HFT Software – Update on activities

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Topics

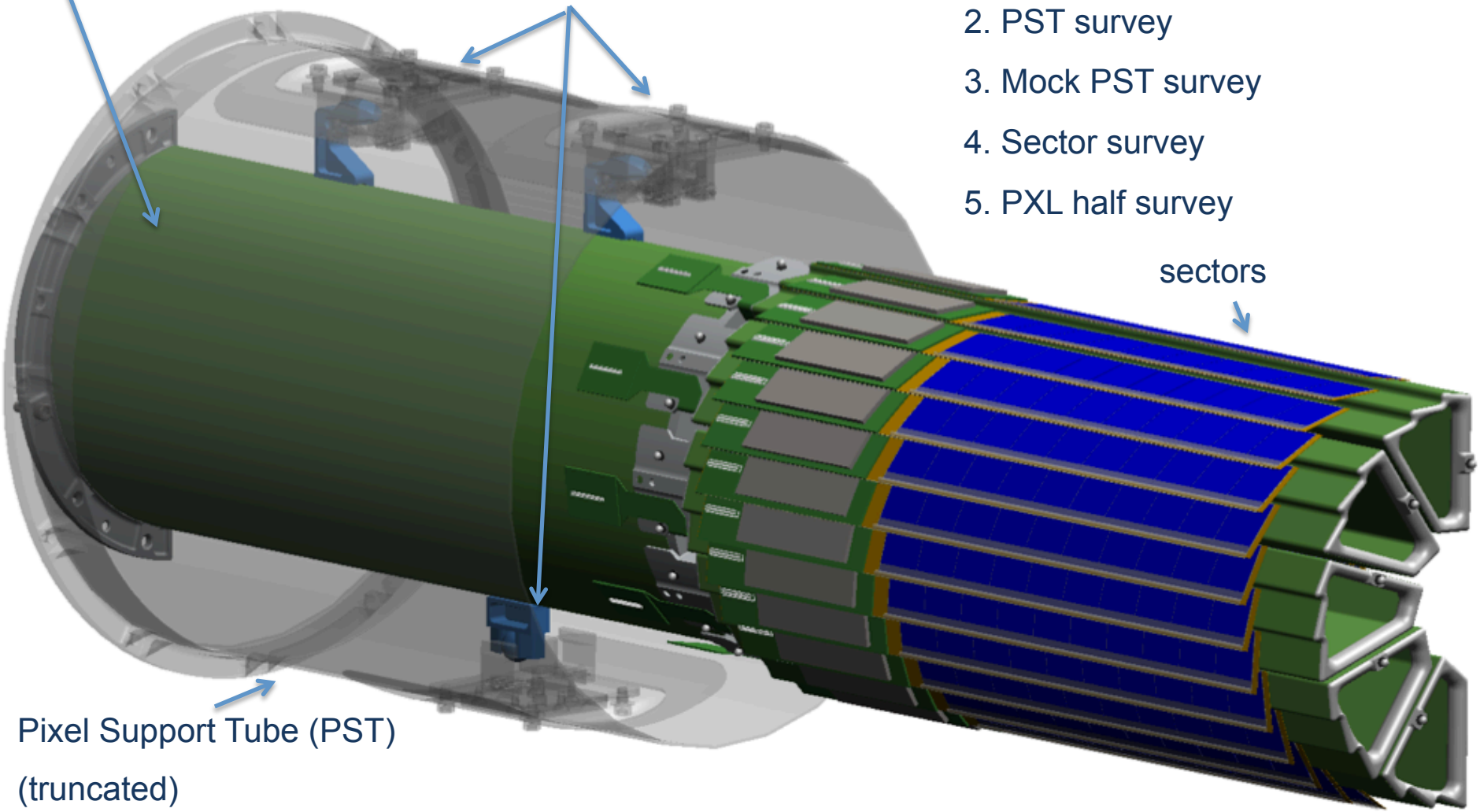
- Survey of detectors
- Alignment work
- Geometry modeling
- Offline chain in STAR

Qiu Hao (LBL)

