PERFORMANCE STUDIES

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Expected momentum resolution

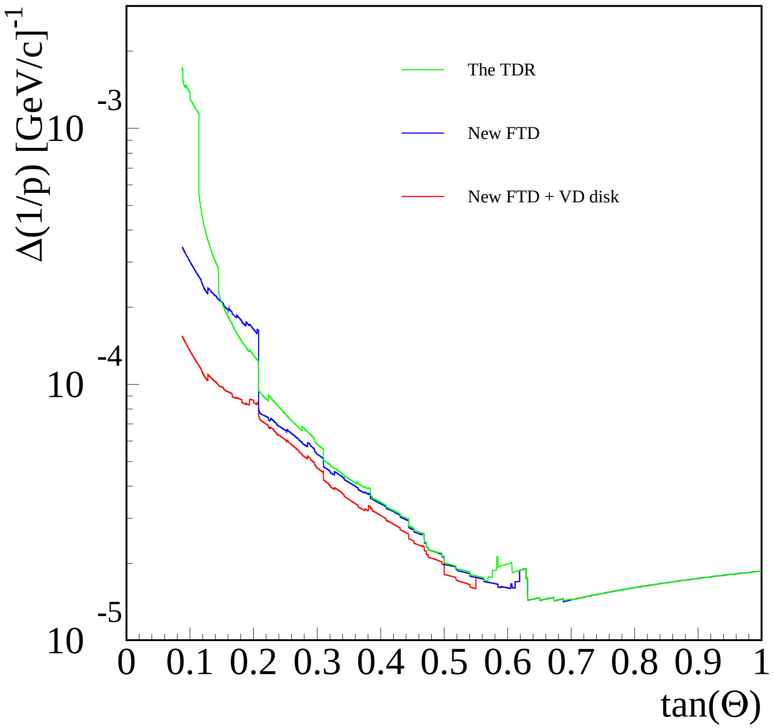
$$\sigma(1/p) = (8 \star 330/B)\ \sin\theta\sigma(S)/L^2 \text{ at high } p$$

Where:

- B= B-field in T
- L= length of the coda (“the lever arm”) in cm. In the barrel,L= radius of the outermost tracking detector, In the forward L=$\tan\theta$times the Z of the outermost tracking detector.
- $\sigma(S)$ = error on the sagita in cm. $\sigma(S) \propto 1/\sqrt{n}$. n (the number of measured points) is a function of L.

The TDR and the FTD++

- I: The divergence in the TDR: Once the last disk is hit, n goes as $1/\sqrt{\tan\theta}$.
- II: The step: End of The Vertex Detector
- Remedy I:Add *disks* all the way to the end of the TPC (5 more strip-disks)
- Remedy II: Add a *pixel disk* with $\sigma_{point} = 4\mu$just outside the VD
- Also: better point-resolution in all disks (7 μ).



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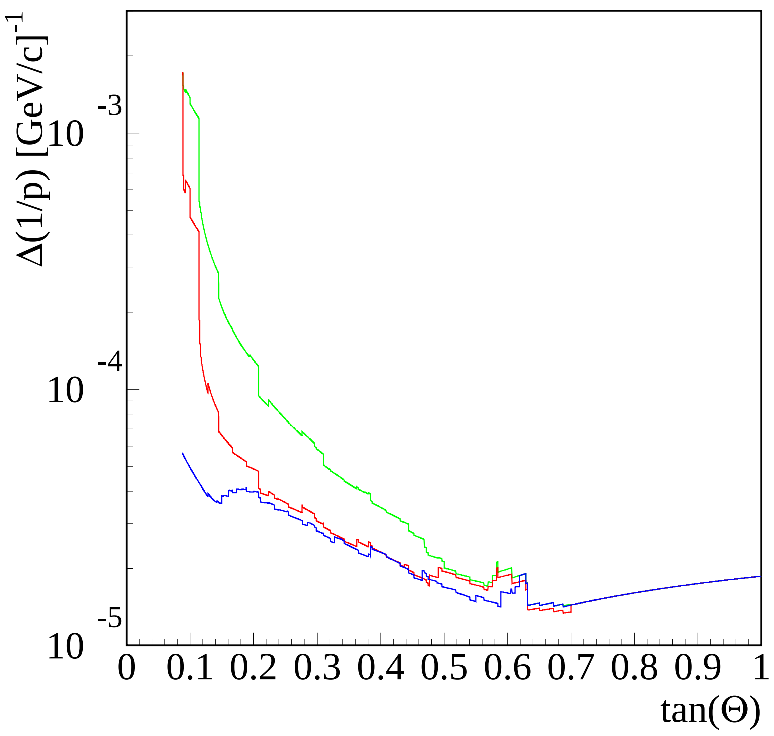

