Software Update

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- Status Update
- Run-13 plans – priorities
- Summary

LEVEL-3 Milestones

Software			
3	Review of CMM software progress	4/5/12	5/17/12
3	Alignment software Review	9/20/12	10/12/2012
3	PXL CMM database delivered for prototype	11/15/12	11/15/12
3	PXL online software ready for engineering run	12/4/12	12/4/12
3	IST online software for ladder tests	1/13/13	1/13/13
3	Alignment software ready for engineering run	1/18/13	1/18/13
3	SSD online software complete	5/14/13	5/14/13
3	IST online software complete	7/24/13	7/24/13
3	IST CMM database delivered	8/17/13	8/17/13
3	PXL CMM database delivered for production sectors	8/22/13	8/22/13
3	PXL online software ready for production run	10/1/13	10/1/13

Activities since mid-Sept (LBL f2f)

- PXL Survey + related work (see also Hao's talk)
- IST Simulation environment –Geometry modeling
- HFT Geometry model – Run13 some update
- HFT Alignment studies
- HFT Offline

Survey/Alignment progress (see also Hao's talk)

- **PXL**:
  - Updated numbering document to include layer definitions
    http://drupal.star.bnl.gov/STAR/system/files/HFT_numbering_scheme_v5.pdf
  - **Initial work in clarifying interface Survey<->Alignment**
    http://drupal.star.bnl.gov/STAR/event/2012/10/19/hft-software/alignment-work
- **SSD/IST** coming up next (see Jim's/Gerrit's talks)

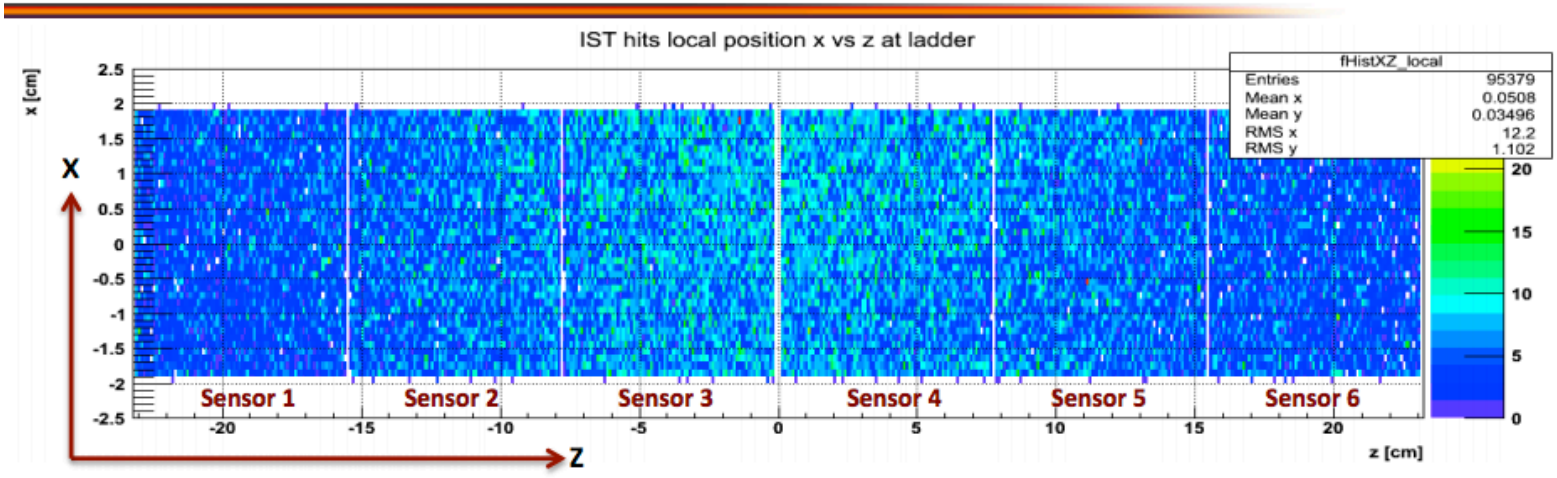
- IST Software

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)