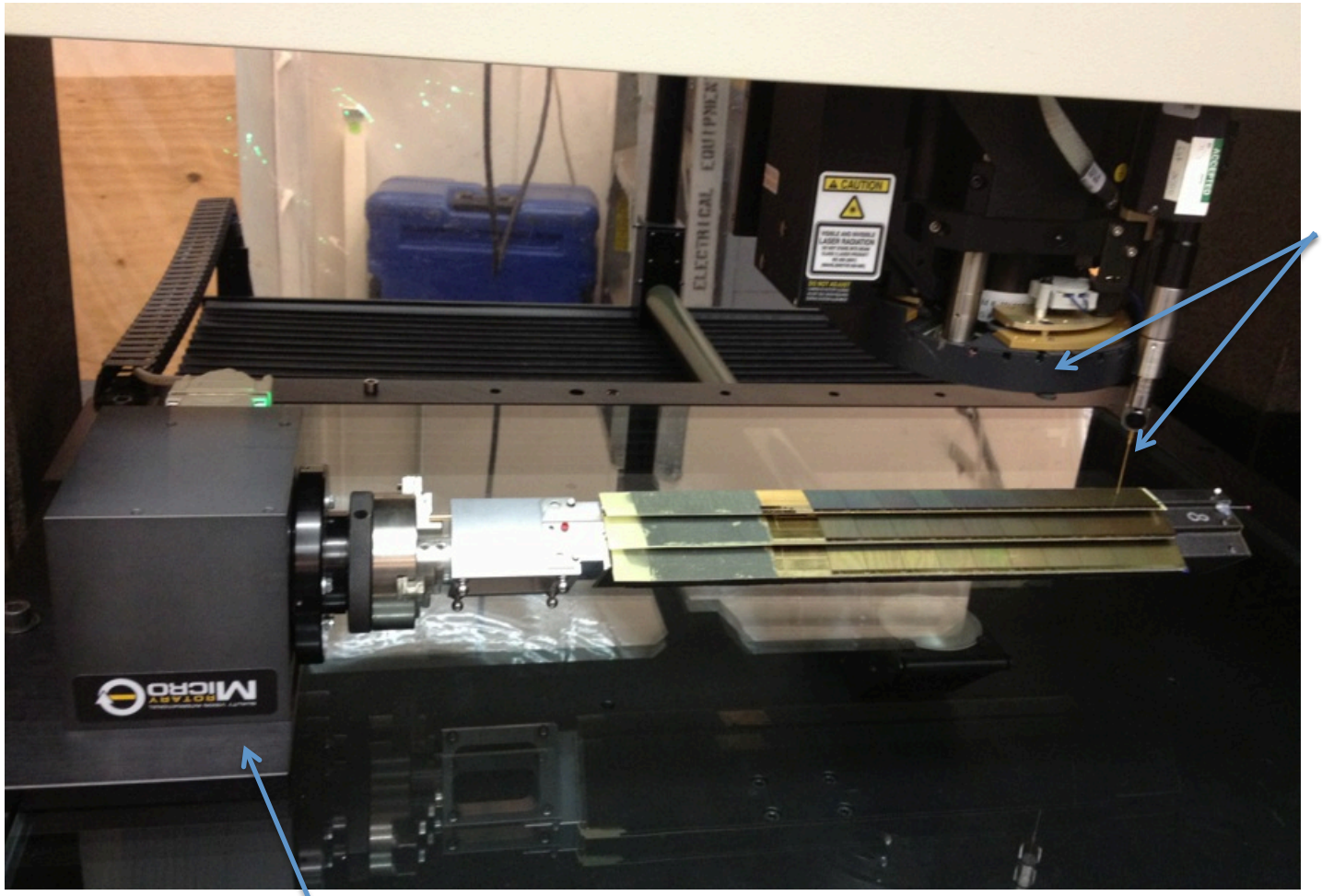
Overall Survey Plan

Steps:

1. Kinematic mounts survey
2. PST survey
3. Mock PST survey
4. Sector survey
5. PXL half survey



Test Sector Survey Set-up

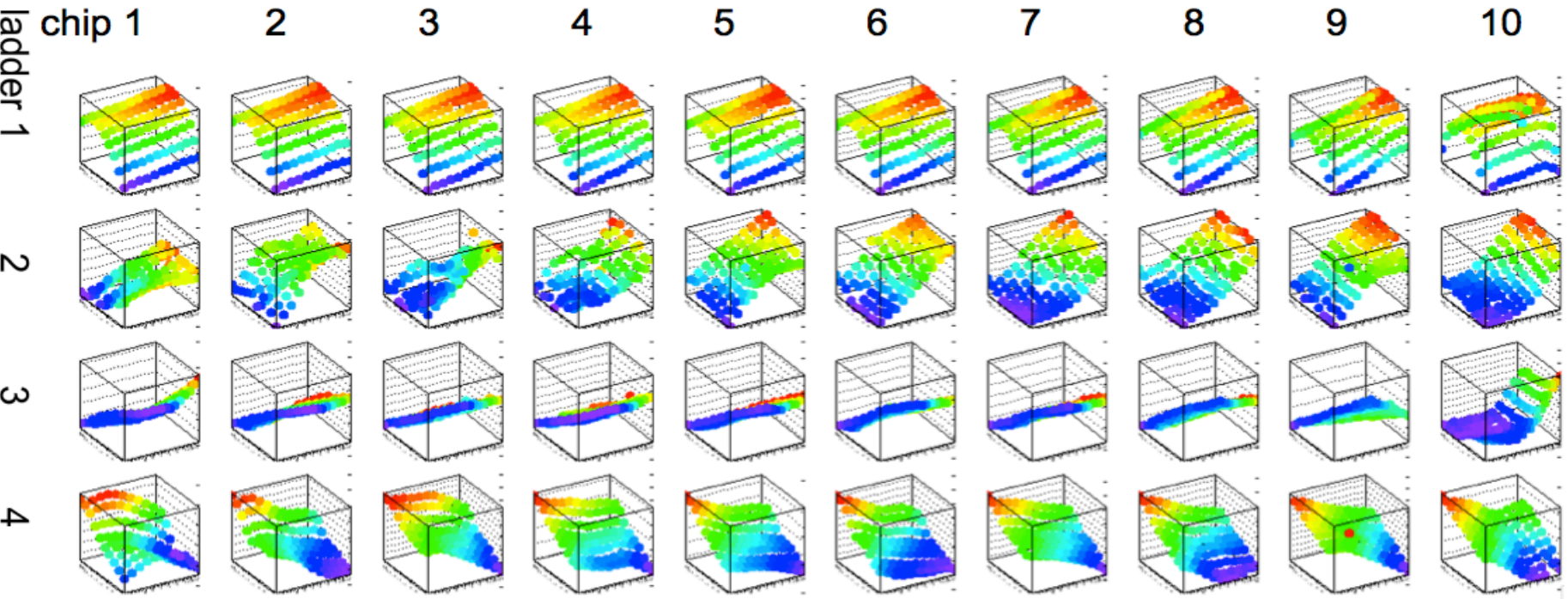


vision and stylus probes, both with μm level precision

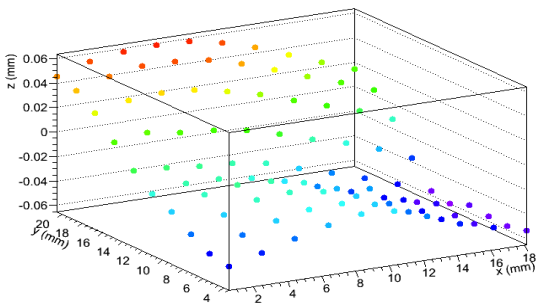
A Coordinate Measuring Machine (CMM) is used.

