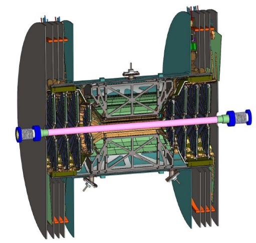
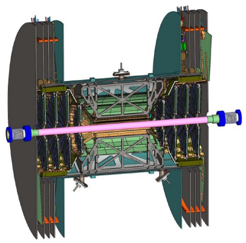


FVTX Detector Assembly

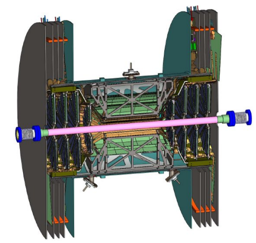
Stephen Pate
New Mexico State University
(FVTX Assembly Management
WBS 1.7)



Talk Outline

- Final Wedge Preparation at BNL
- Assemble Wedges onto Cooling Plates (Disks)
- Disk Metrology
- Assemble Disks into Cages
- Cage Metrology
- Schedule
- People

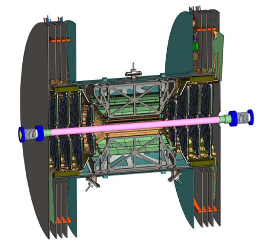
Final Wedge Preparation at BNL



- Select a destination for each wedge
- Bend the HDI
- Attach Thermal Pedestals
- Prevent “faulty injection line 1” problem
- Connect backplane to wedge ground
- Remove HDI tab

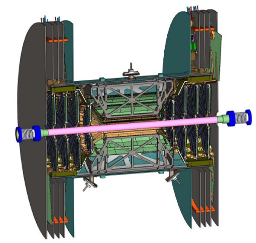
A number to remember: 2 x 2 x 4 x 24 = 384 wedges

Select a destination for each wedge



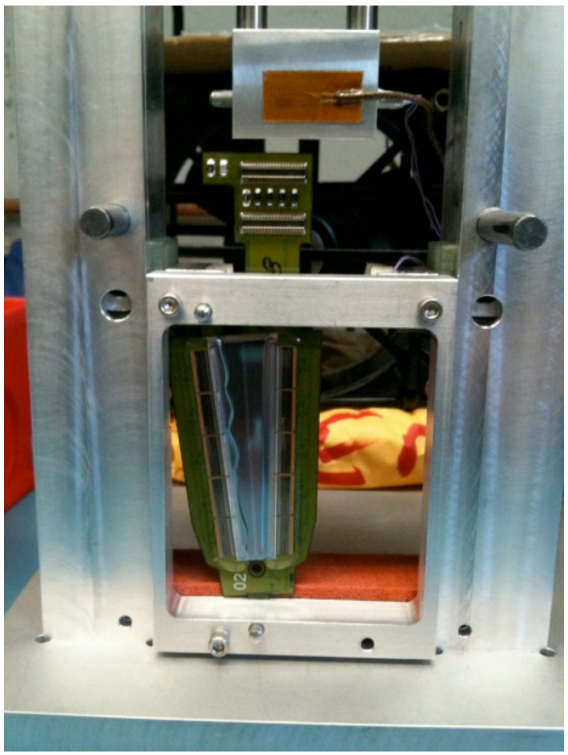
Many subsequent steps (HDI bending, thermal mounts, etc.) depend on the final location of the wedge in the detector.

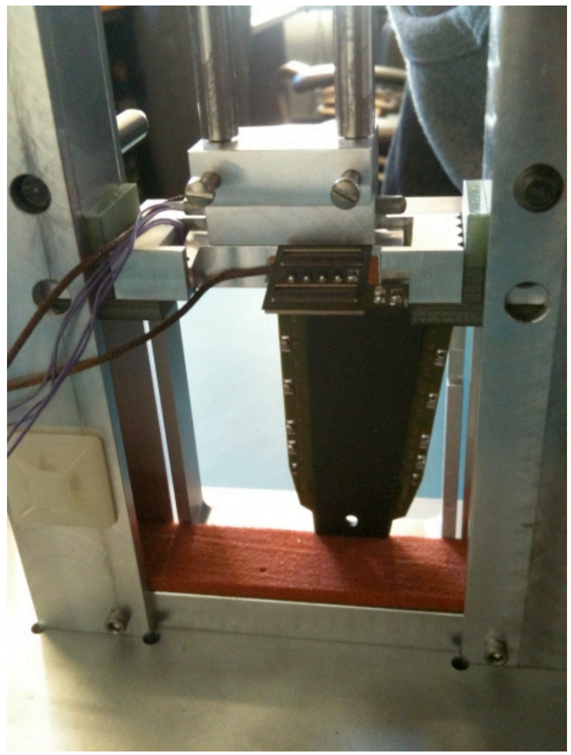
Travelers, spreadsheets, and the database are used to track this – make unique assignments and make sure that all wedge positions are filled.



Bend the HDI

System developed and built at UNM. Now in use at BNL.

