SiD02 tracking resolutions with missing layers

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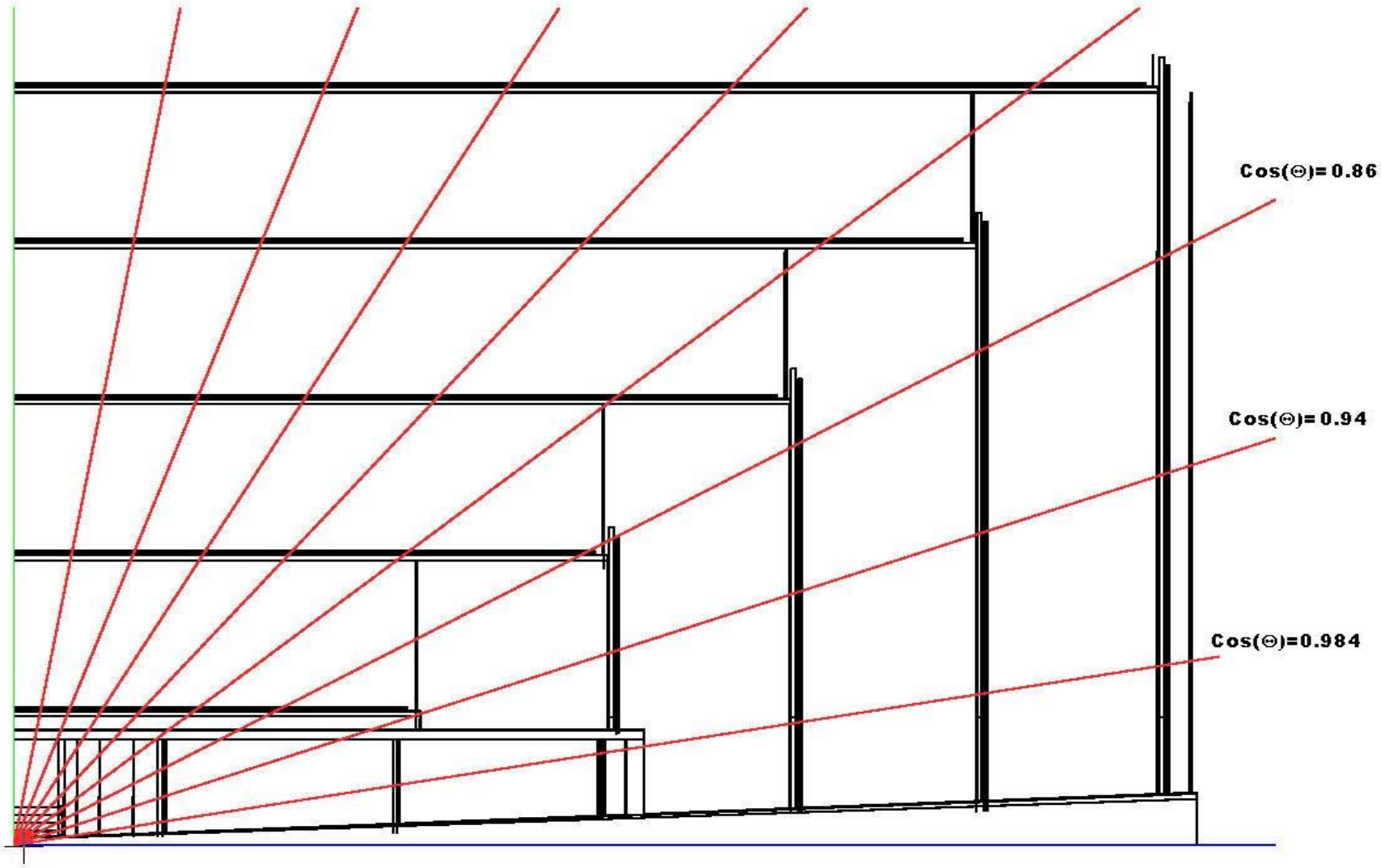
SiD02 tracker geometry