In order to probe different ladder surfaces, the rotary head rotates the sector to different angles

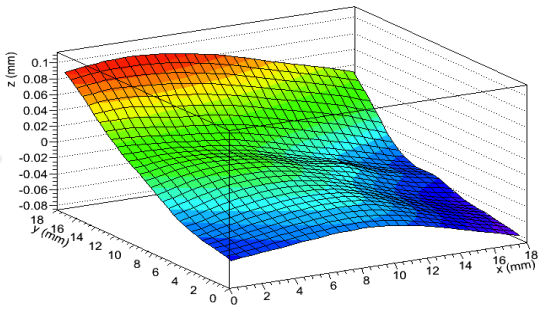
Test Sector Survey Results

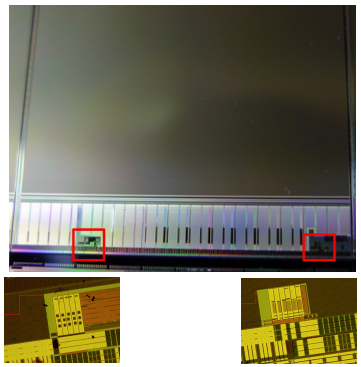


- 11 × 11 measurements on each chip, more than 5000 steps, ~10 hours in all
- ~1 hour with some manual work, the rest is automatic
- a maximum variation of 200 μm >> position resolution of the PXL detector
- repeatable within 30 μm, mostly within 10 μm



TPS





Survey Summary

- PXL in good shape, SSD/IST in the works (less demanding)
- Some issues with repeatability, stability vs Temp. or handling
  - Possible use of laser probe
- Interface with Offline alignment in the works
- Waiting for prototypes to measure (~January)

Alignment

- Procedures established and reviewed
- We now have a fully functioning alignment environment, including the PXL, IST and SSD detectors based on Yuri et al. SVT/SSD work
- Simple tests (by hand) are done
- We plan to use the chain for Run-13 alignment, then think of upgrades

PXL sectors

PXL Halve 1/2 ALL

IST SSD

Test Results

FIXED ALL+Vertex– MEDIUM STATS

dX mkm	dY mkm	dZ mkm	alpha mrad	beta mrad	gamma mrad	Comment
57.27+-23.28	-1.21+- 1.01	-36.58+-30.43	-0.00+- 0.01	-0.04+- 0.05	0.04+- 0.04	Average for PXL Sector 1
3.83+- 2.65	-1.41+- 1.85	61.27+-28.01	0.06+- 0.04	-0.03+- 0.05	0.01+- 0.04	Average for PXL Sector 2
-1.03+- 0.72	2.31+- 2.20	54.55+-28.16	-0.05+- 0.02	0.02+- 0.01	0.01+- 0.08	Average for PXL Sector 3
3.24+- 0.71	6.10+- 2.96	23.03+-27.66	0.03+- 0.02	0.01+- 0.01	-0.15+- 0.15	Average for PXL Sector 4
-1.39+- 2.31	-2.23+- 1.51	6.69+-26.02	0.00+- 0.02	-0.03+- 0.04	-0.13+- 0.07	Average for PXL Sector 5
1.71+-23.40	-0.07+- 0.92	-12.20+-30.05	-0.00+- 0.01	0.02+- 0.05	-0.08+- 0.04	Average for PXL Sector 6
		22.60+-29.45		0.02+- 0.05	0.04+- 0.04	Average for PXL Sector 7
-0.36+- 0.65	-0.95+- 2.21	52.58+-33.04	0.04+- 0.02	-0.00+- 0.01	0.03+- 0.08	Average for PXL Sector 8
	3.85+- 2.84	6.80+-29.28	0.01+- 0.02	-0.01+- 0.01	-0.02+- 0.15	Average for PXL Sector 9
-0.24+- 2.56			-0.00+- 0.03	0.04+- 0.05	0.07+- 0.08	Average for PXL Sector 10
	-3.70+- 0.84	18.69+-12.02	-0.01+- 0.01	0.01+- 0.01	0.03+- 0.02	Average for PXL - Shell 1
2.56+- 0.56	-1.70+- 0.82	14.95+-12.59	-0.01+- 0.01	-0.00+- 0.01	-0.07+- 0.02	Average for PXL - Shell 2
3.42+- 0.39	-1.94+- 0.53	15.57+- 8.72	-0.01+- 0.00	0.01+- 0.00	-0.03+- 0.01	Average for All PXL
-9.34+- 1.24	6.95+- 1.27	11.47+- 9.85	-0.01+- 0.00	-0.00+- 0.00	-0.00+- 0.01	Average for All Ist
-5.90+- 1.16	5.65+- 1.24	3.47+- 7.88	-0.00+- 0.00	0.00+- 0.00	-0.02+- 0.01	Average for All Ssd

