Distorted geometries effects

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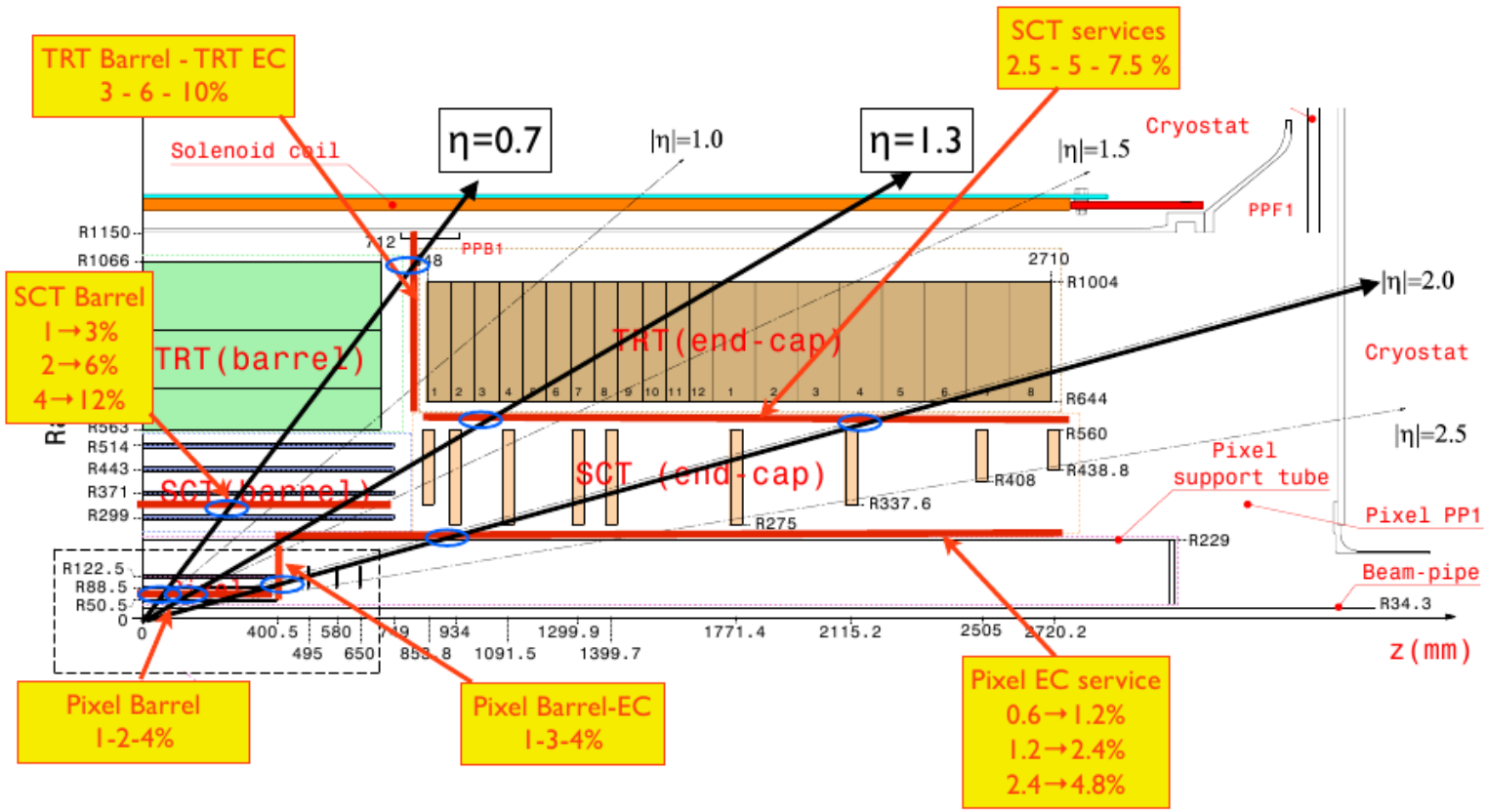
η	E [GeV]	Position	$\Delta X_0(\%)$ in r direction	$\Delta X_0(\%)$ view by the track
0.7	25, 50	Pixel Barrel	1, 2, 4	1.26, 2.51, 5.02
		SCT Barrel	1÷3, 2÷6, 4÷12	2.18, 4.36, 8.72
		TRT Barrel-TRT EC	3, 6, 10	4.96, 9.93, 16.54
1.3	25, 50	Pixel Barrel	1, 2, 4	1.97, 3.94, 7.88
		SCT services at R=55cm	2.5, 5.0, 7.5	4.92, 9.85, 14.78
2.0	50, 100	Pixel Barrel-EC	1, 3, 4	1.04, 3.11, 4.15
		Pixel EC services	0.6 ÷ 1.2, 1.2÷2.4, 2.4÷4.8	2.69, 5.39, 10.78
		SCT services at R=55cm	1, 2.5, 5	3.76, 9.40, 18.81

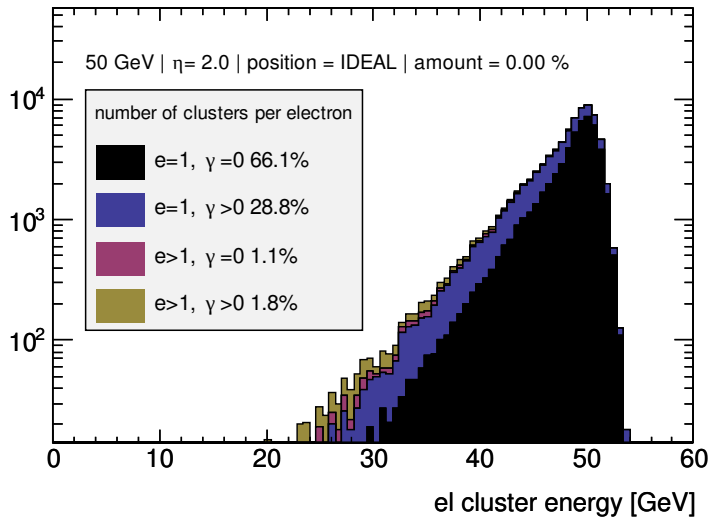
54 datasets, 20 geometry tags, $80\,000$ monoenergetic $e^{\pm}$ per dataset

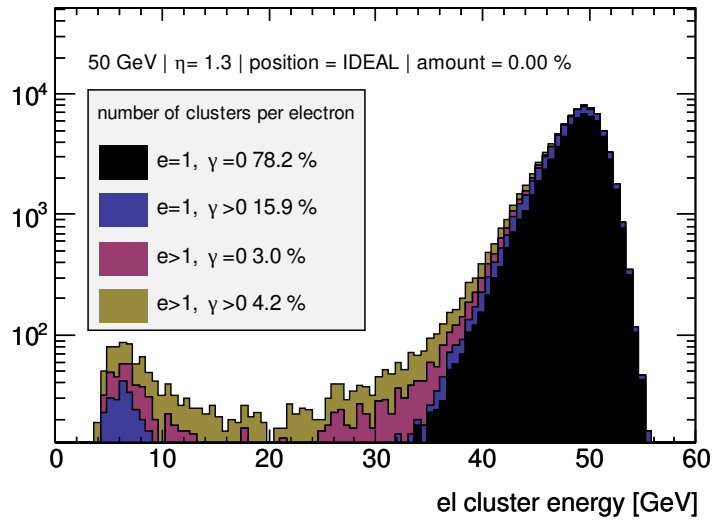
$\Delta\eta = 0.1$ $\Delta\phi = \pi/2$ no vertex spread