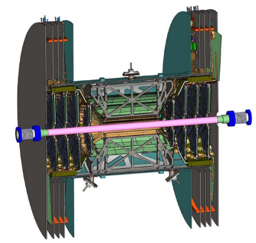




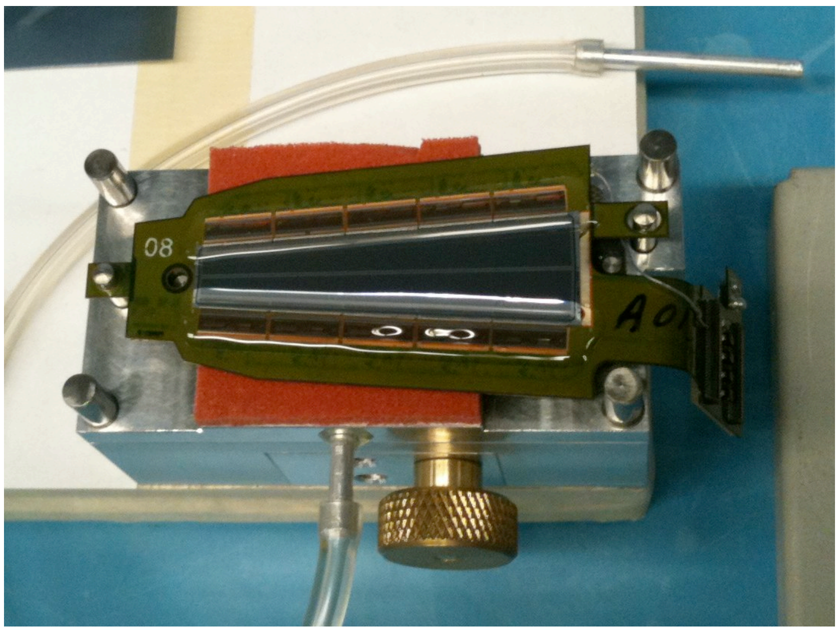
Wedge is placed in precise position in frame.

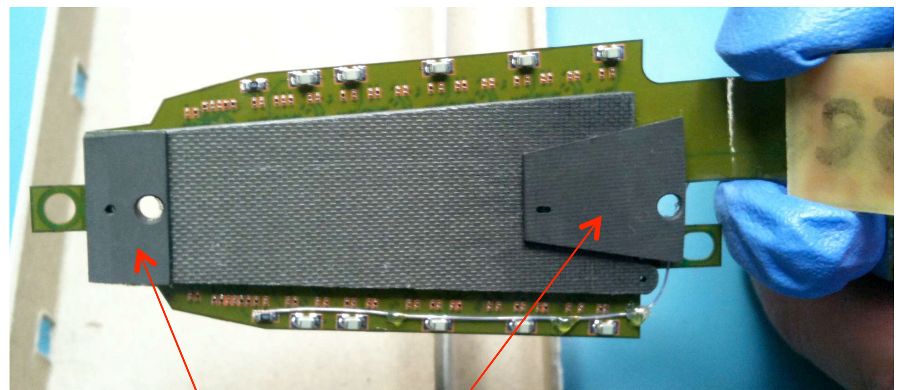
Neck of the HDI is bent in a form and heated to 100C for a few minutes.

Attach Thermal Pedestals



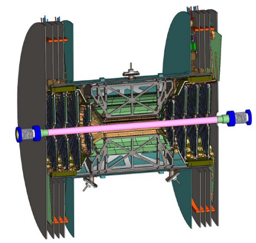
Arclad used as fixative. Vacuum fixture designed and built at UNM; now installed at BNL and in use.





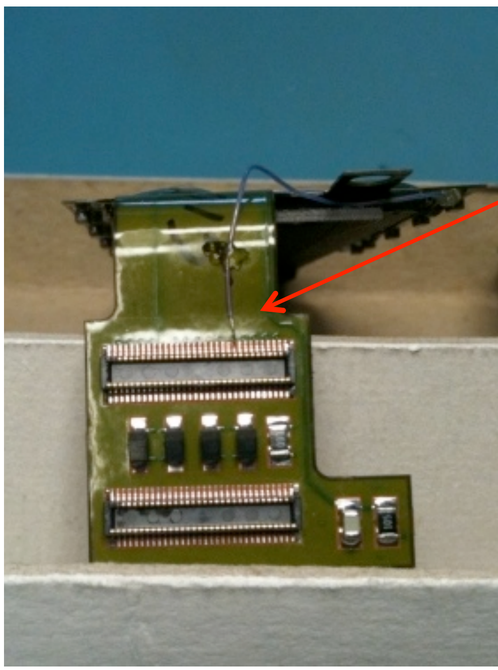
pedestals

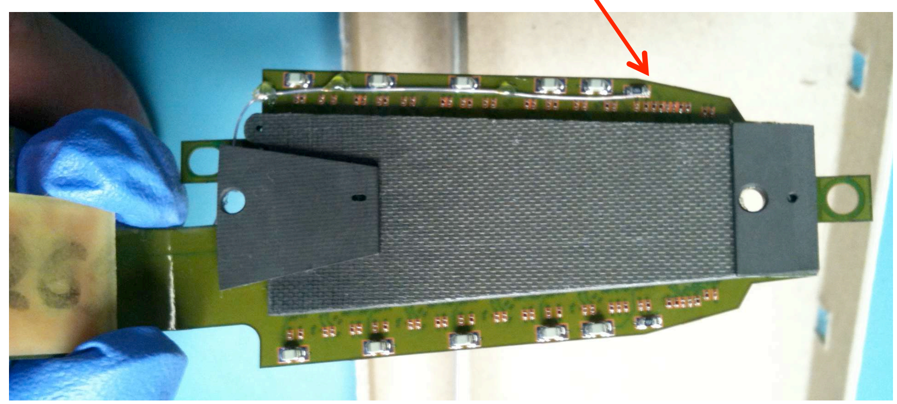
Prevent “faulty injection line 1” problem



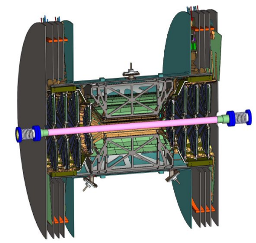
Several small wedges turned up with a faulty trace on the bottom layer of the HDI. (See details in David Winter’s wedge assembly talk.) This fault turned up only after handling. Dyconex have an (ex post facto) explanation for this and believe the (new) large HDIs should not develop this problem.