- Statistics matter (up to a point)
- Averages come from several histo fits

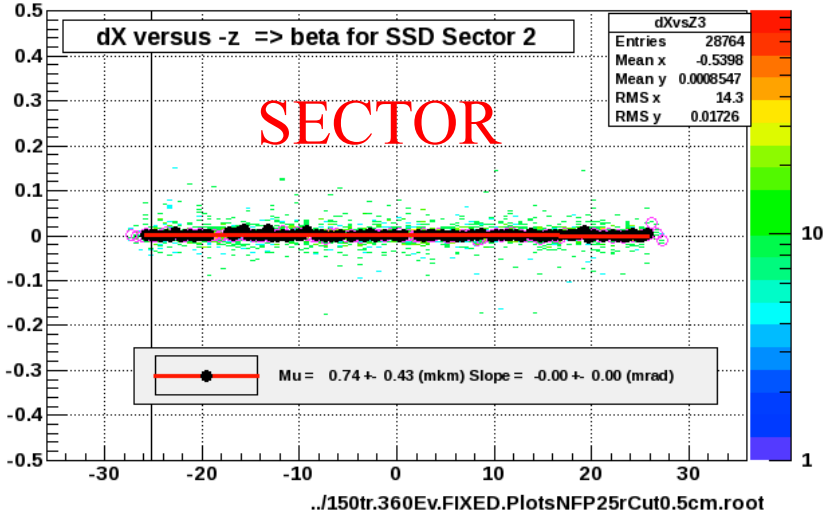
Test Results

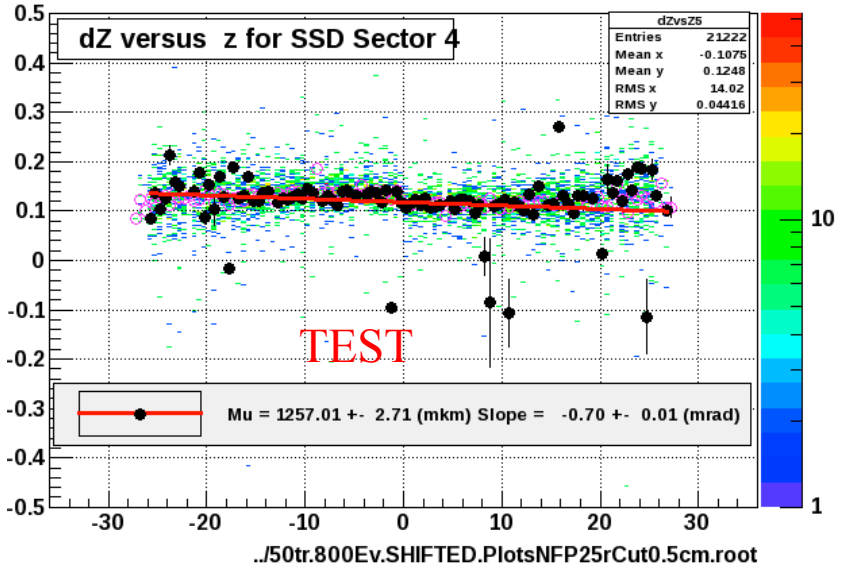
FIXED – MED STATS

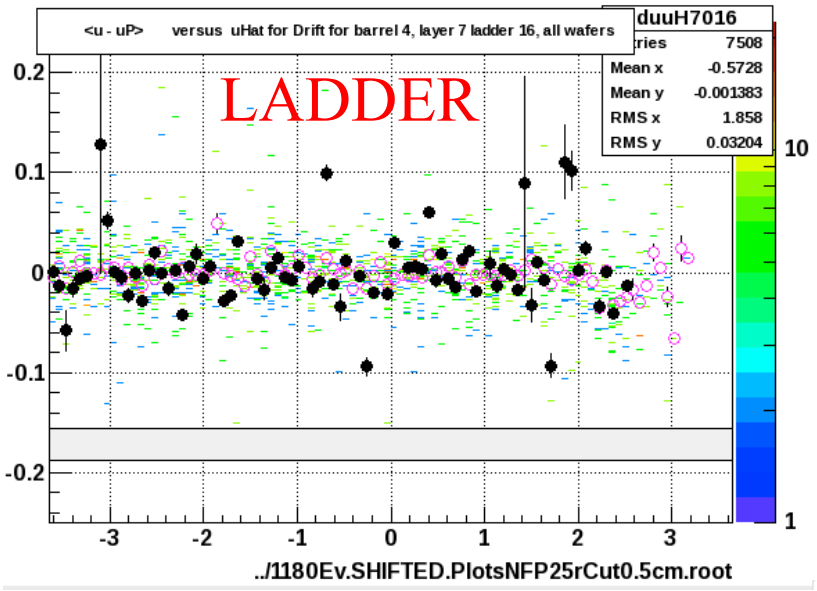
dX mkm	dY mkm	dZ mkm	alpha mrad	beta mrad	gamma mrad	Comment
						../star_institutions_ksu_bouchet_RUNSVT_PXL_PRODPlotsNFP25rCut
0.00+- 0.00	0.00+- 0.00	0.00+- 0.00	0.00+- 0.00	0.00+- 0.00	0.00+-935.77	LSF/Sum Over PXL Shell 2
-5.65+-10.65A				0.01+- 0.02A		dXvsZ_1/dX versus -z => beta for PXL Half 2
	-37.26+-19.03A		-0.09+- 0.01A			dYvsZ_1/dY versus z => alpha for PXL Half 2
		24.76+-17.82A				dZvsZ_1/dZ versus z for PXL Half 2 slope = -1.33+- 0.04
1.49+- 0.64A						dX4dx_1/dX vs -1+jx*vx => dx for PXL Half 2
	-3.07+- 2.41A					dX4dy_1/dX vs jx*vy => dy for PXL Half 2
			-0.18+- 0.06A			dX4da_1/dX vs jx*(-vy*z+vz*y)=> alpha for PXL Half 2
				0.02+- 0.01A		dX4db_1/dX vs -z+jx*(vx*z-vz*x)=> beta for PXL Half 2
			0.11+- 0.02A			dX4dg_1/dX vs y+jx*(-vx*y+vy*x)=> alpha for PXL Half 2
3.06+- 2.96A						dY4dx_1/dY vs jy*vx => dx for PXL Half 2
	-5.19+- 1.29A					dY4dy_1/dY vs -1+jy*vy => dy for PXL Half 2
			-0.05+- 0.02A			dY4da_1/dY vs z+jy*(-vy*z+vz*y)=> alpha for PXL Half 2
				-0.13+- 0.06A		dY4db_1/dY vs jy*(vx*z-vz*x)=> beta for PXL Half 2
					-0.02+- 0.04A	dY4dg_1/dY vs -x+jy*(-vx*y+vy*x)=> gamma for PXL Half 2
			0.19+- 0.06A			dZ4da_1/dZ vs -y+jz*(-vy*z+vz*y)=> alpha for PXL Half 2
				-0.08+- 0.06A		dZ4db_1/dZ vs x+jz*(vx*z-vy*x)=> beta for PXL Half 2
					-0.09+- 0.17A	dZ4dg_1/dZ vs jz*(-vx*y+vy*x)=> gamma for PXL Half 2
1.54+- 0.63	-4.84+- 1.13	24.76+-17.82	-0.03+- 0.01	0.01+- 0.01	-0.02+- 0.04	Average for PXL - Shell 2