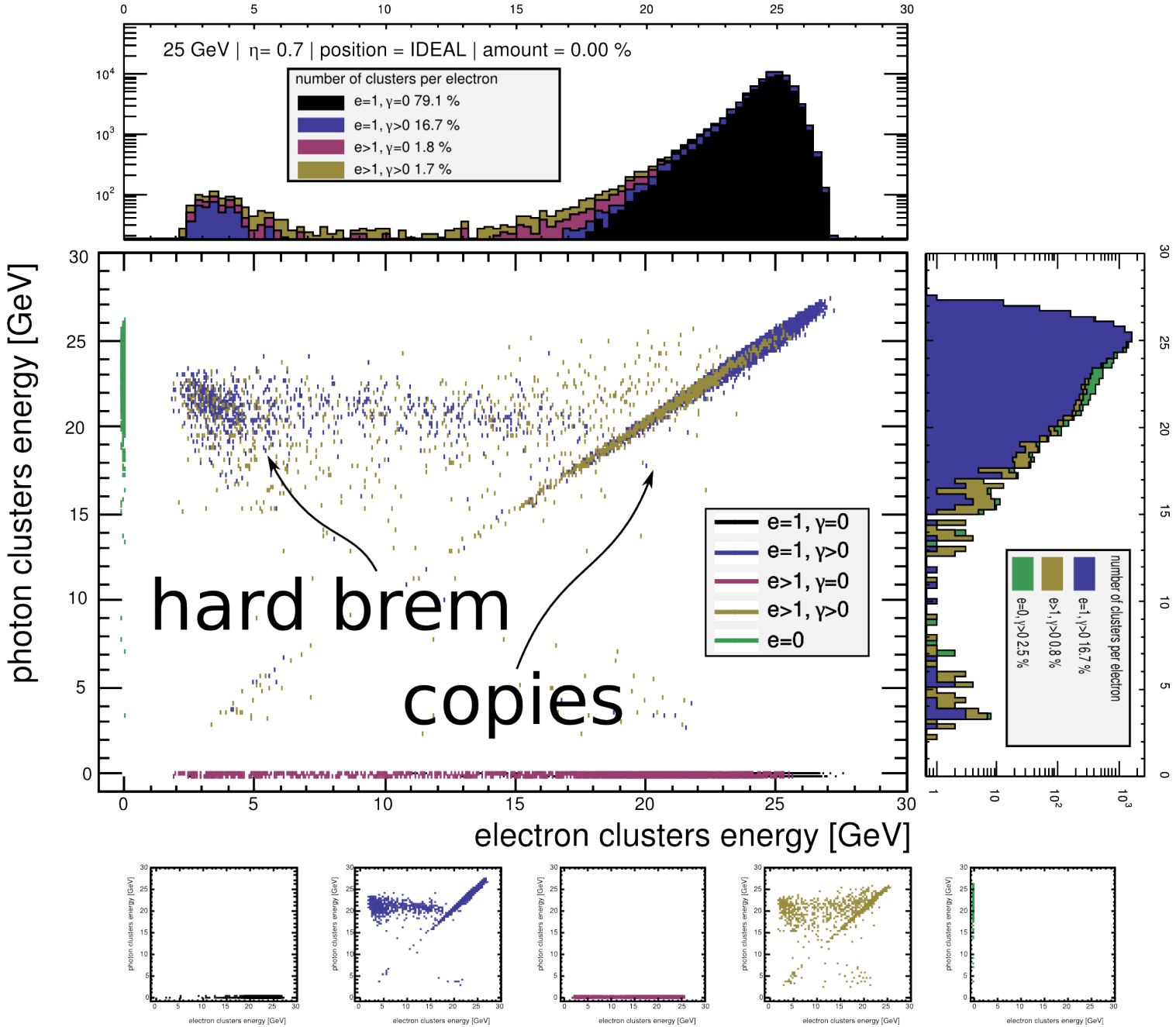
Event selection

All events, no IsEM selections



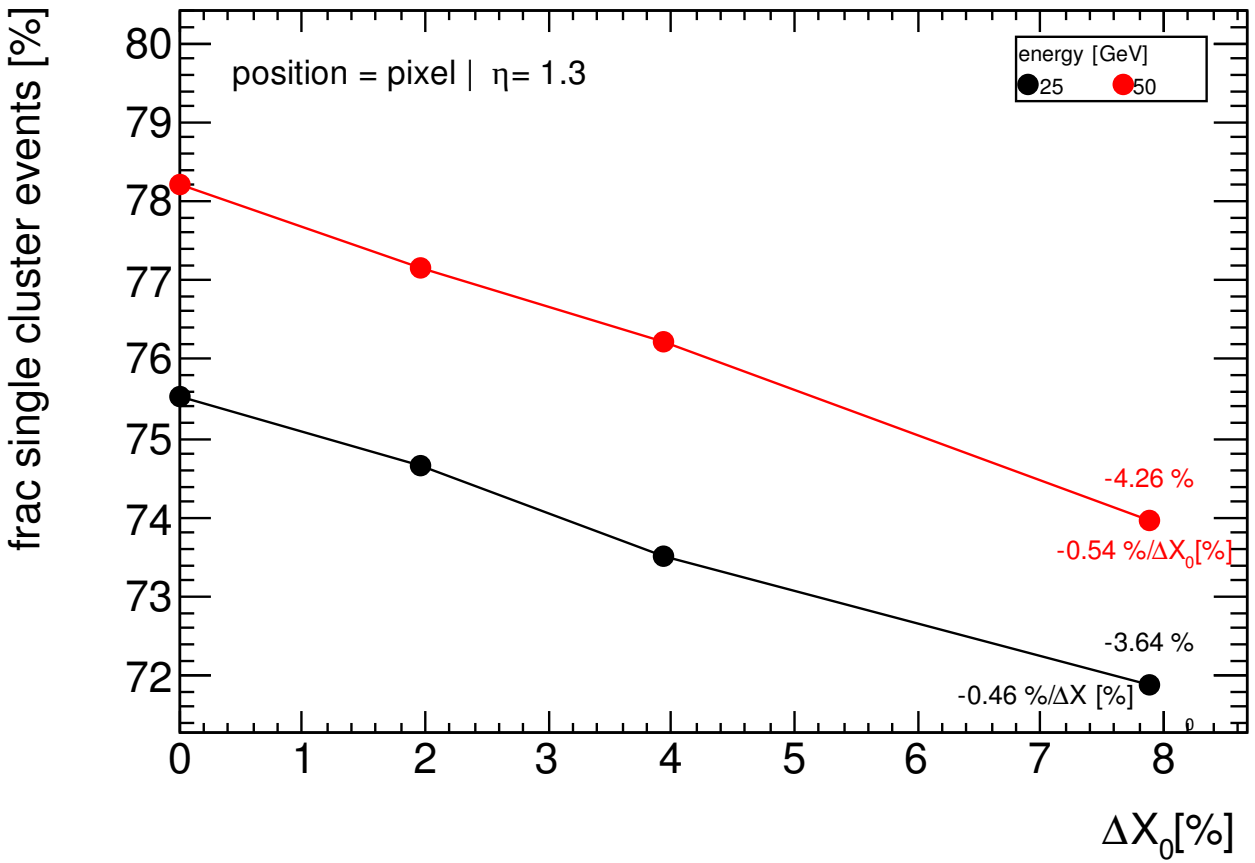


For simplicity we require: number of electron clusters = 1, number of photon clusters = 0 (the black one)


25 GeV | η= 0.7 | position = IDEAL | amount = 0.00 %
number of clusters per electron
e=1, γ=0 79.1 %
e=1, γ>0 16.7 %
e>1, γ=0 1.8 %
e>1, γ>0 1.7 %
hard brem
copies
e=1, γ=0
e=1, γ>0
e>1, γ=0
e>1, γ>0
e=0
photon clusters energy [GeV]
electron clusters energy [GeV]
number of clusters per electron
e=0, γ>0 2.5 %
e>1, γ>0 0.8 %
e=1, γ>0 16.7 %

Single electron cluster

The number of events with only one electron cluster doesn't change too much adding material. The biggest increase is adding material in the pixel barrel location at $\eta = 1.3$. Usually the variation is $\lesssim 1\%$.