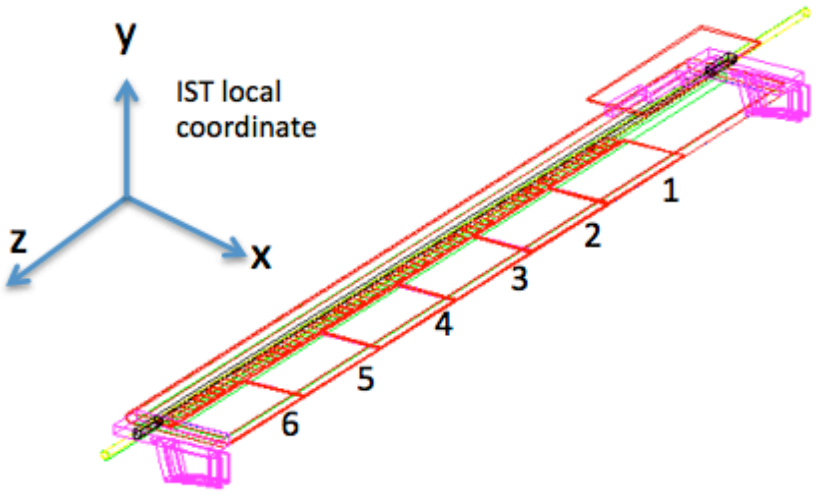
- Some work on the IST fast simulator already done
- IST geometry vastly improved (geant modeling)
- Details can be found e.g. here:

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

New IST geometry – local position check



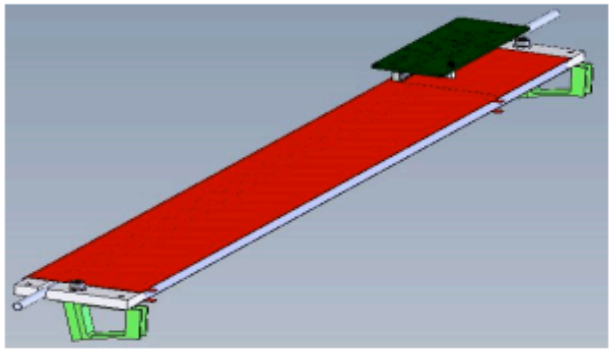
New geometry for IST (AgML) – modeling



New geometry for IST stave:

gexec .$STAR_HOST_SYS/lib/xgeometry.so

draw IBAM 40 40 0 10 10 .4 .4

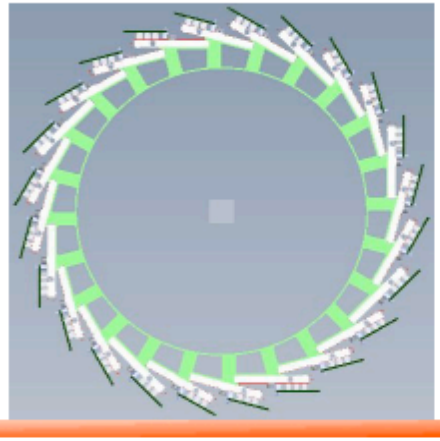


solidworks

New geometry for whole IST detector:

gexec .$STAR_HOST_SYS/lib/xgeometry.so

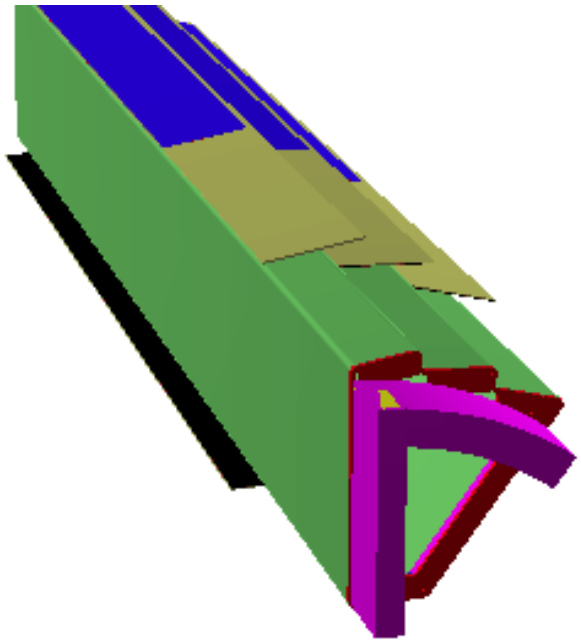
draw IBMO 0 90 0 10 10 .5 .5

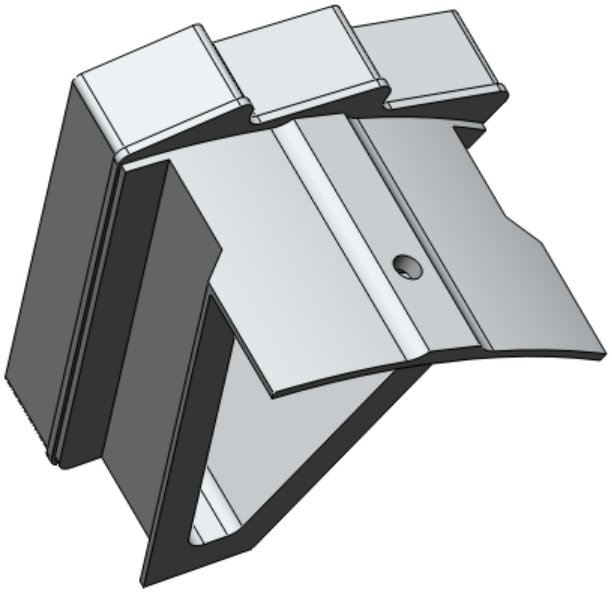


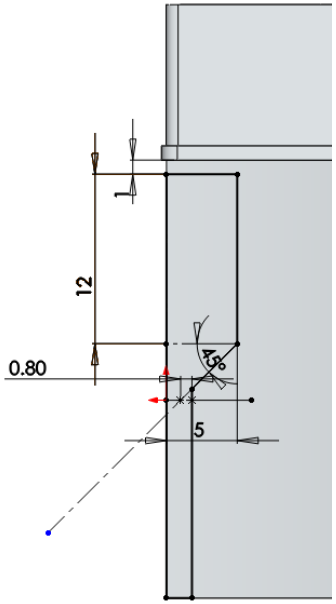
solidworks

HFT Geometry for Run-13

- Flemming/Amilkar did some more coding work on 'heavy' stuff
  - D-tube and Sector supports







HFT Alignment studies

- Review – done
- We now have a fully functioning alignment environment, including the PXL, IST and SSD detectors based on older SVT/SSD work
  - a TPC t0-like bug still persists. Geometries used for MC generation and track reconstruction are not consistent
  - Yuri suggested the direct use of root geometry matrices. Eliminate going back/forth to tables step
  - We plan to use the 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
  - one of the goals of the engineering run