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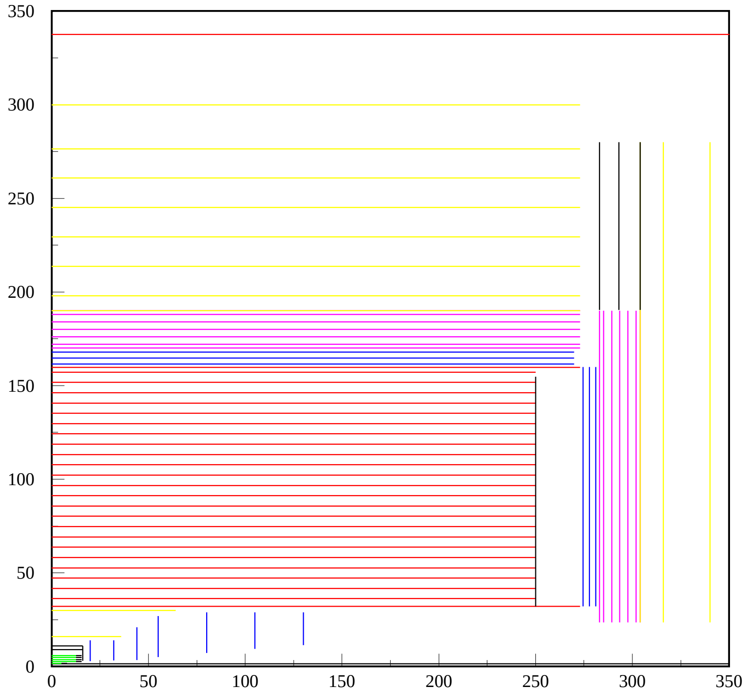

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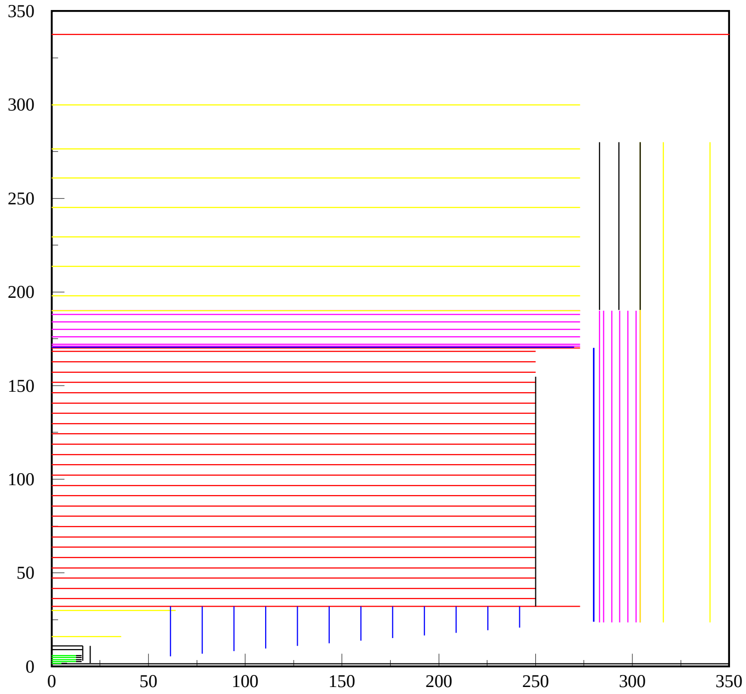
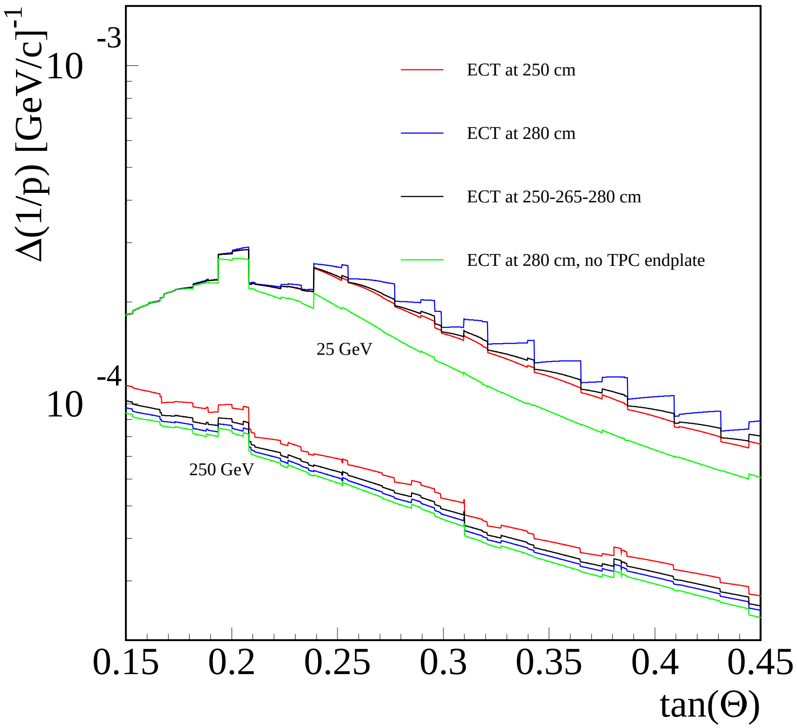