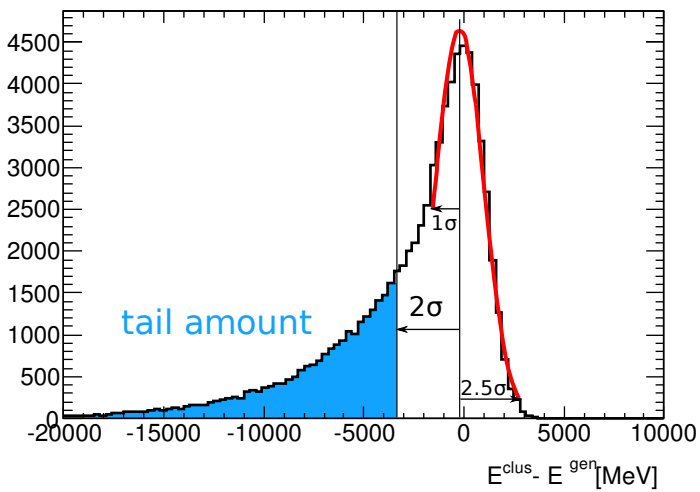
Observables

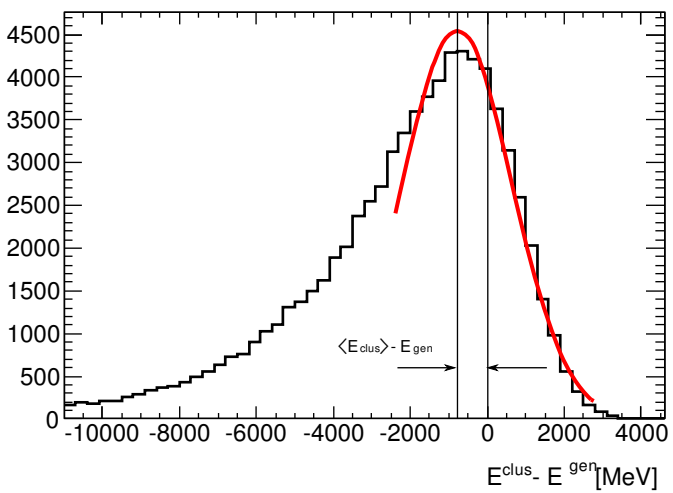
Absolute resolution : the standard deviation of the fitted gaussian from $E_{\text{rec}} - E_{\text{gen}}$

Variation from linearity : the mean of the fitted gaussian from $E_{\text{rec}} - E_{\text{gen}}$, divided by E_{gen}: $\frac{\langle E_{\text{rec}} \rangle}{E_{\text{gen}}} - 1$

Tail distortion : fraction of events below 2σ

IsEM selections : fraction of events selected as EM (tight/medium/loose) on the reconstructed sample

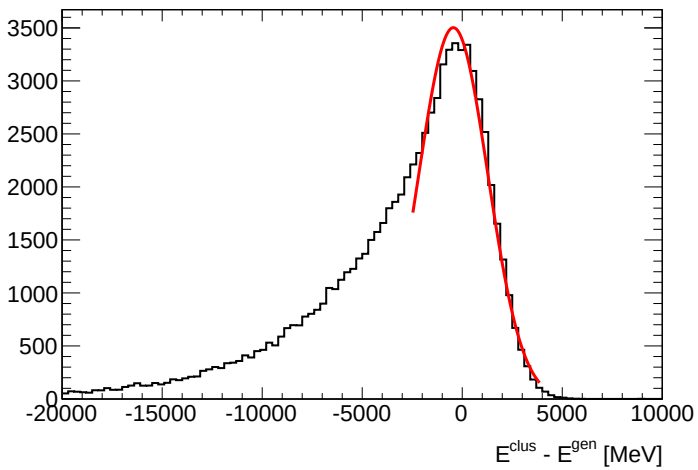




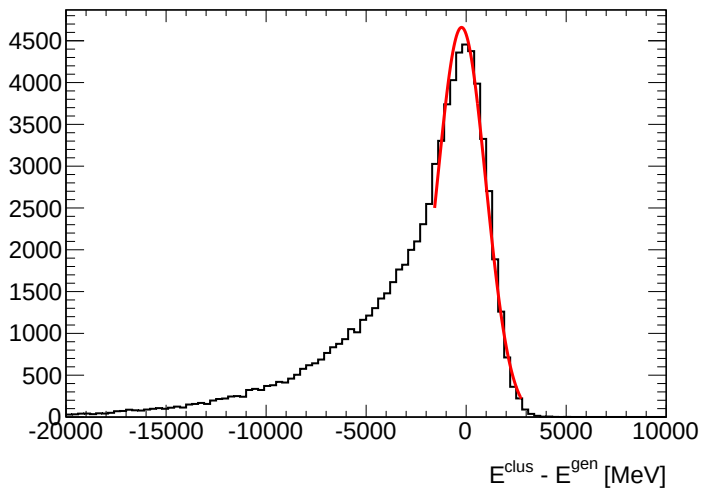
Fit procedure (crucial!)

Using 3 iterative steps varing the fit region. The last fit is in $(-1\sigma, 2.5\sigma)$.

Not every fits are very good:



(e) big tail



(f) small tail

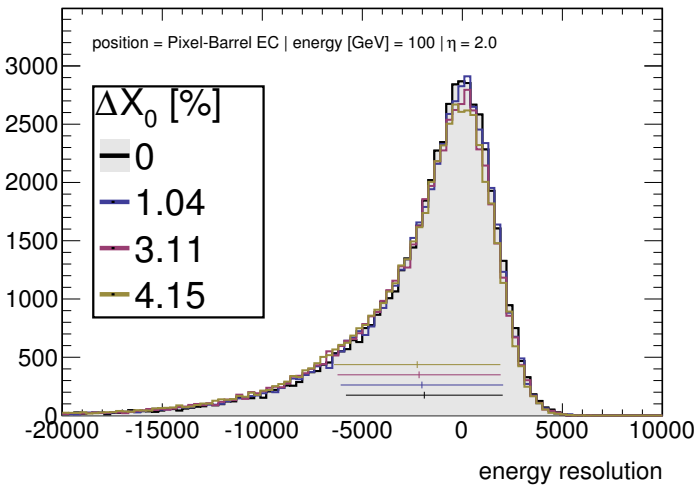
Resolution and in particular linearity are biased by the tail