PXL sectors

PXL Halve 1/2 ALL

IST SSD

Test Results

SHIFTED SSD (some) – MEDIUM STATS

dX mkm	dY mkm	dZ mkm	alpha mrad	beta mrad	gamma mrad	Comment
31.18+-37.04	-0.96+- 1.27	-25.11+-42.73	-0.00+- 0.01	-0.11+- 0.11	-0.04+- 0.06	Average for PXL Sector 1
8.47+- 2.04	-1.49+- 2.97	89.95+-44.84	-0.37+- 0.11	0.26+- 0.11	0.04+- 0.05	Average for PXL Sector 2
-2.81+- 0.92	11.56+- 3.13	114.36+-43.79	-0.14+- 0.03	0.10+- 0.03	-0.10+- 0.11	Average for PXL Sector 3
1.87+- 0.72	7.04+- 3.09	-14.97+-45.15	0.01+- 0.02	-0.12+- 0.03	-0.06+- 0.20	Average for PXL Sector 4
2.95+- 4.01	14.88+- 2.27	-36.74+-39.06	0.03+- 0.06	0.47+- 0.26	-0.06+- 0.10	Average for PXL Sector 5
17.18+-36.09	2.69+- 1.41	10.13+-43.33	0.00+- 0.01	-0.09+- 0.10	-0.05+- 0.07	Average for PXL Sector 6
		65.38+-46.00		0.54+- 0.15	-0.01+- 0.06	Average for PXL Sector 7
-2.08+- 0.96	4.23+- 2.99	-27.47+-46.58	0.03+- 0.03	0.14+- 0.04	-0.11+- 0.13	Average for PXL Sector 8
	7.92+- 3.30	-53.86+-40.89	-0.02+- 0.02	-0.04+- 0.02	-0.06+- 0.17	Average for PXL Sector 9
2.32+- 4.26				-0.29+- 0.21	0.01+- 0.12	Average for PXL Sector 10
	-11.07+- 1.34	11.91+-17.68	-0.10+- 0.01	0.00+- 0.01	-0.06+- 0.04	Average for PXL - Shell 1
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
-0.63+- 0.53	-9.71+- 0.91	19.02+-12.11	-0.06+- 0.01	0.01+- 0.01	-0.05+- 0.01	Average for All PXL
-4.80+- 1.81	12.82+- 1.72	23.46+-10.86	-0.02+- 0.01	0.00+- 0.01	0.01+- 0.01	Average for All Ist
-4.48+- 1.58	10.67+- 1.54	-619.20+-13.75	-0.01+- 0.00	-0.04+- 0.00	-0.01+- 0.01	Average for All Ssd

- Statistics matter (up to a point)
- Averages come from several histo fits
- Some mis-behavior detected (most due to stats but not all)

