Evaluation of Hit-Acceptance in the Transition Region of the Barrel and Forward SCT's

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- In a proposed layout of the centre-tap module to the Forward geometry, the modules are arranged so that adjacent modules in a ring are placed in the front and the backside of a disk atlternatively.

- The separation of the alternating modules is, e.g., 20 mm.

- Since half of the modules in a ring is recessed by the amount in the z-direction, we may have chance to loose a hit, specially in the first disk next to the Barrel cylinder, where we can not move the disk to center to recover the loss of the hits.

- In the current Semiconductor Tracker, the number of high precision layers in the Barrel is 6 (not including the inner-most B-Pixel layer). The Forward disks are arranged so that there are more than 6 layers to be hit.

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- In this note, the probability of having more than or equal to 6 (layer-) hits is evaluated for the alternating module layout (Alternative Wheel Desgin). The probability is also called as "Hit-acceptance ($n \geq 6$)".

- Evaluation was done for the straight tracks, having assumptions of :
  1) No acceptance loss in the ϕ direction,
  2) A 2 mm insensitive band (in ϕ) in the center of the 128 cm module length (where the active length was taken to be 123 mm counting for the pair of the 1 mm edge insensitive region and the pair of the 0.5 mm in the overlap of adjacent modules in the z-direction),
  3) Gaussian distribution of the primary interaction points, with a spatial spread of 56 mm in sigma.

- A summary table of geometry, a graphical view of the geometry, and the hit-acceptance ($n \geq 6$) are presented in the following pages.

Table of Geometry

Element	r_inner [mm]	r_outer [mm]	z_left [mm]	z_right [mm]		
Pixels						
Cylinder#1	110.00	-	-384.00	384.00		
Cylinder#2	159.00	-	-384.00	384.00		
Disk #1	110.00	208.40	468.00	-		
Disk #2	110.00	208.40	628.00	-		
Disk #3	110.00	208.40	776.00	-		
Disk #4	159.00	208.40	1075.00	-		
Strips						
Cylinder#1	300.00	-	-750.50	750.50		
Cylinder#2	373.00	-	-750.50	750.50		
Cyliner #3	447.00	-	-750.50	750.50		
Cylinder#4	520.00	-	-750.50	750.50		
			Current z [mm]		Alt Wheel z_front [mm]	z_back [mm]
Disk #1	260.00	560.00	824.50	-	824.50	845.50
Disk #2	322.00	560.00	914.50	-	914.50	935.50
Disk #3	260.00	560.00	1061.50	-	1061.50	1082.50
Disk #4	260.00	560.00	1249.50	-	1249.50	1270.50
Disk #5	260.00	560.00	1449.50	-	1449.50	1470.50
Disk #6	260.00	560.00	1684.50	-	1684.50	1705.50
Disk #7	322.00	560.00	2124.50	-	2124.50	2145.50
Disk #8	386.00	560.00	2517.50	-	2517.50	2538.50
Disk #9	434.00	560.00	2767.50	-	2767.50	2788.50

Notes:
(1) In the current design, the middle ring was not recessed by 21 mm.
(2) In the alternative wheel, the front-back separation was taken to be 21 mm in the calculation.

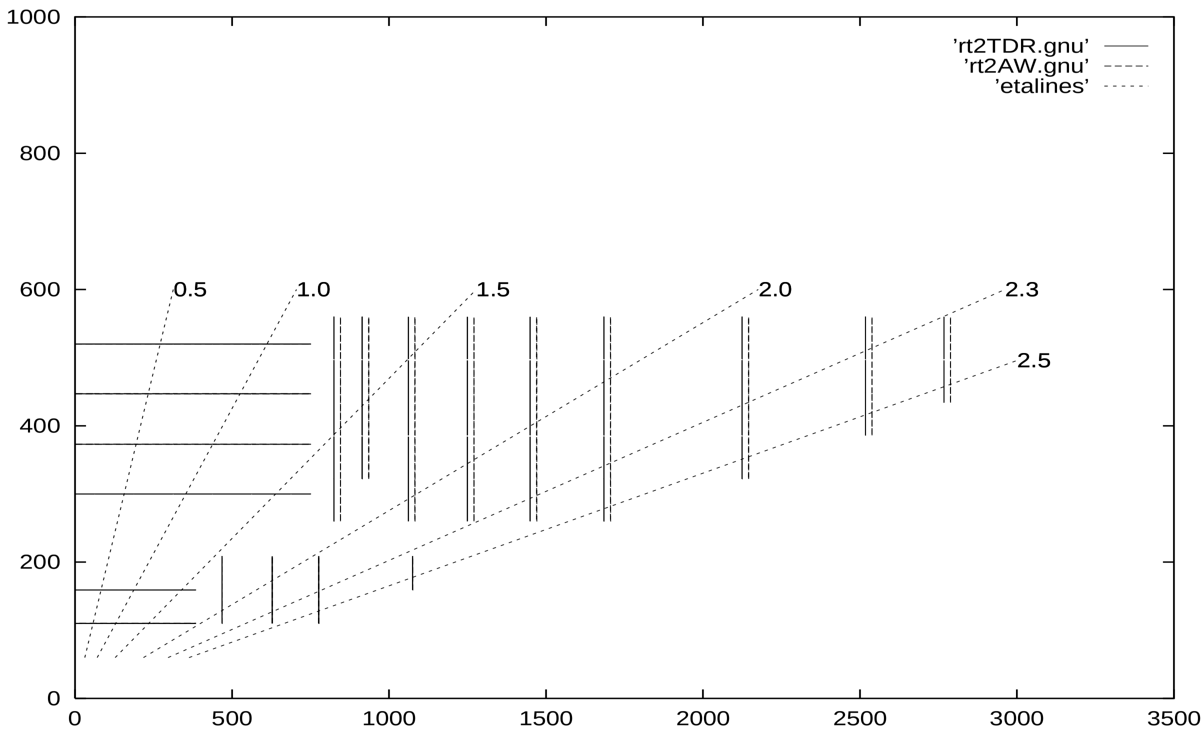

Fig. 1 Graphical representation of the quadrant of the SCT layers

Fig. 2 Hit-acceptance with a number of hit-layers is greater than or equal to 6, as a function of pseudo-rapitiday.

Conclusion

- **In the transition region of the Barrel and the Forward, there is a loss due to the recessed modules in the alternative wheel design.**
- **The loss (in point and difference from the current design) is about 7% at the maximum, and only 0.5 % difference when the loss is averaged over in the full acceptance range of the pseudo-rapitidy (0 to 2.5), where the averaged loss is 95.8 % in the current design and 95.3 % in the alternative wheel design.**
- **In summary, the loss was not as bad as I had expected; rather in the range of not over-riding the virtures of lower noise and good thermal performance of the centre-tap module design.**
- **If I could add, I would be more concerned on the (averaged) loss of about 5 % which is spanning in the wide range of pseudo-rapidity and is caused by the (tiny) 2 mm gap (insensitive) in the middle of modules.**