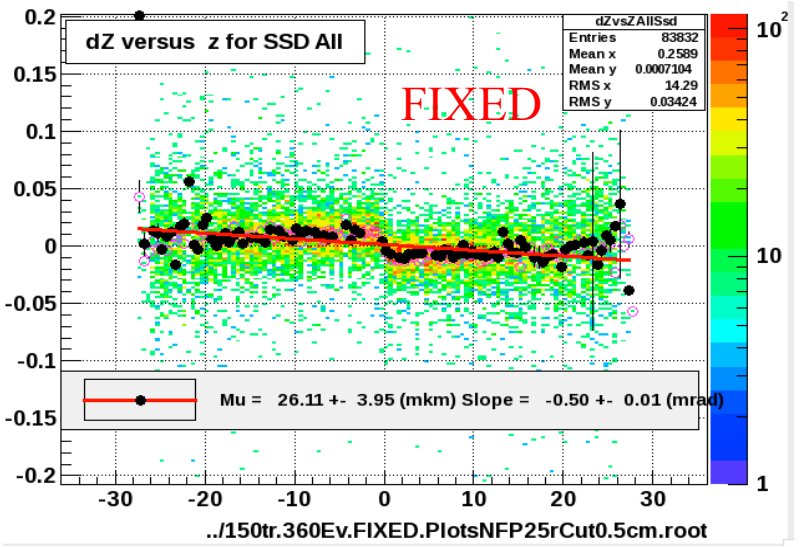
- Averages result from several fits

Results


dX versus -z => beta for SSD Sector 2
dXvsZ3
Entries 28764
Mean x -0.5398
Mean y 0.0008547
RMS x 14.3
RMS y 0.01726
SECTOR
Mu = 0.74 +- 0.43 (mkm) Slope = -0.00 +- 0.00 (mrad)
../150tr.360Ev.FIXED.PlotsNFP25rCut0.5cm.root


dZ versus z for SSD Sector 4
dZvsZ5
Entries 21222
Mean x -0.1075
Mean y 0.1248
RMS x 14.02
RMS y 0.04416
TEST
Mu = 1257.01 +- 2.71 (mkm) Slope = -0.70 +- 0.01 (mrad)
../50tr.800Ev.SHIFTED.PlotsNFP25rCut0.5cm.root


<u - uP> versus uHat for Drift for barrel 4, layer 7 ladder 16, all wafers
duuH7016
Entries 7508
Mean x -0.5728
Mean y -0.001383
RMS x 1.858
RMS y 0.03204
LADDER
../1180Ev.SHIFTED.PlotsNFP25rCut0.5cm.root


dZ versus z for SSD All
dZvsZAllSsd
Entries 83832
Mean x 0.2589
Mean y 0.0007104
RMS x 14.29
RMS y 0.03424
FIXED
Mu = 26.11 +- 3.95 (mkm) Slope = -0.50 +- 0.01 (mrad)
../150tr.360Ev.FIXED.PlotsNFP25rCut0.5cm.root

Alignment summary

- We have a chain for Run-13 alignment
- Need to establish a VMC application for detailed studies/debugging
- Need to change the starting point from ideal to surveyed geometry
  - work started
  - one of the goals of the engineering run