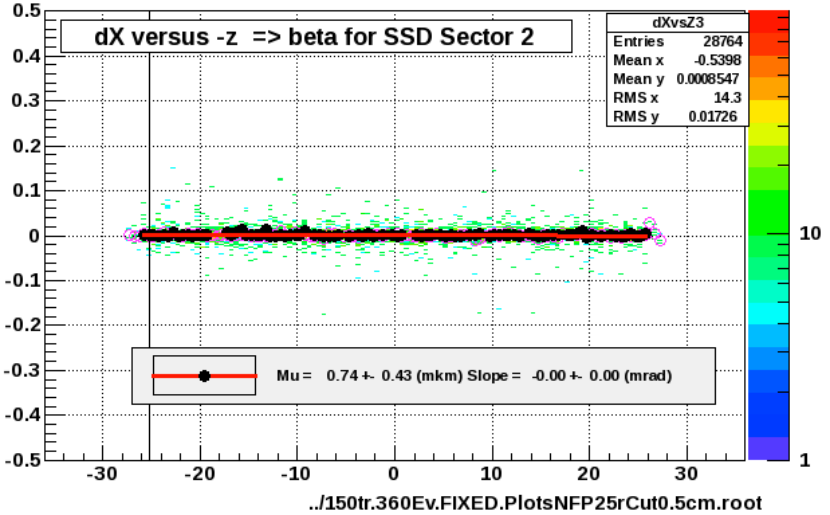
Test Results

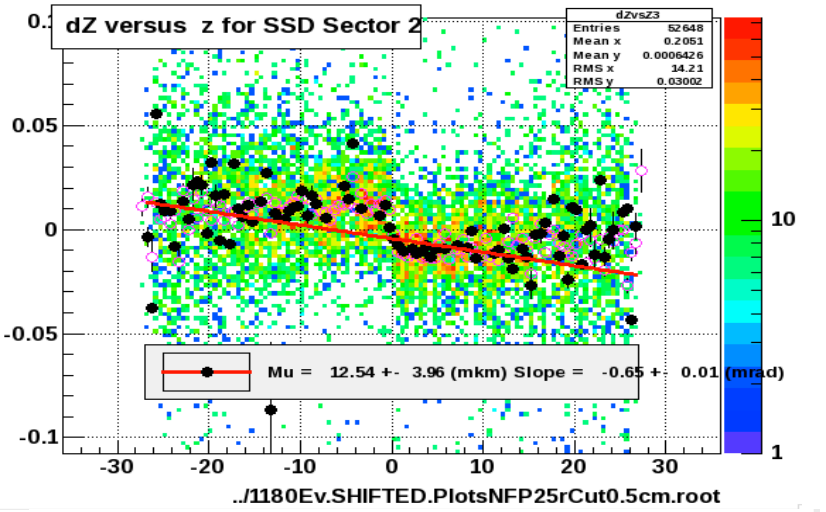
FIXED – MED STATS

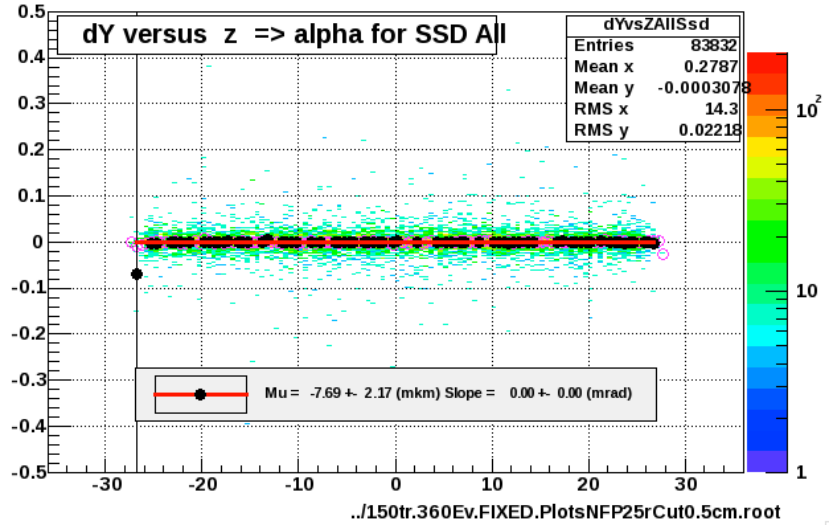
dX mkm	dY mkm	dZ mkm	alpha mrad	beta mrad	gamma mrad	Comment
						../star_institutions_ksu_bouchet_RUNSVT_PXL_PRODPlotsNFP25rCut
0.00+- 0.00	0.00+- 0.00	0.00+- 0.00	0.00+- 0.00	0.00+- 0.00	0.00+-935.77	LSF/Sum Over PXL Shell 2
-5.65+-10.65A				0.01+- 0.02A		dXvsZ_1/dX versus -z => beta for PXL Half 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

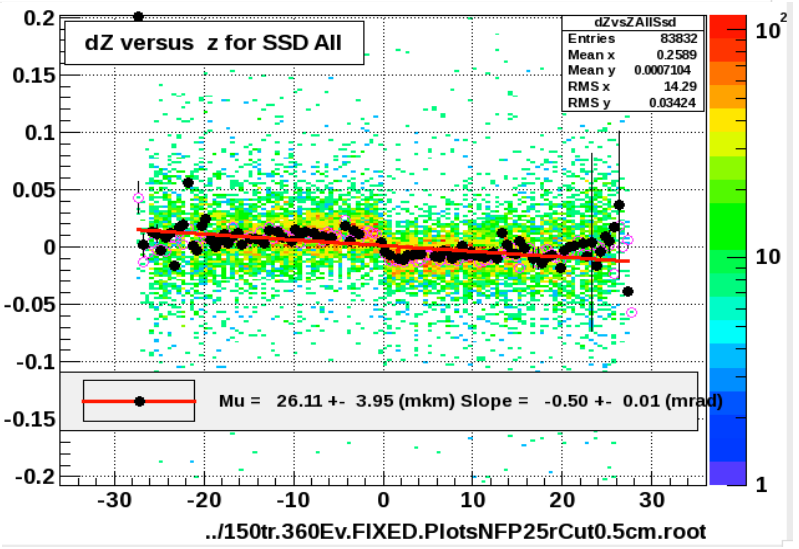
- Averages result from several fits
- Some mis-behavior detected (next slides)

