

WG4 Progress Report

R. Santoro, A. Tauro

Chapter V (I)

5	Mechanics, Services and Integration	1
5.1	Introduction and System Overview	1
5.1.1	Present ALICE layout and accessibility to inner detectors	2
5.1.2	Overall requirements for the ALICE ITS upgrade	3
5.2	Conceptual design integration and mechanics	4
5.2.1	Three pixel layers	5
5.2.1.1	The pixel carbon-foam stave	6
5.2.1.2	The pixel polyimide micro-channel stave	7
5.2.1.3	The pixel silicon micro-channel stave	7
5.2.2	Three pixel layers plus n strip layers	8
5.2.2.1	The strip stave	8
5.2.3	Muon Forward Tracker	9
5.2.3.1	Consideration on the barrel and forward acceptance	9
5.2.3.2	Discussion on the option with the conical beam pipe and accessibility consideration	9
5.2.3.3	Integration with the actual forward detectors	9

Present ITS

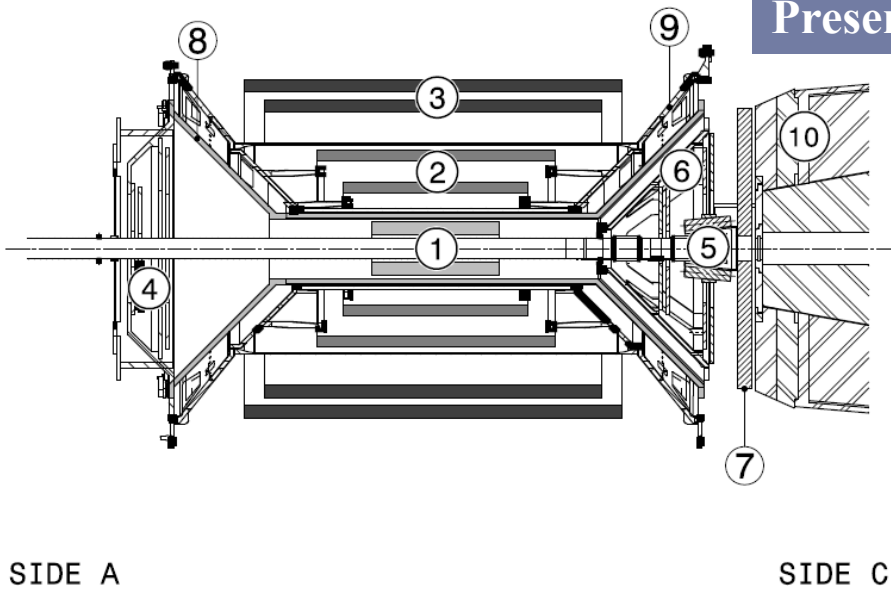
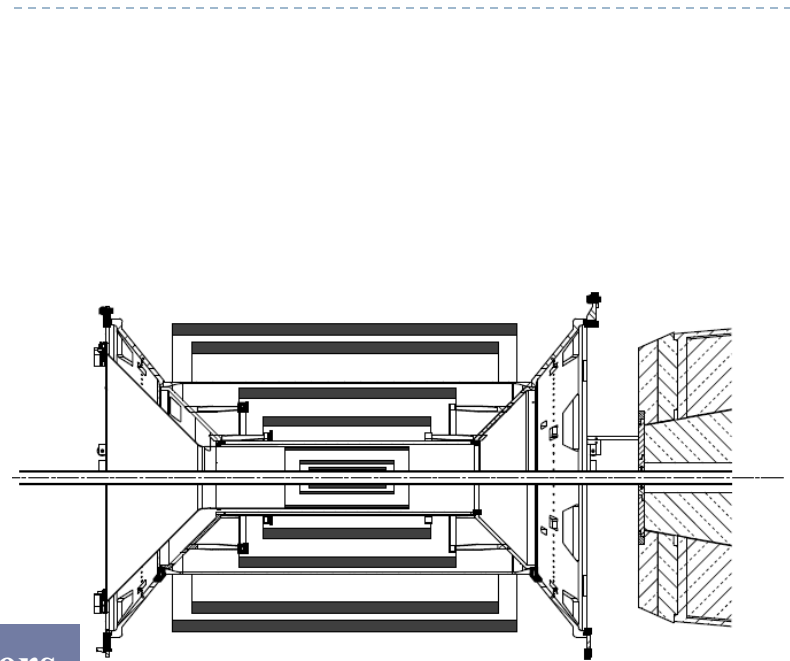


Figure 5.1: Cross section of the current ITS barrel: (1) pixel detector, (2) drift detector, (3) strip detector, (4) FMD2, (5) T0, (6) FMD3, (7) V0, (8) pixel cone, (9) drift and strip cone and (10) Front Absorber.