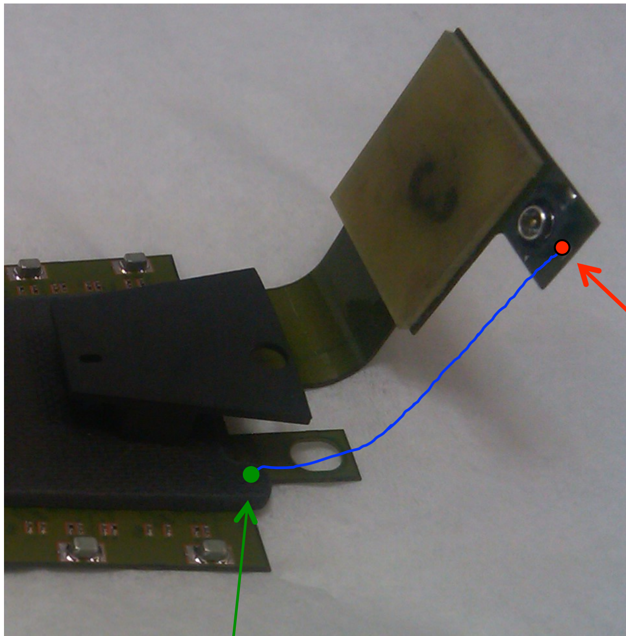
On small wedges, connect a wire from pin P1-9 to the capacitor on side1.





Connect backplane to wedge ground

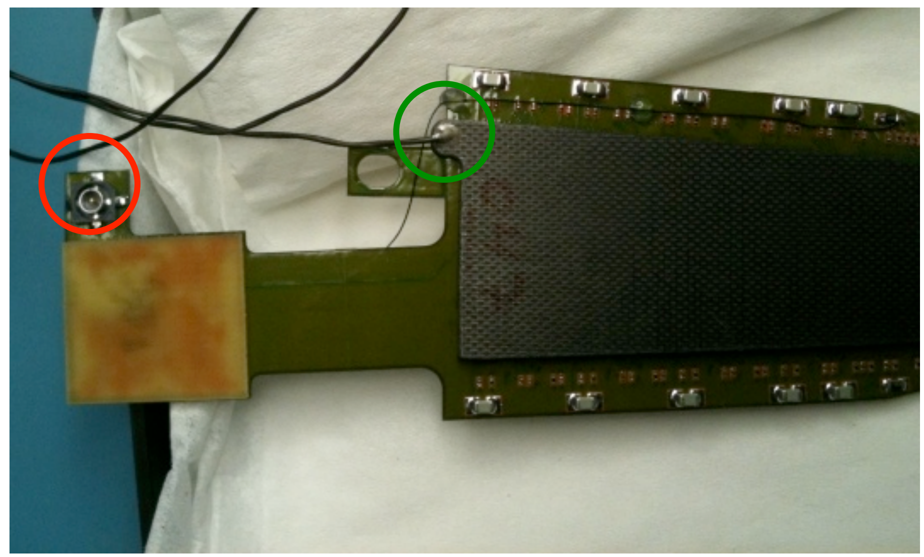




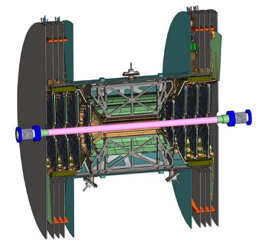
Bulk material of backplane is conductive carbon fiber; needs to be in common ground with analog and digital grounds of wedge.

Solder wire to bias ground tab.

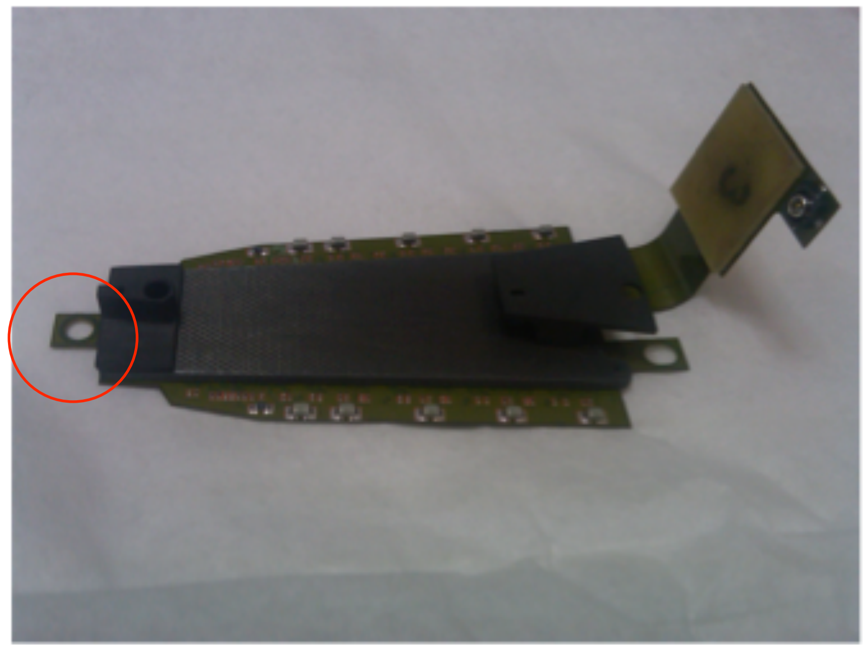
Connect wire into pre-made hole in backplane with conductive epoxy.



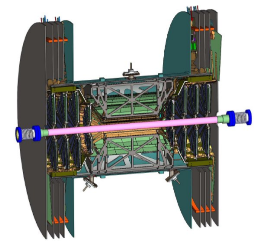
Remove HDI tab



This tab is needed for many assembly processes prior, but must be sliced off before wedge is placed on the cooling plate.

