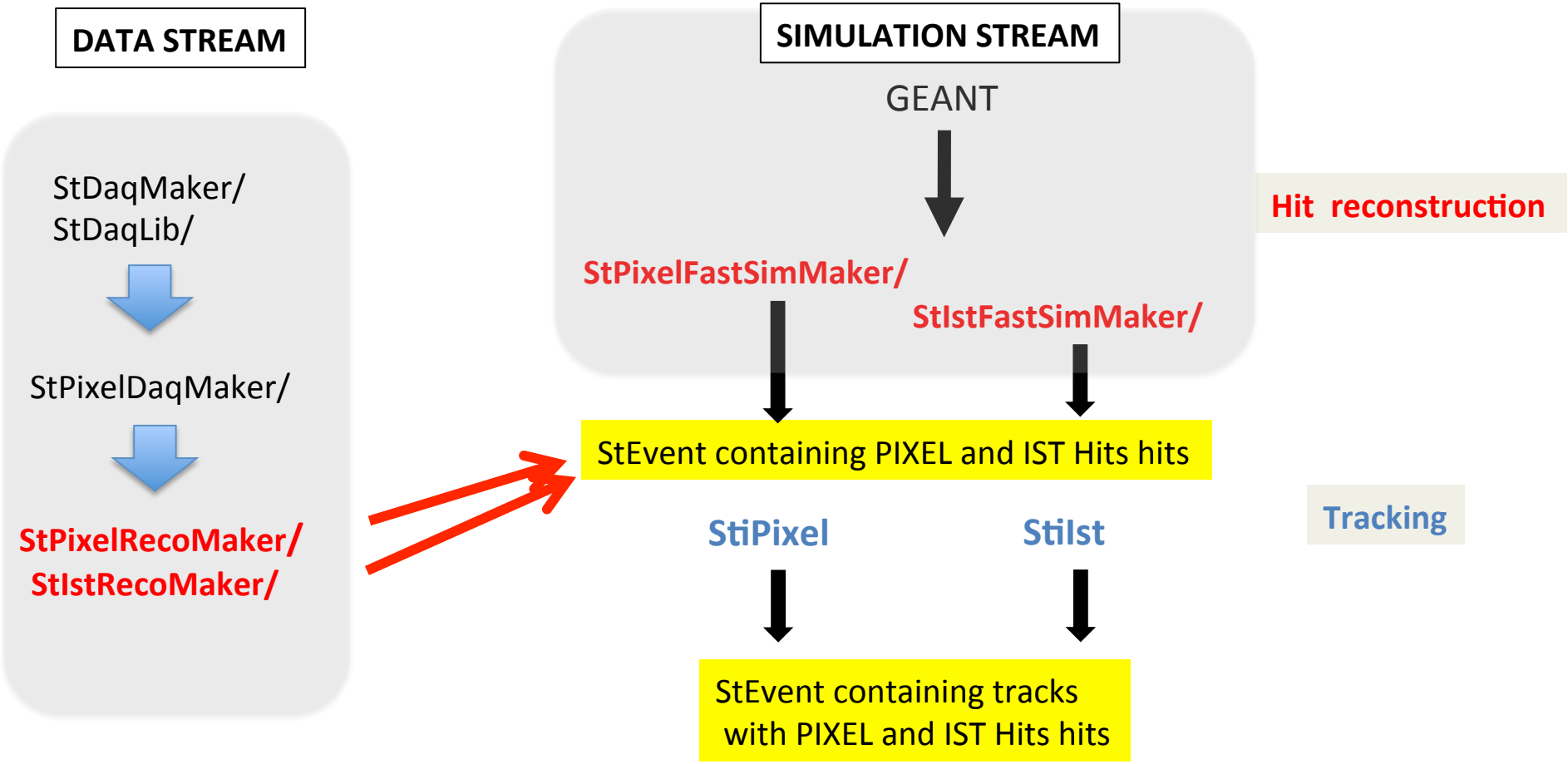
HFT Software Status

S. Margetis, KSU



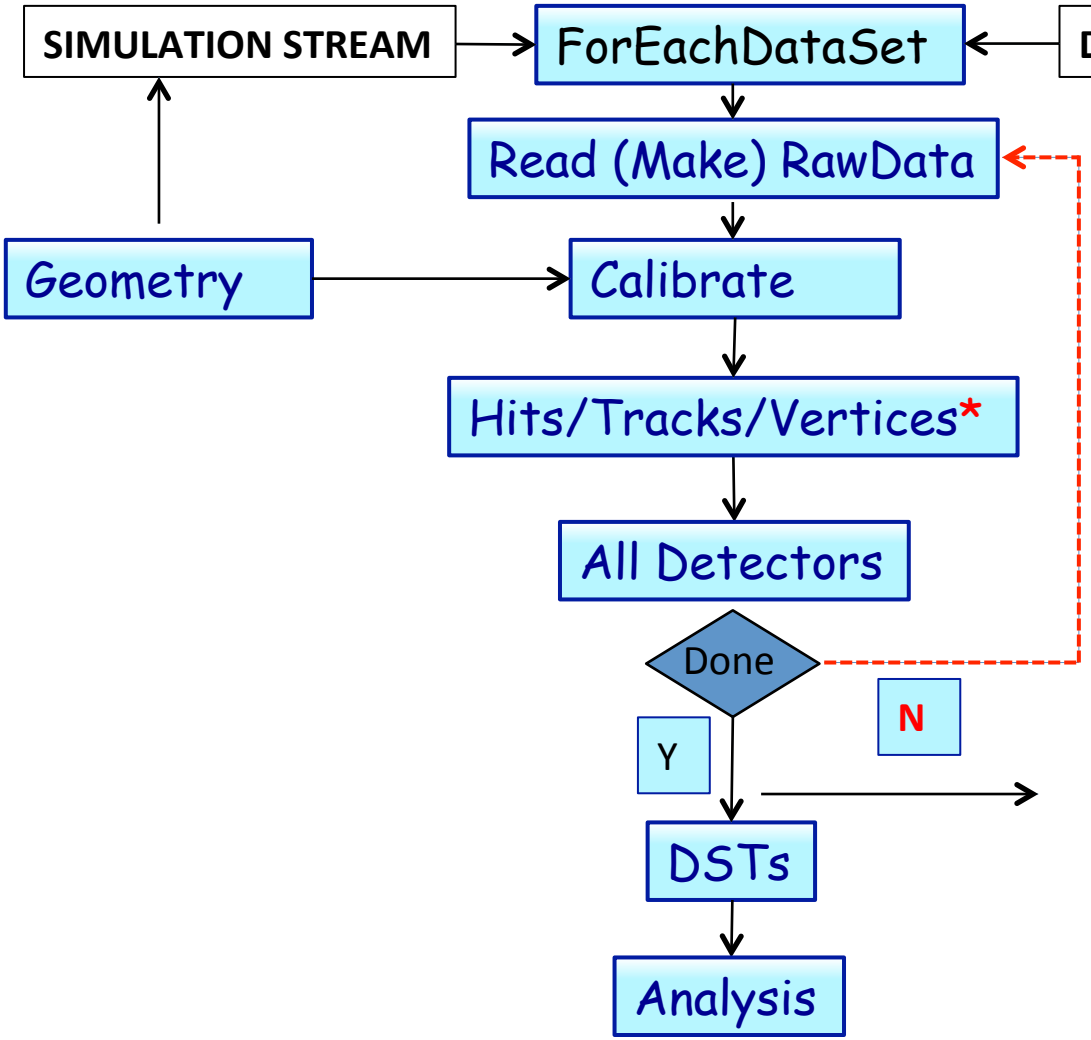
Outline

- Brief overview of subsystem
- Technical Progress since last review
- Construction Plans
- Outstanding technical issues and plans
- Schedule & Cost
  - Cost to date and projection (from Sarah)
- Resources
  - People, institutions and
- Risk assessment; value engineering
- Summary

Overview of subsystem

- WBS 1.6 (Software) is the sum of Online and Offline software modules
- The Online software is a sub-detector deliverable and contains Slow controls, online monitoring etc
- The Offline software is responsible for the event reconstruction starting from raw data all the way to particle quantities. It includes tasks like alignment, hit/track/vertex finding etc
- WBS 1.6 is divided into two parts. Part one (On-scope) contains all the essential tasks for the successful operation of the detector (Calibrations etc). Part two contains all the rest
- Subsystem meets weekly to plan work and get updates
- Subsystem is an integral part of STAR's S&C environment, interacting very closely with it on a regular basis.