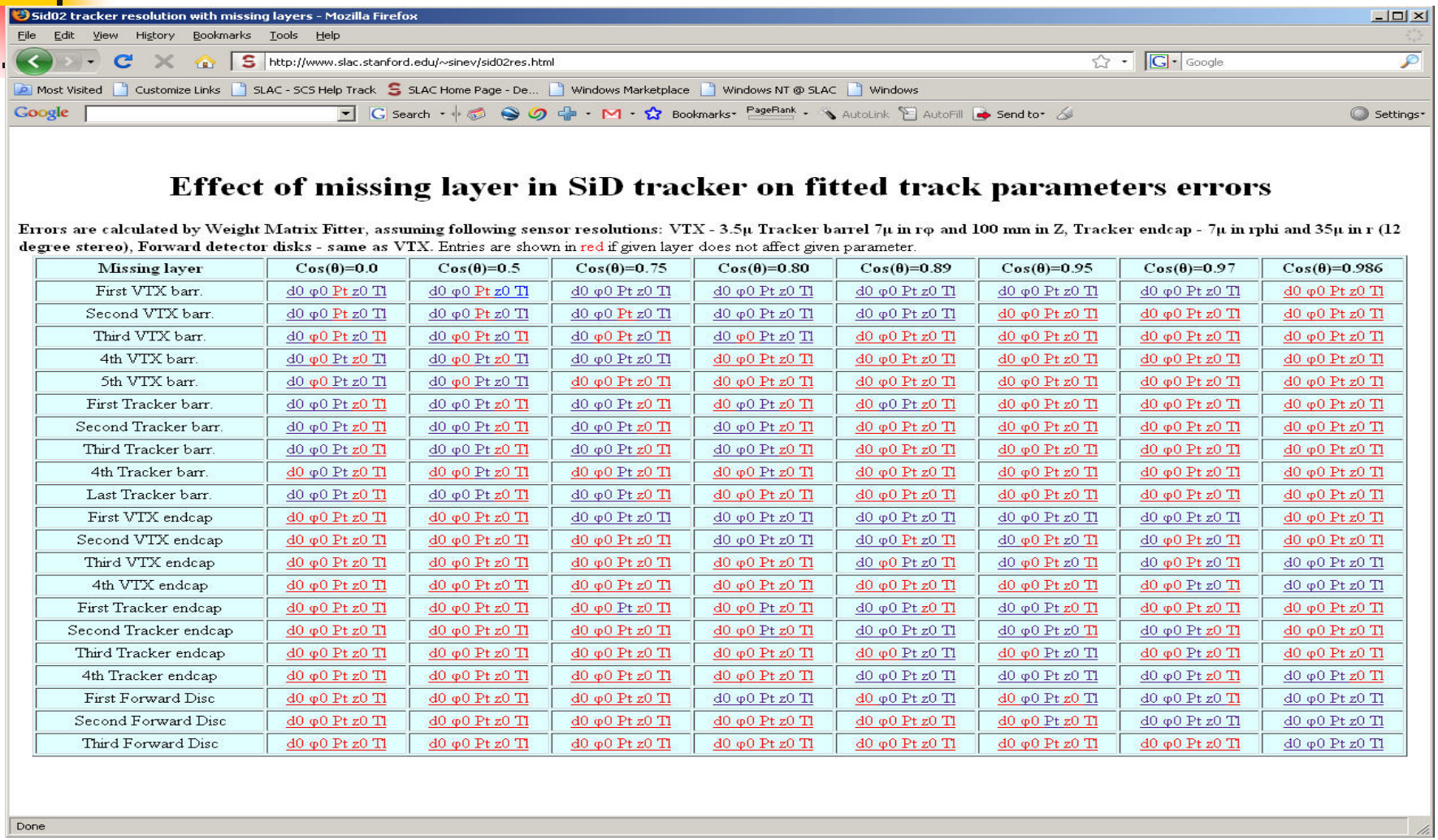


What I did

- Using Weight Matrix Fitter I can get tracker resolution for any detector configuration. I can mask any layer in the tracker or vertex detector, which means that I consider it as dead.
- To get covariance matrix of track parameter errors, I don't need large statistics of tracks, as for given track parameters covariance matrix is not fluctuating. So I need just one track for any given set of track parameters passed through fitter to get it.
- So, I did this exercise for every possible missing layer for 8 different values of cos(Θ) 0, 0.5, 0.75, 0.8, 0.89, 0.95, 0.972, 0.986, varying particle total momentum from 0.2 to 1000 GeV
- I got 5(parameters) x 8(cos values) x 21 (layers) = 840 plots. However not all of 5 them are different, as not all layers are hit at all values of cos(Θ) . Total number of different plots was 231

You can see it here:

- http://www.slac.stanford.edu/~sinev/sid02res.html



Sid02 tracker resolution with missing layers - Mozilla Firefox

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http://www.slac.stanford.edu/~sinev/sid02res.html

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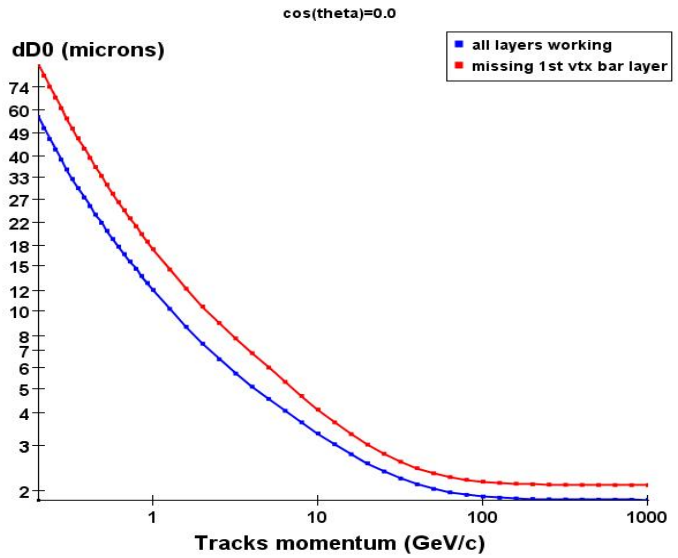
Effect of missing layer in SiD tracker on fitted track parameters errors