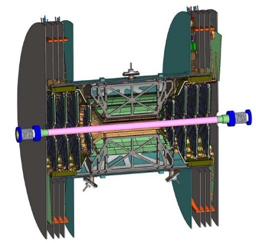


Assemble Wedges onto Cooling Plates



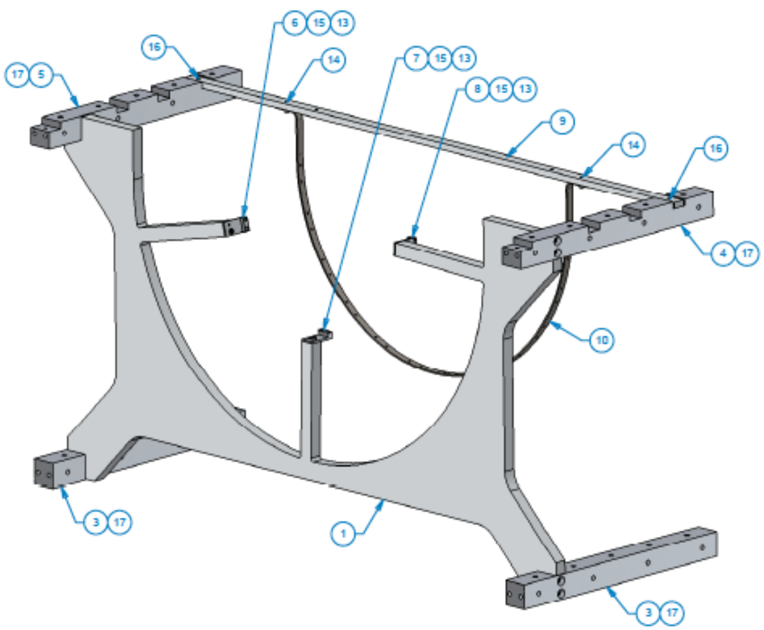
- Use Disk Assembly Fixture to manipulate the cooling plates
- Apply thermal grease to plate faces and to bottom of thermal pedestals
- Attach wedges to cooling plates with torque-limiting screwdriver
- Test wedges; treat disk as a system

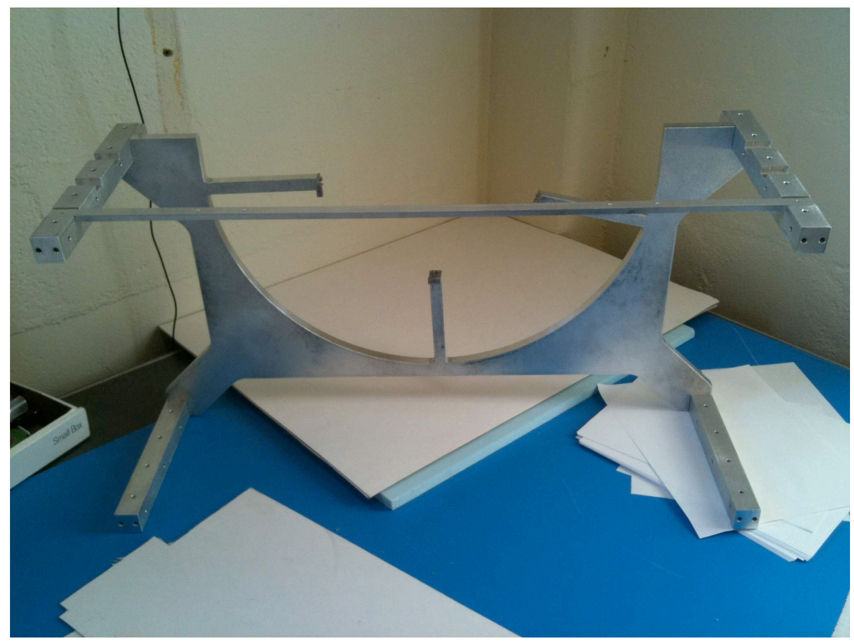
384 wedges distributed over 16 cooling plates



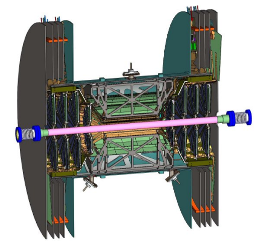
Disk Assembly Fixture

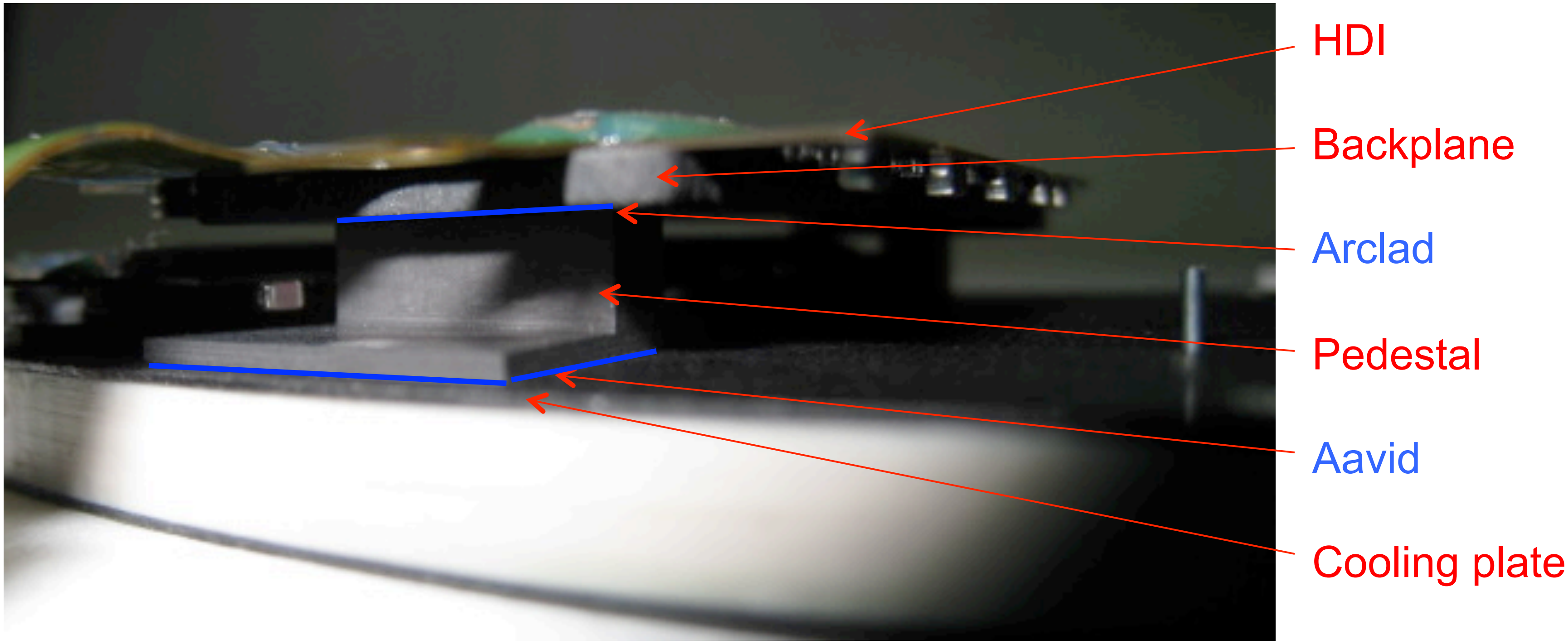
Permits safe handling, orientation and storage of disk for: wedge and cable attachment; electronic testing; metrology; and transportation to cage.