New Pixel layers

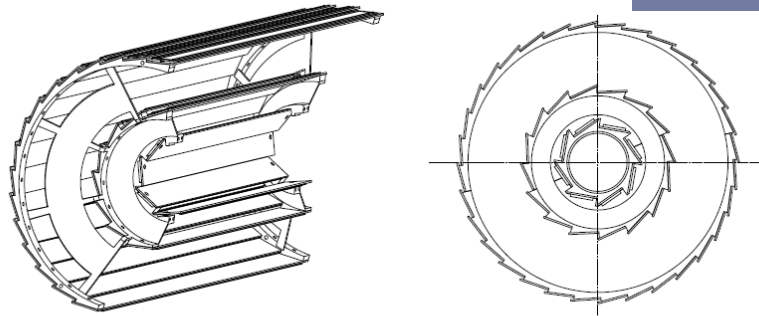


Figure 5.3: 3D view (left) and front view (right) of the new pixel detector.

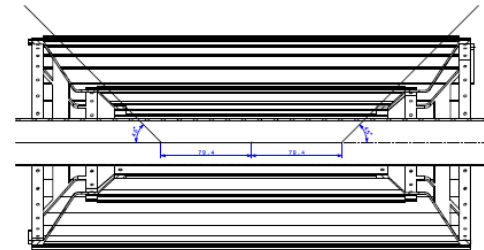


Figure 5.2: Side view of the new pixel detector integrated in the existing ITS (top). A zoom of the 3 pixel layers is also shown (bottom). The length of each pixel is constrained by the coverage in $|\eta|$ considering $\sigma_z = 79.4 \text{ cm}$.

Requirements: 1st scenario

Parameters		
Beam pipe radius	<i>mm</i>	20 (outer radius)
Number of pixel layers		3
Mean radial positions	<i>mm</i>	22, 47, 90
Stave length $\pm z$	<i>mm</i>	210, 270, 370
Power consumption	<i>W/cm²</i>	Less than 0.5
Total material budget per layer	X/X_0 (%)	Less than 0.5

Table 5.1: Requirements for the new three pixel layers

- ▶ Requirements are crucial to define the right strategy especially if we aim for 0.3% of X/X_0 on the first layers
 - ▶ What is the optimal sensor dimension in $r\phi$?
(discussion on-going with Stefan:
<https://indico.cern.ch/getFile.py/access?contribId=7&resId=0&materialId=slides&confId=131413>)
 - ▶ Are the overlap really needed?
 - ▶ What is the expected rigidity from the mechanical point of view?
 - ▶ What is the acceptable gradient in temperature along the sensor?

Requirements: 2nd scenario

Parameters		Pixel	Strip
Number layers		4	3
Mean radial positions	<i>mm</i>	22, 38, 68, 124	235, 396, 430
Stave length $\pm z$	<i>mm</i>	210, 250, 320, 450	670, 1070, 1140
Power consumption	<i>W/cm²</i>	less than 0.5	???
Total material budget per layer	<i>X/X₀ (%)</i>	less than 0.5	less than 1.0

Table 5.2: Requirements for the full ITS upgrade scenario

- ▶ At the moment we didn't started yet with mechanical studies
- ▶ Preliminary discussions have been carried out with the group of Nantes

Chapter V (II)

5.3	Cooling studies	8
5.3.1	Requirements	8
5.3.2	Air cooling	9
5.3.3	Water cooling	9
5.3.4	Other options (CO_2 and C_6F_{14})	9
5.4	R&D and prototyping	9
5.4.1	Carbon foam and carbon fiber structures	9
5.4.2	Polyamide structures	10
5.4.3	Silicon micro channels structures	10
5.4.4	Characterization test for the available prototypes and comparison with the simulations	10