Some plots

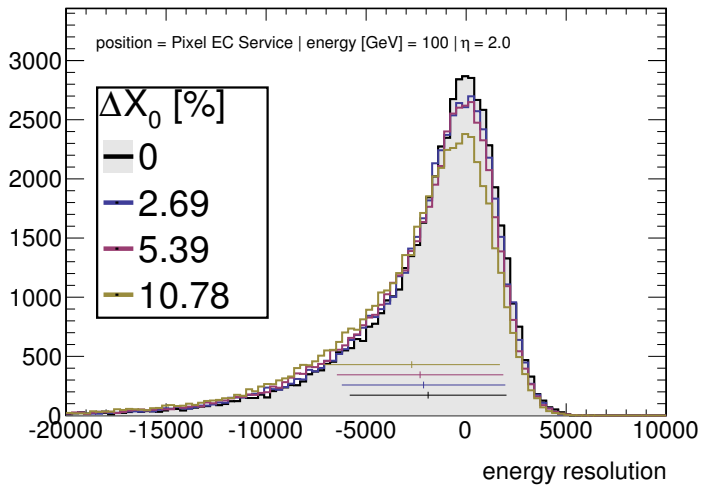
You can find all plots on
www.mi.infn.it/∼turra/distortion

Energy from calibration

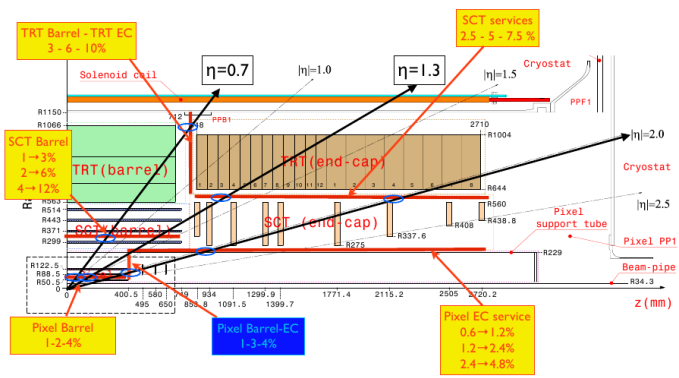
Horizontal bars represent mean and std deviation of the sample (PDG ideogram style) computed from all the events (using under(over)flow).

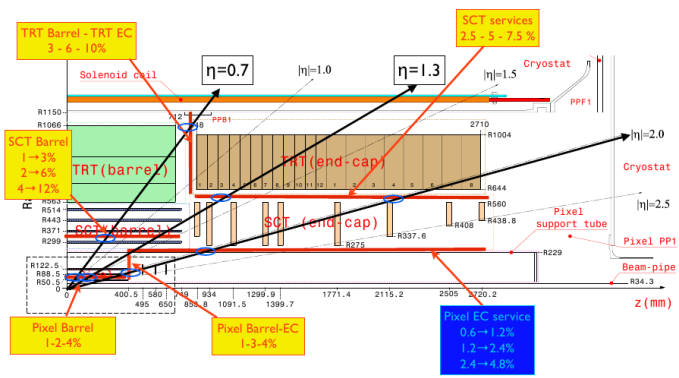


(g) small effect



(h) big effect (more material)

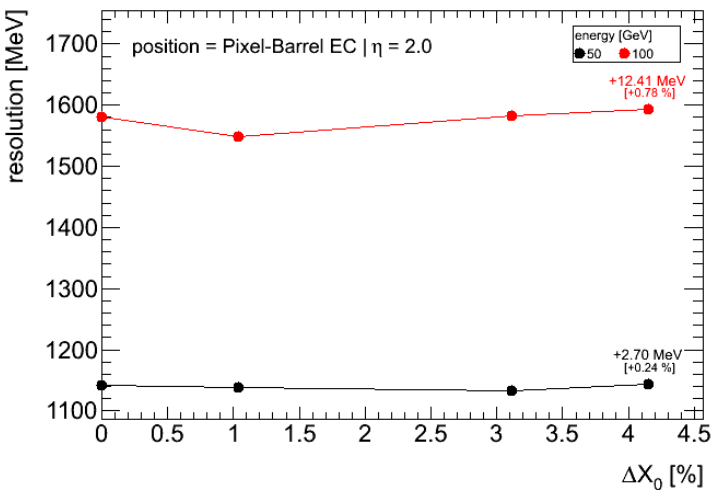




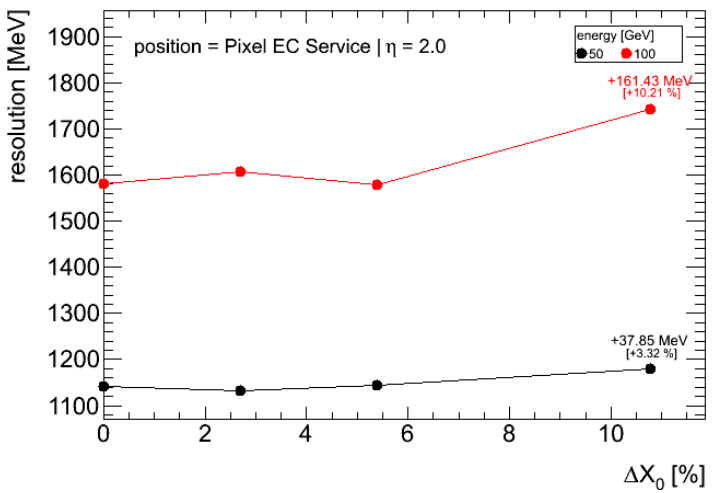
Main effect: tail increase $\Rightarrow$ resolution/linearity effect.

Resolution

Variation of the resolution for $50\,\mathrm{GeV}$ / $100\,\mathrm{GeV}$ electrons.
Resolution is from gaussian fit (bias by the tail).



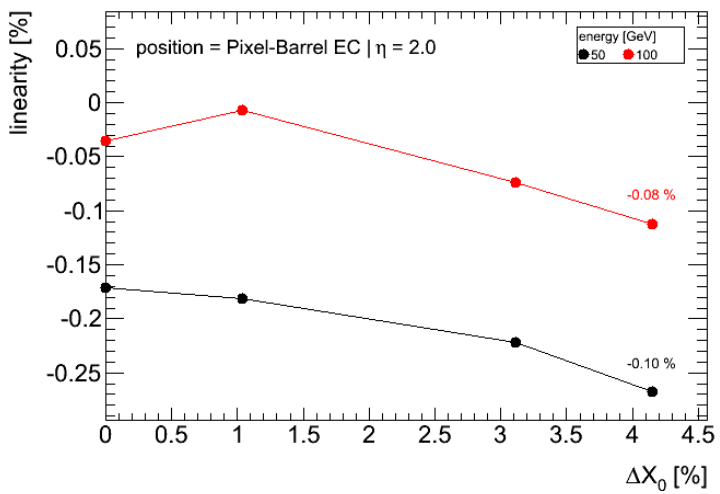
(k) small effect



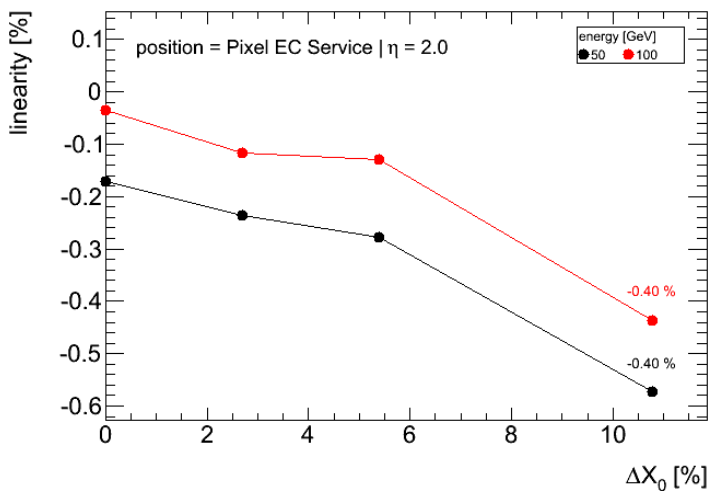
(l) big effect (more material)