General Flowchart of Offline Software Tasks



* VMC, STV, CA ready

Task Overview and FTE needs

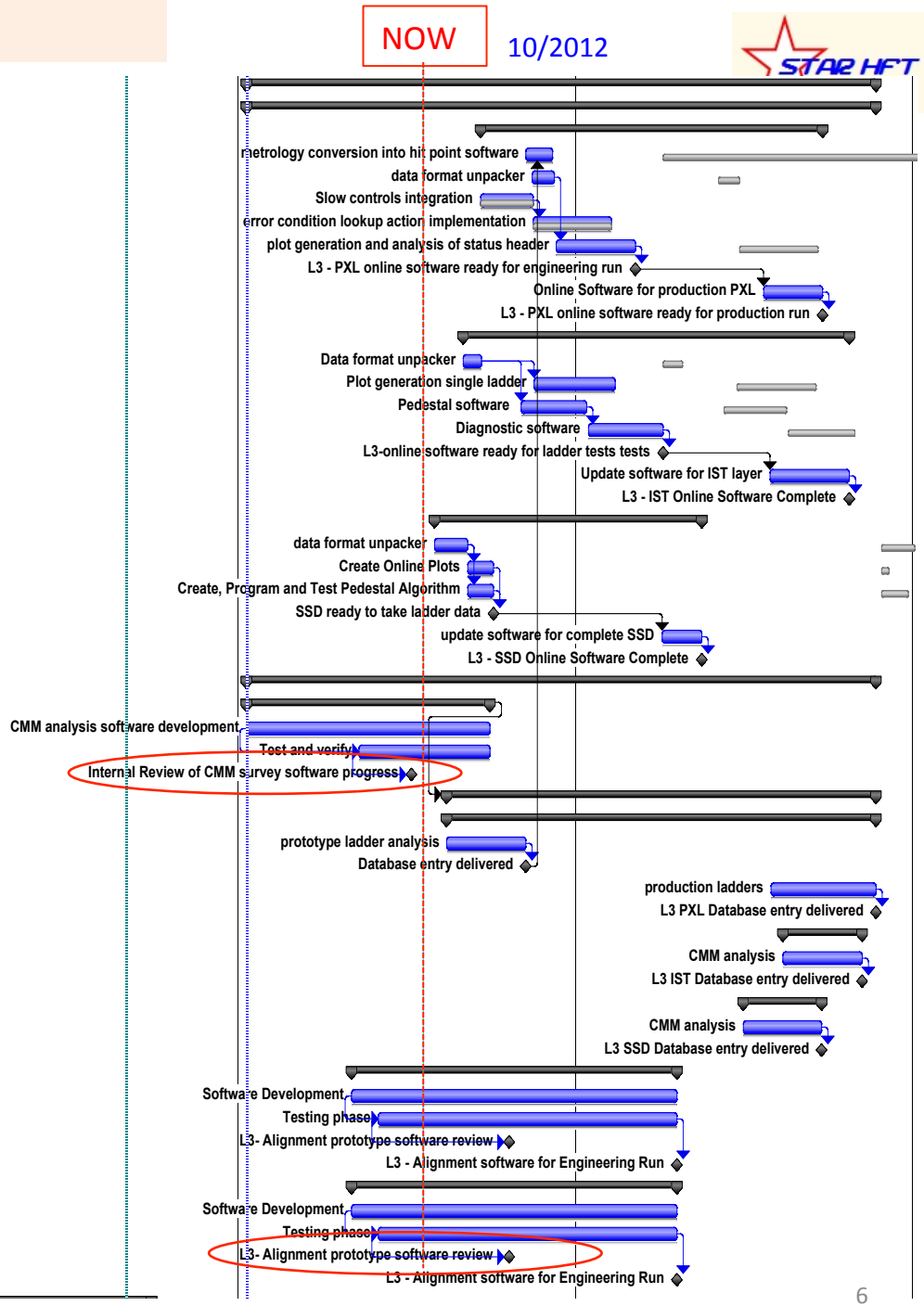
FTEY	Software task	
	Offline	
2	Hit Reconst.	IST
		Pixel
0.2	Tracking	
0.2	Event Vertex	
0.5	Decay Vertex	
2	Calibration Db	SSD
		IST
		PXL
1	Alignment	SSD
		IST
		PXL
	Simulation	
1.1	Geometry	SSD
		IST
		PXL
0.8	Fast/Slow Sim.	SSD
		IST
		PXL
0.5	Embed./Pileup	IST
	Assoc/Analysis	

Total= 8.3

- List is for *Offline* tasks only
- FTE estimates *do not* include BNL-core group contributed effort in tracking/vertex-ing/calibrations etc.
- Numbers are on the under-estimate side
- It comes down to about 4 FTE/year for ~two years
  - We have about half of that

Schedule/Milestones

1.6	**Software**	**0%**	**464 days**
1.6.1	**Online**	**0%**	**464 days**
1.6.1.1	**PXL**	**0%**	**251 days**
1.6.1.1.1	metrology conversion into hit point software	0%	20 days
1.6.1.1.2	data format unpacker	0%	17 days
1.6.1.1.3	Slow controls integration	0%	40 days
1.6.1.1.4	error condition lookup action implementation	0%	60 days
1.6.1.1.5	plot generation and analysis of status header	0%	60 days
1.6.1.1.6	L3 - PXL online software ready for engineering run	0%	0 days
1.6.1.1.7	Online Software for production PXL	0%	45 days
1.6.1.1.8	L3 - PXL online software ready for production run	0%	0 days
1.6.1.2	**IST**	**0%**	**284 days**
1.6.1.2.1	Data format unpacker	0%	14 days
1.6.1.2.2	Plot generation single ladder	0%	61 days
1.6.1.2.3	Pedestal software	0%	50 days
1.6.1.2.4	Diagnostic software	0%	50 days
1.6.1.2.5	L3-online software ready for ladder tests tests	0%	0 days
1.6.1.2.6	Update software for IST layer	0%	60 days
1.6.1.2.7	L3 - IST Online Software Complete	0%	0 days
1.6.1.3	**SSD**	**0%**	**195 days**
1.6.1.3.1	data format unpacker	0%	25 days
1.6.1.3.2	Create Online Plots	0%	1 mon
1.6.1.3.4	Create, Program and Test Pedestal Algorithm	0%	20 days
1.6.1.3.5	SSD ready to take ladder data	0%	0 days
1.6.1.3.7	update software for complete SSD	0%	30 days
1.6.1.3.8	L3 - SSD Online Software Complete	0%	0 days
1.6.1.4	**Calibration and alignment**	**0%**	**464 days**
1.6.1.4.1	**Survey Software**	**0%**	**180 days**
1.6.1.4.1.2	CMM analysis software development	0%	9 mons
1.6.1.4.1.1	Test and verify	0%	5 mons
1.6.1.4.1.9	Internal Review of CMM survey software progress	0%	0 days
1.6.1.4.5	**CMM analysis**	**0%**	**318 days**
1.6.1.4.5.1	**Analysis of PXL**	**0%**	**318 days**
1.6.1.4.5.1.10	prototype ladder analysis	0%	3 mons
1.6.1.4.5.1.11	Database entry delivered	0%	0 days
1.6.1.4.5.1.12	production ladders	0%	4 mons
1.6.1.4.5.1.13	L3 PXL Database entry delivered	0%	0 days
1.6.1.4.5.2	**Analysis of IST**	**0%**	**60 days**
1.6.1.4.5.2.5	CMM analysis	0%	3 mons
1.6.1.4.5.2.6	L3 IST Database entry delivered	0%	0 days
1.6.1.4.5.3	**Analysis of SSD**	**0%**	**60 days**
1.6.1.4.5.3.1	CMM analysis	0%	3 mons
1.6.1.4.5.3.2	L3 SSD Database entry delivered	0%	0 days
1.6.1.6	**Global Alignment**	**0%**	**240 days**
1.6.1.6.1	Software Development	0%	12 mons
1.6.1.6.2	Testing phase	0%	11 mons
1.6.1.6.3	L3- Alignment prototype software review	0%	0 days
1.6.1.6.4	L3 - Alignment software for Engineering Run	0%	0 days
1.6.1.8	**Self Alignment**	**0%**	**240 days**
1.6.1.8.9	Software Development	0%	12 mons
1.6.1.8.10	Testing phase	0%	11 mons
1.6.1.8.11	L3- Alignment prototype software review	0%	0 days
1.6.1.8.12	L3 - Alignment software for Engineering Run	0%	0 days



LEVEL-3 Milestones

Software			
3	Review of CMM software progress	4/5/12	5/17/12
3	Alignment software Review	9/20/12	9/20/12
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

- Survey/Alignment/Db/Online are immediate on-project activities
- Geometry/Offline/Analysis should be there too

Areas of activities since CD2/3 (a year ago)

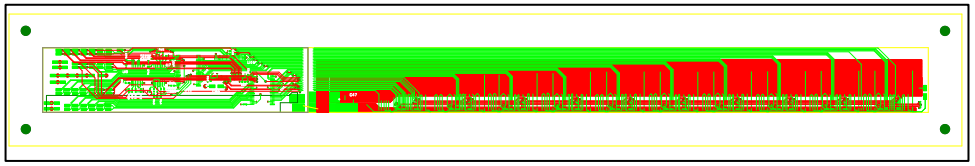
- HFT Geometry model
- HFT Survey & Alignment related work
- Slow/Fast PXL response simulation
- Prototype (BUR) simulations/tracking
- Offline structures (Hits etc)
- Simulation environment (UPC e^- background, Pileup)
- Conventions (naming scheme defined), Db

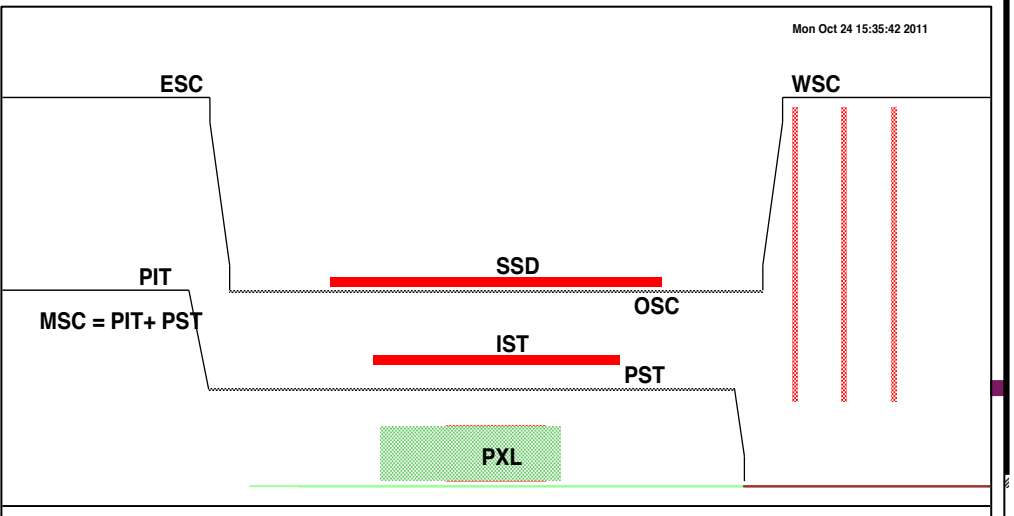
- Hit/Event vertex finders/Kalman fitter for decays
- Evaluation/Analysis framework (see Jonathan's talk)
- Tests of new STV tracker, VMC environment