The silicon envelope: ECT

Move ECT by 30 cm: as *close* as possible, as *far* as possible, or *evenly spaced*. Study the effect of TPC end-plate

- 250 GeV: 30 cm change corresponds to a change of L^2 by 25 %, which is observed. Some effect of the scattering in the end-plate is visible even at this momentum.
- 25 GeV: Dominated by scattering. If the end-plate remains as thick as in the TDR, it is best to place the *ECT as close as possible*

It is best to have a very precise point close a scattering surface

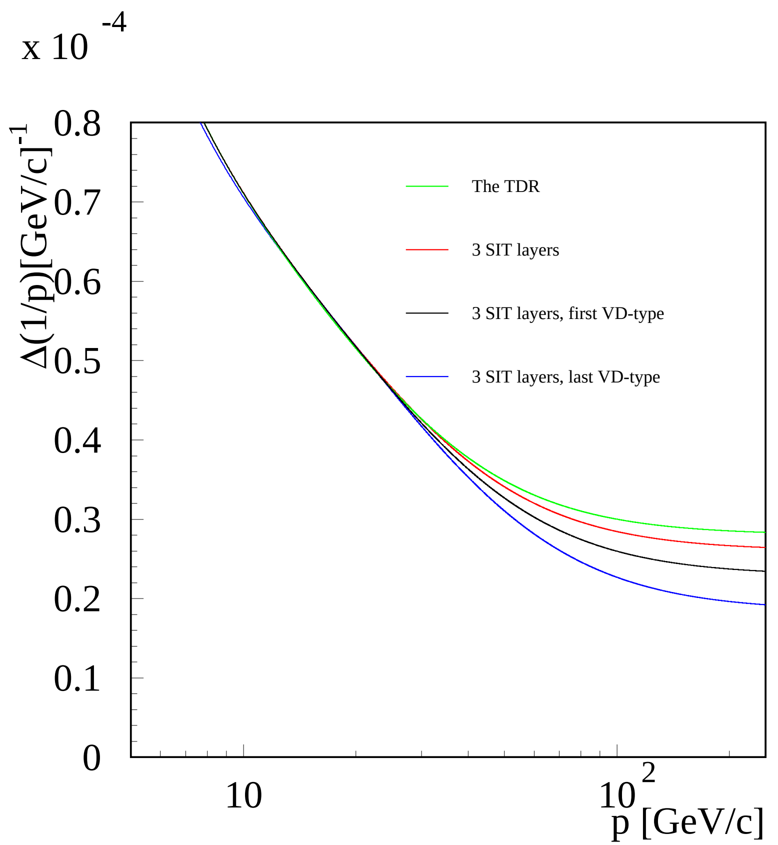


The silicon envelope: SIT

Does it help to have more layers in the SIT. Or more precise ones?

- TDR
- 3 layers,
- 3 layers with the inner-most of VD-type (4 μ)
- 3 layers with the outer-most of VD-type (4 μ)

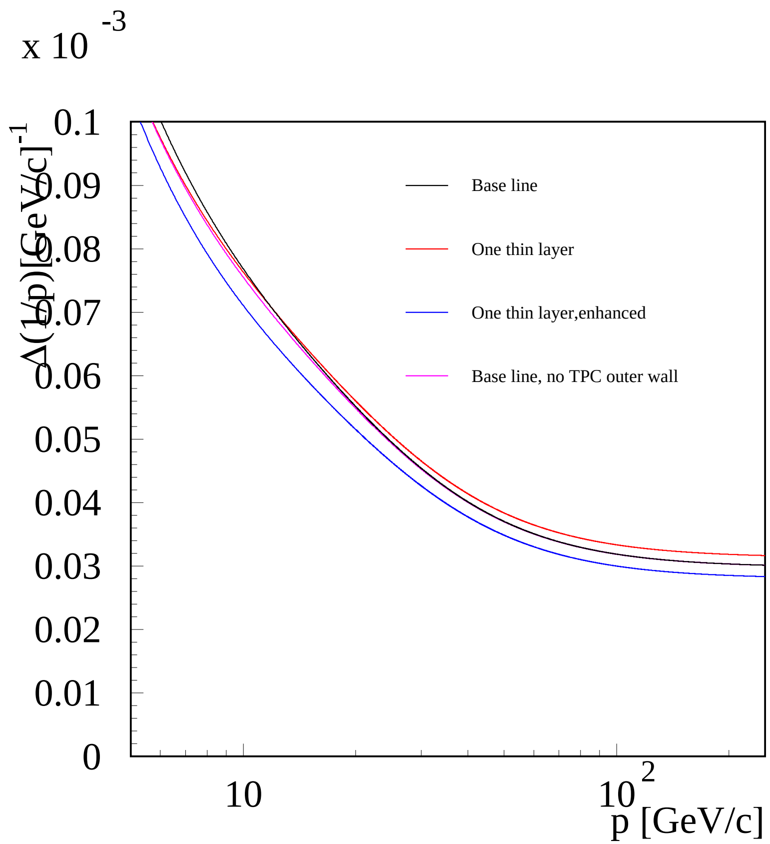
It is best to have a very precise point close a scattering surface