Linearity

Variation of the linearity for $50\,\mathrm{GeV}$ / $100\,\mathrm{GeV}$ electrons. Linearity is from gaussian fit (biased by the tail)



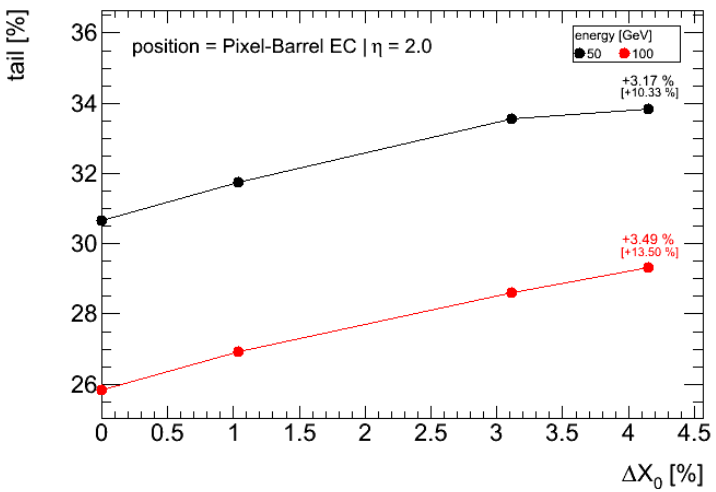
(m) small effect



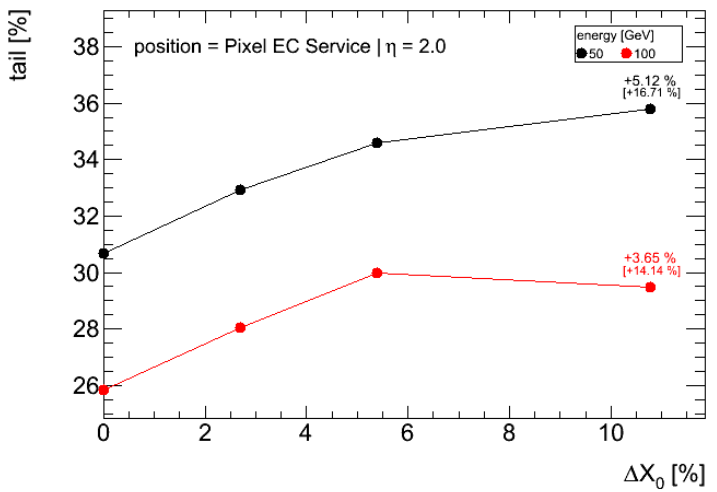
(n) big effect (more material)

Tail

Variation of the tail for $50\,\mathrm{GeV}$ / $100\,\mathrm{GeV}$ electrons.



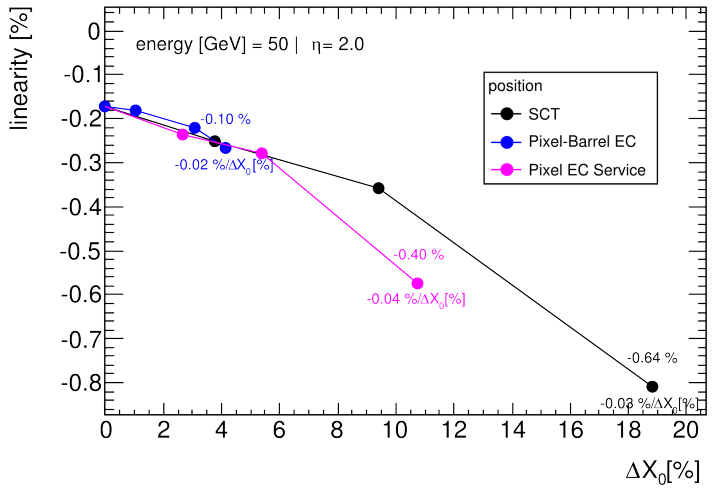
(o) small effect



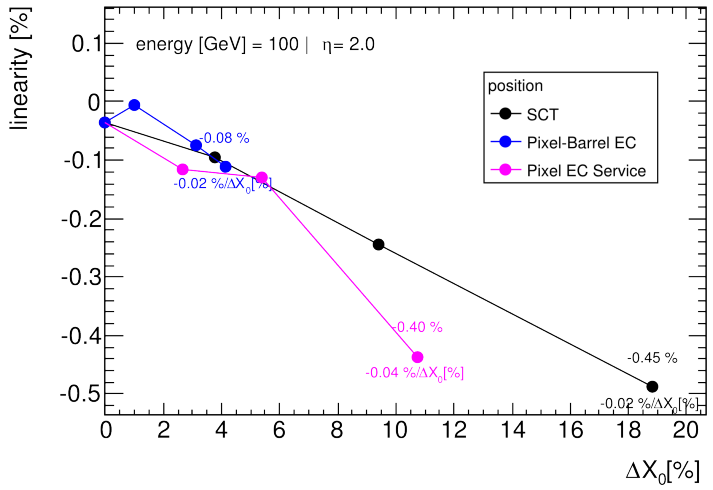
(p) big effect (more material)

Linearity (different visualization)

