HFT Geometry Update

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HFT-PEP

Parameter	Threshold value	Optimal value
Pointing resolution of HFT system (750 MeV/c kaons)	≤60 μm in the r-phi plane and Z	~45 μm in r-phi plane and Z
Single-track efficiency for HFT system, requiring PXL hits on both layers. (1 GeV/c pions)	≥ 60%	≥ 75%

If [beam verification] fails, the capability of the HFT system to achieve the KPPs will be demonstrated through the measurement of subsystem functional parameters and detailed, realistic simulations using the full STAR detector simulation package and analysis software.

…

The pointing resolution in r-phi and Z directions can be calculated with the full STAR detector simulation based on the design parameters, as-built dimensions, and from the results of surveys of the sensor ladders.

…

The single-track efficiency will be calculated using the full STAR simulations package with input taken from the design parameters and as-built dimensions of the detector.

HFT-PEP

Issues

- What we have now
- The next wave as detector designs freeze
  - Anticipated timeline
- Framework (Jason)
- Importance (example)
- Resource overview and needs

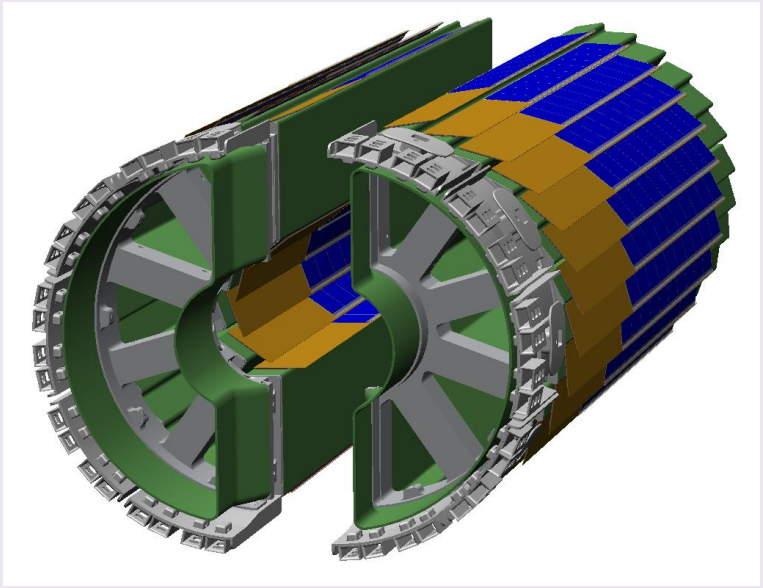
Software task		BNL	IPHC	UCLA	KSU	NPI	MIT	LBL	Purdue	USTC
Offline										
Hit Reconst.	IST						X			
	Pixel							X	X	
Tracking		X	X							
Event Vertex		X	X		X	X				
Decay Vertex		X	X		X	X				X
Calibration Db	SSD	X			X			X		
	IST	X					X			
	PXL	X						X	X	
Alignment	SSD	X			X			X		
	IST	X			X		X			
	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				

ID	Task-name	Duration	Begin-Date	Predecessors	Resources %-Person/FTE
1.6.5.2.2	IST Global Align.	3(1) months	09/01/2011		100/0.3(0.1)
1.6.5.2.3	SSD Global Align.	3(1) months	09/01/2011		100/0.3(0.1)
1.6.5.3	SELF Alignment	9(4) months	09/01/2011	1.6.2.1/1.6.2.2	***100/0.8(0.2)***
1.6.5.3	Test/Verify	3(2) months	09/01/2011	1.6.2.1/1.6.2.2	***100/0.3(0.1)***
1.6.6	**Database/HFT Geometry[4]**	**36 months**	**09/01/2010**		**300/1.1(0.4)**
1.6.6.1	PIXEL Geometry	6(3) months	09/01/2011		100/0.3(0.1)
1.6.6.2	IST Geometry	6(3) months	09/01/2011		100/0.5(0.2)
1.6.6.3	SSD Geometry	3(2) months	09/01/2011		100/0.3(0.1)
1.6.7	**Response Simulators[5]**	**36 months**	**09/01/2010**		**200/0.8(0.3)**
1.6.7.2	IST Simulators	6(3) months	09/01/2011		100/0.5(0.2)
1.6.7.3	SSD Simulators	3(2) months	09/01/2011		100/0.3(0.1)
1.6.8	**Embedding/Assoc.**	**36 months**	**09/01/2011**	**1.6.6/1.6.7**	**100/0.5(0.2)**