- ▶ At this stage different cooling options are taken in consideration
- ▶ There are simulations on the table for some mechanical structures and we are starting the prototyping phase for some of those
 - ▶ Polyimide micro-channel: first samples under test
 - ▶ Structure with carbon foam: material under procurement

Chapter V (III)

5.5	Services	10
5.5.1	Power distribution	11
5.5.2	Data links (optical fibers and cables)	11
5.5.3	Cooling lines	11



- ▶ Power distribution considerations are needed

Chapter V (IV)

5.6	Beam pipe design	11
5.6.1	Dimensions and tolerances	12
5.6.2	Installation, bake-out and supporting	12
5.6.3	Conical section	12
5.7	Detector installation	12
5.7.1	Installation principle and tooling	13
5.7.2	Replacement of a single pixel or strip stave	13
5.7.3	Alignment and spatial mapping	13

- ▶ **Beam pipe:**

- ▶ Very preliminary discussions have been started


- ▶ **Detector installation:**

- ▶ Conceptual studies have been started:

<https://indico.cern.ch/getFile.py/access?contribId=4&resId=0&materialId=slides&confId=143327>

- ▶ More detailed drawings will come soon

Summary

- ▶ Abstract: completed
- ▶ Draft version of text: is still on-going 
- ▶ The first figures are coming ...

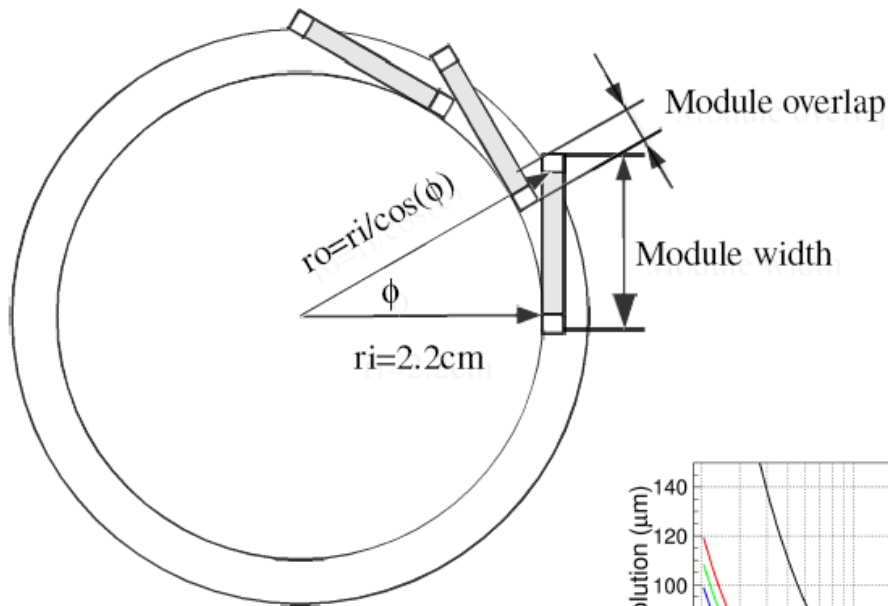
- ▶ The interaction with the other WGs is very important!!!

Spares

Module overlap VS Module width ?

- Question: Is there an optimum regarding these two parameters?

Simulation details



Used sensor properties (in Fast-Tool):

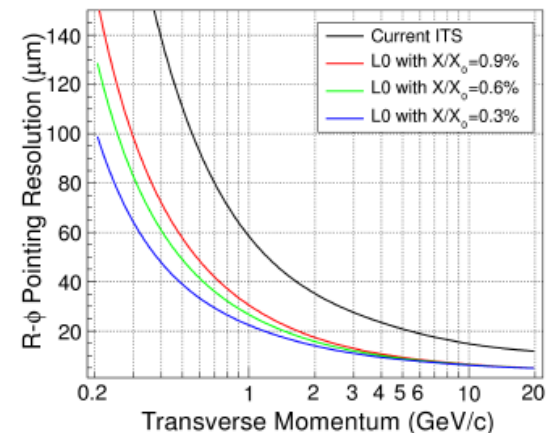
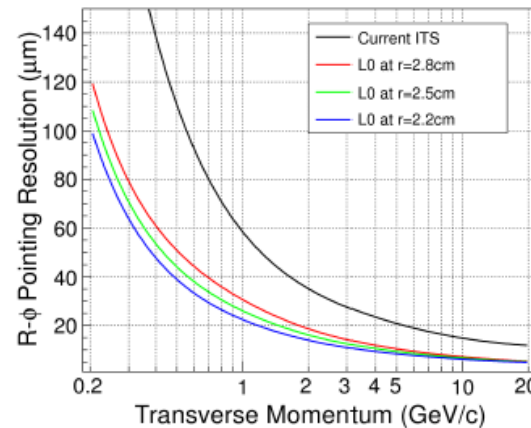
$X/X_0 = 0.3\%$;