Variation of the linearity for all the geometries at $\eta = 2.0$

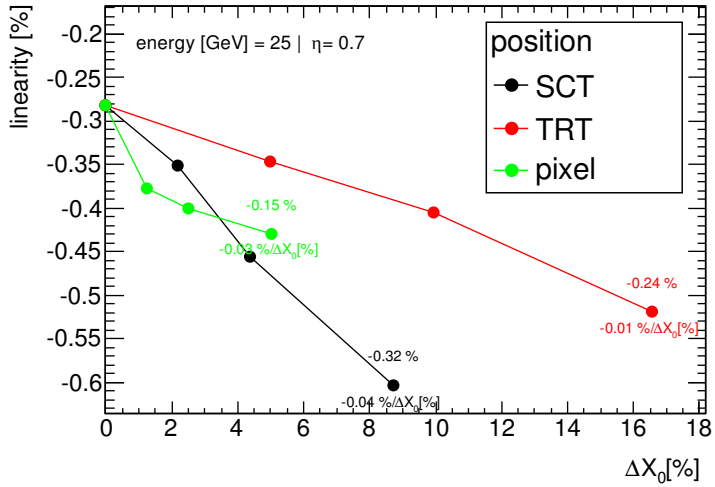


(q) 50 GeV

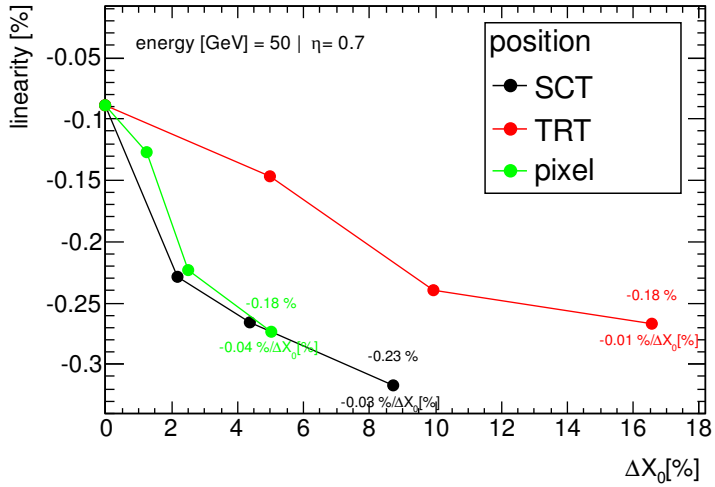


(r) 100 GeV

Variation of the linearity for all the geometries at $\eta = 0.7$

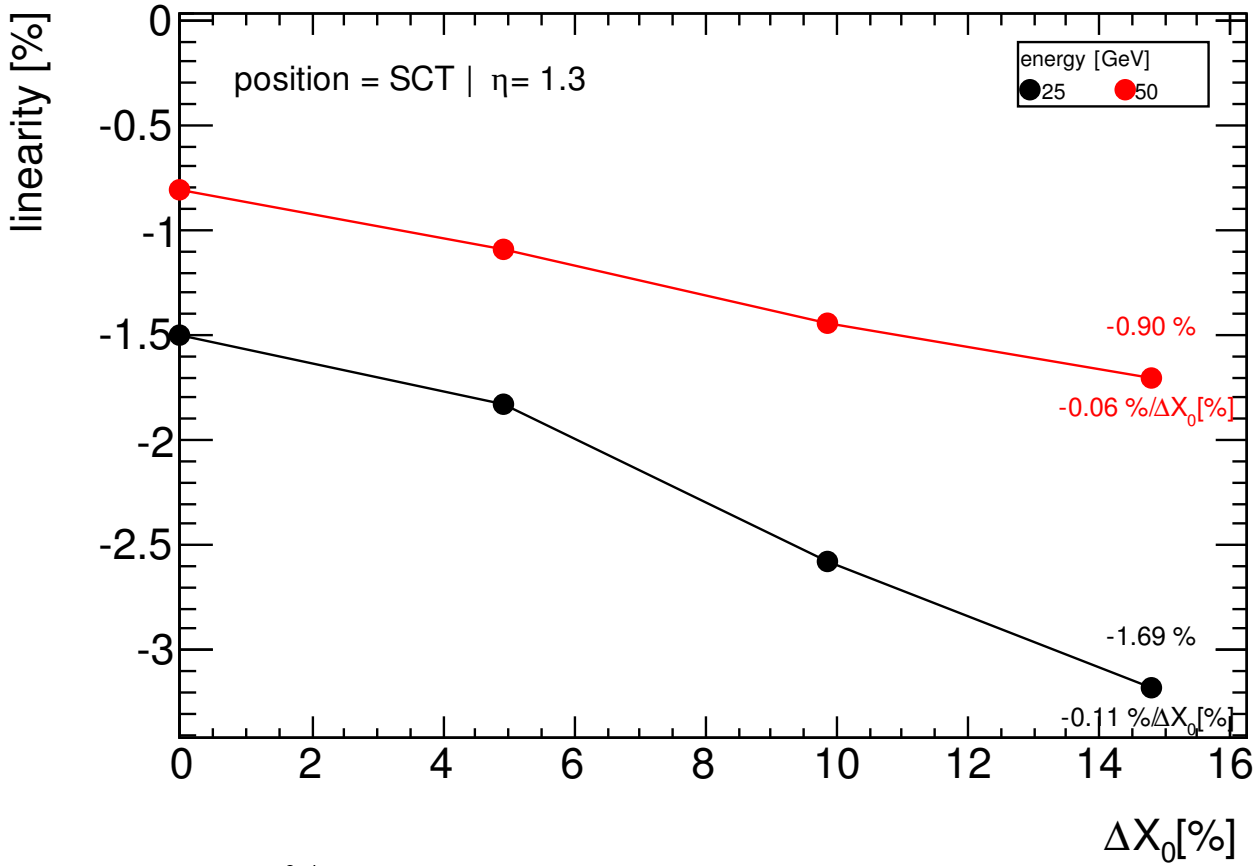


(s) 25 GeV



(t) 50 GeV

Something strange at $\eta = 1.3$?



- Linearity $\simeq -1\%$ with ideal geometry $\Rightarrow$ too big

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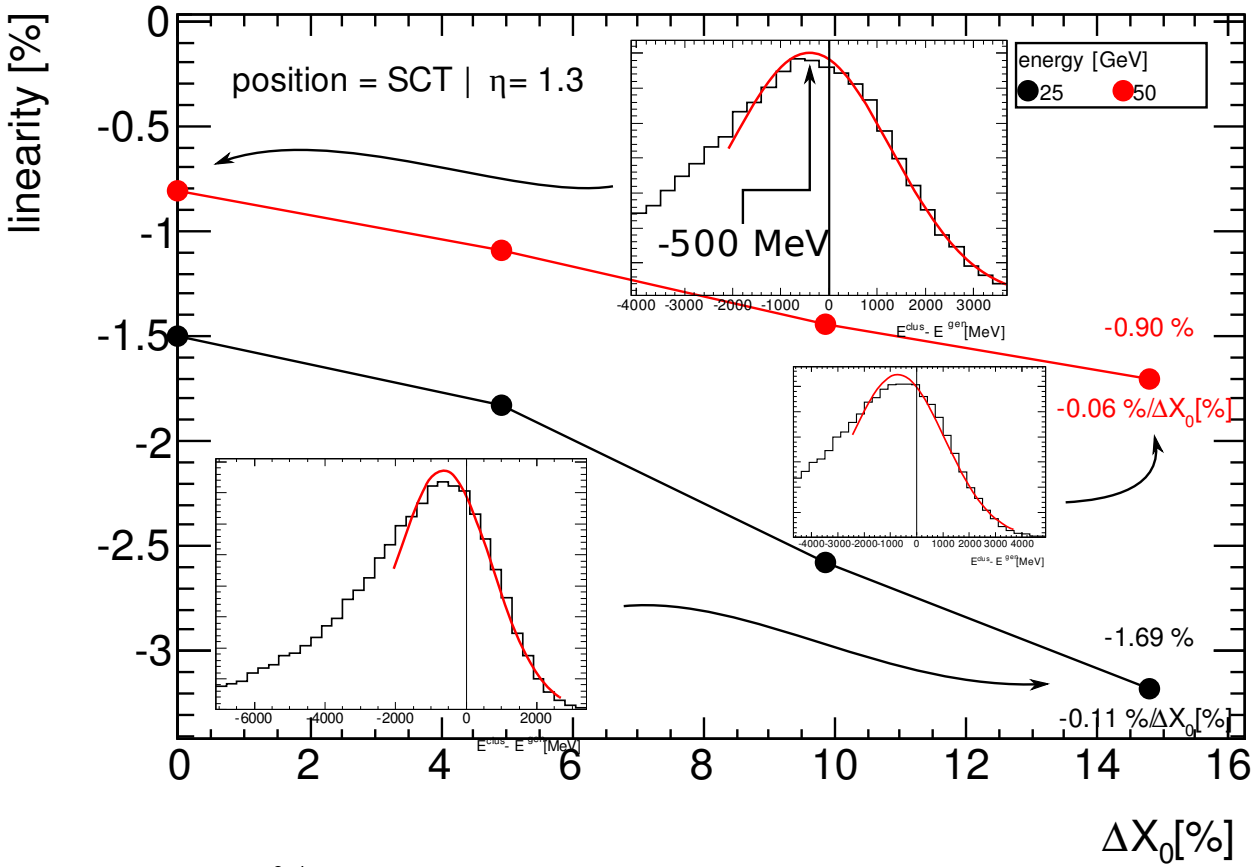