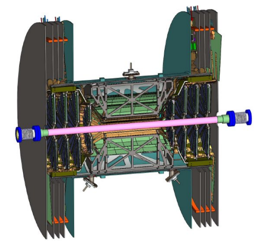
Thermal grease



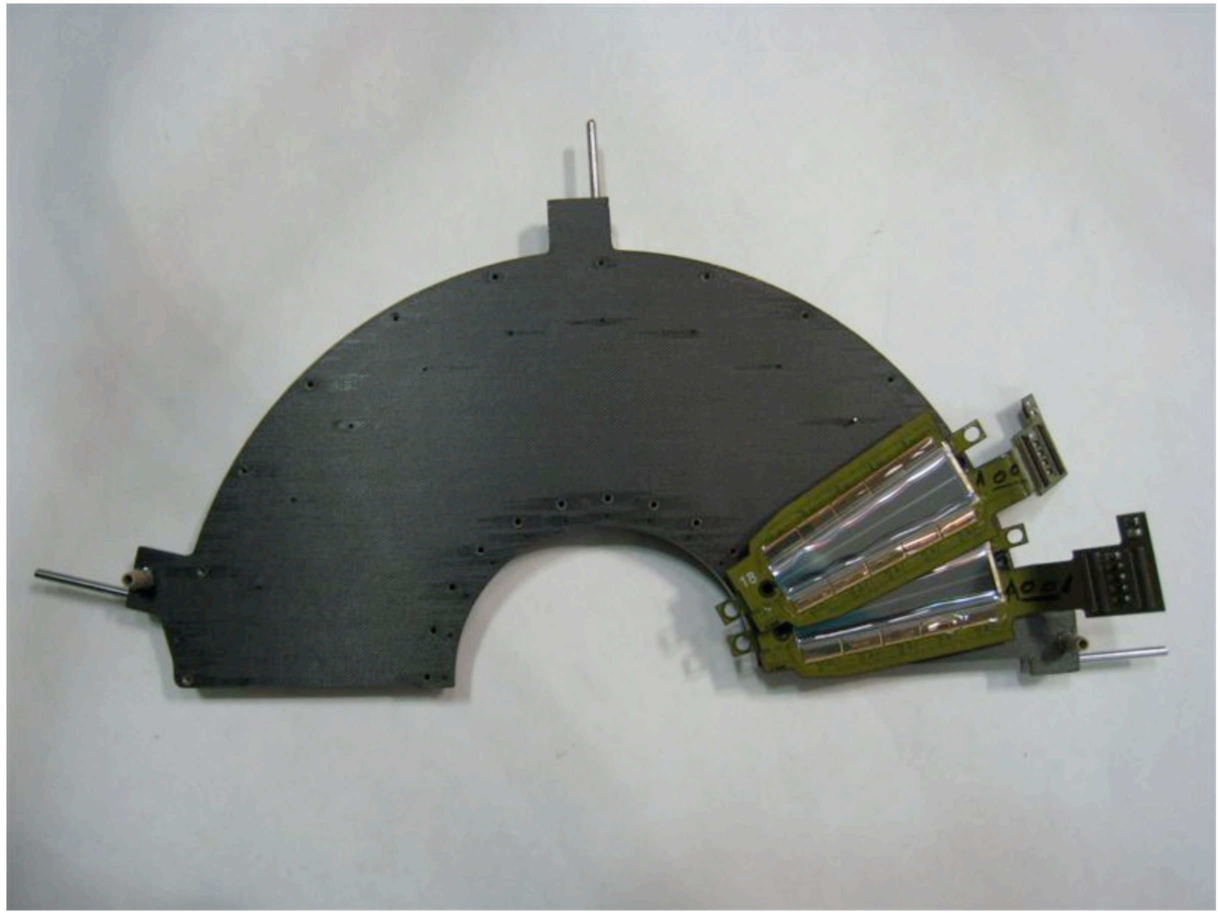


Standard Aavid product used to ensure good thermal conduction between thermal pedestal and cooling plate.

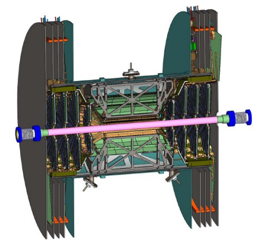
Attach wedges to cooling plates



Two small wedges fitted to a small cooling plate, in test fit at LBNL.



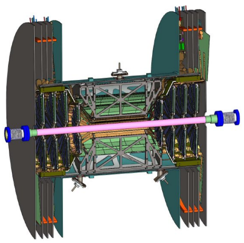
Test wedges; treat disk as a system



Concern: digital cross-talk and noise due to interactions between neighboring wedges

Method: send clocks to as many wedges on a disk as possible, and read out selected wedges; look for changes as a function of turning on/off other wedges; can test validity of grounding assumptions