Results - Global









- dX/dY are fine...dZ shows TPC t0 effect (!)
- This is also responsible for the γ angle effect

SSD hits position from StEvent :

Row	x	y	z	xl	yl	zl
0	-6.275085	22.172990	2.7764999	-2.790498	0.6014999	0.0014993
1	-5.044036	22.103467	26.770500	-1.557498	-1.504499	-0.003500
2	-5.046247	22.118604	26.788499	-1.560498	-1.486500	0.0115001
3	0.7703861	23.185161	-19.88649	-3.258496	-0.311499	0.0004962
4	15.069697	-16.17649	29.589500	1.0365052	1.3145004	0.0004962
5	7.5190558	-20.55773	5.7924995	2.8084950	-0.732500	0.0004950
6	0.0566745	-21.84609	-11.80950	3.4364988	-0.934500	0.0004993
7	-19.47356	-11.68815	-21.04849	-1.689494	-1.473498	0.0005006
8	**-22.04654**	**-3.881427**	**-15.68849**	**-0.393502**	**-0.463499**	**0.0004975**

Position of SSD hits from the MC input

SSD hits saved after track matching :

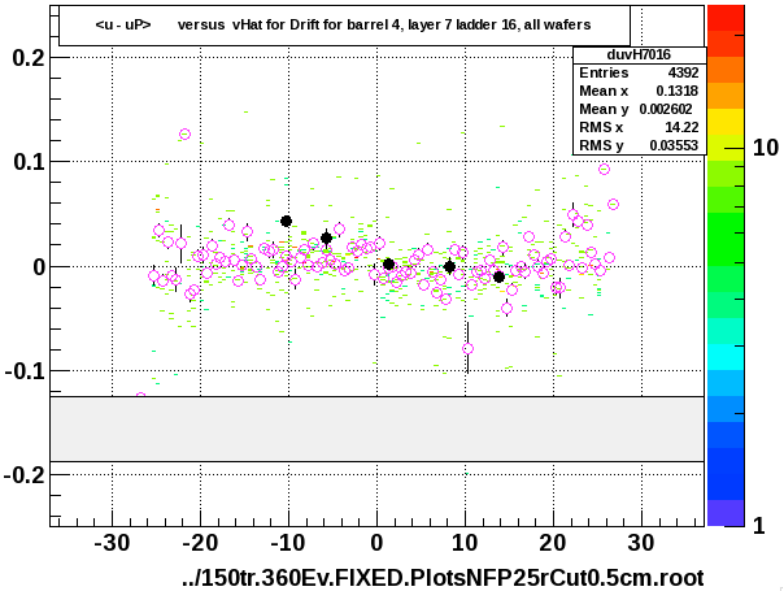
Row	Instance	fHits.xG	fHits.yG	fHits.zG	fHits.u	fHits.v
0	1	0.7702019	23.1847	-19.88649	-3.258496	-0.311499
0	**6**	**-22.04604**	**-3.881453**	**-15.68849**	**-0.393502**	**-0.463499**
0	8	-19.47308	-11.68802	-21.04849	-1.689494	-1.473498
0	11	0.0567007	-21.84559	-11.80950	3.4364988	-0.934500
0	13	7.5189251	-20.55725	5.7924995	2.8084950	-0.732500
0	15	15.069422	-16.17608	29.589500	1.0365052	1.3145004