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- Peak is clearly at $-500\,\mathrm{MeV} \Rightarrow -500\,\mathrm{MeV}/5\,\mathrm{GeV} = -1\%$ (not a fit problem)

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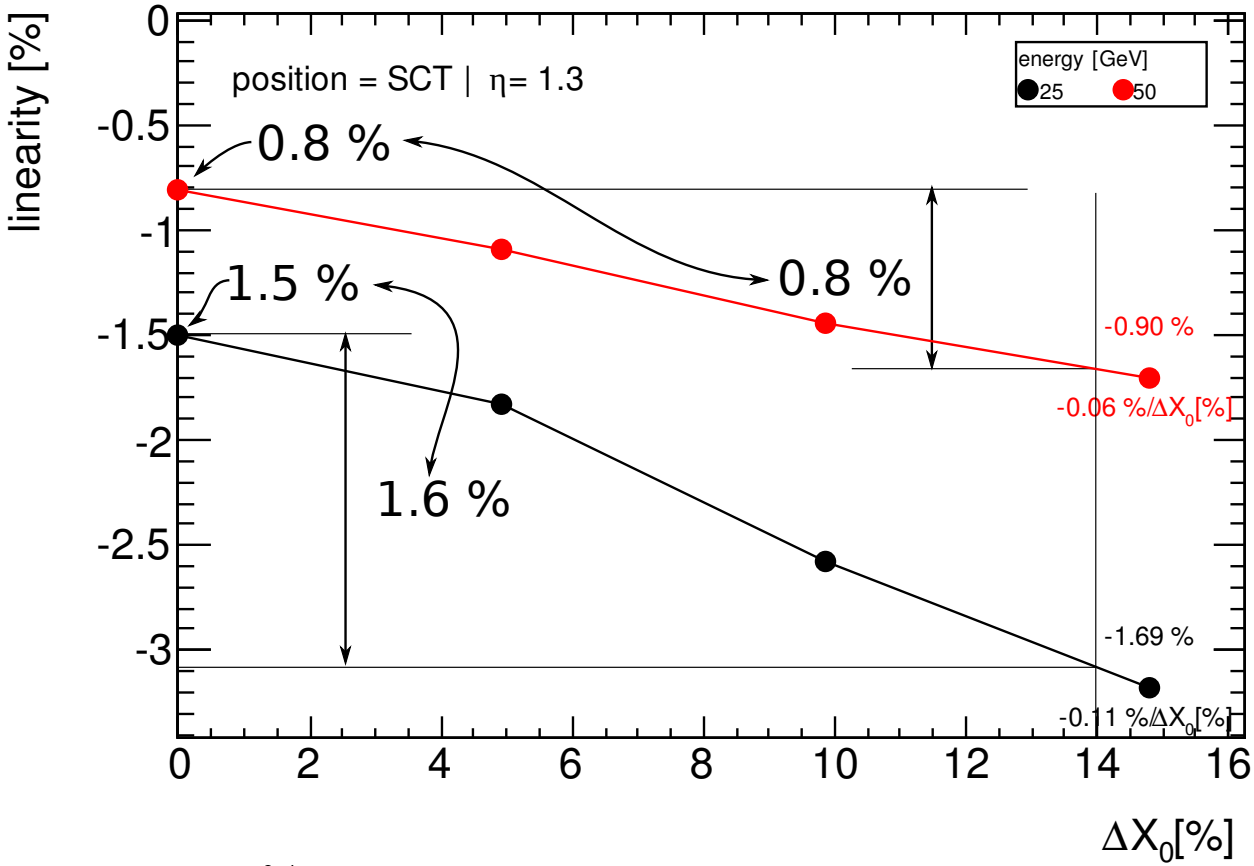

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- This discrepancy may be consistent with $14\%\Delta X_0$ ($7\%\Delta X_0$ in radial direction) in the SCT services or $16\%\Delta X_0$ ($8\%\Delta X_0$ in the radial direction) in the pixel barrel (only a guess to be investigated).

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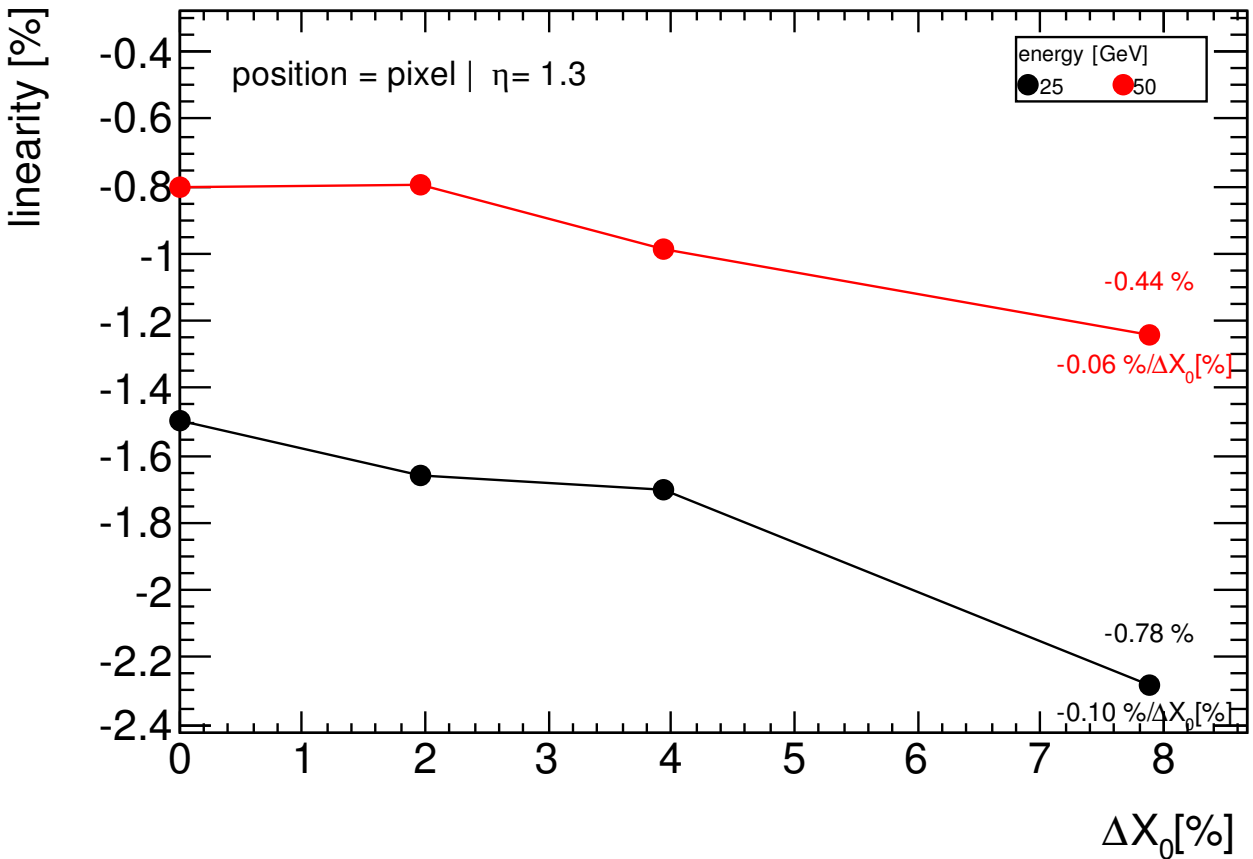