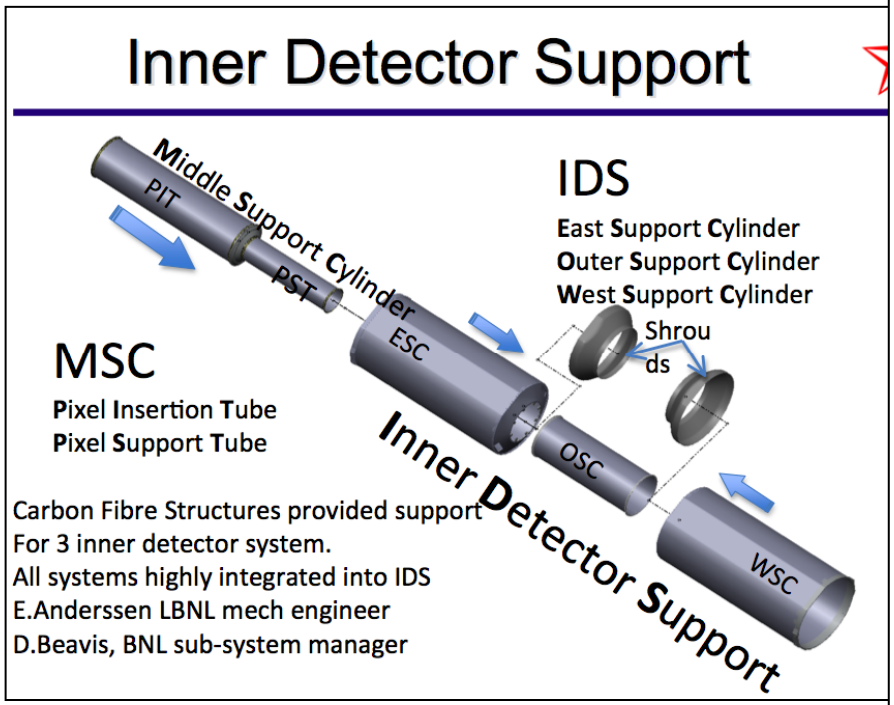
- **'Online' data format/slow controls/online QA/Db considerations**

•HFT Geometry model update

- Creating the Y2013 [a/b] geometry in AgML based on Solid-Works Models
- We had an internal review in March, working on recommendations etc
- Work on SSD/IST in progress
- Work on details of support structures etc in progress
- Manpower probably O.K. but help is more than welcomed (no skills)