Resolution = $4\mu\text{m}$;

Two effects:

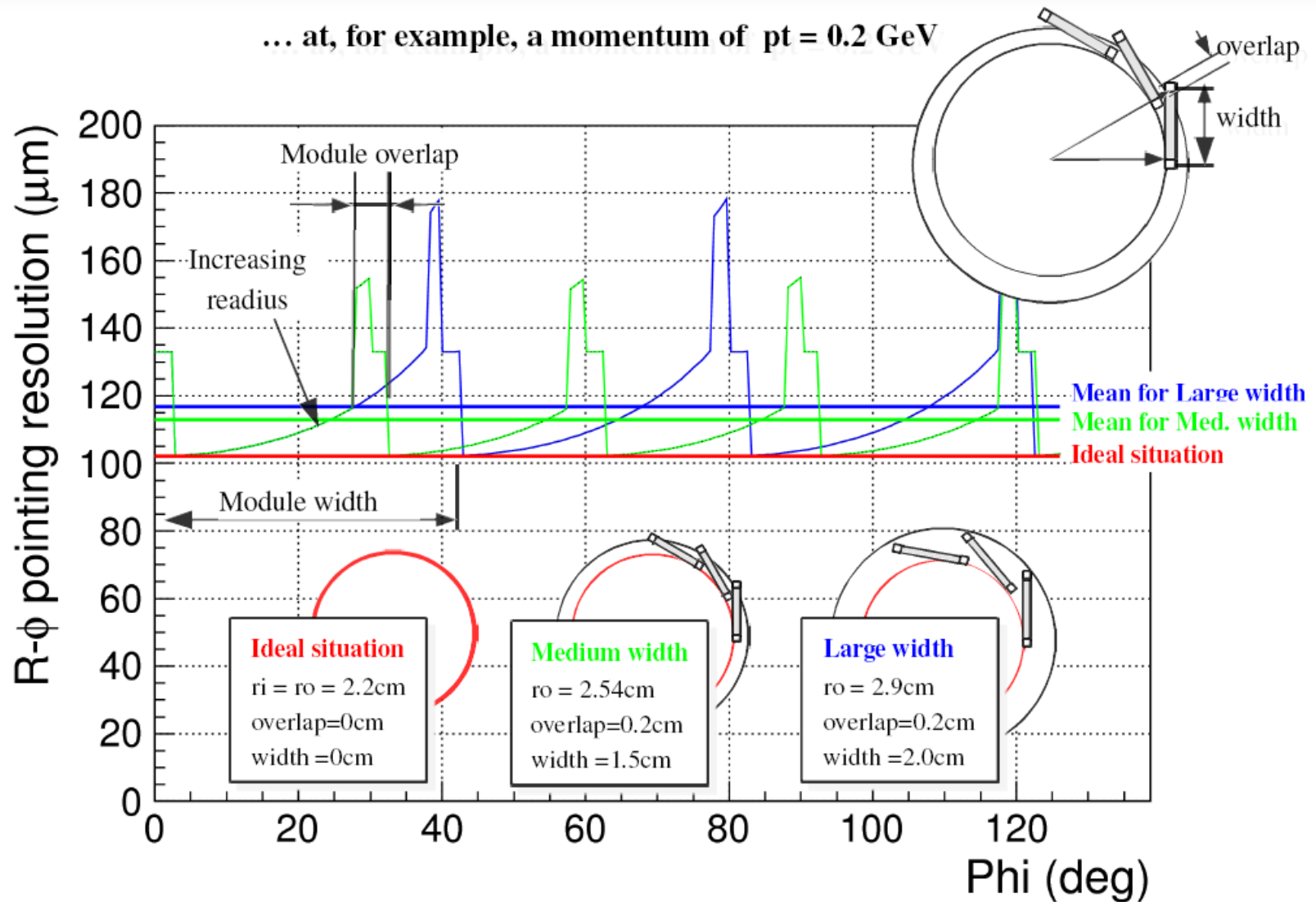
- Increased material budget (x2) with bigger *overlap* ...
- Increasing outer radius r_o with increasing *width*

What is worse? Radius or Material?