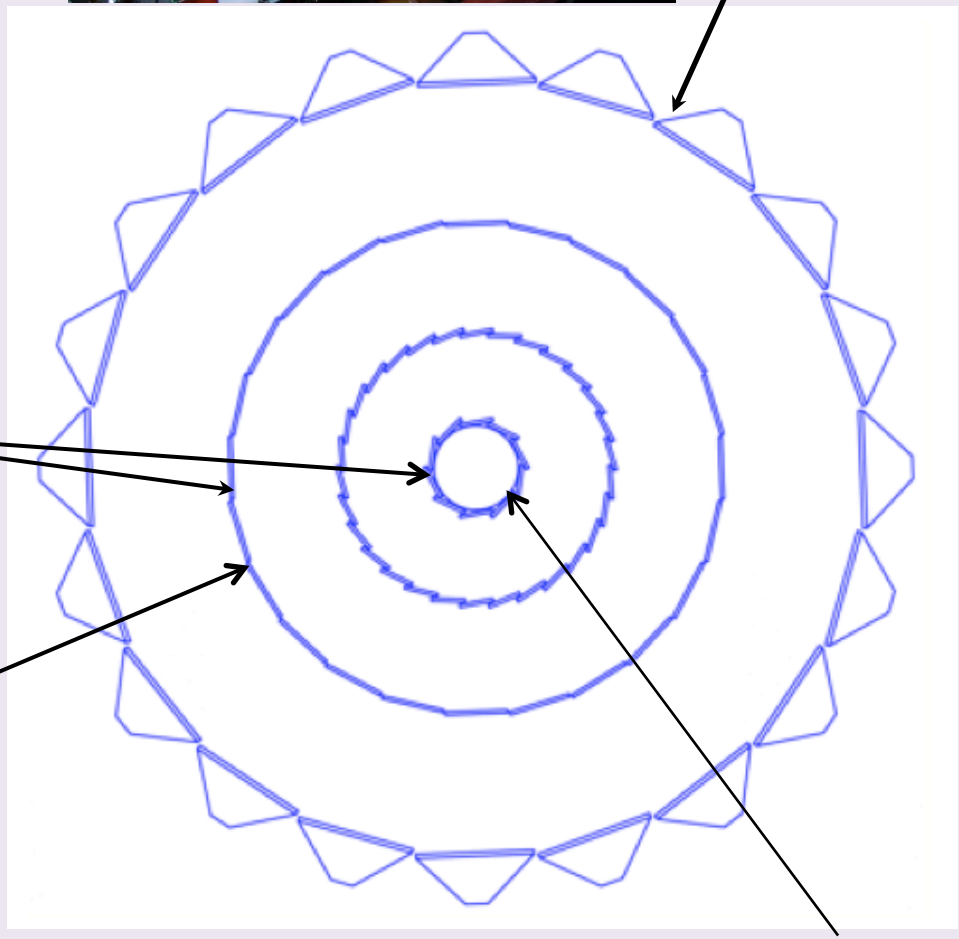
[4] The estimated effort doesn't include possible/major infrastructure changes.
[5] The effort for PIXEL response simulator is included in the Hit Finder task. We did not account efforts for possible very-slow simulator development.

HFT Elements

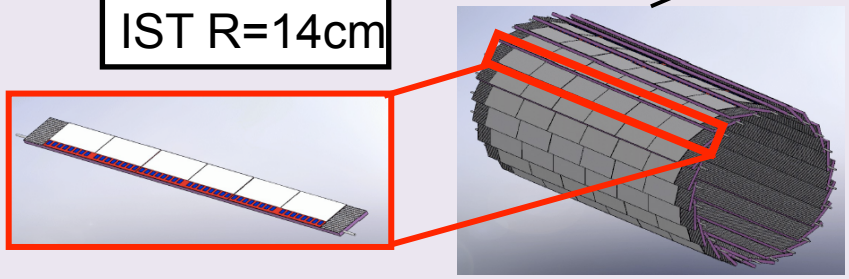
SSD+ R=22cm



Pixel 1-2 R=2.5, 8cm



IST R=14cm



New beam pipe

- We need design drawings
  - Need $\langle X_0 \rangle$ estimates in sandwiched areas (glue etc)
  - Decide on appropriate abstraction level (see SVT example later)