Disk Metrology

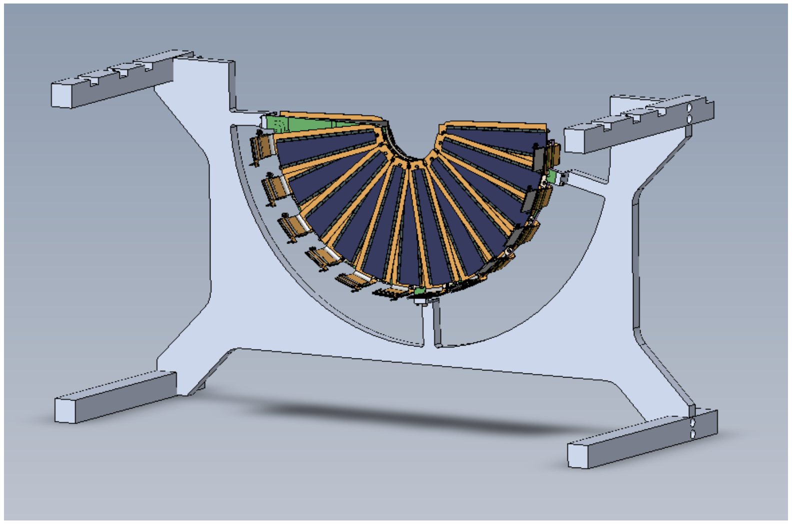


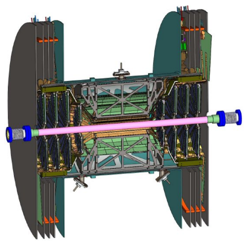
Goal is to locate the 24 sensors (and their many strips) on a disk to within 10 microns in *x* and *y*

Hexagon Metrology (R.I.) has suitable 5-axis CMM with switchable stylus and camera capabilities; 5 micron resolution

Stylus will locate three survey monuments on perimeter of the disk – establish coordinate system

Camera will locate reference marks on sensors; both sides of disk will be done at once



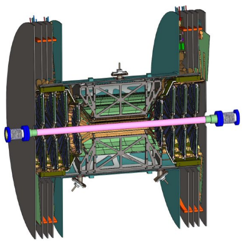


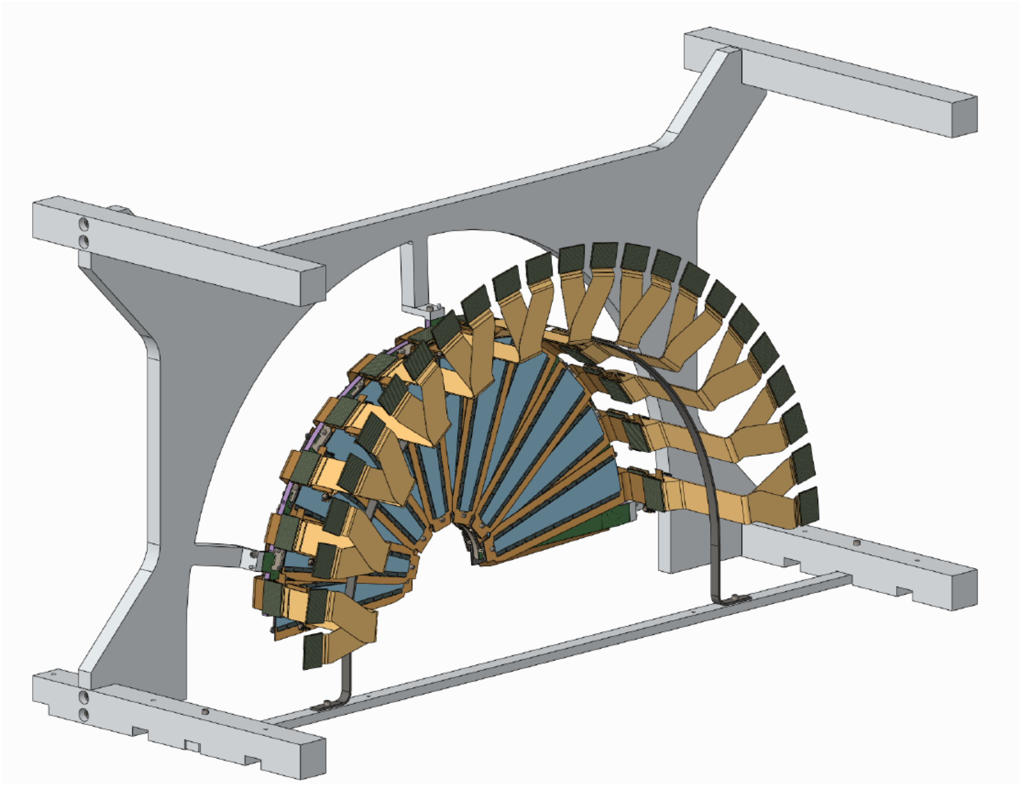
Assemble Disks into Cages

- Attach bias & signal cables to wedges
- Attach thermocouples and cooling lines to the disk
- Place Disk in Cage
- Electronic Tests of Disks in Cage