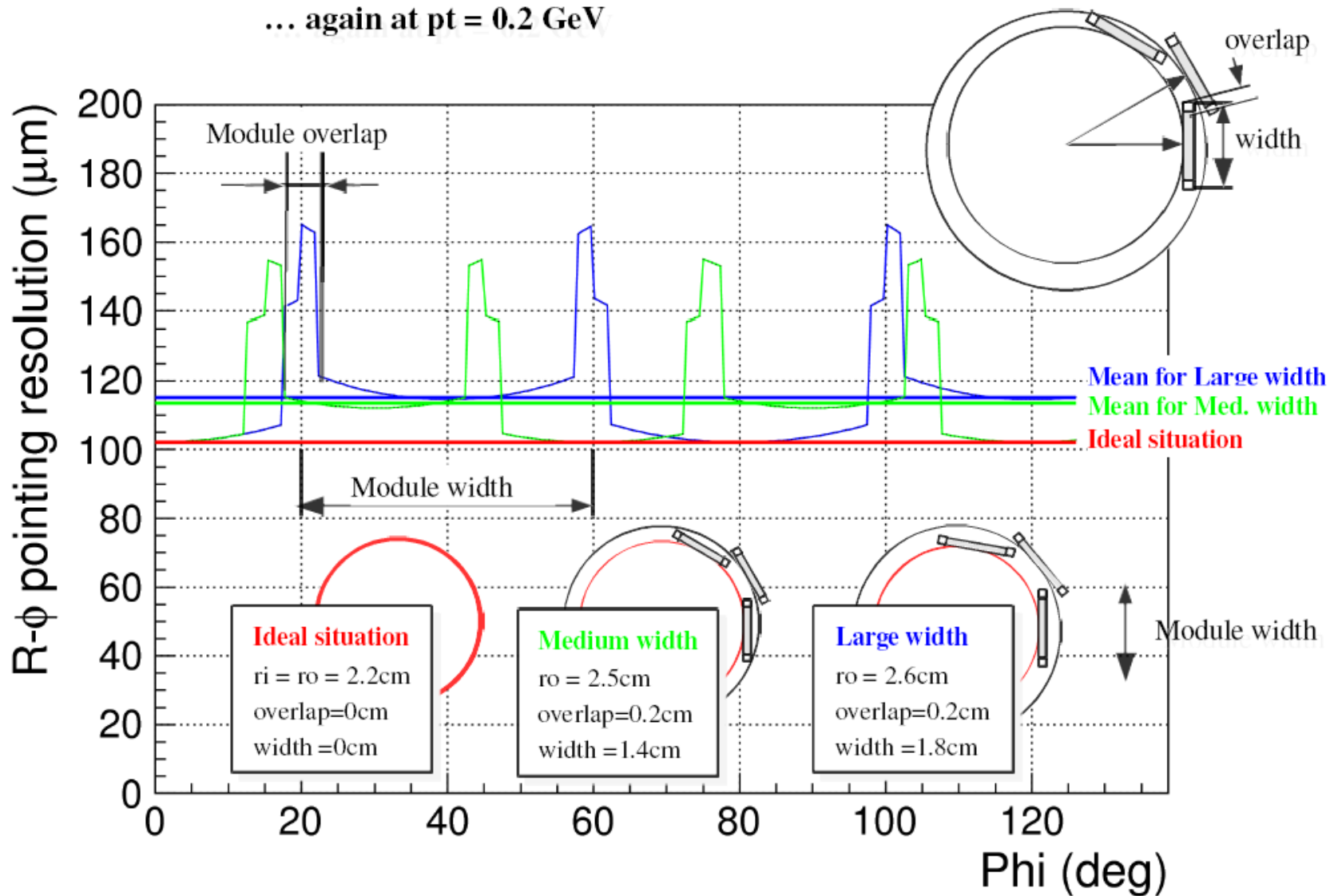
How it looks in azimuthal direction?