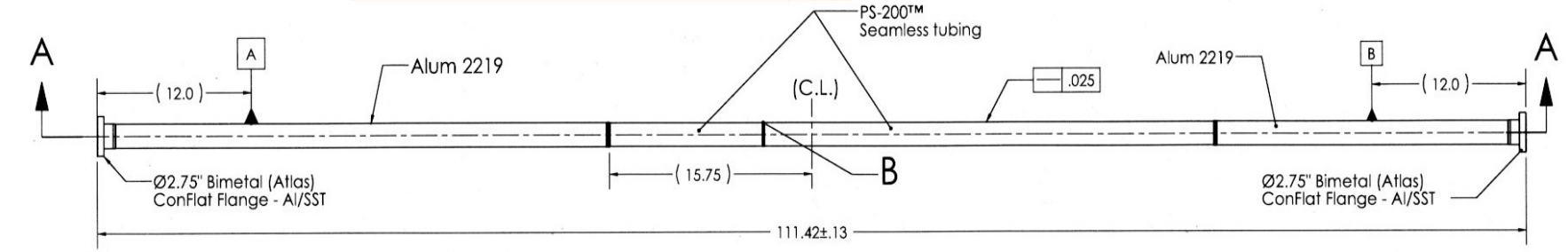
- If 2-3 people devote 20-30% of their time to this I anticipate substantial progress in the next half year

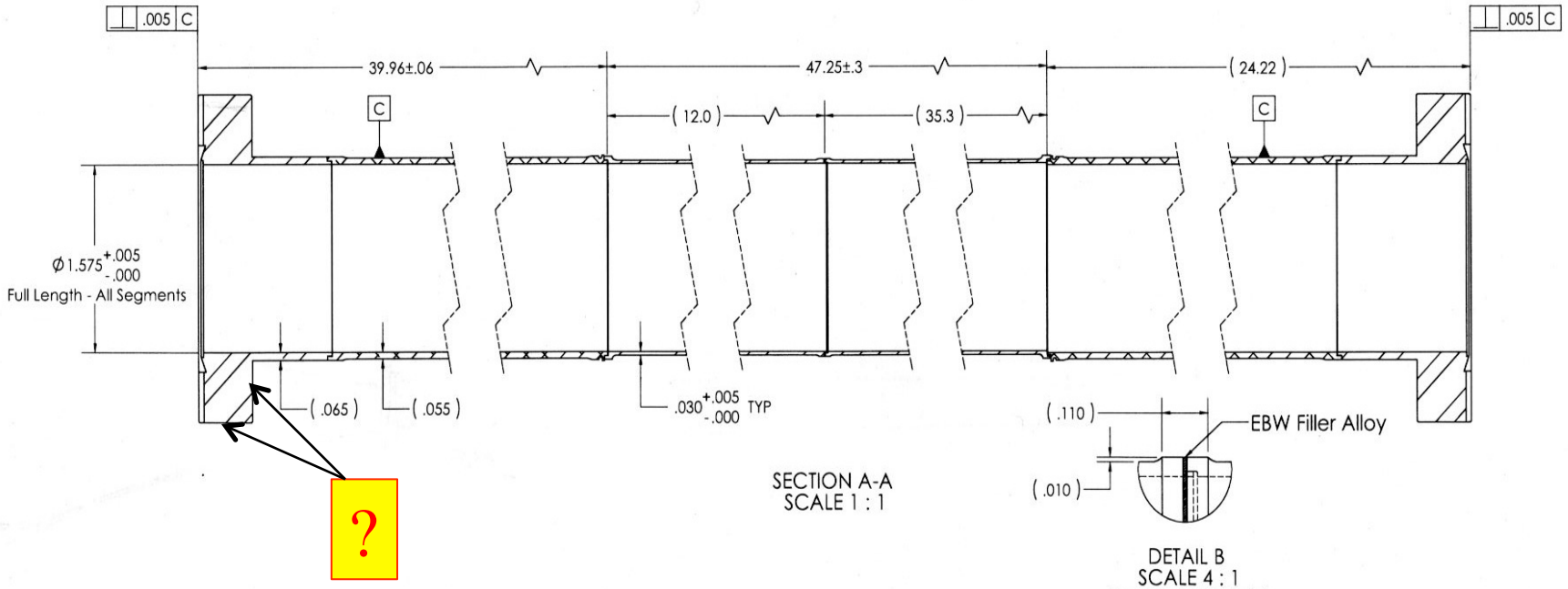
Customer Approval:

(signature) (date)

New Beam Pipe

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
.	A	Initial release.	3/22/10	D. Harris
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.