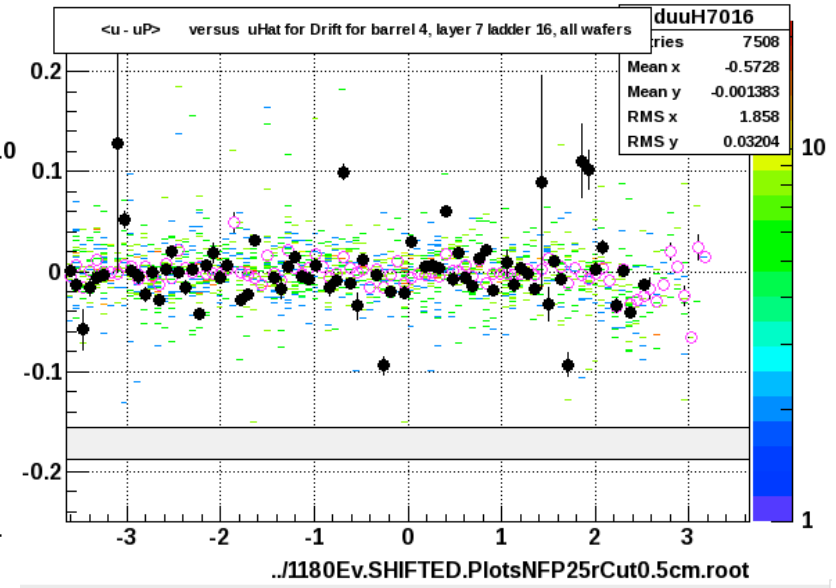
Positions of SSD hits used to evaluate residuals

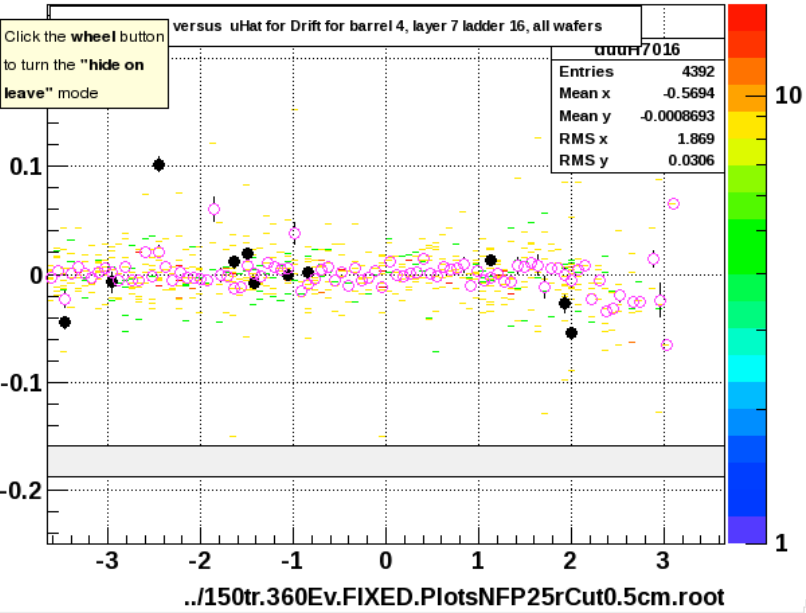
- Hits are transformed several times from the global system (STAR) to a local system ("attached" to SSD wafer)
- This implies the use of rotation matrices, which numbers are derived from the geometry tables
- Although some very slight differences (<10μm), maybe due to float/double approximation), hits positions are identical
- It means that in the residual(= hit position – track projection) , the track projection should be the reason of the split