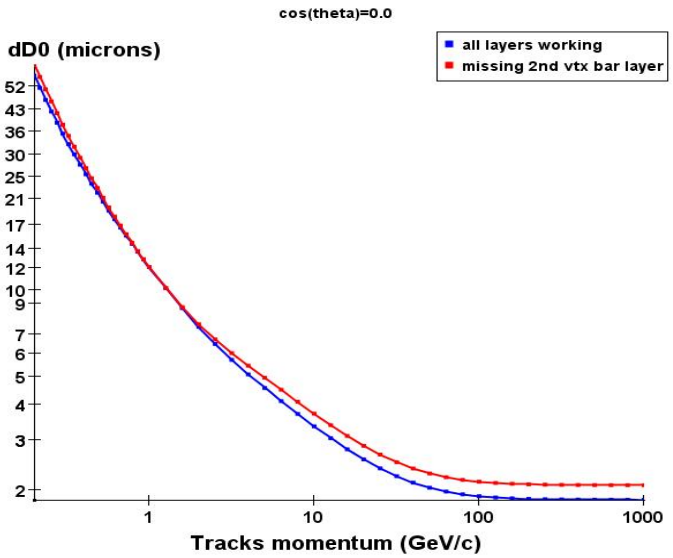
Errors are calculated by Weight Matrix Fitter, assuming following sensor resolutions: VTX - 3.5μ Tracker barrel 7μ in rφ and 100 mm in Z, Tracker endcap - 7μ in rphi and 35μ in r (12 degree stereo), Forward detector disks - same as VTX. Entries are shown in red if given layer does not affect given parameter.

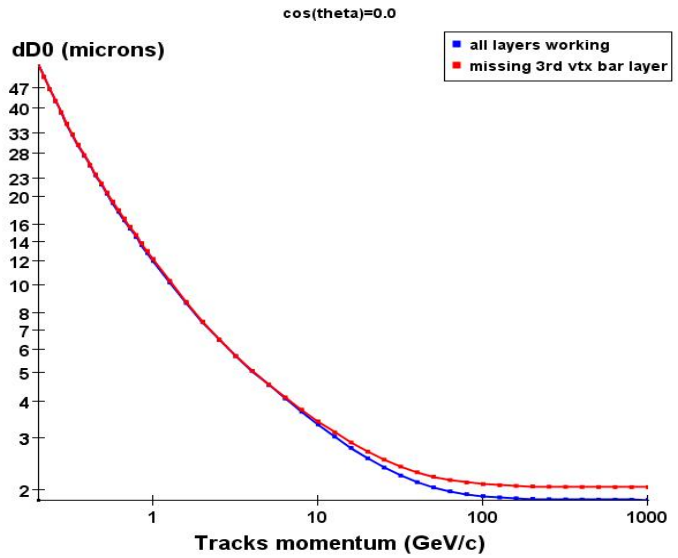
Missing layer	Cos(θ)=0.0	Cos(θ)=0.5	Cos(θ)=0.75	Cos(θ)=0.80	Cos(θ)=0.89	Cos(θ)=0.95	Cos(θ)=0.97	Cos(θ)=0.986
First VTX barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Second VTX barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Third VTX barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
4th VTX barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
5th VTX barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
First Tracker barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Second Tracker barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Third Tracker barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
4th Tracker barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Last Tracker barr.	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
First VTX endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Second VTX endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Third VTX endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
4th VTX endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
First Tracker endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Second Tracker endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Third Tracker endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
4th Tracker endcap	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
First Forward Disc	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Second Forward Disc	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl
Third Forward Disc	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl	d0 φ0 Pt z0 Tl