SECTION A-A
SCALE 1 : 1

DETAIL B
SCALE 4 : 1
Be / Be EBW Joint

NOTES:
1. MATERIAL: BERYLLIUM PS-200™, 2219 ALUMINUM, Al/SST NON-ROTATABLE CONFLAT FLANGES AS SPECIFIED.
2. ASSEMBLY TO BE BAKEABLE TO 250° C.
3. ASSEMBLY TO BE VACUUM TIGHT: MASS SPEC. LEAK RATE NOT TO EXCEED 1 E-10 Std cc/sec He.
4. BERYLLIUM SECTION OD TO BE PASSIVE COATED AND BAKEABLE TO 250°c.
5. ALUMINUM SECTIONS TO BE SINGLE PIECE OR MULTIPLE SEGMENTS, AS REQUIRED TO MAINTAIN STRAIGHTENSS.
6. CONCENTRICITY OF ID TO OD FOR ALUM AND BERYLLIUM TUBES TO BE ±.003".
7. FLANGE PERPENDICULARITY TO BE DETERMINED RELATIVE TO THE ALUMINUM SEGMENT IT IS JOINED WITH.
8. STRAIGHTNESS TO BE MEASURED WITH ASSEMBLY SIMPLY SUPPORTED AT DATUMS A AND B.

INTERPRET DRAWING PER ANSI Y14.5 M-1994.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTION ±1/16
ANGLES ±0.5
.XX ±0.03
.XXX ±0.005
FINISH (Ra): 63

BW-ELECTROFUSION PROPRIETARY
INFORMATION INCLUDED IN THIS DOCUMENT NOT TO BE DISSEMINATED WITHOUT PRIOR WRITTEN AUTHORIZATION.

	NAME	DATE
DRAWN	D. HARRIS	3/19/10
ENG APPR.	.	.