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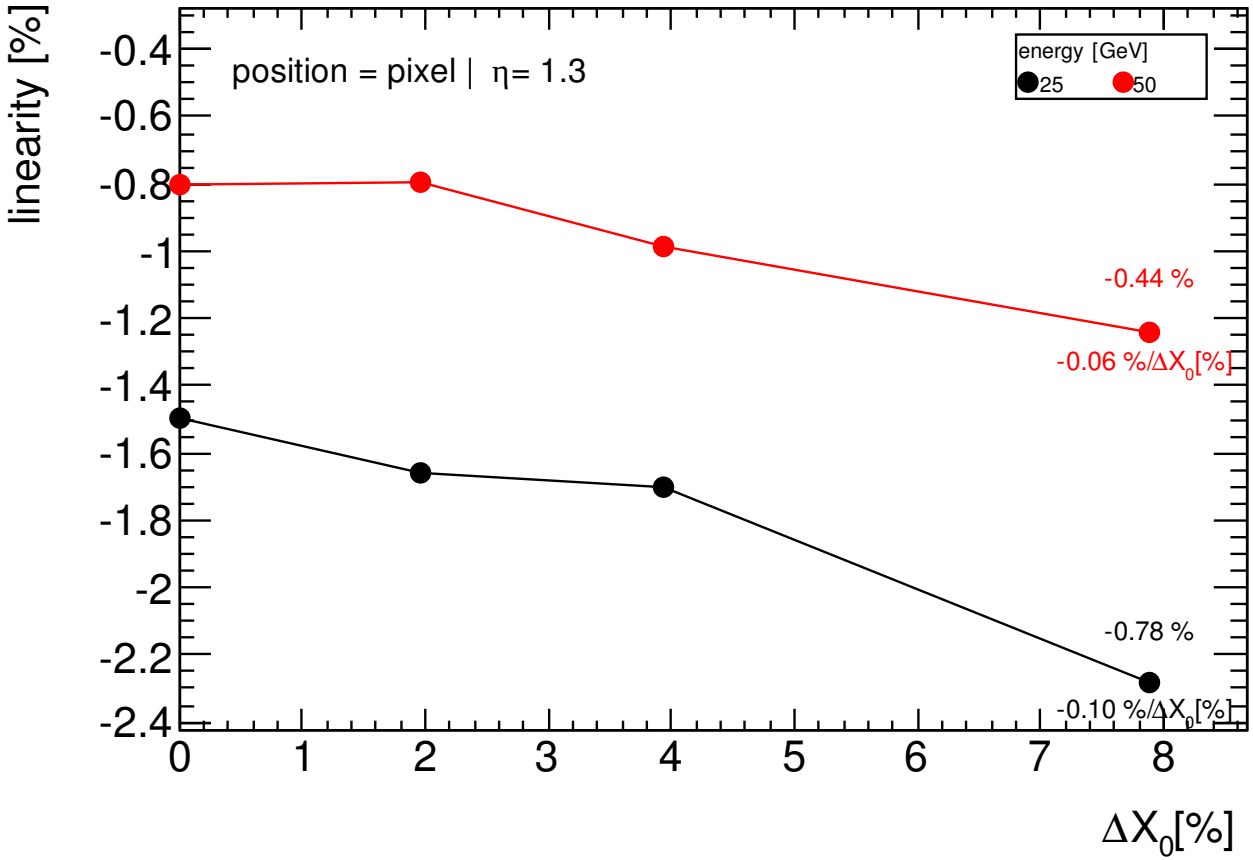
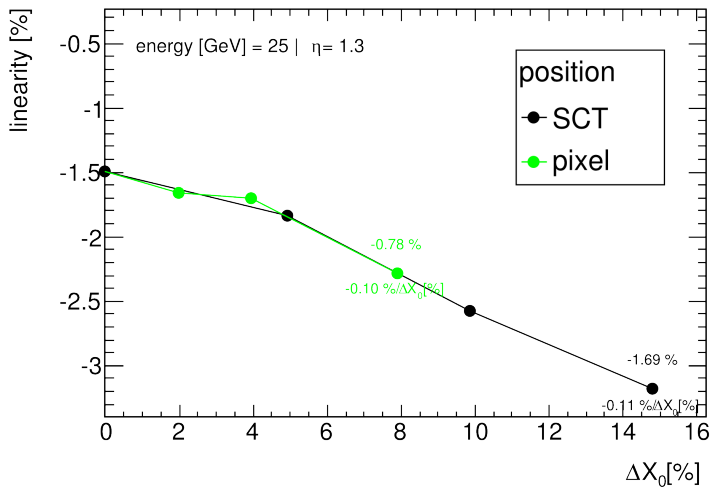
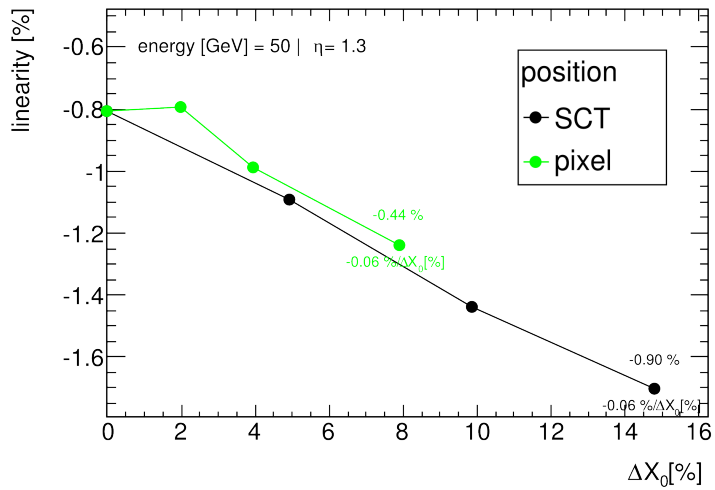


To be verified: this discrepancy is due to the differences between the ideal geometry used in this study (`ATLAS-GEO-06-00-00`) and the geometry used to calculate the parameters of the calibration algorithm (`ATLAS-CSC-05-00-00`)



(u) 25 GeV



(v) 50 GeV

Conclusions and future improvements

- We have computed the variations of the resolution, linearity, isEM selections, ... varying 3 η directions, 2 energies, 6 locations for additional material, 3 amounts of additional material. Every number and plot are available for other studies, corrections, ...
- There is a problem at $\eta = 1.3$ on the linearity
- We are looking at the shower shape variables and efficiencies: tons of plots on the web site: `www.mi.infn.it/~turra/distortion`

Thanks to: Danilo Banfi, Leonardo Carminati, ,Grant Gorfine, Luciano Mandelli, Guillaume Unal