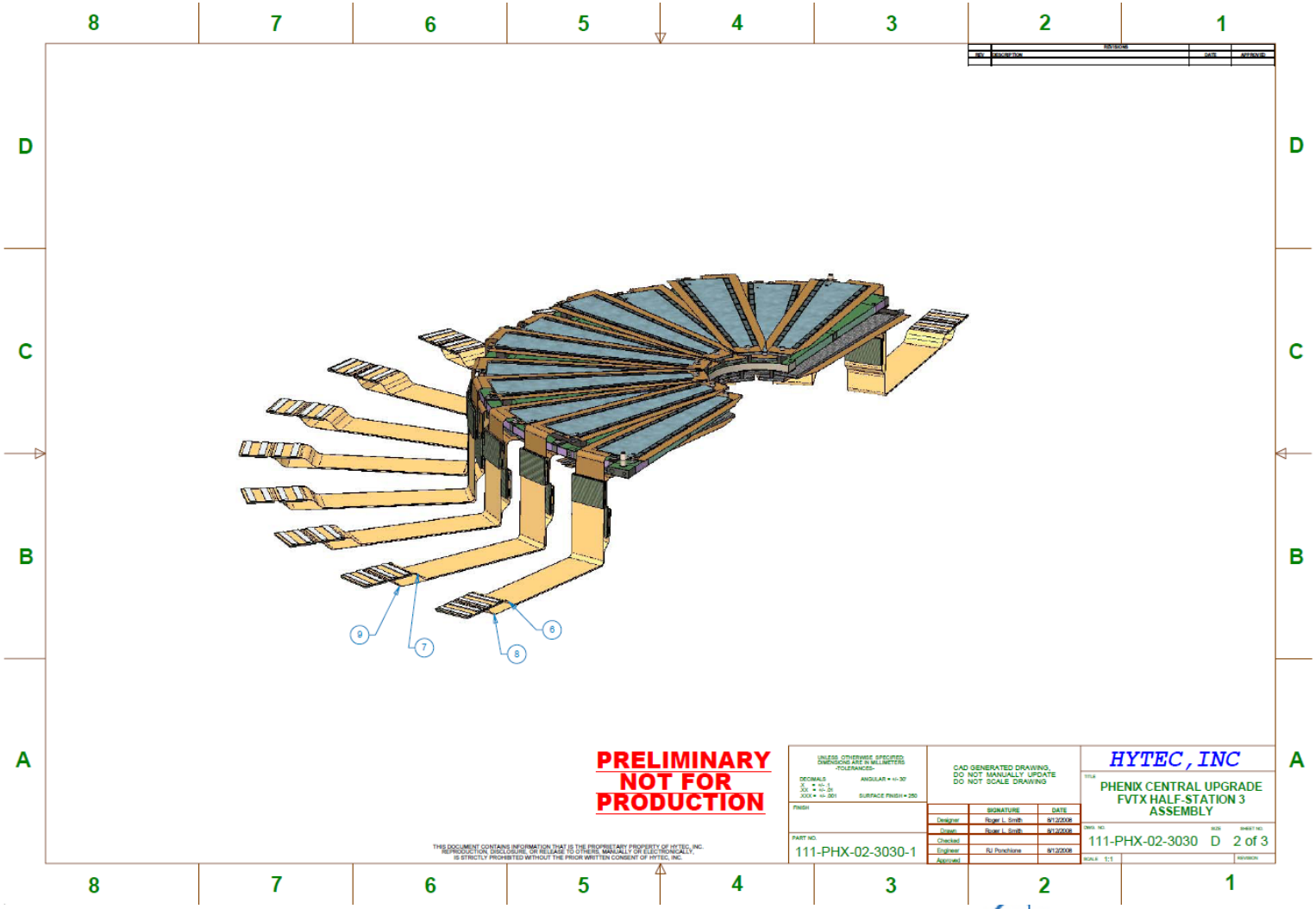
PHENIX CENTRAL UPGRADE FVTX HALF-STATION 3 ASSEMBLY

111-PHX-02-3030-1

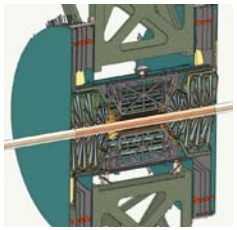
111-PHX-02-3030 D 1 of 3

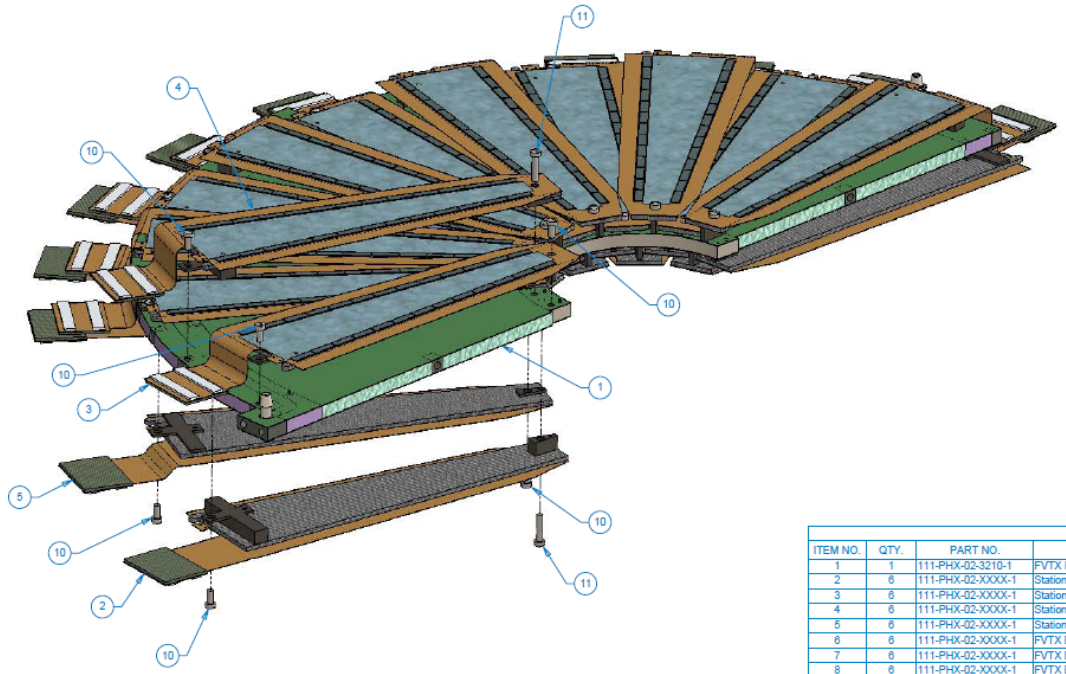
Station 3 Assembly with Ext. Cables:





Station 4 Assembly:





PARTS LIST				
ITEM NO.	QTY.	PART NO.	DESCRIPTION	MATERIAL
1	1	111-PHX-02-3210-1	FVTX Half Station 2-3-4 Support Panel Assembly	
2	6	111-PHX-02-XXXX-1	Station 4 Back Side Sensor Module Assembly - High	
3	6	111-PHX-02-XXXX-1	Station 4 Front Side Sensor Module Assembly - Low	
4	6	111-PHX-02-XXXX-1	Station 4 Front Side Sensor Module Assembly - High	
5	6	111-PHX-02-XXXX-1	Station 4 Back Side Sensor Module Assembly - Low	
6	6	111-PHX-02-XXXX-1	FVTX Disk 4 Extender 1-A	
7	6	111-PHX-02-XXXX-1	FVTX Disk 4 Extender 1-B	
8	6	111-PHX-02-XXXX-1	FVTX Disk 4 Extender 2-A	
9	6	111-PHX-02-XXXX-1	FVTX Disk 4 Extender 2-B	
10	36		Fillister Hd Screw, #2-56 UNC-2B X 3/16"lg	Nylon
11	12		Fillister Hd Screw, #2-56 UNC-2B X 3/8"lg	Nylon