CUSTOMER: BROOKHAVEN NAT'L LABS
MATERIAL: AS NOTED

BRUSHWELLMAN
Electrofusion Products

TITLE: EB WELD BEAM PIPE
STAR

SIZE	DWG. NO.	REV
B	30006	A

SCALE: 1:12 | DO NOT SCALE DRAWING | SHEET 1 OF 1

Beam Pipe

Beam Pipe Test XML Code

```
<Document file="StarVMC/Geometry/TestGeo/TestGeo3.xml">

<Module name="TestGeo3" comment="Test of paramterized placer

 <Author name="Amilkar Quintero" />
  <Created date="29/Jun/2011" />

 <!-- What is this?-->
  <CDE>
  AGECOM,GCUNIT,GCONST
  </CDE>

  <!-- Declare all volumes -->
  <Content>
     PIPE,PALU,PBER
  </Content>

  <!-- Pipe versioning information -->
  <Structure name="PIPV">
      <var type="float" name="version" />
      <var type="int"   name="config"  />
  </Structure>

  <!-- Pipe geometry information -->
  <Structure name="PIPG">

      <var type="float" name="version" />
      <var type="float" name="zoffset" />
      <var type="float" name="yoffset" />
      <var type="float" name="xoffset" />

      <var type="float" name="zoffber" />

      <var type="float" name="vacdens" />
      <var type="float" name="zslice(14)" />
      <var type="float" name="rmin(14)" />
      <var type="float" name="rmax(14)" />
  </Structure>

  <Export language="Mortran">
     REAL INCH/2.54/;
  </Export>

  <!-- Fill all structures _after_ declaration of structs and variables -->
  <Fill name="PIPV" comment="Pipe version" >
     <var name="version" value="1.0" comment="2.0 version of the beam pipe"/>
     <var name="config"  value="1"   comment="Configuration is one" />
  </Fill>

  <Fill name="PIPG" comment="Pipe geometry">
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      <var name="vacdens" value="1.25E-8" comment="Vacuum density... needs to be verified" />

      <var name="xoffset" value="0.0" comment="Default x position " />
      <var name="yoffset" value="100.0" comment="Default y position " />
      <var name="zoffset" value="0.0" comment="Default z position " />

      <var name="zoffber" value="-15.75*2.54" comment="Offset of beryllium" />

      <var name="zslice"  comment="Z slices in the pipe :: flange length is unknown ::"  value="{-55.71 *
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inch, 31.5 * inch, 43.72 * inch, 43.72 * inch, 54.71 * inch, 54.71 * inch, 55.71 * inch }" />
```
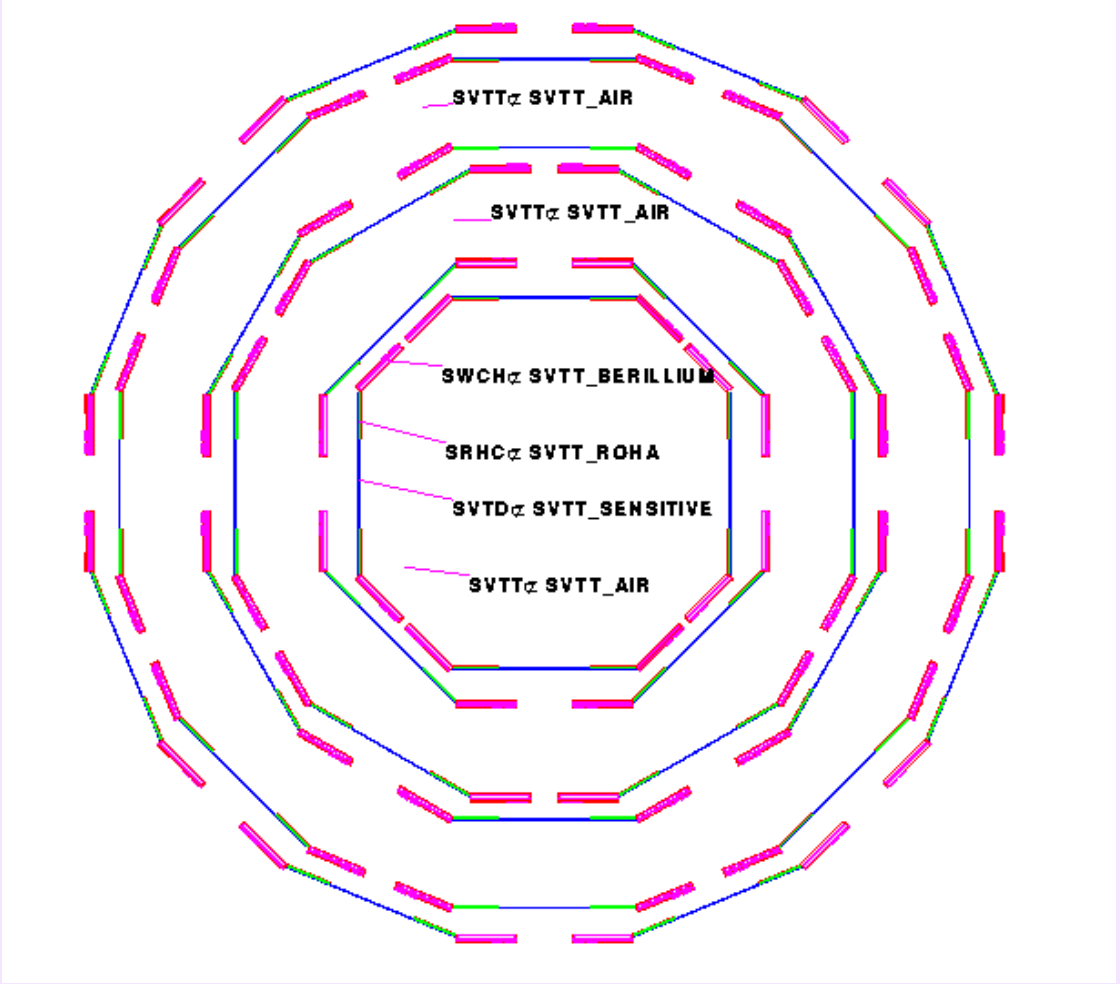
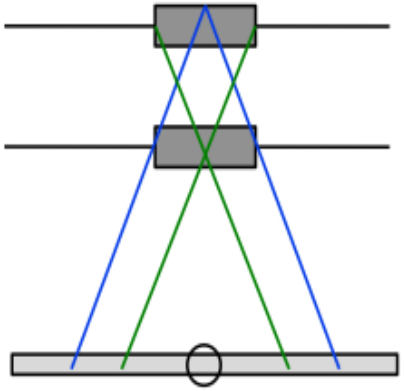
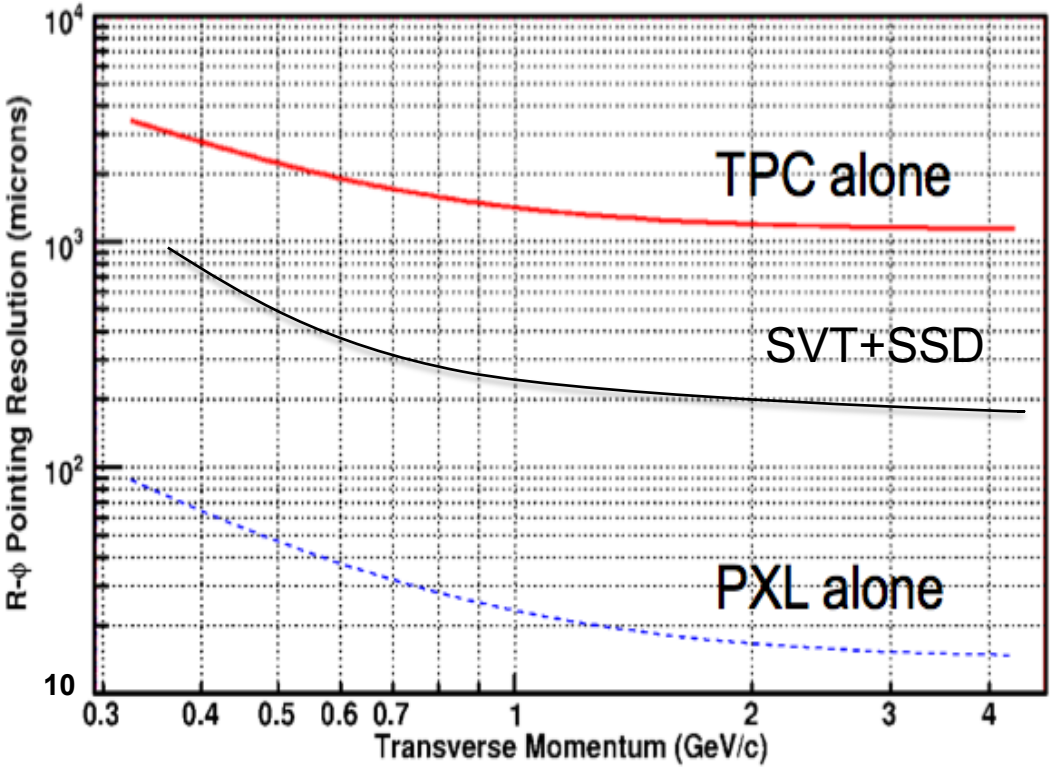