... at, for example, a momentum of $pt = 0.2 \text{ GeV}$



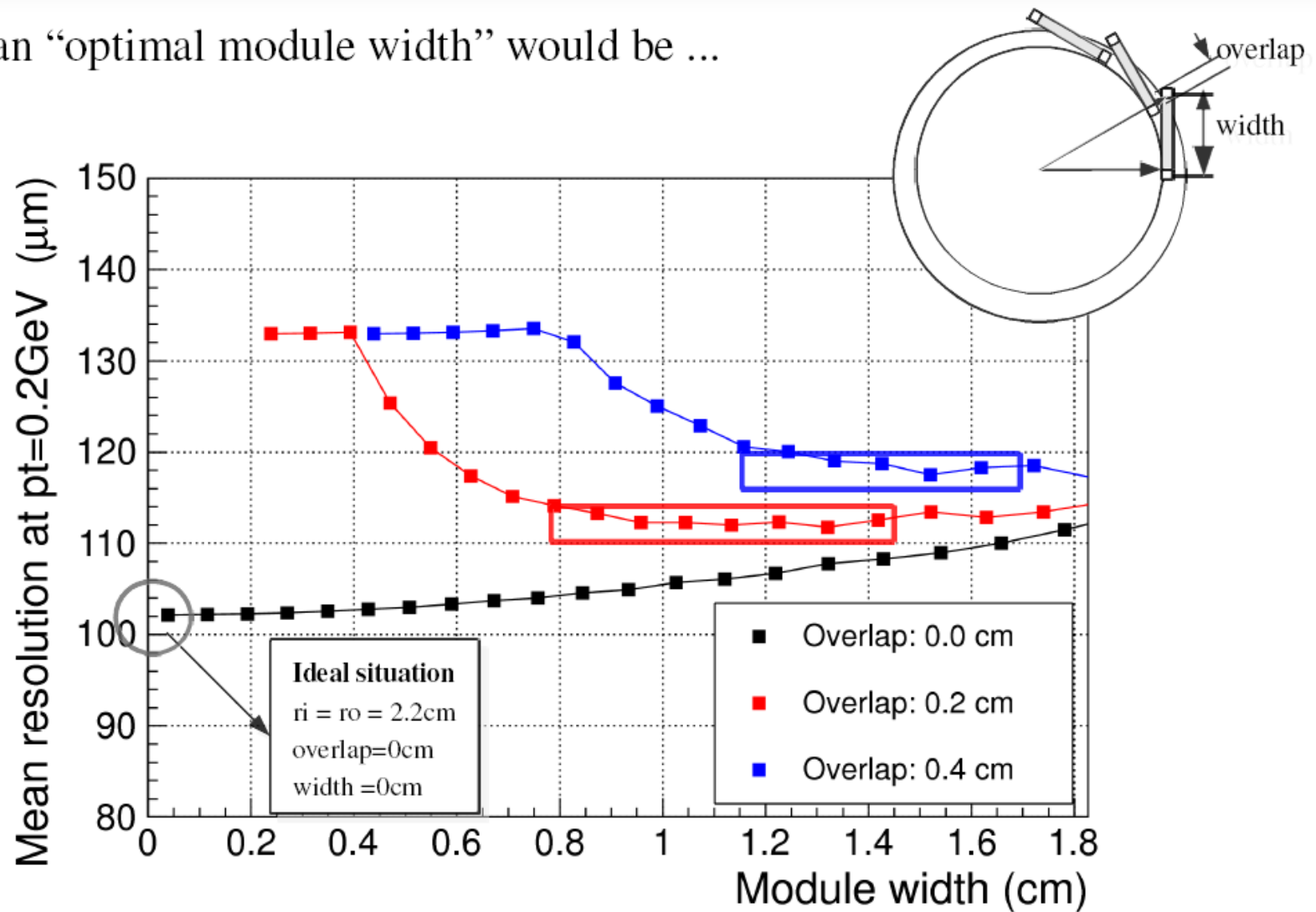
Different angle of the modules?

... again at $pt = 0.2$ GeV



Depending on the overlap ...

... an “optimal module width” would be ...



Again it depends on the overlap ...

Note: I have put in an “artificial clearance” of $dr=2\text{mm}$ between two modules ...