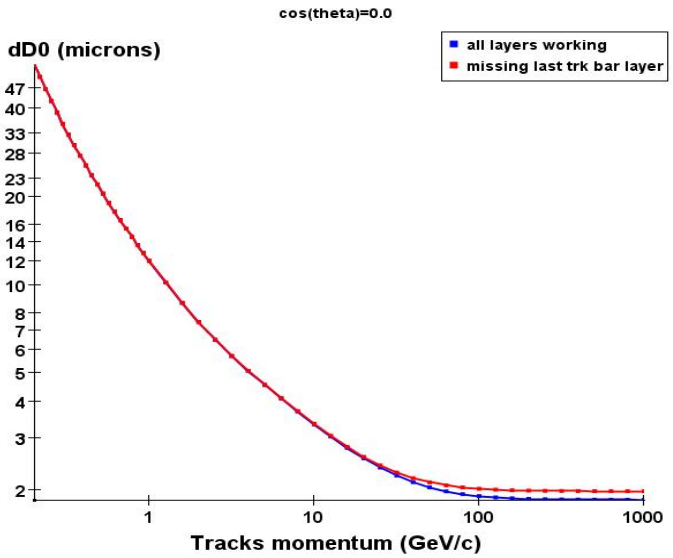
Done

Some examples: d0 at cos(Θ)=0.0

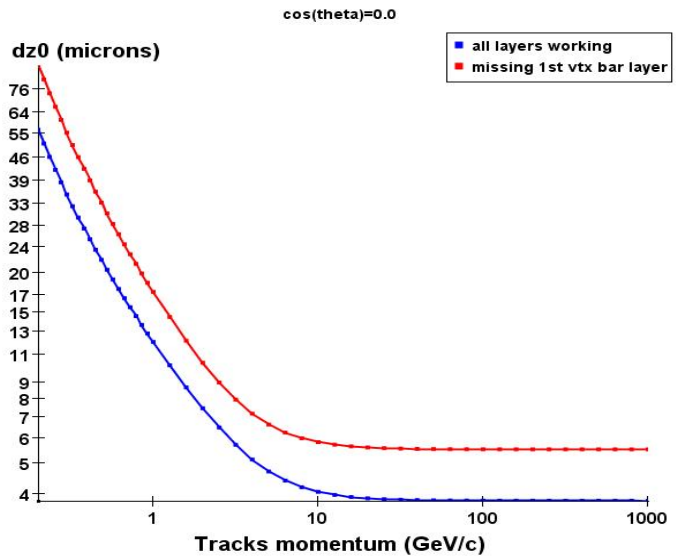


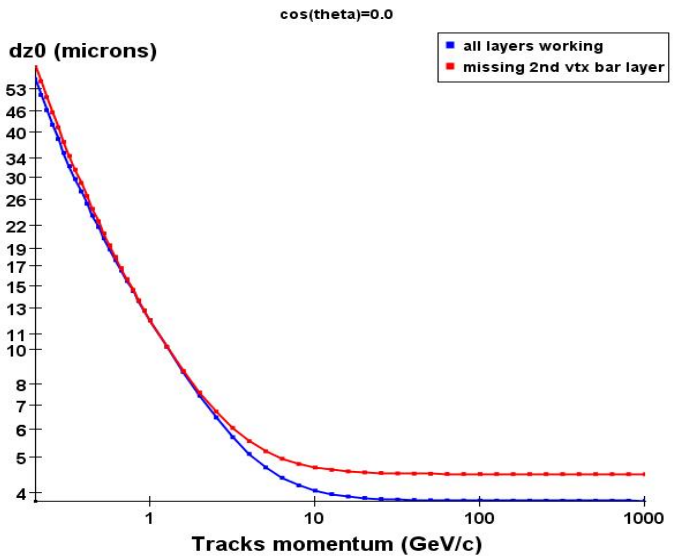


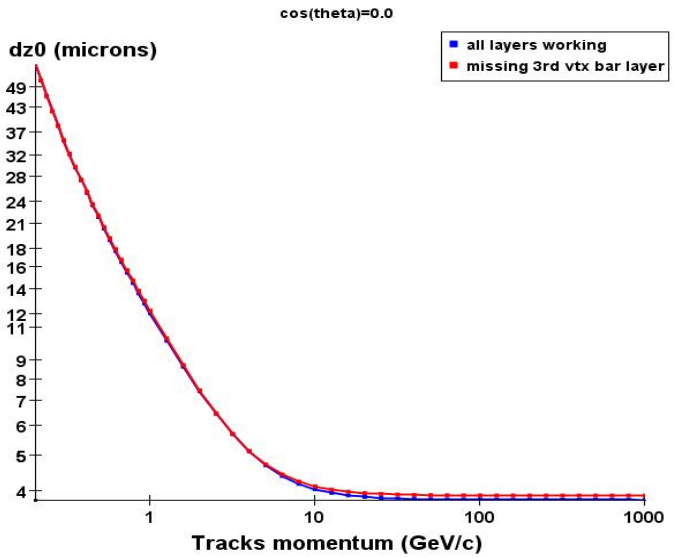


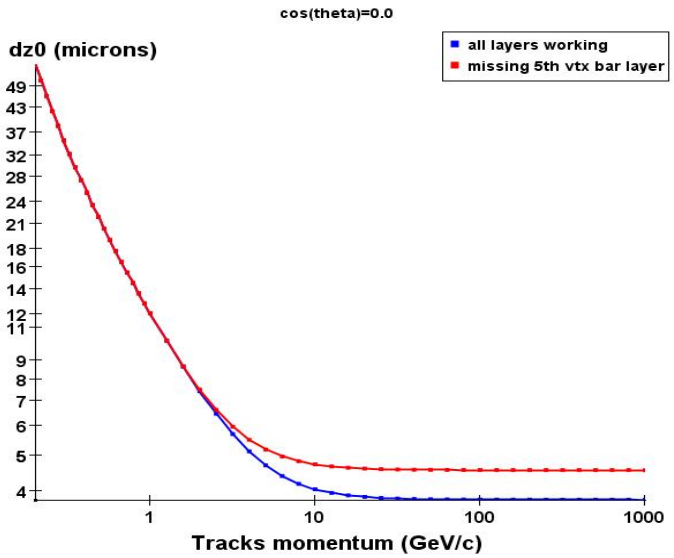


Some examples: z0 at cos(Θ)=0.0

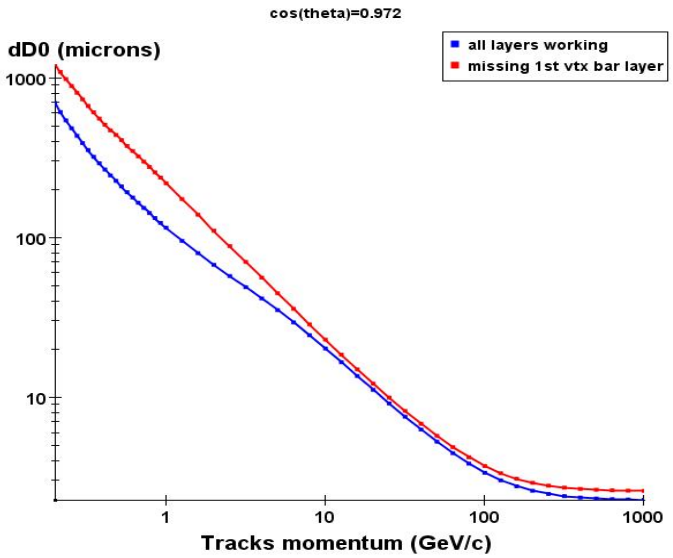


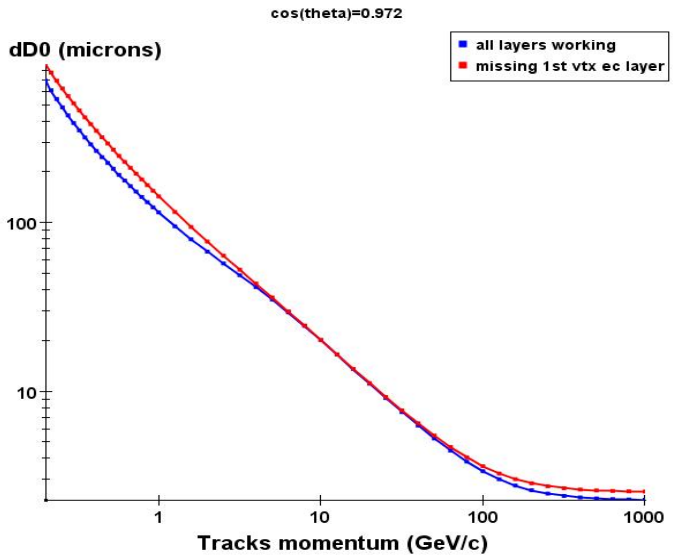