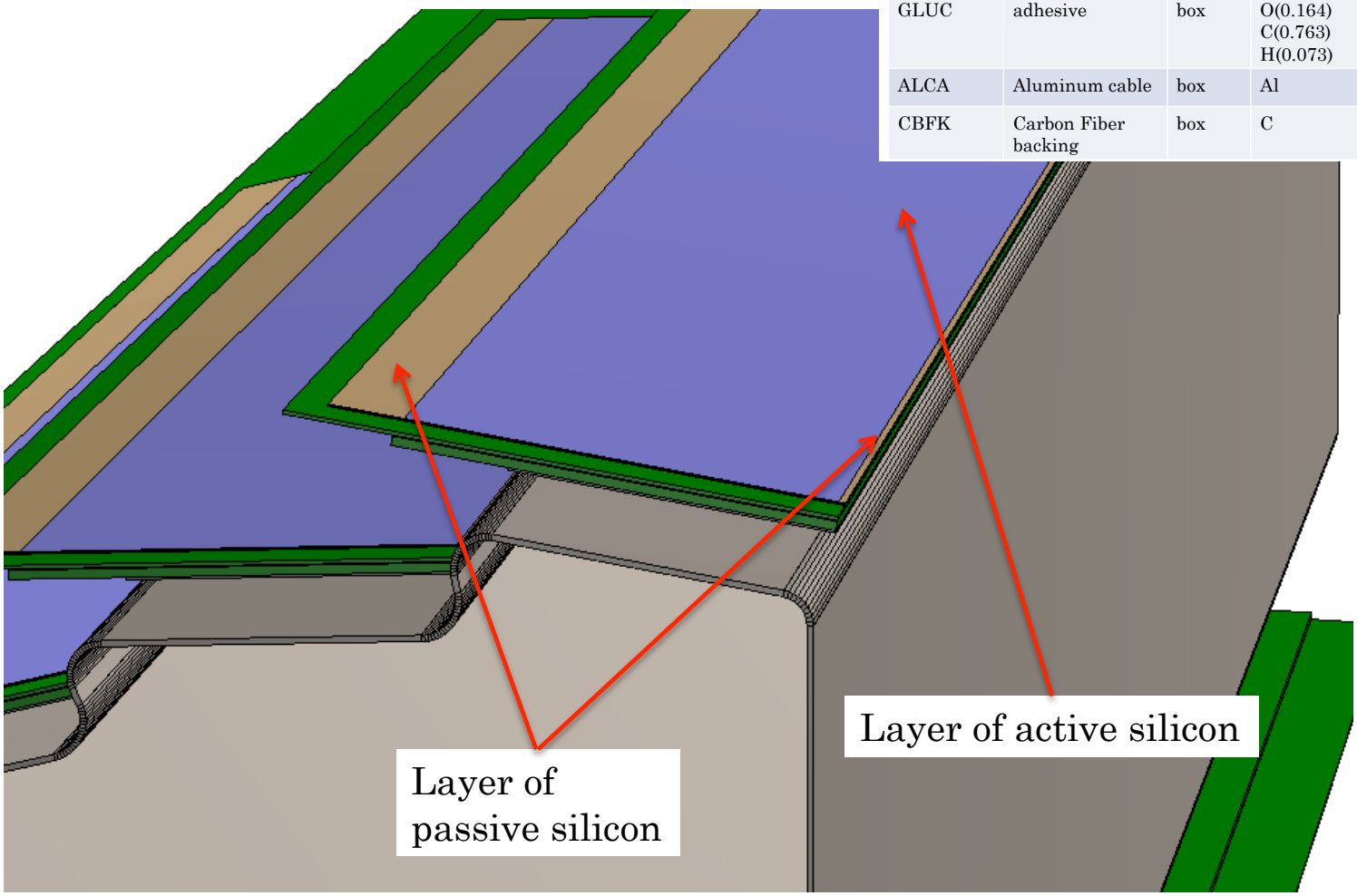
Geometry

- We have a rather detailed Geant model for Run-13 and Run-14
- Work in putting dead material in progress
- In AGML (thanks Jason for invaluable help)

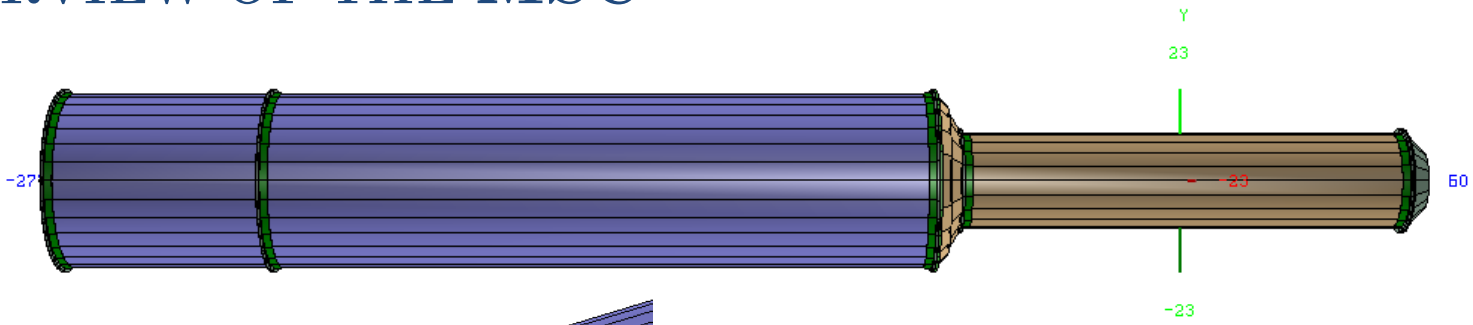
PXL sector modeling in GEANT

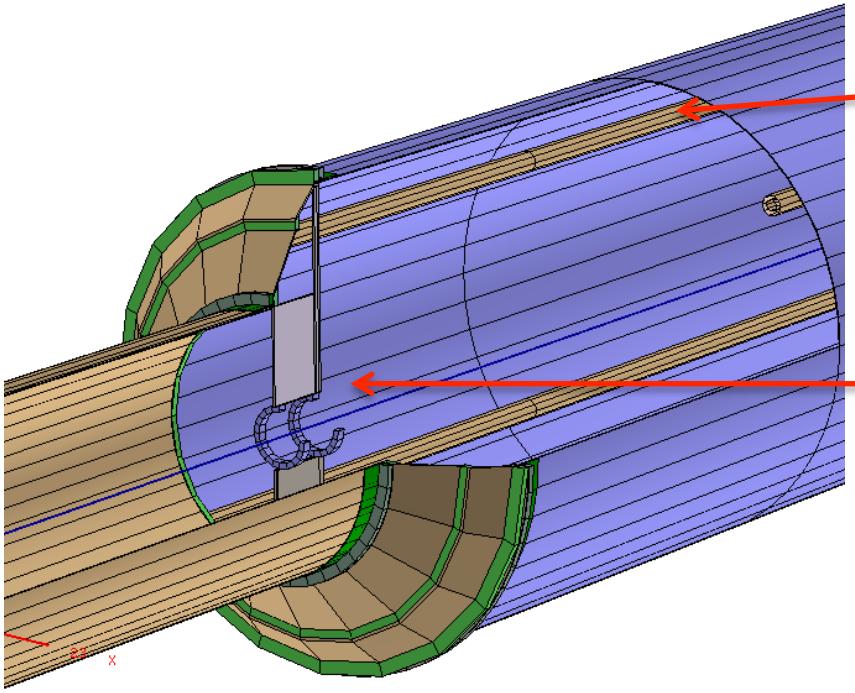
SUMMARY OF MATERIAL BUDGET

GEANT NAME	piece	shape	Composition / mixture	Radiation length [cm]	Density[g/cm^3]
PLAC	Silicon active	box	Si	9.36	2.33
SIFR	Silicon passive	box	Si	9.36	2.33
SIFL	Silicon passive	box	Si	9.36	2.33
GLUA	adhesive	box	O(0.164) C(0.763) H(0.073)	34.7	1.2(*)
GLUB	adhesive	box	O(0.164) C(0.763) H(0.073)	34.7	1.2(*)
GLUC	adhesive	box	O(0.164) C(0.763) H(0.073)	34.7	1.2(*)
ALCA	Aluminum cable	box	Al	23.7(*)	2.7(*)
CBFK	Carbon Fiber backing	box	C	68(*)	1.3(*)