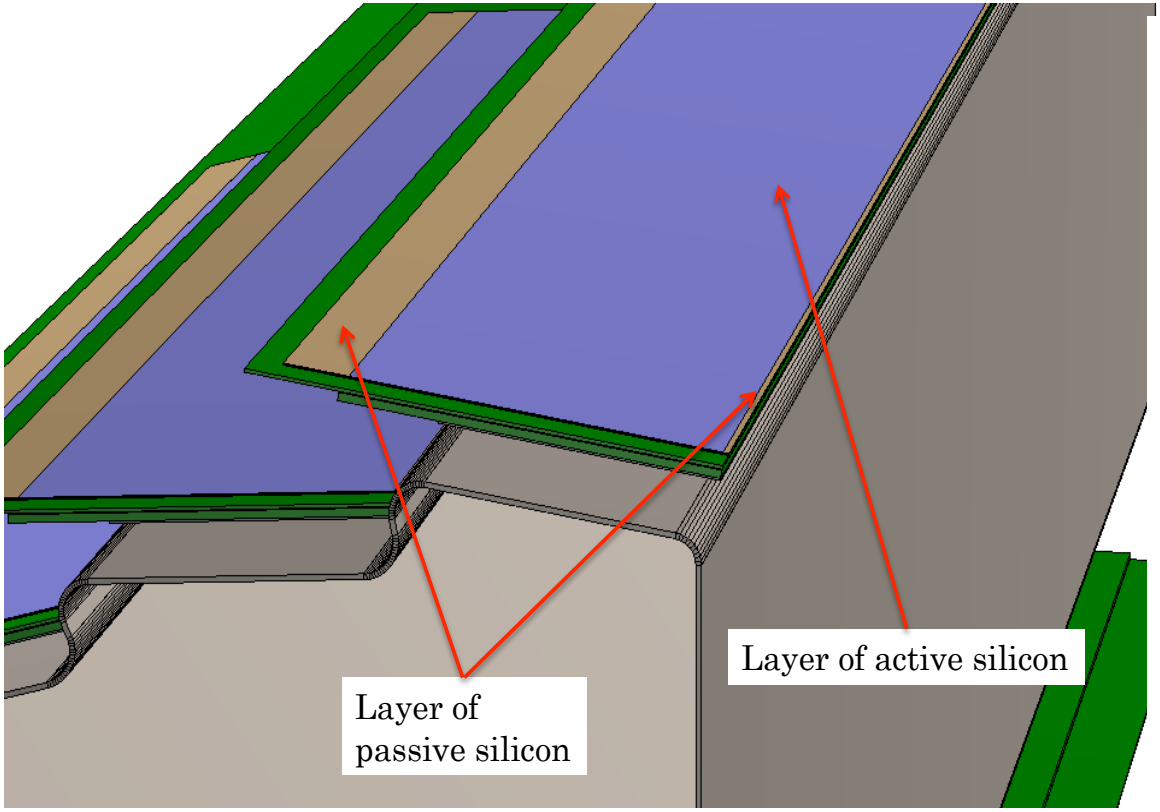


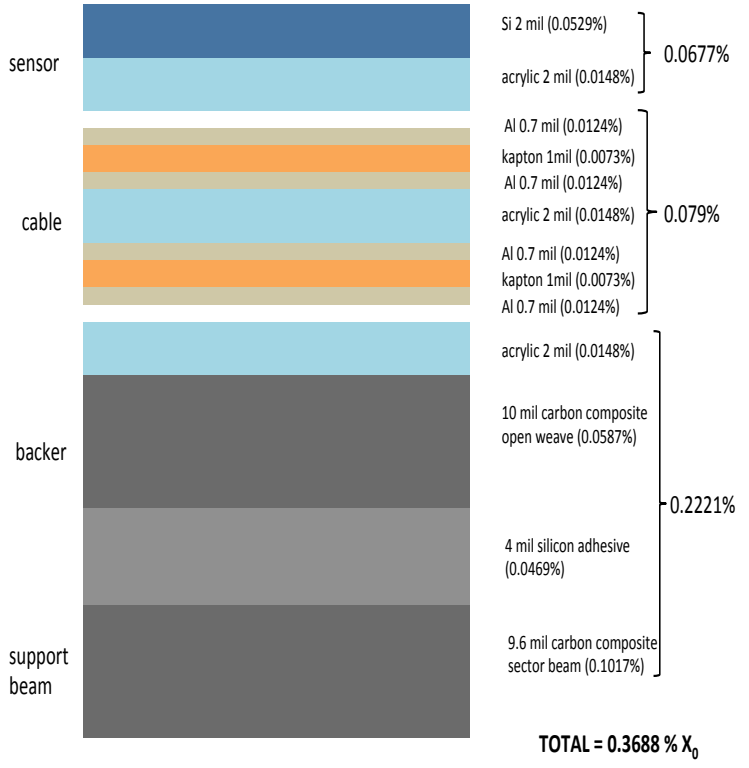
PXL sector modeling in GEANT

- detailed work on structure and thickness
- optimization in progress

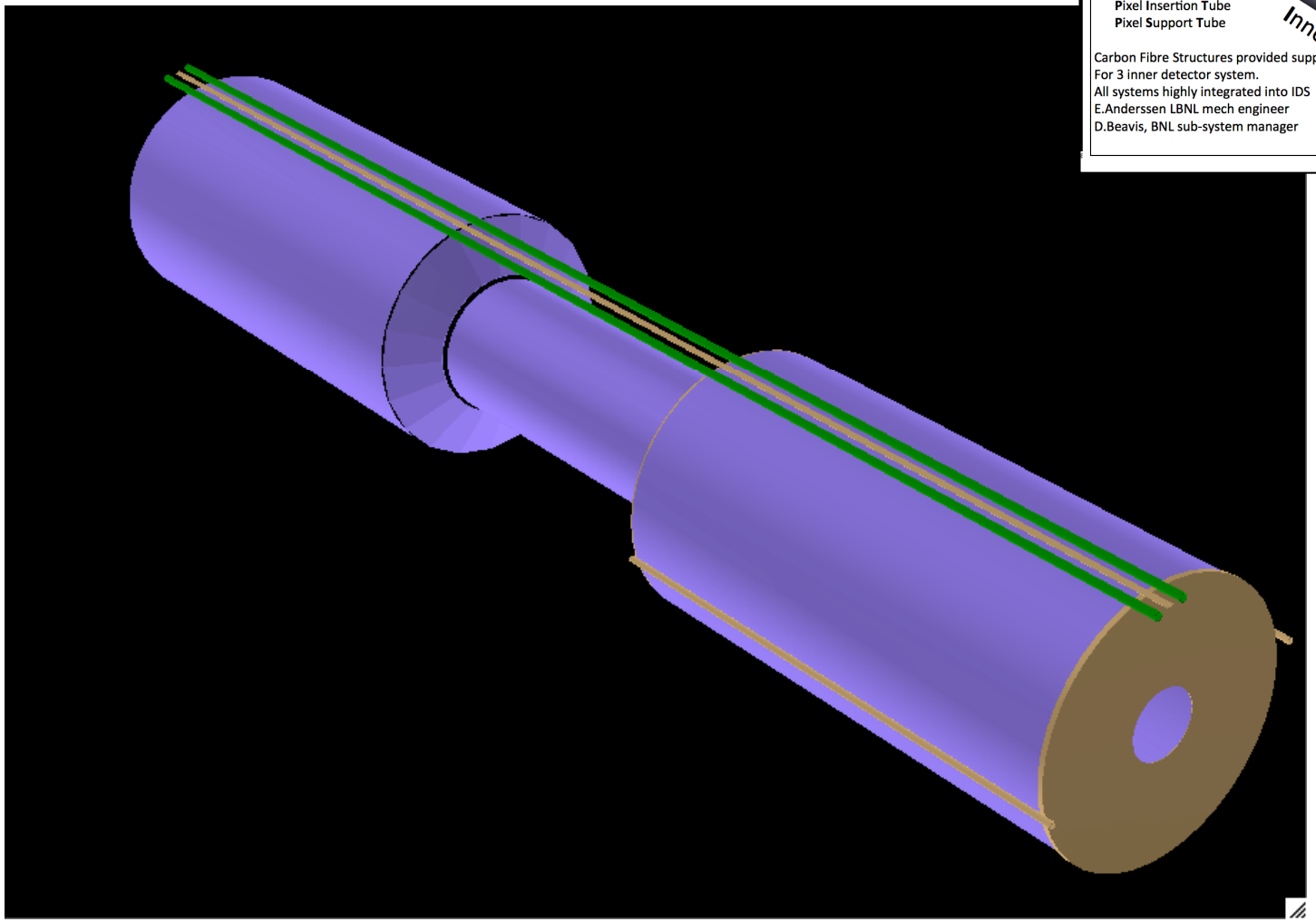
SUMMARY OF MATERIAL BUDGET

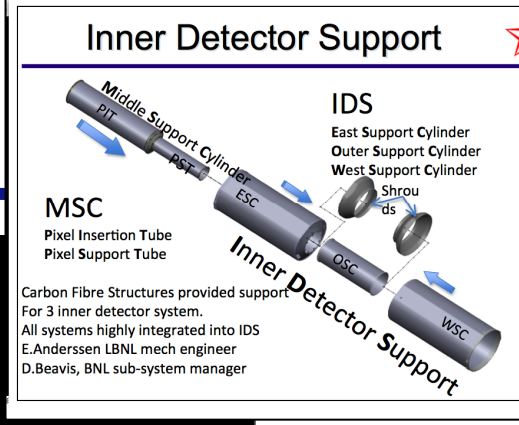
GEANT NAME	piece	shape	Composition / mixture	Radiation length [cm]	Density[g/cm^3]
PLAC	Silicon active	box	Si	9.36	2.33
SIFR	Silicon passive	box	Si	9.36	2.33
SIFL	Silicon passive	box	Si	9.36	2.33
GLUA	adhesive	box	O(0.164) C(0.763) H(0.073)	34.7	1.2(*)
GLUB	adhesive	box	O(0.164) C(0.763) H(0.073)	34.7	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(*)



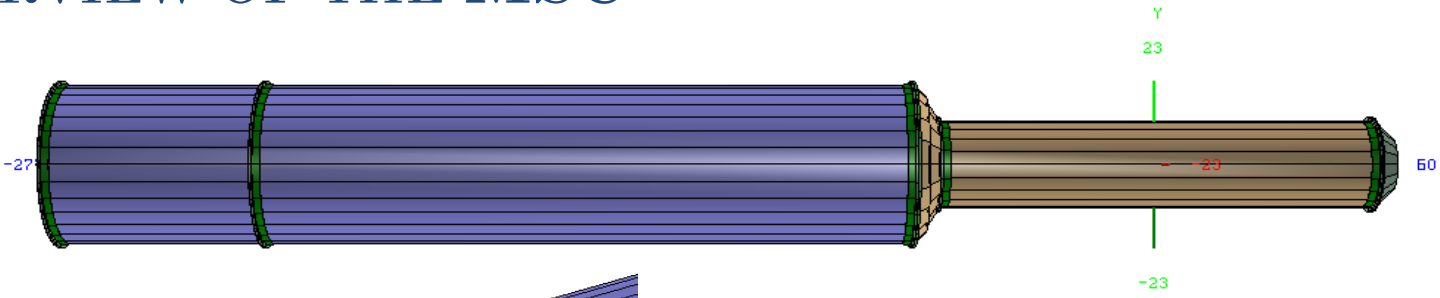


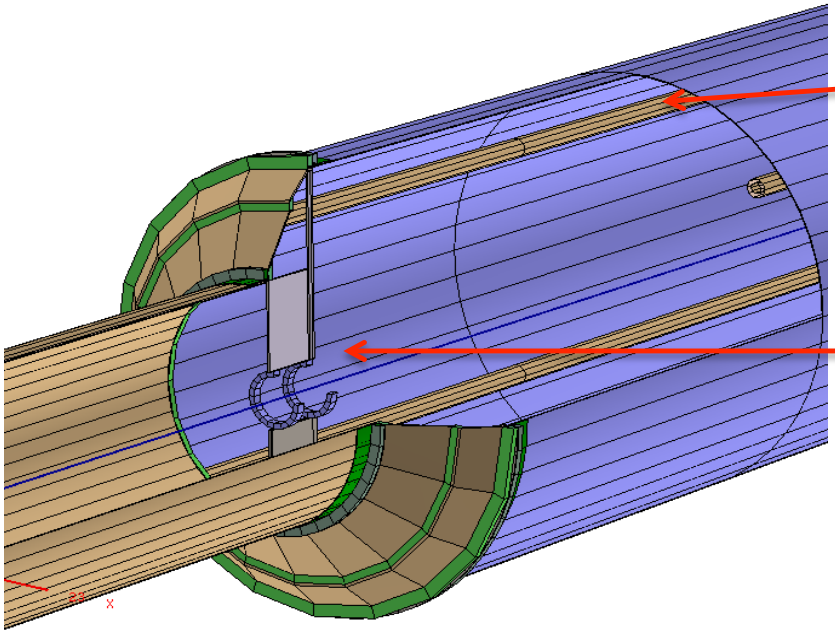
Title




Inner Detector Support
Middle Support Cylinder
PIT
PST
ESC
IDS
East Support Cylinder
Outer Support Cylinder
West Support Cylinder
Shrou
ds
MSC
Pixel Insertion Tube
Pixel Support Tube
OSC
WSC
Inner Detector Support
Carbon Fibre Structures provided support
For 3 inner detector system.
All systems highly integrated into IDS
E.Anderssen LBNL mech engineer
D.Beavis, BNL sub-system manager

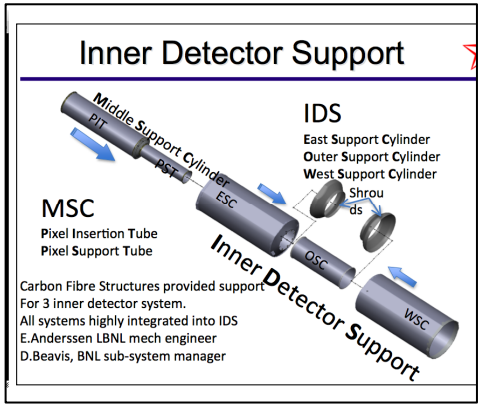
Overview of the MSC





rails

Rings surroundings the beam pipe

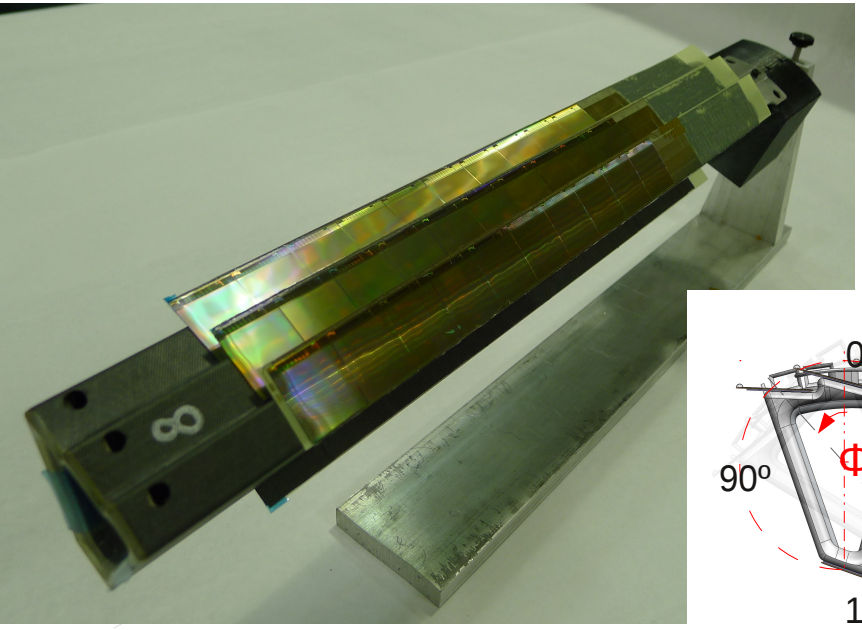


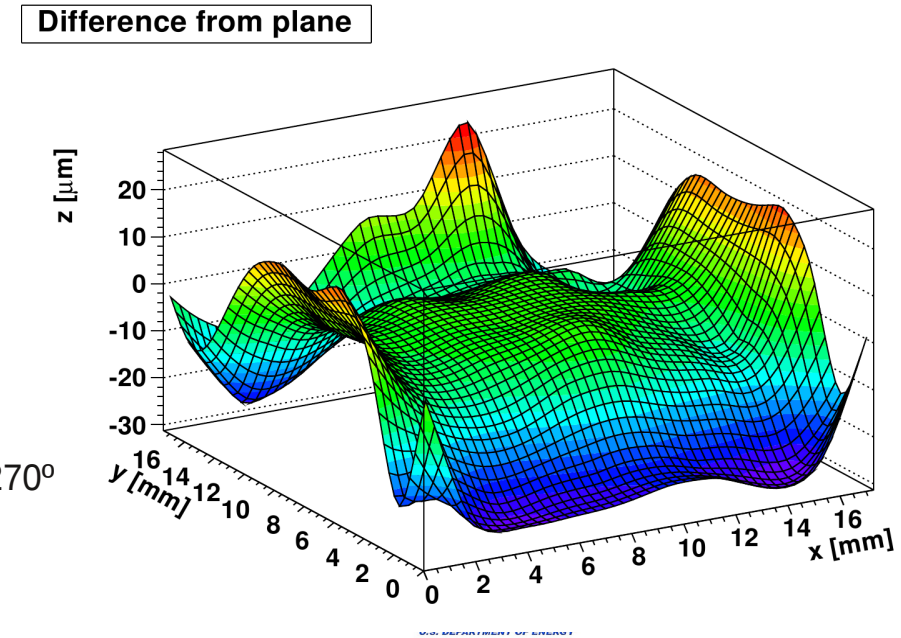
•: temporary until implementation of real material (slide 39)