16 disks placed into a total of 4 cages

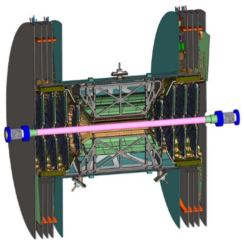
Attach bias & signal cables to wedges

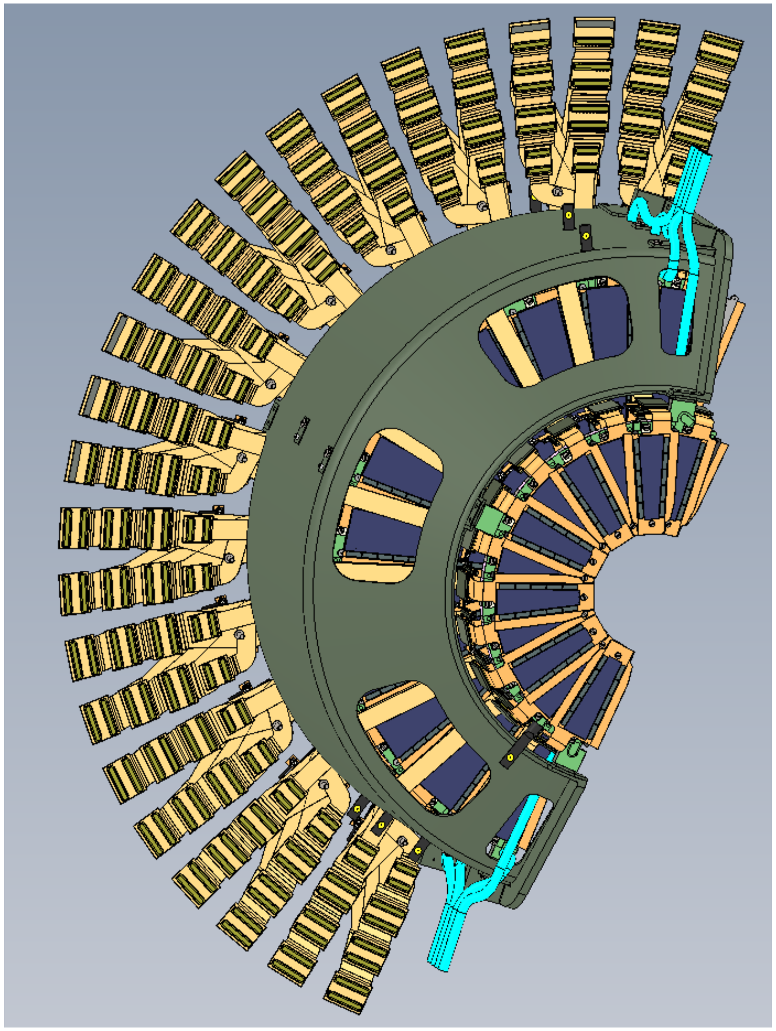




Bias and signal cables are held in place by hoop (and string) in preparation for placement in the cage and attachment to the ROCs.

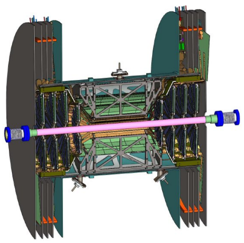
Attach thermocouples and cooling lines



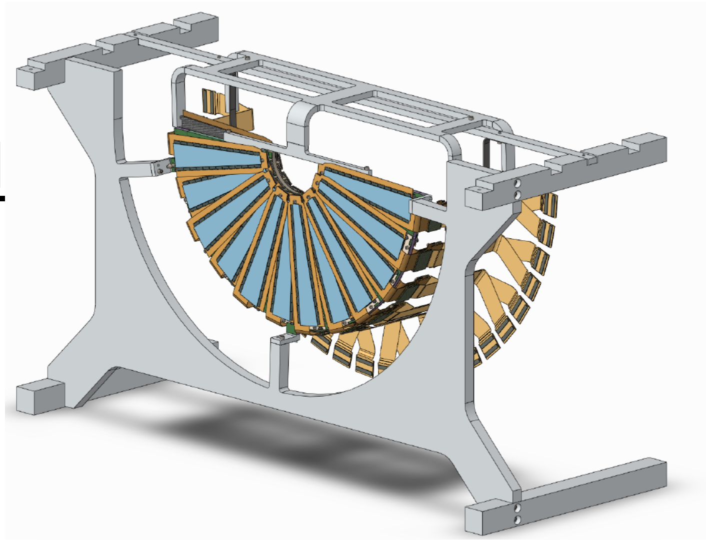


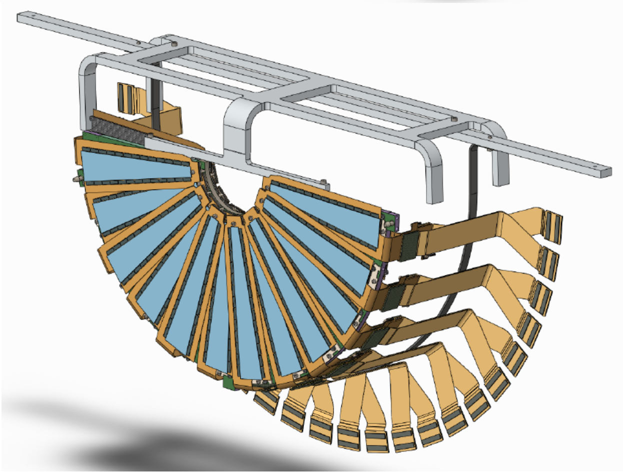
Cooling lines and thermocouple wires will need to be fed through the openings in the cage (see blue cooling lines in the figure, for example), so must be attached to disks before placement in cage.

Thermocouples are attached near cooling inlet and outlet points on each disk.

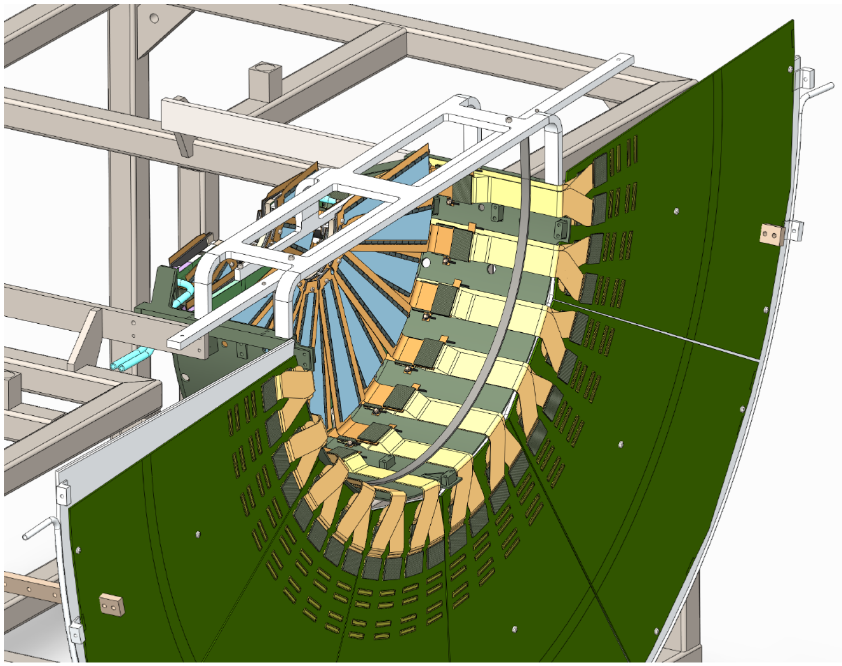


Place Disk in Cage

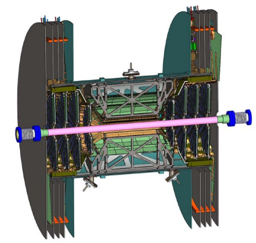
1 

2 

1. Attach carrier to disk
2. Lift disk up
3. Place disk in cage

3 

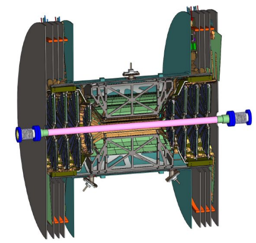
Electronic Tests of Disks in Cage



Similar concern as with disks: digital cross-talk and noise due to interactions between neighboring wedges