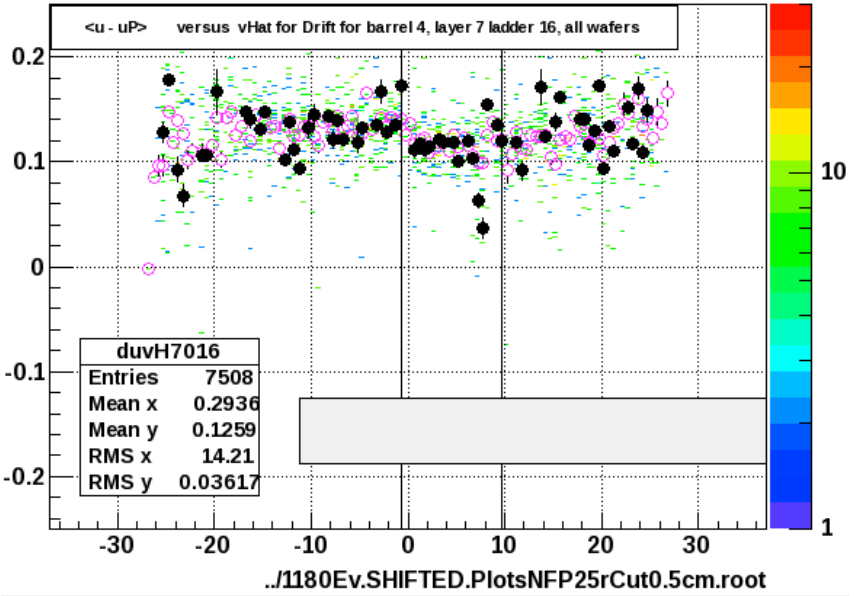
Results – Ladder/local

- FIXED left - SHIFTED right
- u (rphi) UP - v (beam) right









HFT Offline chain

- We had an initial pass on tasks/names (especially for the PXLs)
- J. Rusnak will work with Xin, Hao on PXL Offline
  - Leo also has manpower from his end on some overlapping tasks

- J. Rusnak started to implement the new scheme for hits/tracks definition in the STAR software (split of the common IST/PXL structure)

More specific request for Calibration/Alignment:

Inputs:

- <dN/deta> ~ 3 in pp500
- ~5-10MHz event rate. 1-2 Kevents mbias pileup in PXL, 250-500 in TPC (40us drift time). ~10Ktracks pileup in PXL, ~2-3K in TPC roughly
- If a TOF multiplicity cut of >10 tracks (dN/deta) is imposed I use the factor of 10 (10%) penalty [see backup picture from Flemming's work*]. If >20 factor 250 (0.4%)
- I assume (see backup slide from spin presentation) that the penalty for a vertex-z cut of +-10cm over the diamond is a factor of 10 (10%) [plot shows a v_sigma ~ 30 cm]

Needs:

- 50-100Ktracks/sensor -> stat error of alignment ~micron
- times 30 (outer-ladders in 4pi) * 10 (sensors/ladder) [x300] gives 15-30Million track sample total OR >2 Mevents sample (depends on trigger mult. value)[>10 or >20]

Assumptions:

- Defocus/displace beam at STAR when PXL gets installed by 2\sigma_xy each -> reduce event rate by ~100 factor. This gives ~ 10-20 PXL and 2-5 TPC pileup events with 20-30 pileup tracks in TPC…not bad.

* http://drupal.star.bnl.gov/STAR/blog/videbaks/2012/nov/29/pp-multiplicity

Results:

- Defocused beam rate: 50-100 KHz [no problem]
- After multiplicity cut >10 (>20) ~5-10KHz (~200-400Hz)
- + after z-vertex cut 0.5-1.0 KHz (~20-40Hz)

- Average tracks/event in PXL (3/10 sectors)(2 eta units) : 5 (10)

Need:

- >2 (>2) Million events or
- >4(100)Kseconds or
- **~1 hour of >10 mult. cut OR 30 hours >20 mult. cut**

- Note: A factor of two in multiplicity (20 instead of 10 tracks in the event) gains 1.44 smaller error in event vertex error.

LOOKS O.K.

Summary

- Big progress on Alignment work and significant progress in other areas (especially the critical ones)
- Run-13 will give us, hopefully, a lot of data for finalizing the areas of calibrations/offline