- SVT – an example of abstraction
- Detail matters (see next few slides as an example)



Projection error is a strong function of first-layer distance and thickness

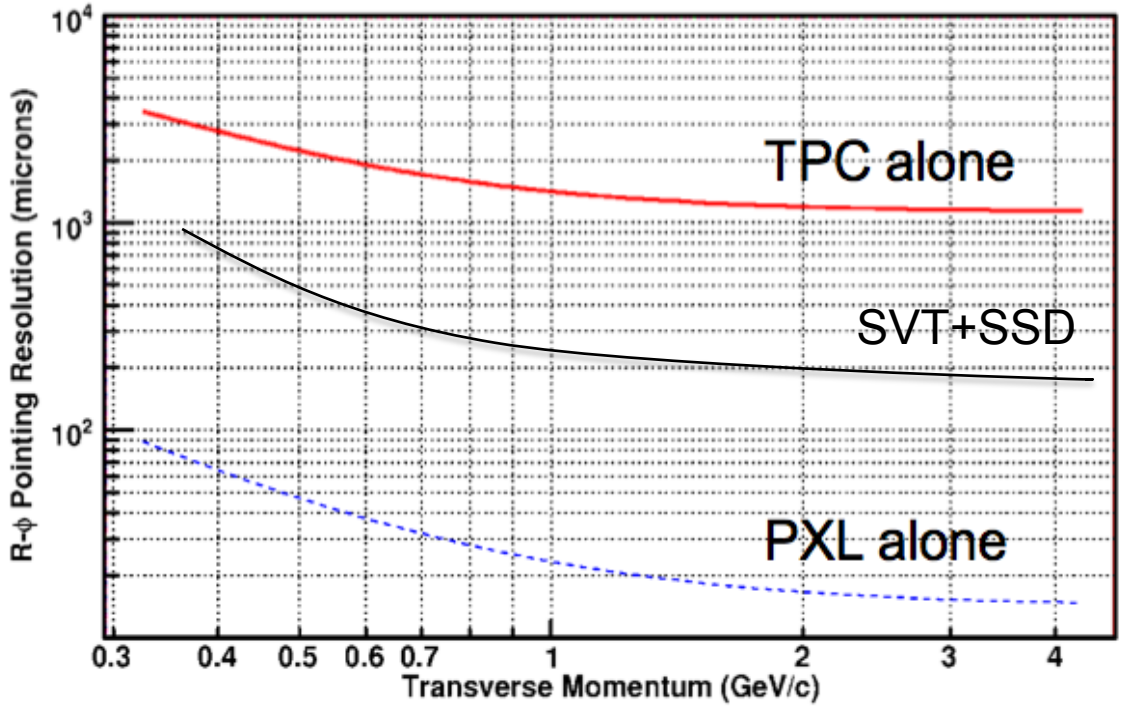




$$\sigma^2 = \frac{\sigma_1^2 r_2^2 + \sigma_2^2 r_1^2}{(r_2 - r_1)^2} + \frac{\theta_{mcs}^2 r_1^2}{\sin^2(\theta)}$$