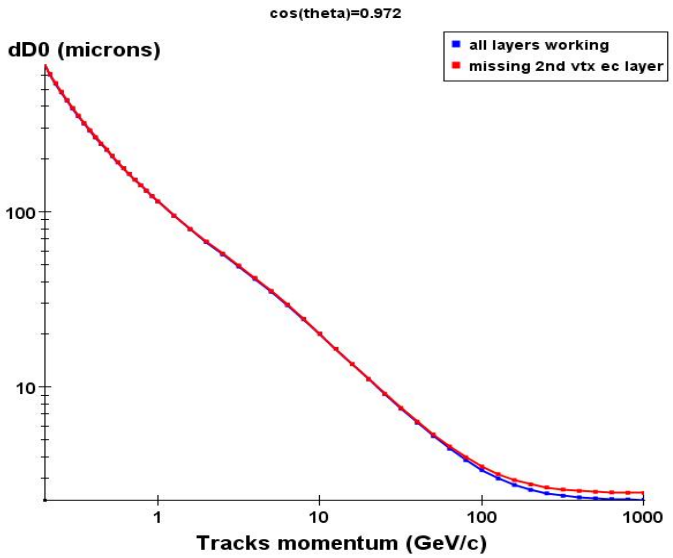


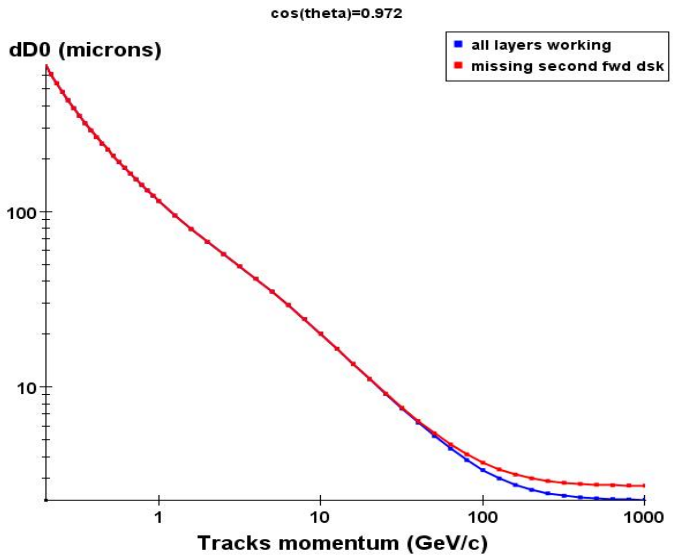


Some examples: d0 at cos(Θ)=0.972

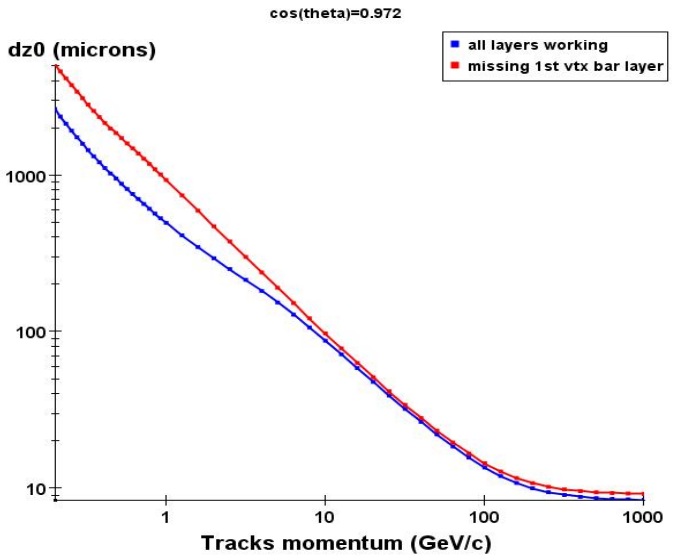


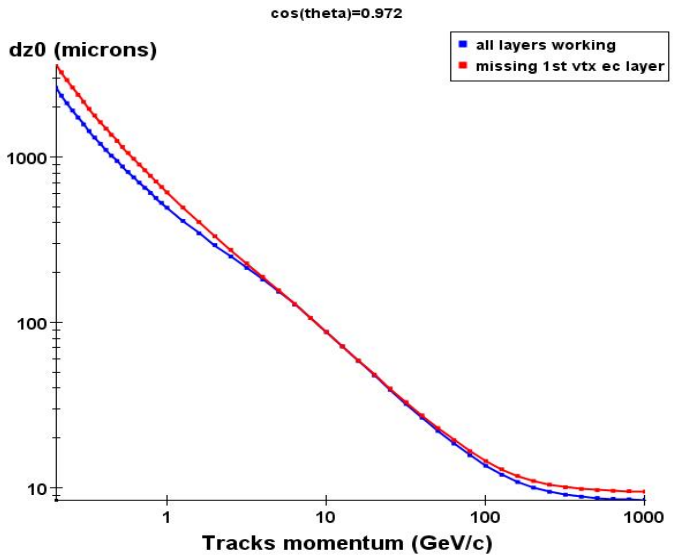


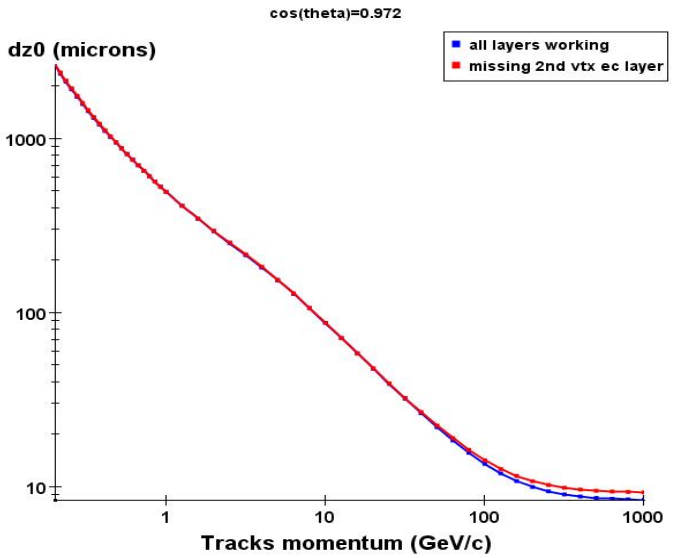


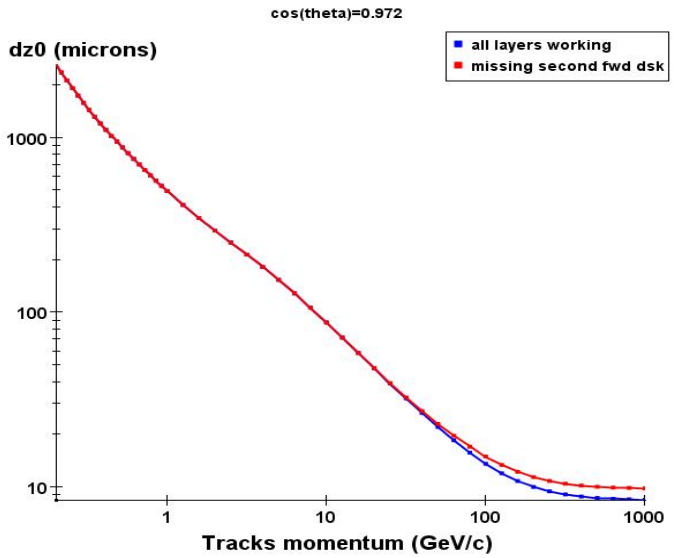


Some examples: z0 at cos(Θ)=0.972