PRELIMINARY NOT FOR PRODUCTION

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS -TOLERANCES- DECIMALS .X = +/- .1 .XX = +/- .01 .XXX = +/- .001 ANGULAR = +/- 30' SURFACE FINISH = 250

FINISH

THIRD ANGLE PROJECTION

PART NO. 111-PHX-02-3040-1

CAD GENERATED DRAWING. DO NOT MANUALLY UPDATE DO NOT SCALE DRAWING

	SIGNATURE	DATE
Designer	Roger L. Smith	8/12/2008
Drawn	Roger L. Smith	8/12/2008
Checked		
Engineer	RJ Panchione	8/12/2008
Approved		

HYTEC, INC

TITLE: PHENIX CENTRAL UPGRADE FVTX HALF-STATION 4 ASSEMBLY

DWG. NO. 111-PHX-02-3040 SIZE D SHEET NO. 1 of 3

SCALE 3:2 REVISION

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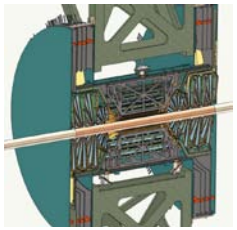
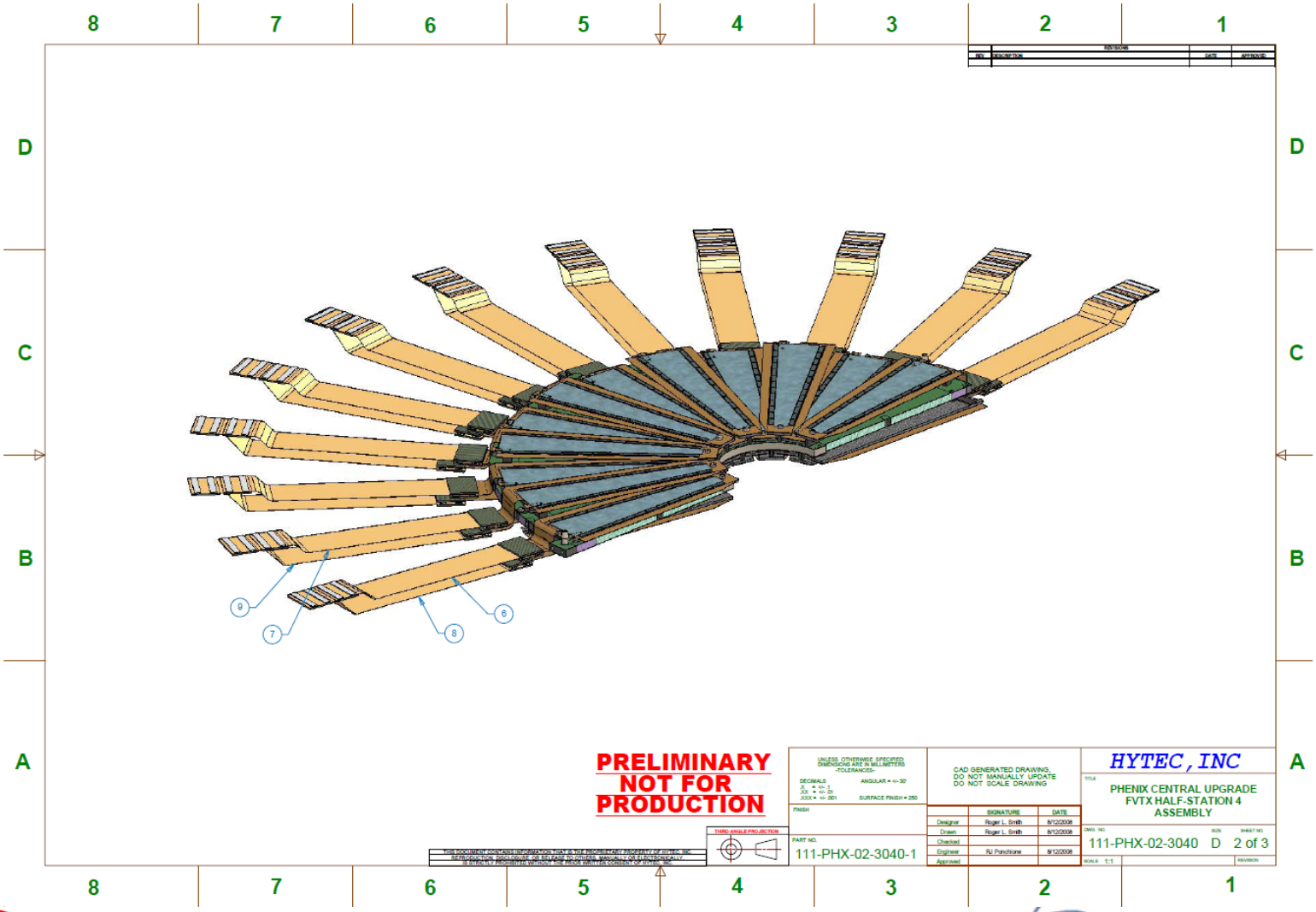
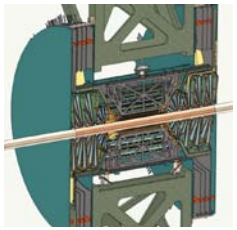
Station 4 Assembly with Ext. Cables:

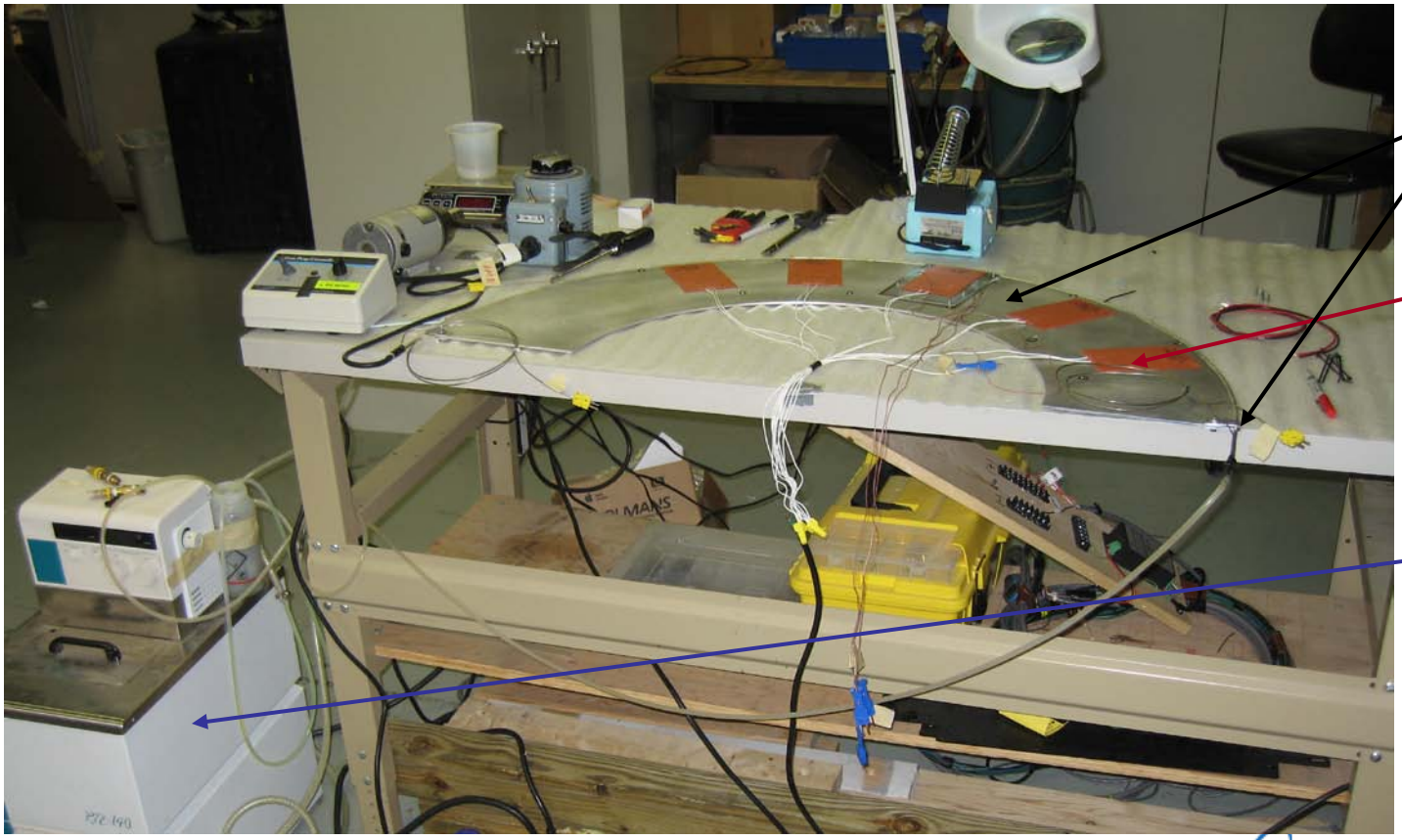




Model heat transfer in lab big wheel. Study in process at HYTEC by John Derrig:



- Model heat transfer in wedge assembly
- Model heat transfer from ROC cards to cooling plate

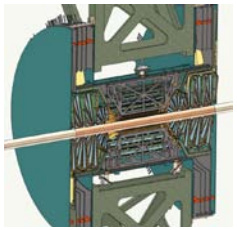


1/8 inch Aluminum 6061 cooling plate, 3/16 dia tube running along perimeter.

Watlow heater 75 watt, mimics SPIRO card from Pixel layer.

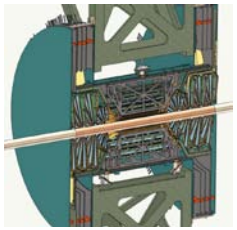
Circulating bath with NOVEC 7200 flowing at 0 degrees C.

Tasks still needed to complete HYTEC's role:



- Complete thermal an mechanical analysis of wedge design with updated power specifications for fPHX chips. Confirmation needed via lab measurements on prototype at UNM, especially temperature.
- Finalize detailed design/drawings for station disk and cage with proposed production facility at LBNL.
- Update fixtures for wedge assembly.
- Design assembly fixtures for station and cage assembly – including support of big wheel. Integrate FVTX half assembly with VTS half barrel assembly via fixtures.
- Specify cooling requirements for stations.

Summary: WBS 1.6 Mechanics – Schedule Dates & Manpower



- WBS 1.6 10/21/2005 – 9/29/2009
  - WBS 1.6.1 Specifications 10/21/2005 – 2/9/2006
  - WBS 1.6.2 Support Structure Cage 4/1/2007 – 12/25/2009
  - WBS 1.6.3 Wedge Backplane 4/11/2008 – 6/19/2009
  - WBS 1.6.4 Support Disk 1/4/2007 – 8/28/2009
  - WBS 1.6.5 Alignment and Assembly 8/1/2008 – 3/5/2009
- Manpower
  - 1 engineers
  - 1 physicist liaison
  - *HYTEC:*
    - 1 Engineer
    - 1 Designer