$$\theta_{mcs} = \frac{13.6\,(MeV/c)}{\beta\ p}\sqrt{\frac{x}{X_0}}$$

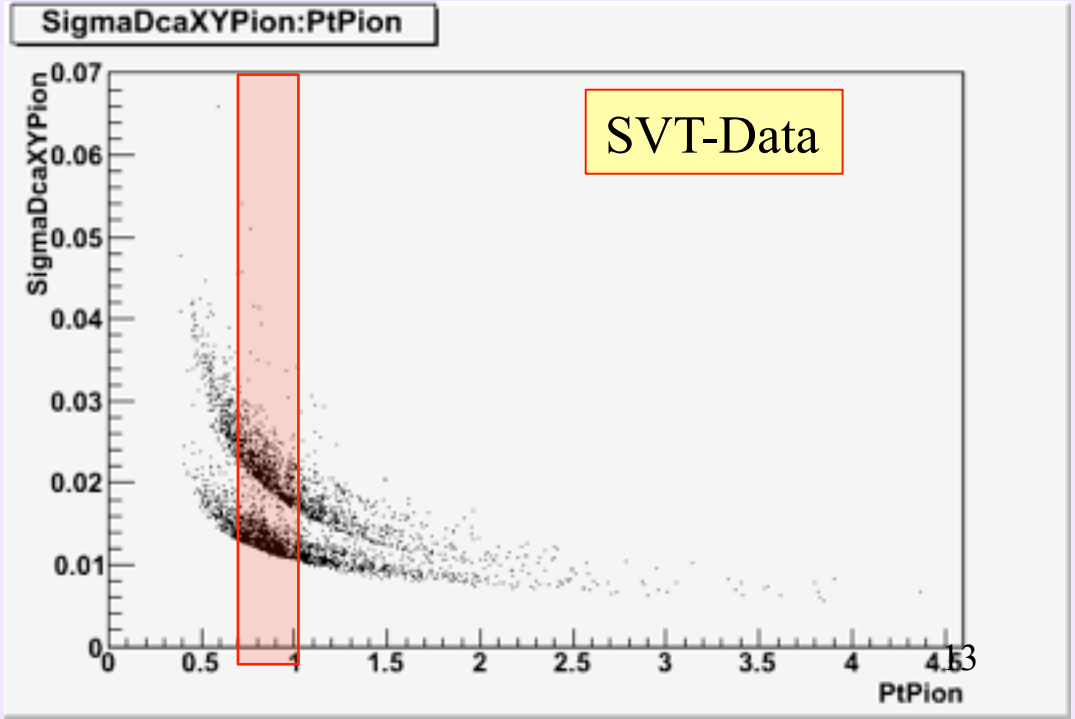
- **In the critical region for Kaons from D^0 decay, 750 MeV to 1 GeV, the PXL single track pointing resolution is predicted to be 20-30 μm … which is sufficient to pick out a D^0 with $c\tau$ = 125 μm**
- **The system (and especially the PXL detector) is operating at the MCS limit**