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

•HFT Survey work

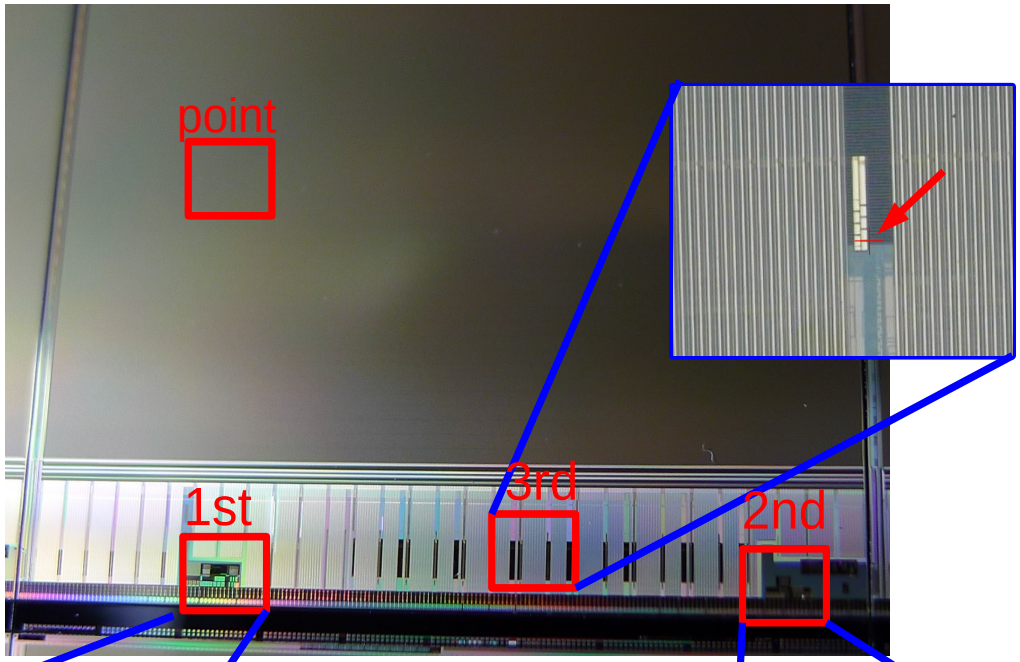
- PXL+SSD work has already begun
  - Single chip and 3-chip ladder done. Full PXL sector (photo) ready to go
  - SSD ladder preliminary survey done
  - IST preliminary work on prototype ladder about to begin at BNL
- We had an internal review on procedures/general scheme in May
- A lot of detailed work in front of us, but expertise is building up
- Manpower issue addressed but there are tasks available





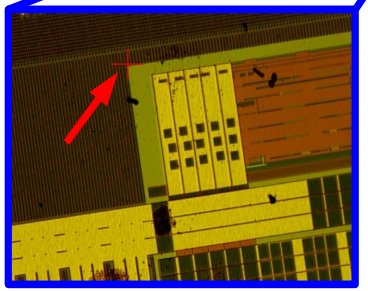
Sensor's features for individual pixel coordinates identified
- Need be programmable

x=4594.225 µm
y=10000.00 µm
z=0 µm

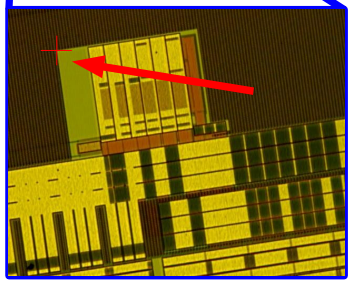


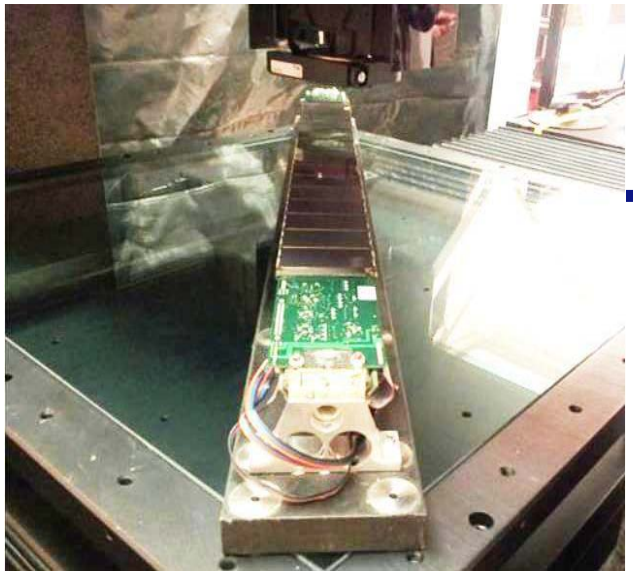
x=? µm
y=? µm
z=0 µm

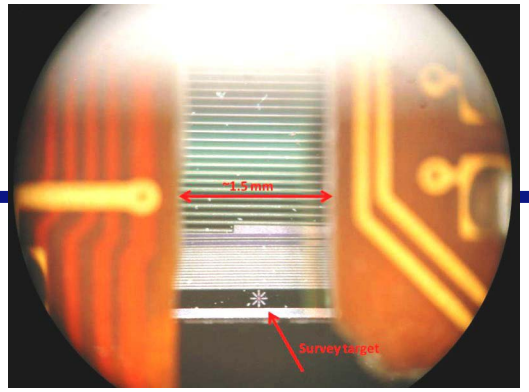
x=4594.225 µm
y=920.775 µm
z=0 µm



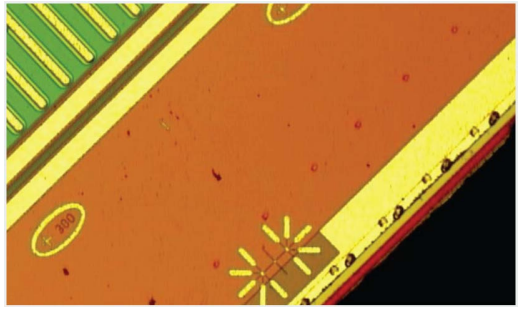
x=18165.075 µm
y=871.6 µm
z=0 µm



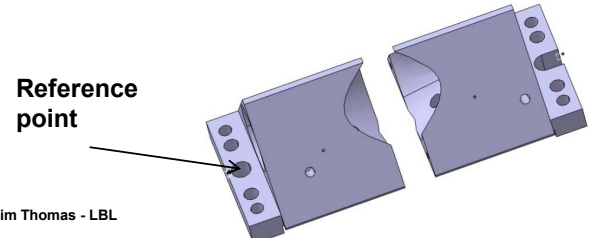


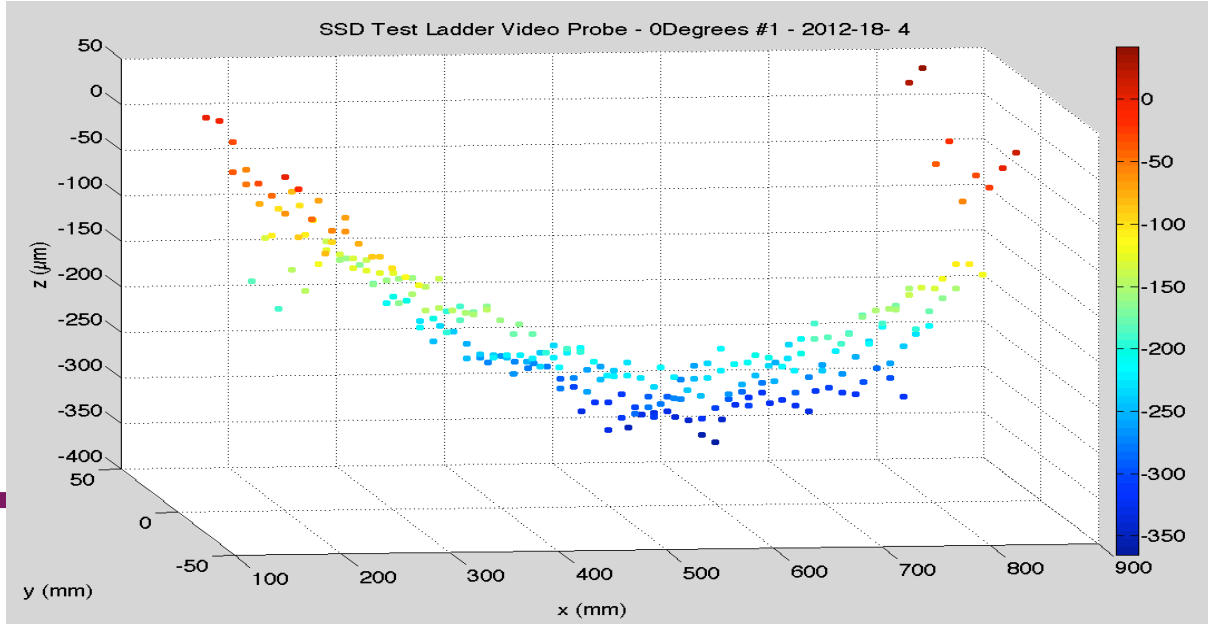


Target on end of wafer (backside)