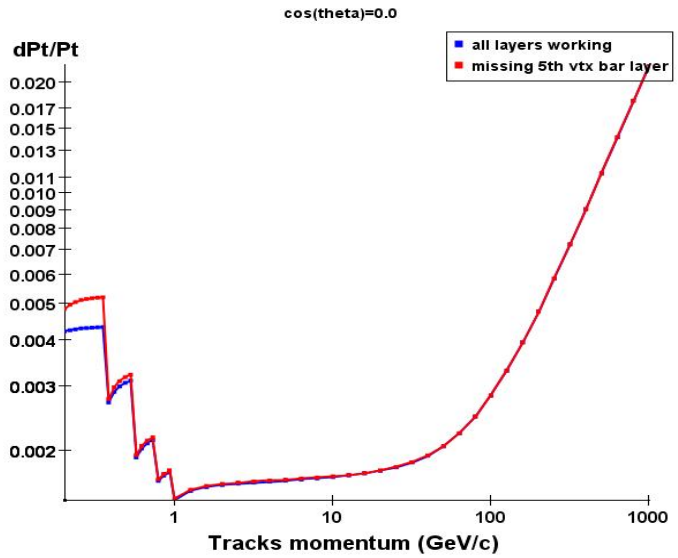


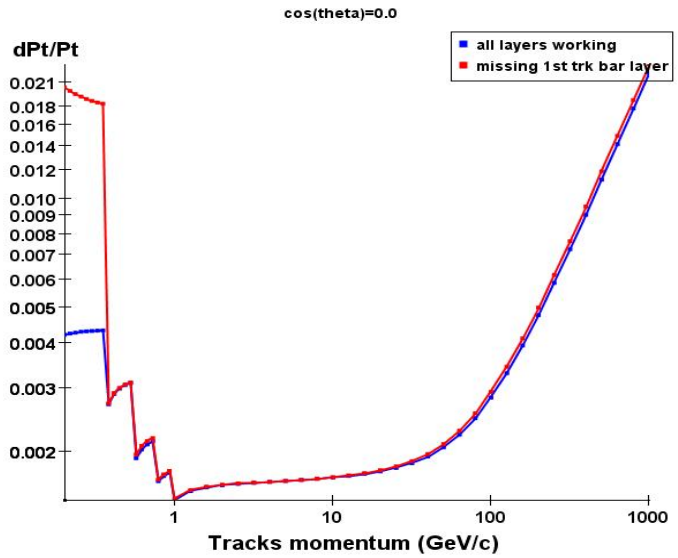


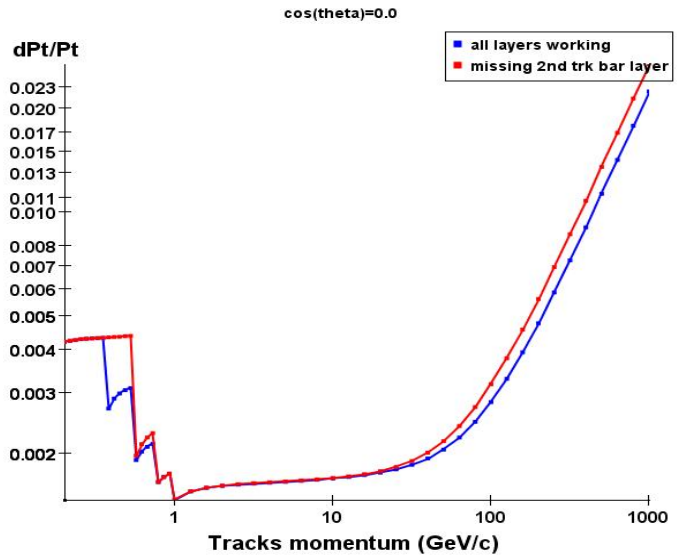


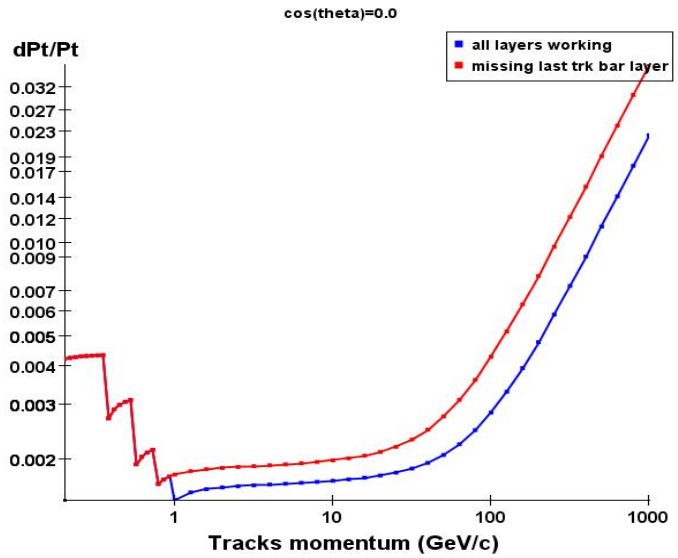


Some examples: dPt/Pt at cos(Θ)=0.0

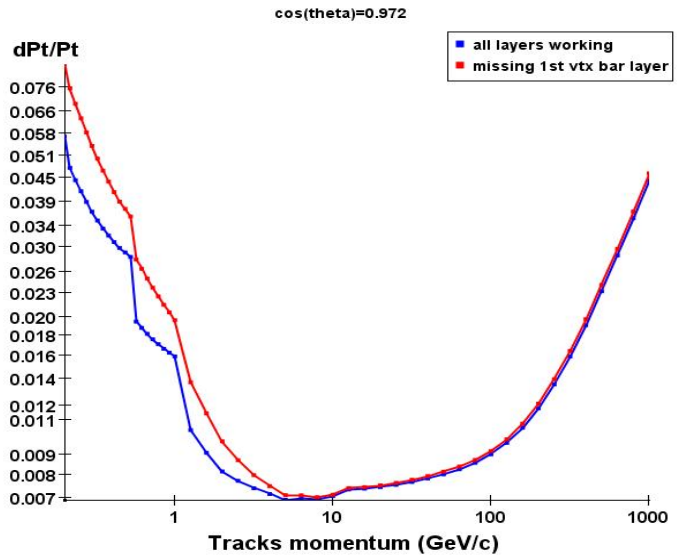


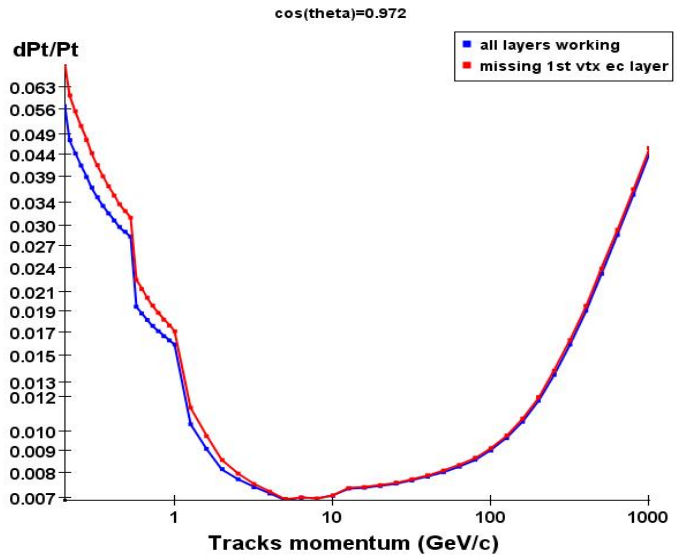


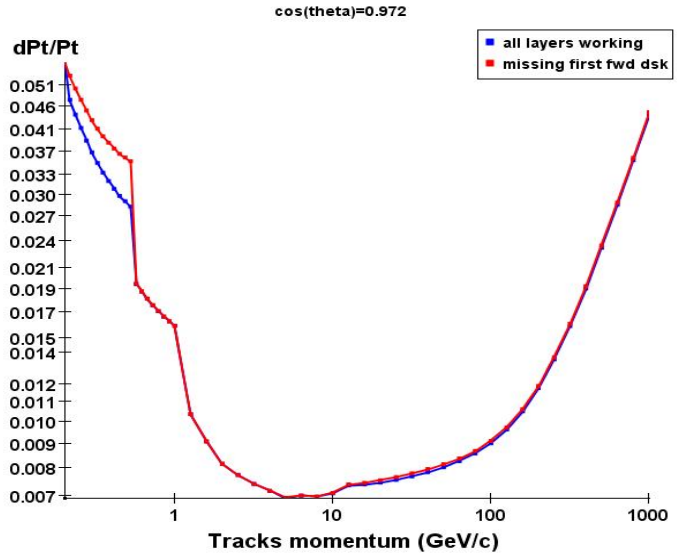


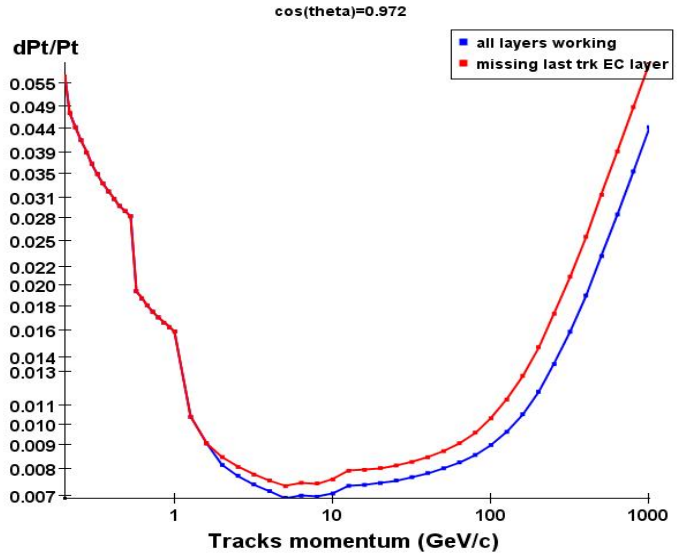


Some examples: dPt/Pt at cos(Θ)=0.972









How can it be used for benchmark studies ?

- What I have available is the resolution tables, used for fast monte-carlo – in the same format as Bruce's tables. So, any physics parameter for benchmark processes can be extracted from fast monte-carlo simulation, using "layer deficient" table. I have 21 such tables and can provide them on request.

Conclusions

- We can see, that no one single layer could ruin tracker performance. The track parameters resolution is sensitive to missing layer, but effect is not dramatic.
- From the other hand, we see, that there is no “unneeded” layers. Every layer plays a role in achieving maximum performance goal