Similar method: send clocks to as many wedges in a cage as possible, and read out selected wedges; look for changes as a function of turning on/off other wedges; can test validity of grounding assumptions

For testing of a cage, realistic power supplies and cooling must be employed due to the large number of wedges involved.

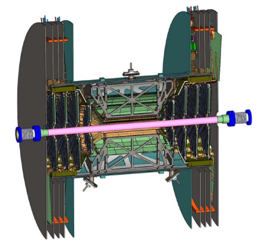


Cage Metrology

- Disks have survey monuments; same ones used in disk metrology
- Cage has survey monuments too
- BNL has brand new 5-axis CMM with stylus capability
- Locate disks in cage to high precision

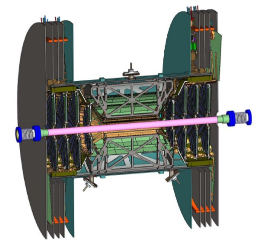
This capability did not exist at the beginning of the project, so the precision now available for this step far exceeds what we had in mind earlier (theodolite survey).

Schedule



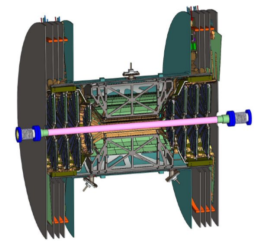
- Detailed schedule of detector assembly sub-tasks has been developed based on a few assumptions
  - Time for bending, testing, attaching wires and thermal mounts for 24 wedges is 2 weeks; this becomes 1 week later in the schedule
  - Time for assembling and testing a disk is 2 weeks; this becomes 1 week later in the schedule
  - Time for assembling and testing the first cage is 4 weeks; 3 weeks for next three cages
  - Have enough people so that some tasks can be in parallel to each other (bending || attaching || disk assembly)
  - As we presently only have one disk test stand at BNL, the schedule assumes disks are assembled and tested in series; a 2nd disk test stand can be provided along with more people as well
  - Cages are assembled and tested in parallel with disks; assumes creation of test stand at BNL for cages (to be done)

Schedule



Activity Name	Duration (Days)	Start Date	Finish Date
FVTX Assembly	232.00	7/9/10	6/9/11
1st Small Disk...	53.00	9/10/10	11/23/10
2nd Small Disk...	33.00	11/3/10	12/21/10
3rd Small Disk...	36.00	11/5/10	1/5/11
4th Small Disk...	41.00	11/5/10	1/12/11
Disk Metrology...	129.00	7/9/10	1/17/11
1st Large Disk (Station 2)...	68.00	11/5/10	2/18/11
2nd Large Disk (Station 3)...	22.50	2/2/11	3/4/11
3rd Large Disk (Station 4)...	25.00	2/7/11	3/11/11
2nd Set; 3 Large Disks to Hexagon Metrology...	3.00	3/14/11	3/16/11
Extension Cables: Order-to-delivery...	65.00	9/7/10	12/8/10
1st Cage with Disks...	77.00	12/15/10	4/8/11
4th Large Disk (Station 2)...	27.50	2/9/11	3/18/11
5th Large Disk (Station 3)...	30.00	2/14/11	3/25/11
6th Large Disk (Station 4)...	32.50	2/16/11	4/1/11
3rd Set; 3 Large Disks to Hexagon Metrology	3.00	4/4/11	4/6/11
2nd Cage with Disks...	64.00	1/31/11	4/28/11
7th Large Disk (Station 2)...	35.00	2/21/11	4/8/11
8th Large Disk (Station 3)...	37.50	2/23/11	4/15/11
9th Large Disk (Station 4)...	40.00	2/28/11	4/22/11
4th Set; 3 Large Disks to Hexagon Metrology	3.00	4/25/11	4/27/11
3rd Cage with Disks...	16.00	4/28/11	5/19/11
10th Large Disk (Station 2)...	42.50	3/2/11	4/29/11
11th Large Disk (Station 3)...	45.00	3/7/11	5/6/11
12th Large Disk (Station 4)...	47.50	3/9/11	5/13/11
5th Set; 3 Large Disks to Hexagon Metrology	3.00	5/16/11	5/18/11
4th Cage with Disks...	16.00	5/19/11	6/9/11

People



<u>Onsite (now)</u>

Christine Aidala (LANL fellow); Jeongsu Bok (UNM student); Robert Pak (BNL); Elaine Tennant (NMSU student); Michal Tomasek (IPAS Prague); Feng Wei (NMSU postdoc)

<u>Onsite (soon)</u>

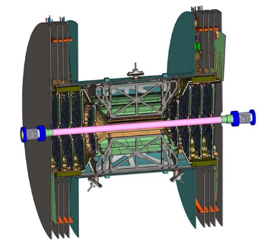
James Bowen (ISU student); Abraham Meles (NMSU student); Jiri Popule (IPAS Prague)

<u>Onsite (in the works)</u>

another postdoc, another student

<u>Will cycle in and out:</u> various senior persons from Columbia, LANL, NMSU, & UNM.

Effort fully supported by BNL PHENIX Technical Staff.



Summary

Start of detector assembly greatly delayed by HDI production – but now we have started!

Schedule of tasks understood and planned.

Team in place onsite to push detector assembly forward.

First disk to be assembled in November 2010; last cage finished in June 2011.