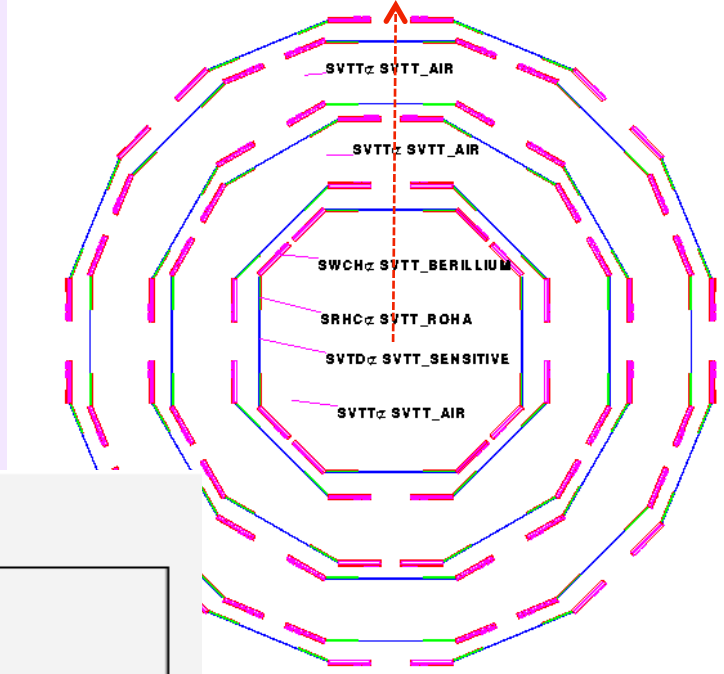


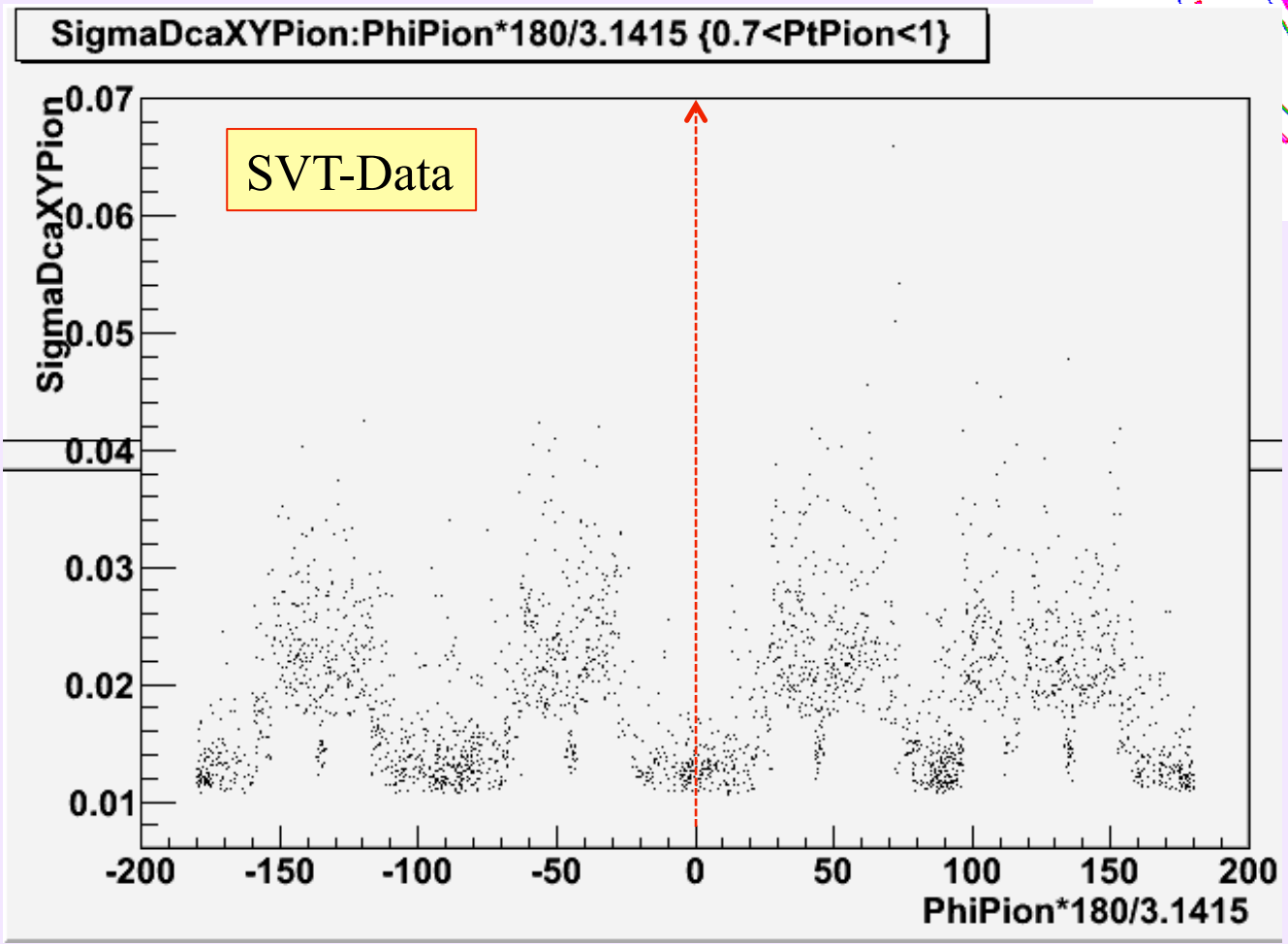
DCA -XY

Simplified

Realistic




SVTT SVTT_AIR
SVTT SVTT_AIR
SWCH SVTT_BERILLIUM
SRHC SVTT_ROHA
SVTD SVTT_SENSITIVE
SVTT SVTT_AIR


SigmaDcaXYPion:PhiPion*180/3.1415 {0.7<PtPion<1}
SVT-Data
SigmaDcaXYPion
0.07
0.06
0.05
0.04
0.03
0.02
0.01
-200
-150
-100
-50
0
50
100
150
200
PhiPion*180/3.1415

Summary

- We are ready to move on
- We need interaction with the engineers:
  - To get the design drawings
  - For $\langle X_0 \rangle$ estimates in sandwiched areas (glue etc)
  - Decide on appropriate abstraction level

- If 2-3 people devote 20-30% of their time to this I anticipate substantial progress in the next half year