Overview of the MSC





rails

Rings surroundings the beam pipe

•: temporary until implementation of real material (slide 39)

GEANT NAME	piece	Composition / mixture	Radiation length	density
ALL(*)	Carbon Fiber	C	23.9	1.3(*)

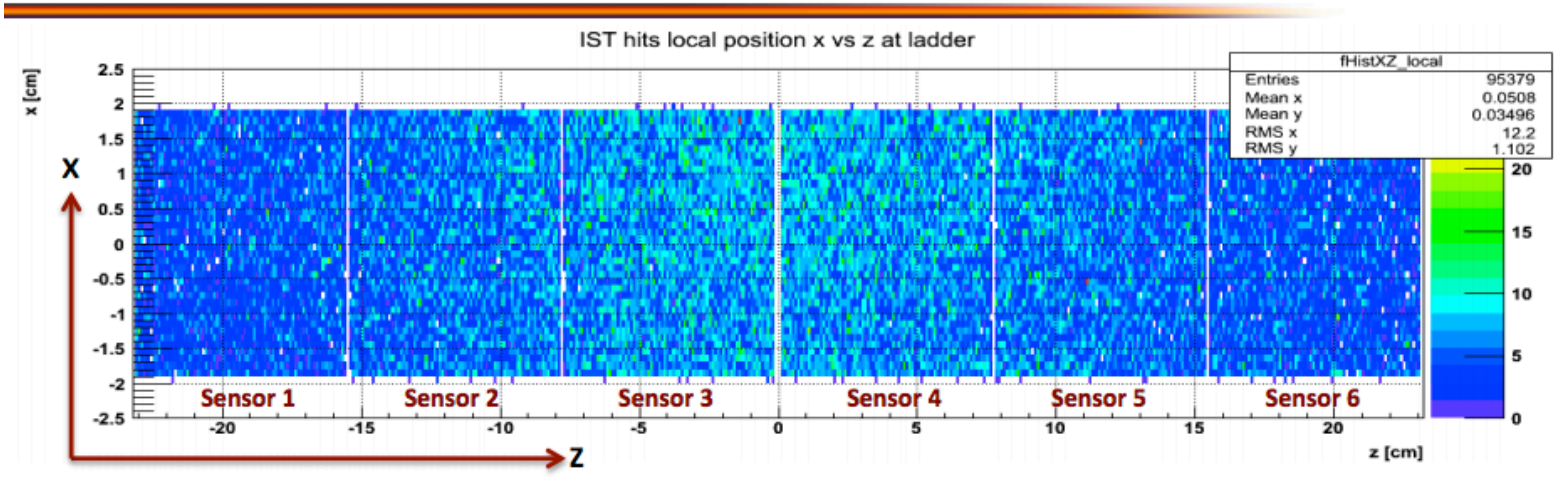
IST

Part name	Material (currently used in geometry)
CFoam	Carbon
Choneycomb	Carbon fibre reinforced plastics (CFRPMix)
CF Skin	Carbon fiber
Kapton hybrid	G10
Cooling tube	Aluminium
Cooling liquid	Water
Endcap	Delrin
Support ring block	Delrin
Transition board	G10
T-Board connector	Delrin
Sensor active area	Silicon (sensitive)
Sensor dead area	Silicon (passive)
APV chips	Silicon (passive)

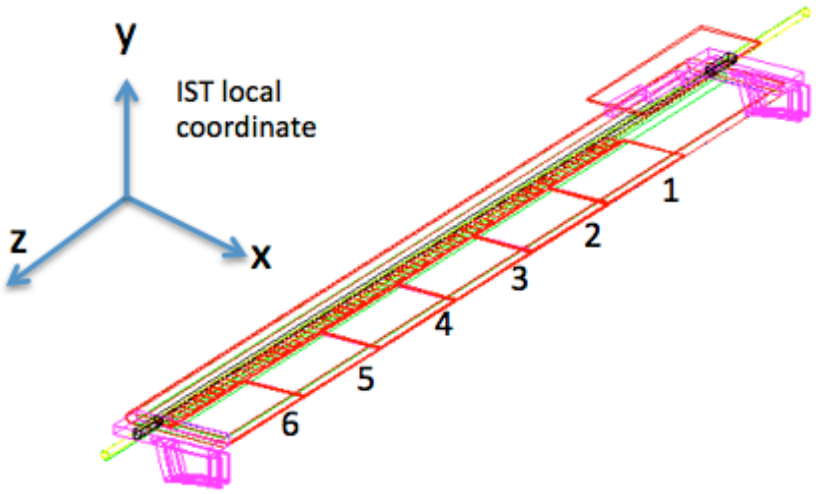
- IST geometry vastly improved (geant modeling)
- Details can be found e.g. here:

http://drupal.star.bnl.gov/STAR/system/files/istGeometryUpdate_20121019.pdf

New IST geometry – local position check



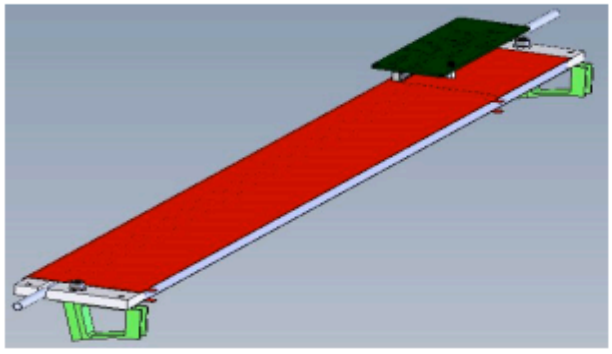
New geometry for IST (AgML) – modeling



New geometry for IST stave:

gexec .$STAR_HOST_SYS/lib/xgeometry.so

draw IBAM 40 40 0 10 10 .4 .4

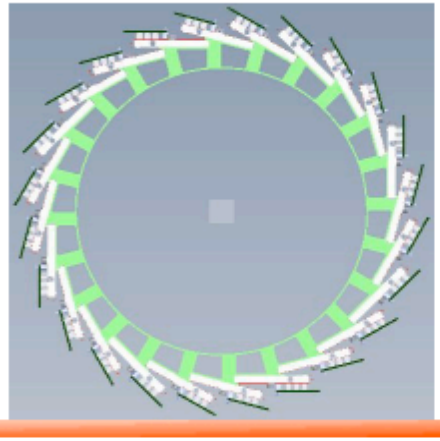


solidworks

New geometry for whole IST detector:

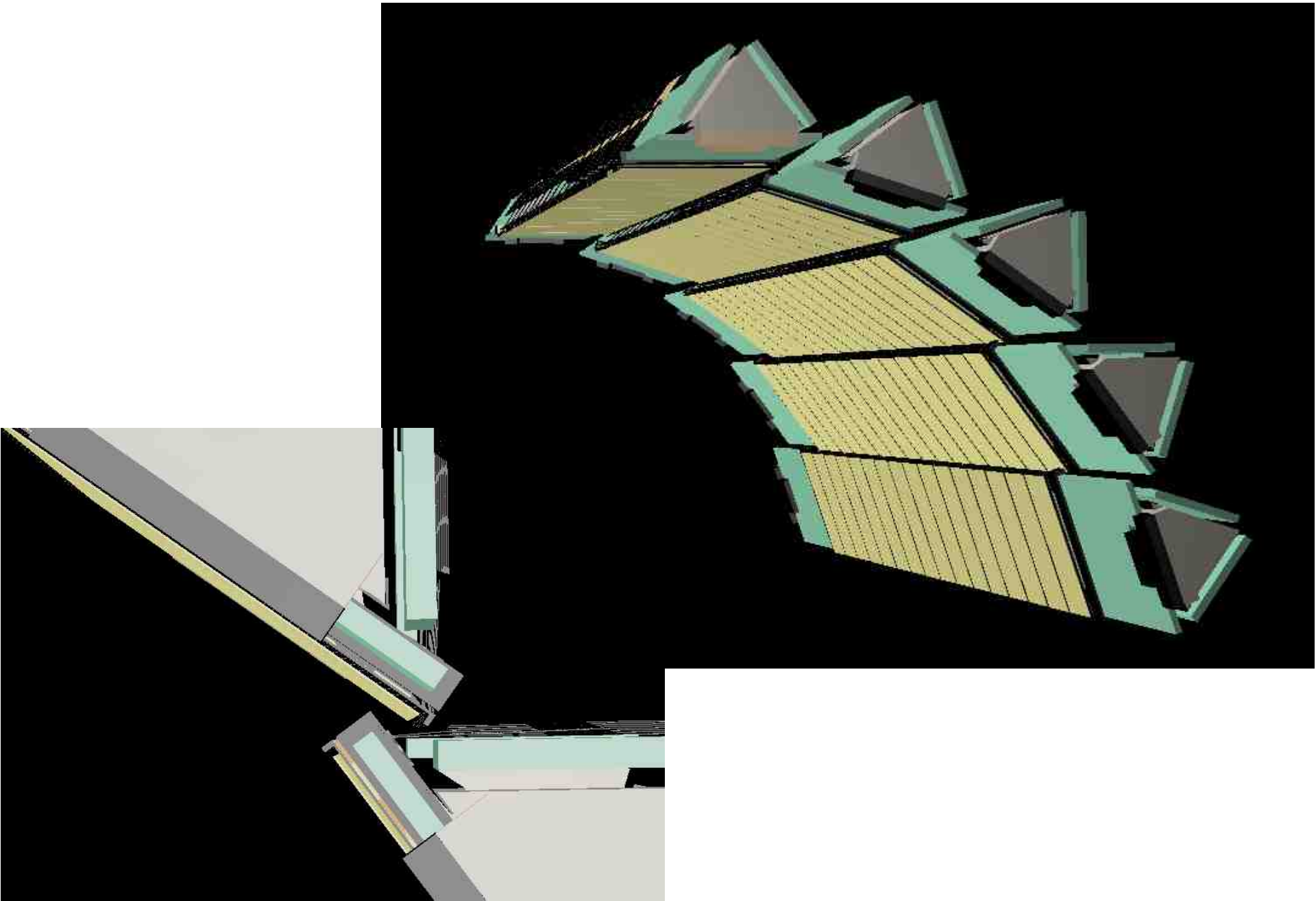
gexec .$STAR_HOST_SYS/lib/xgeometry.so

draw IBMO 0 90 0 10 10 .5 .5



solidworks

(Old) SSD reconfigured



HFT Offline code in STAR

- Just started moving on this
- We agreed to start with **Simulation** code, i.e. dev13 for this year's run and dev14 for next year
    - There are sort term goals (week[s]) and longer term (month[s]) goals
    - We have almost everything in private directories-people with Karma need to move them to final places
    - Make the move from StRndHit -> StHftHit structure
    - Modify chain downstream to accept changes
- Data chain less developed (modulo SSD that most of it exists)
    - Identifying missing modules and people to build them
        - PXL cluster/hit finder
    - online environment is detector deliverable
    - fast offline/QA chain not existing
    - engineering run + data will be the driving force to coalesce

- I will give more detailed reports on this in the near future