The silicon envelope: SET

How to distribute the SET layers?

- TDR+SET: SET takes 10 cm of the TPC, and has three layers with 25 μresolution
- TDR+thinSET: SET “nothing” of the TPC, and has one, 25 μresolution layer
- TDR+thinSET, with 14.4 $\mu(= 25/\sqrt{3})$ resolution
- Same thing, in the low end of the spectrum



Scattering makes little difference, since the SET is quite short. At high momentum, the $1/L^2$-factor favours pushing the SET as far out as possible, and at lower momenta, it is more worthwhile to retain as much as possible of the TPC lever-arm.

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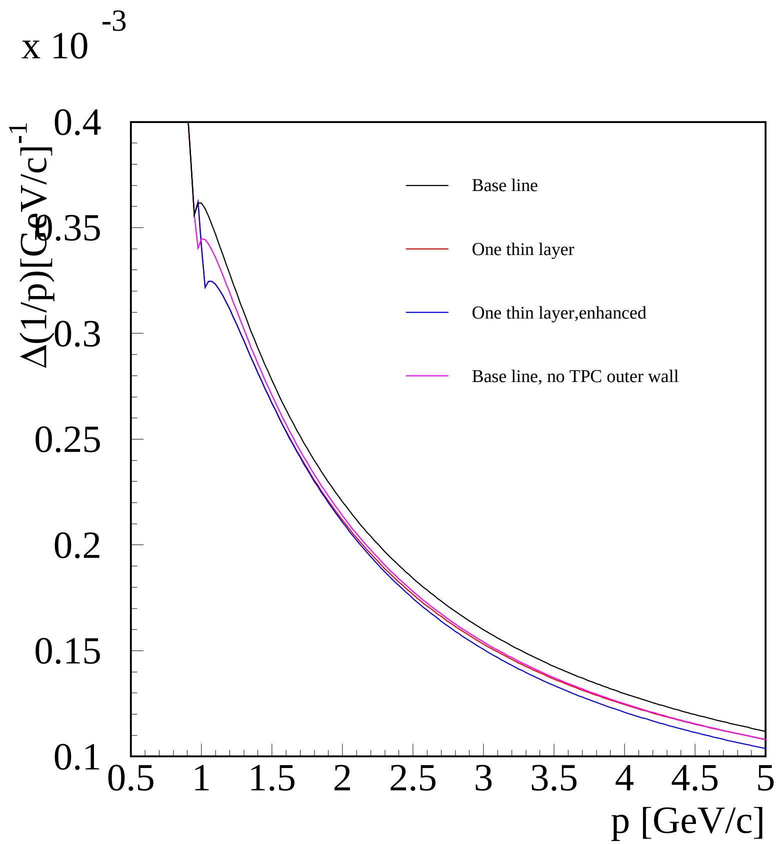

Summary

- A set of thumb-rules to estimate the performance of the tracking-system wrt. p measurement:
  - It's the lever-arm...
  - For p, the position of scattering surfaces is most important. MS close to the edges of the measuring range does not hurt. Consequently, adding precise points close to un-avoidable scatterers is a good idea..
  - Extremely high precisions at either edge doesn't pay: Having the end-points fixed is only 20% better than having the same error in all points..
- These principles lead to a modest proposal how to ameliorate the TDR design:
  - Extend the FTD all the way to the end of the TPC, and distribute them evenly..
  - Add a micro-pixel disk to the end-plate of the VD..
  - Distributing the ECT evenly between the TPC and the ECAL is the best compromise over p.
  - Fit the SIT with an outer layer with highest possible $R\phi$-precision.
  - Attempt to make the SET thin, and as close to the ECAL as possible.
- The first two points will geatly ameliorate the resolution at the lowest angles. If the disks are made more precise (7μ) the design goal of $\sigma(1/p) < 5\,10^{-5}$ can be met at all angles.