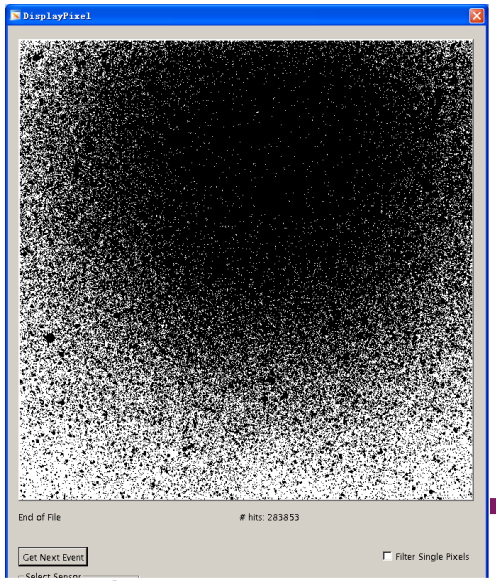
Targets on edges of wafer (front)

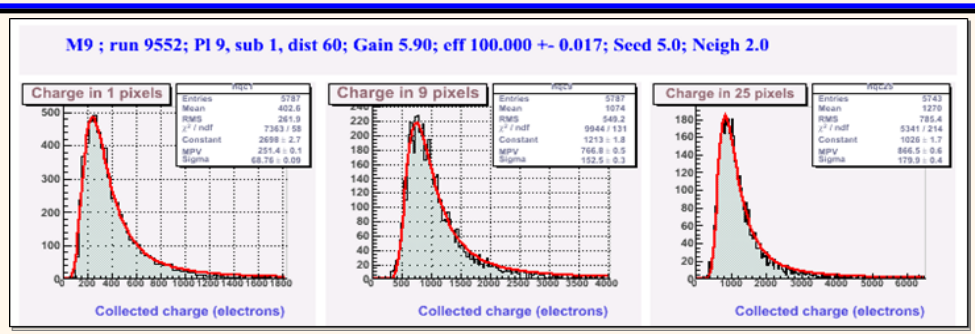


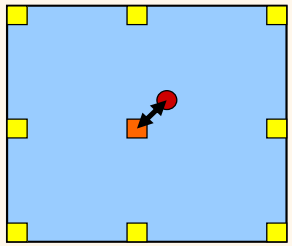


•Slow/Fast PXL response simulation

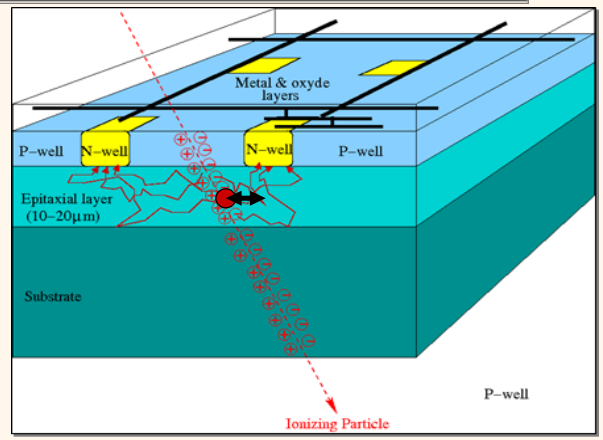
- Most work done by IPHC (Strasburg) Collaborators
- The have developed a Root program, DIGMAPS, for response studies
- Analyzed CERN test-beam data with our sensors to fix parameters
- We are about to get their tune to use for our studies and compare with default "geometrical mean" approach. Then, build fast simulator with appropriate errors.
- SSD exists, IST is relatively simple (but still not there yet)
- Need people to actively pursue these tasks





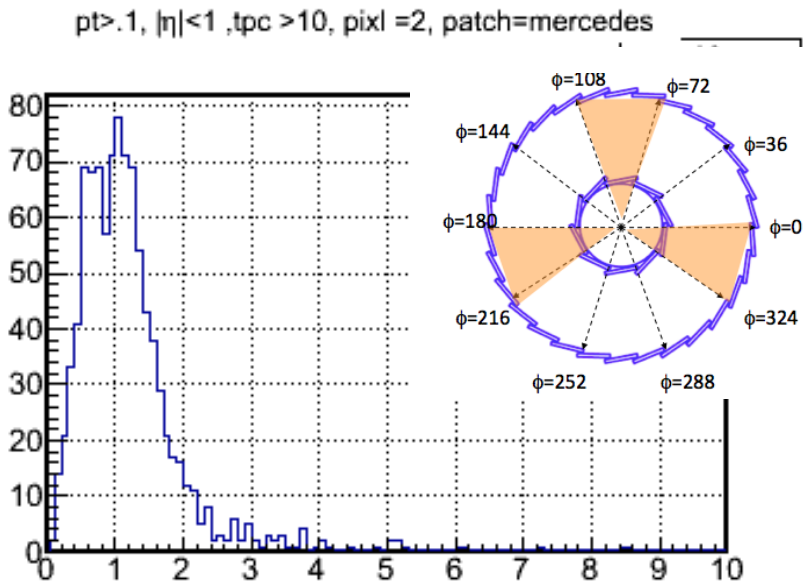


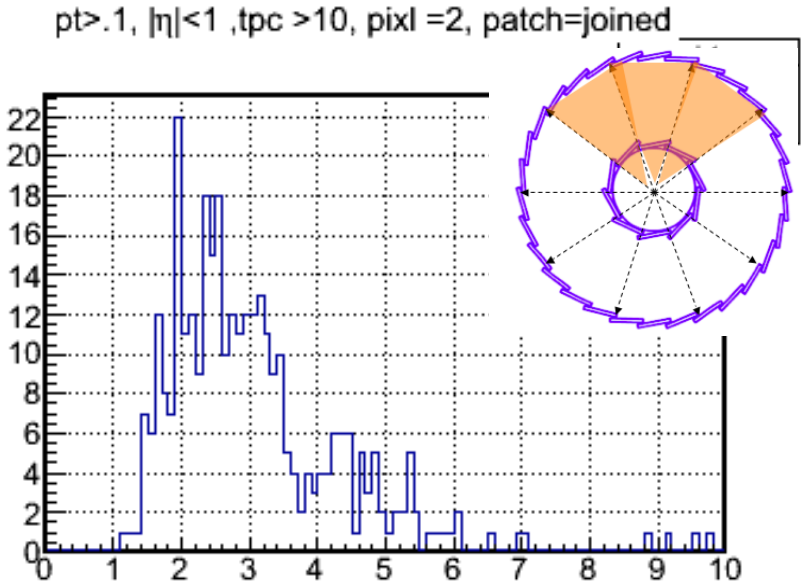
= Collecting diodes
= seed diode
= Impact position
= seed-impact distance



- Tracking (Physics?) with TPC+PXL prototype ?

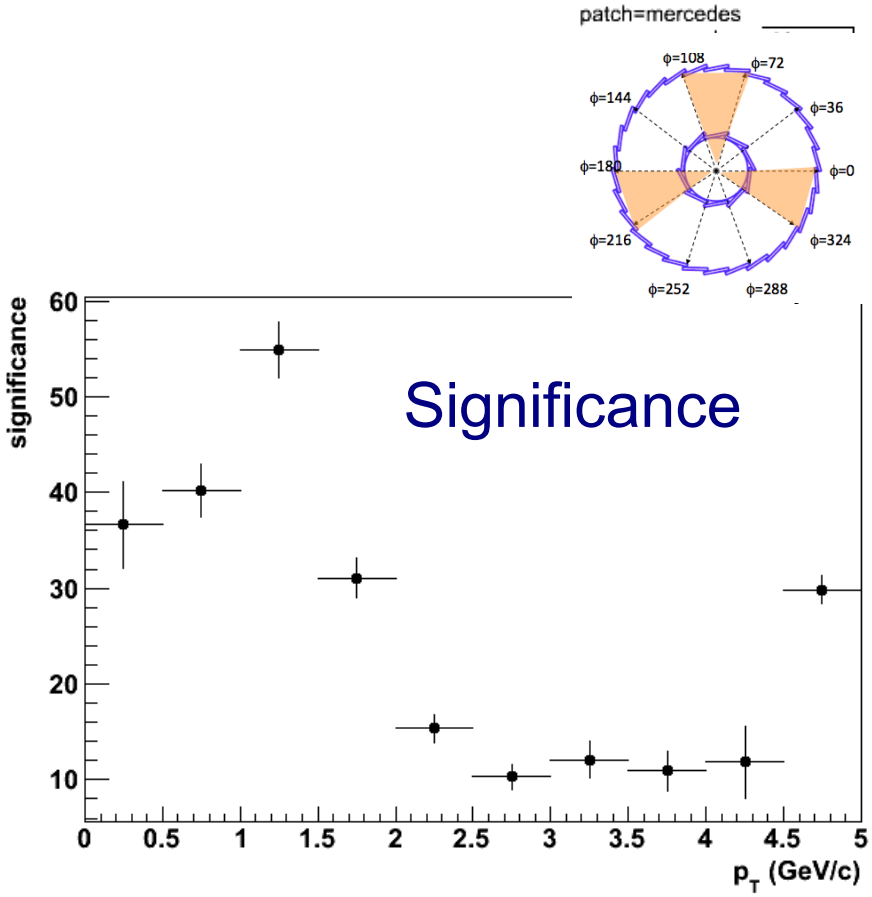
- BUR simulations done and presented (Hao/Jonathan)
- Simulations show (see next slide too) that there are physics opportunities but reality might be different
- This connects to the bigger issue of Tracking and whether inside-out tracking is possible. Is CA useful ? We work in that direction.
- This is vital work for the project. ANY help and idea is invaluable.

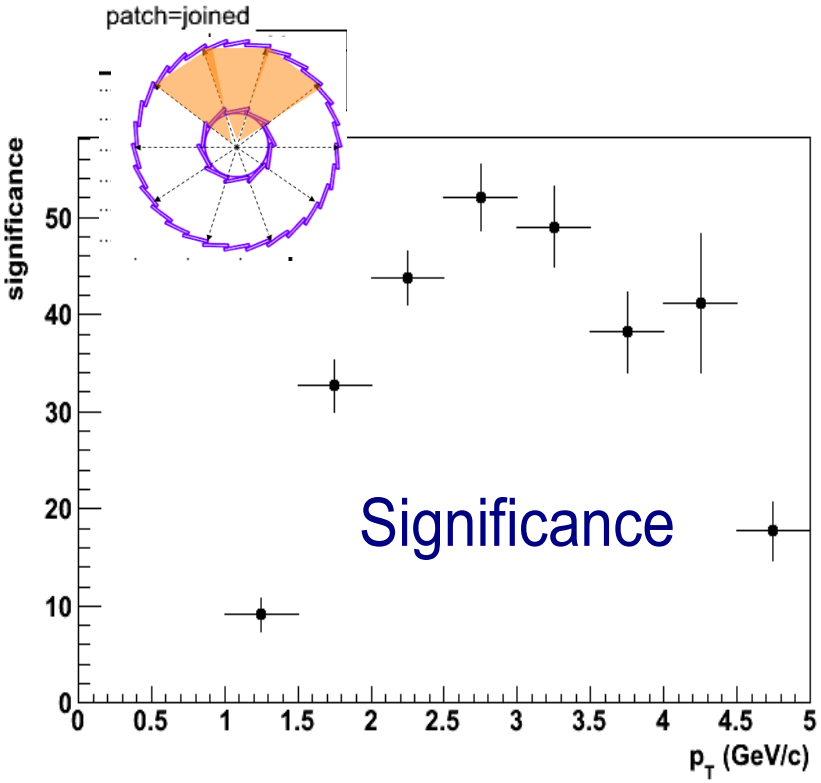




acceptance D0

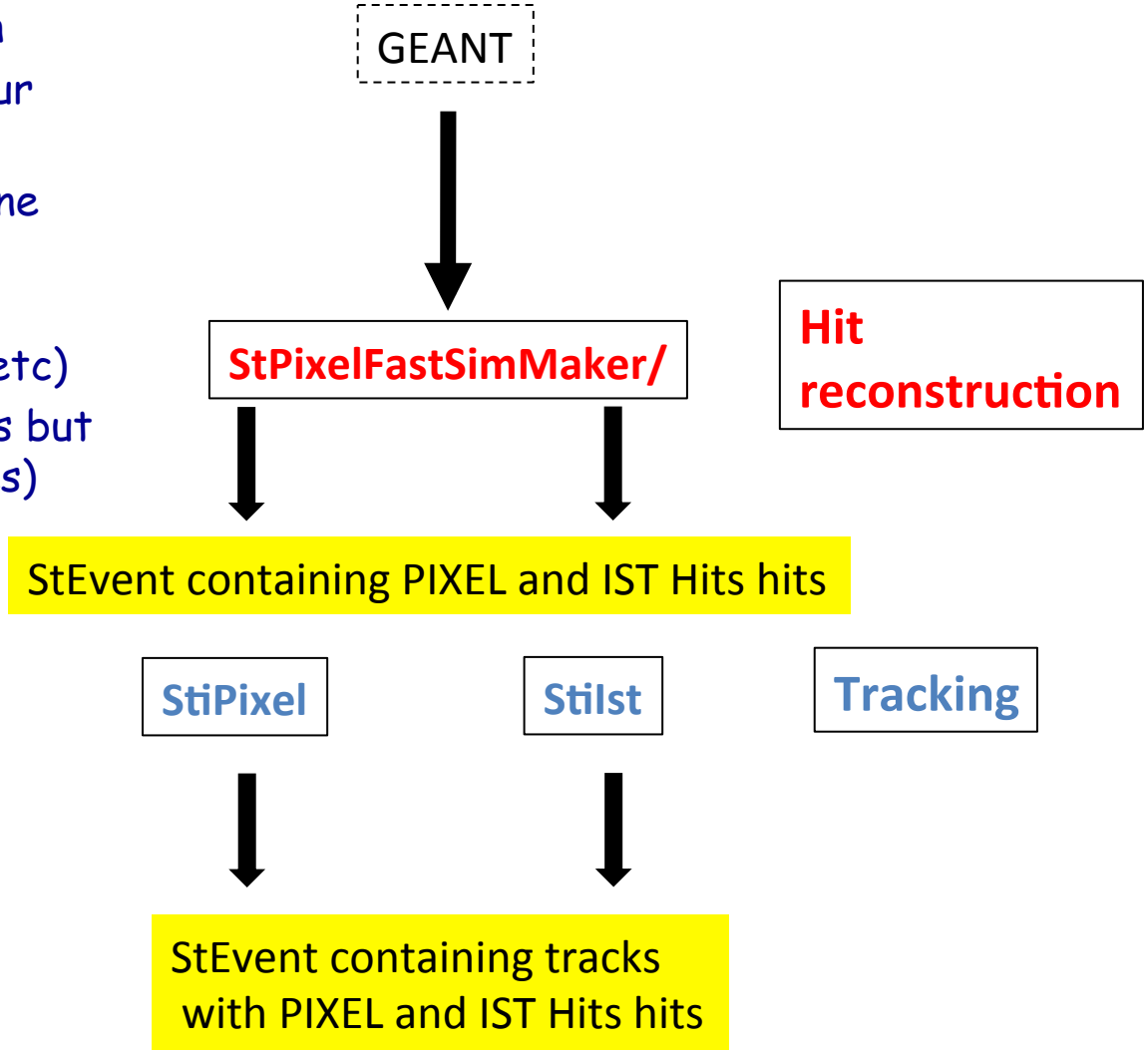
BUR (Hao) results based on full simulations

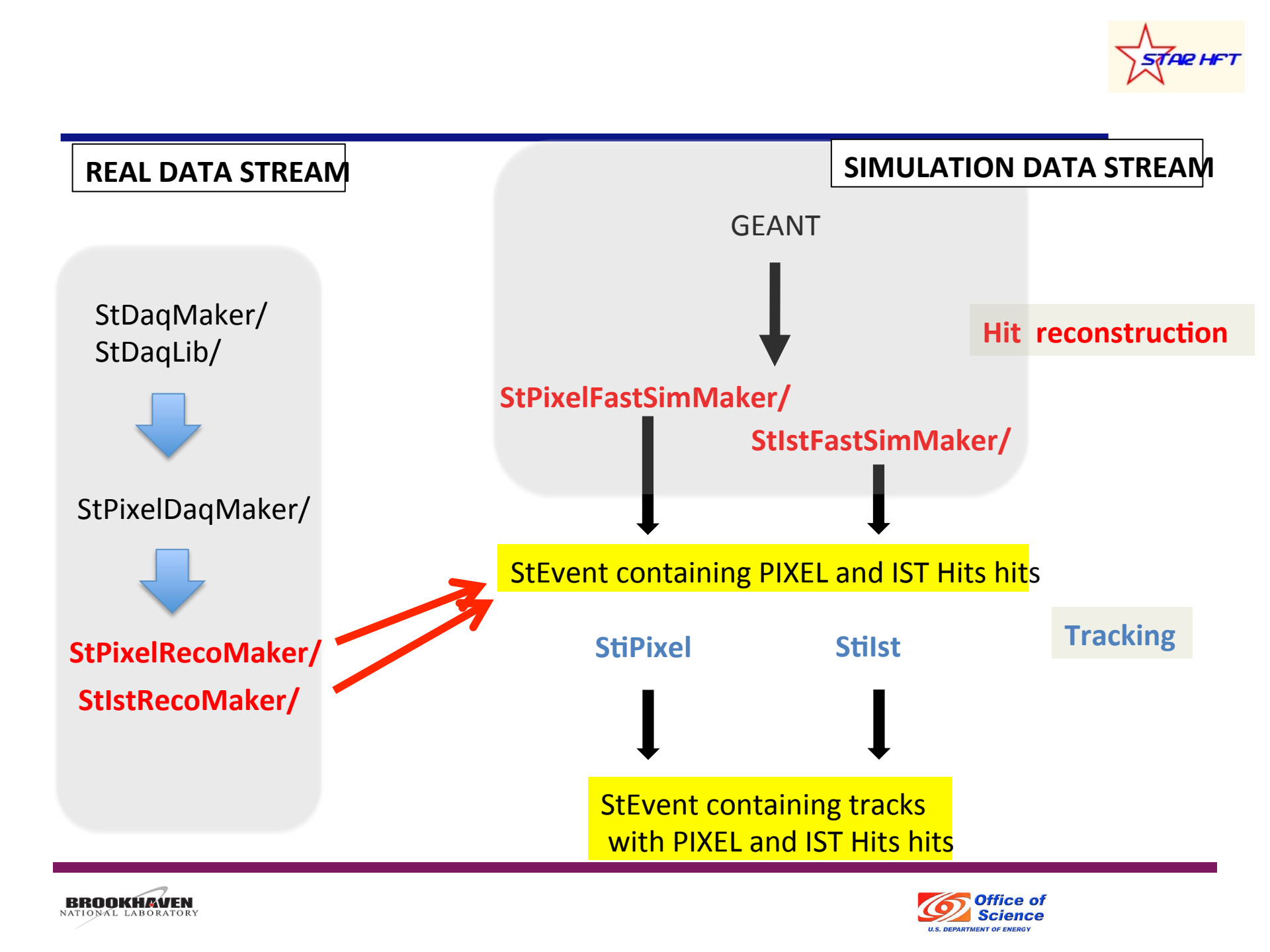


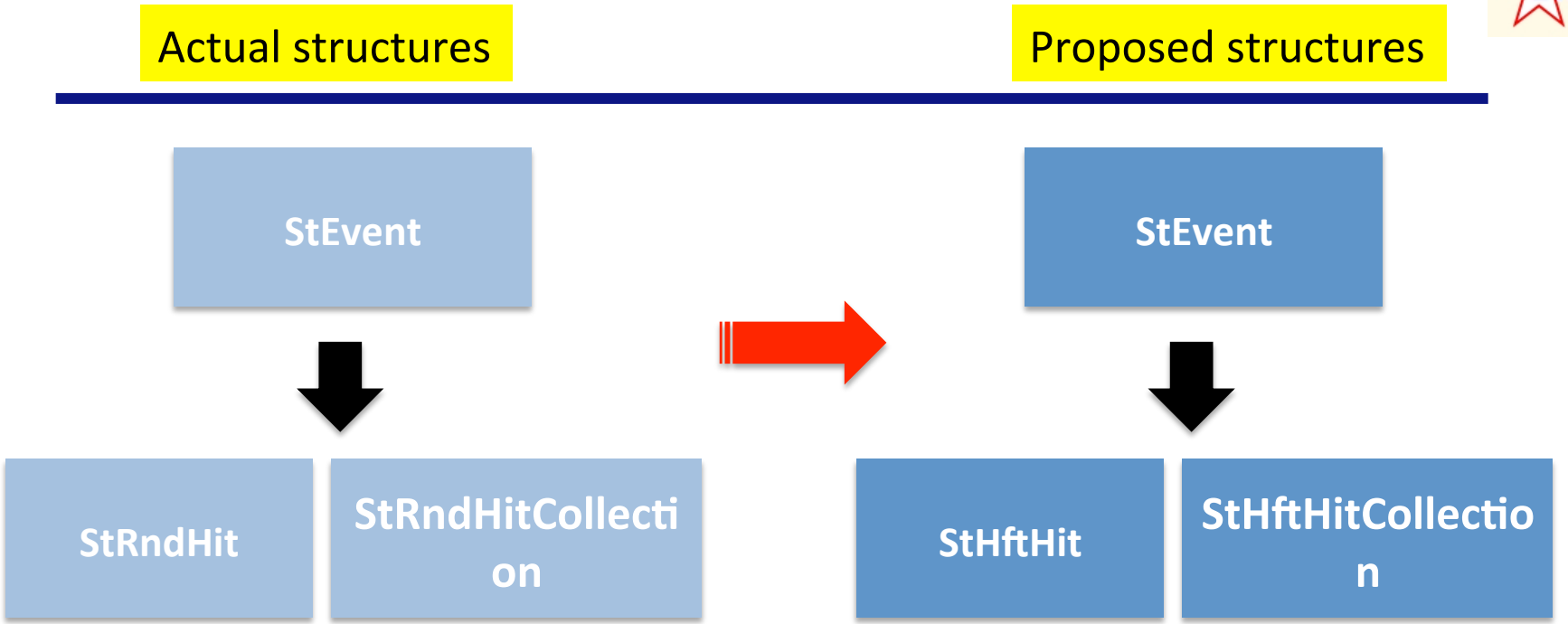


Offline chain

- Need to establish working chain
- Modify structures/makers to our needs
- Closely tied to S&C territory, one needs to be careful
- Need to stay informed on new strategies (e.g. no minimc need etc)
- We 've gone through initial loops but far from being done (see 2 slides)
- Expert help invaluable



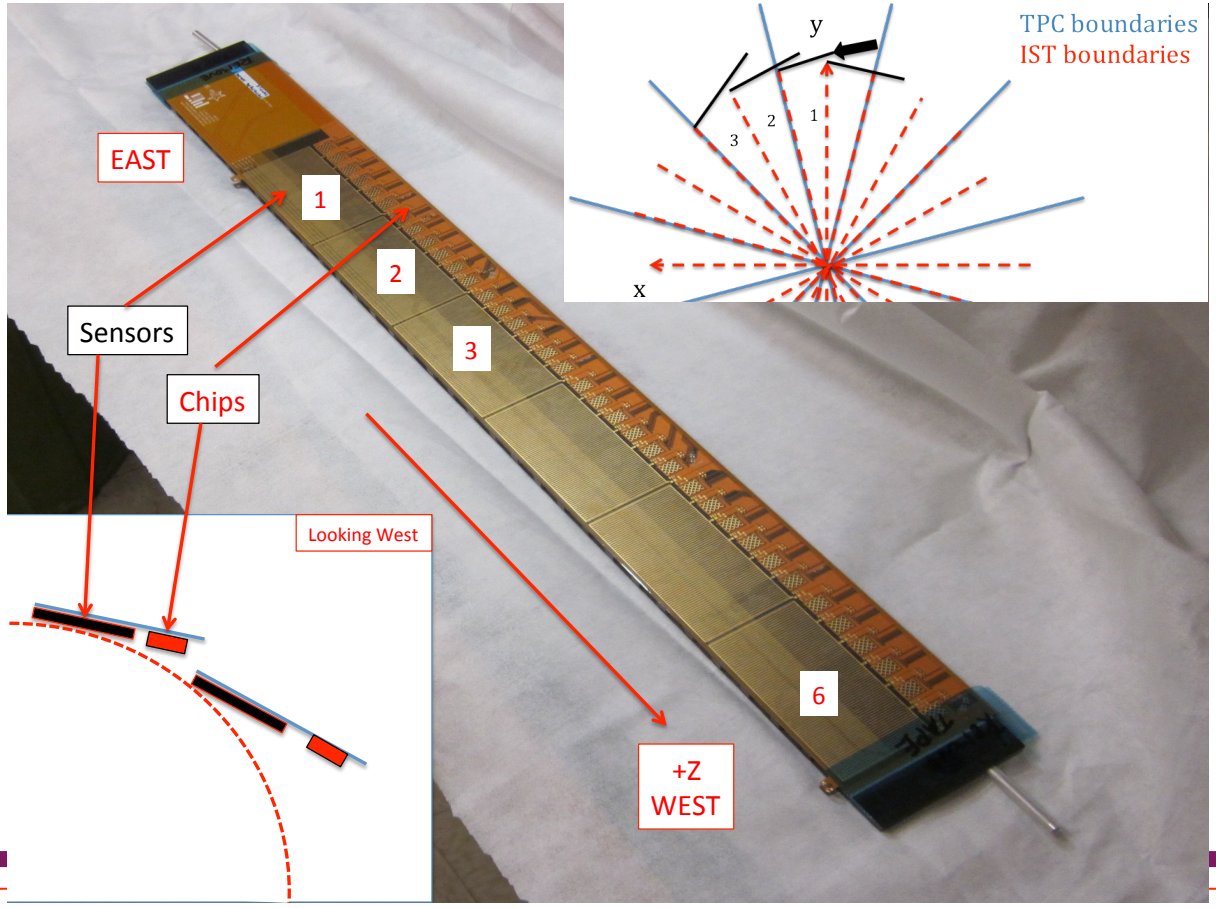

REAL DATA STREAM
SIMULATION DATA STREAM
GEANT
StDaqMaker/
StDaqLib/
StPixelDaqMaker/
StPixelRecoMaker/
StIstRecoMaker/
StPixelFastSimMaker/
StIstFastSimMaker/
Hit reconstruction
StEvent containing PIXEL and IST Hits hits
StiPixel
StiIst
Tracking
StEvent containing tracks
with PIXEL and IST Hits hits



- A unique **PIXEL/IST** hit structure and hit collection
- No sub collection (LayerHitCollection, SectorHitCollection) because it is redundant :
  - Make the hits collection ***isSortable()*** to retrieve the hits the way we want.

•Numbering convention for detector elements

- We have defined and documented the scheme for all HFT elements
- Complies with STAR conventions
- IST example is shown below



http://drupal.star.bnl.gov/STAR/event/2012/03/09/hft-software/hft-numbering-schemedoc-10

Miscellaneous

- Simulation environment (UPC e^- background, Pileup mechanism)
  - We did improve our understanding and way of generating this
  - We still need to put all this to work with STAR's official pileup scheme
- Event vertex finders
  - Important evaluation work goes on now
- Web Docs
  - Jonathan and I are organizing better our Off-Drupal personal doc areas
  - Jerome provided an afs area for Off-Drupal (really public) access
  - Drupal pages need rework from scratch

Still to do

–Besides things I have already mentioned above

- Raw data unpackers/Cluster-Hit finders
- Tests of new STV tracker, VMC environment
- 'Online' data format/slow controls/online QA/Db considerations

- **Make sure we are ready when data starts flowing**

Software task		BNL	IPHC	UCLA	KSU	NPI	~~MXT~~ UIC	LBL	Purdue	USTC
Offline										
Hit Reconst.	IST						X			
	Pixel							X	X	
Tracking		X	X							
Event Vertex		X			X	X				
Decay Vertex		X	X		X	X				X
Calibration Db	SSD	X			X			X		
	IST	X					X			
	PXL	X						X	X	
Alignment	SSD	X			X			X		
	IST	X			X		X			
	PXL	X			X			X	X	
Simulation										X
Geometry	SSD	X			X			X		
	IST	X					X			
	PXL	X						X		
Fast/Slow Sim.	SSD				X			X		
	IST				X		X			
	PXL		X					X	X	
Embed./Pileup	IST				X		X	X	X	X
Assoc/Analysis		X			X	X				

NEEDS UPDATE

Summary

- …

Charge for Review

1. Technical: Is the design of the STAR HFT MIE technically sound? Are there plans in place for resolving any remaining technical issues to meet the CD-4, *Approve Start of Operations*, performance requirements?

2. Cost, Schedule, Risk, and Contingency: Are there adequate resources to complete the project within the cost and schedule of the approved performance baseline? Is there adequate cost and schedule contingency to address the remaining risks?

3. Management: Is the project being properly organized, staffed, and managed for its successful execution? Are plans being developed for the transition to operations and for achieving optimal performance following project completion?

4. ES&H: Are ES&H aspects being properly addressed? Are Integrated Safety Management Principles being followed?

5. Prior Reviews: Has the project responded appropriately to the recommendations from previous reviews?