Bichsel Model

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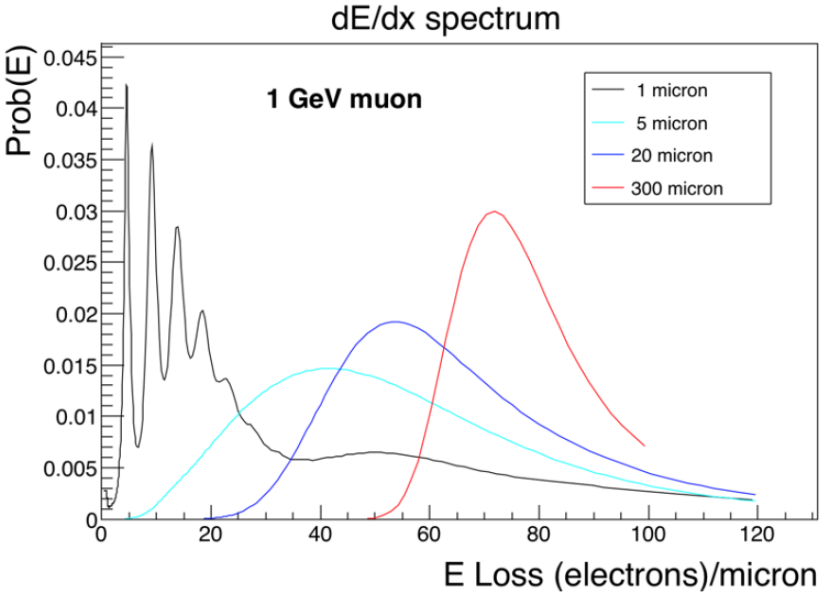
Why Bichsel Model

- Straggling function: the pdf of total energy loss(Δ) $f(\Delta)$

Landau distribution
(Neglect the binding energy)

✓ $\Delta \gg$ binding energy of Si

✗ Δ Comparable to binding energy (thin absorber)



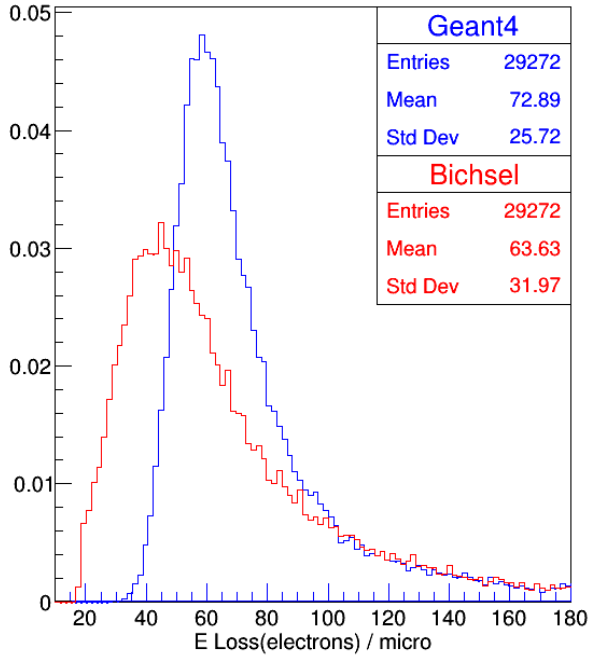
- Bichsel model : straggling function for thin absorber
- Analytic straggling function:

$$f(x,\Delta) = \sum_{n=0}^{\infty} \frac{m^n}{n!} e^{-m} \sigma(\Delta)^{*n}$$

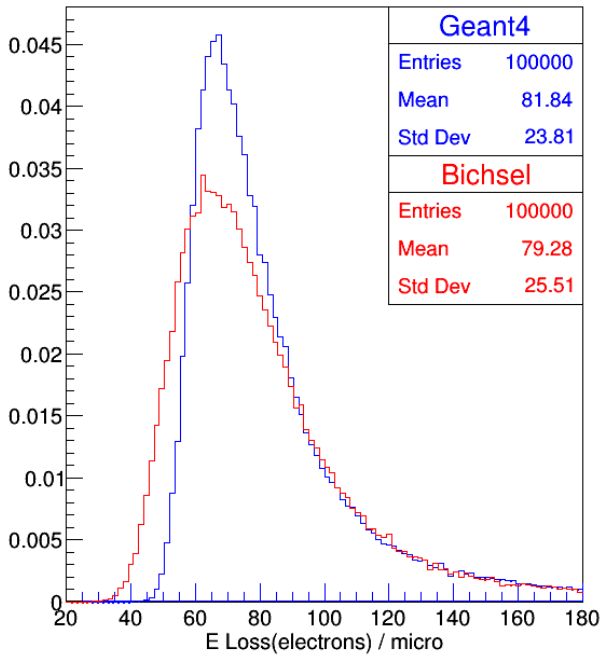
n-fold convolution

Energy deposition

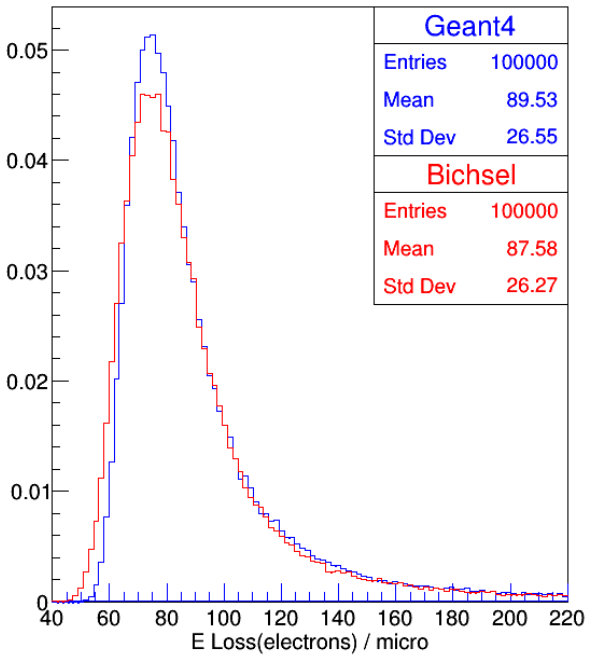
Track length 10 um

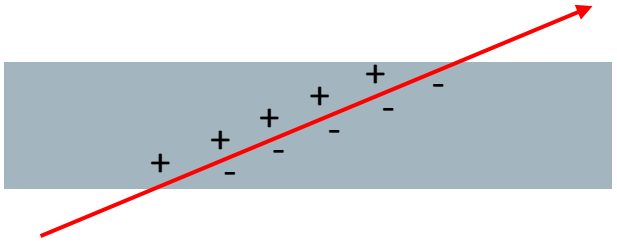


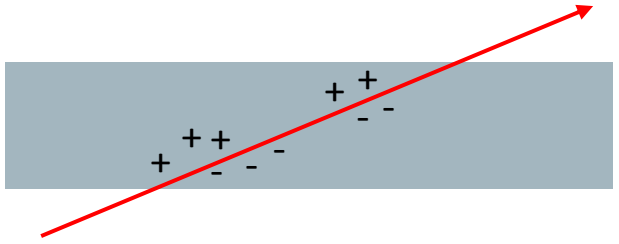
Track length 50 um

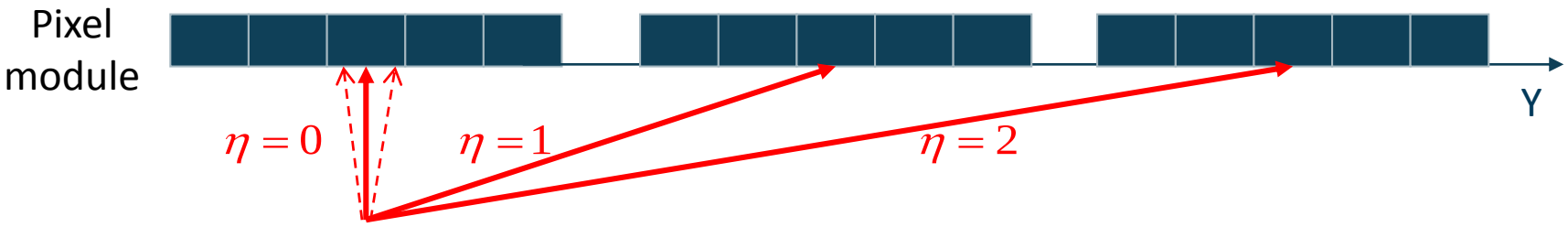


Track length 150 um

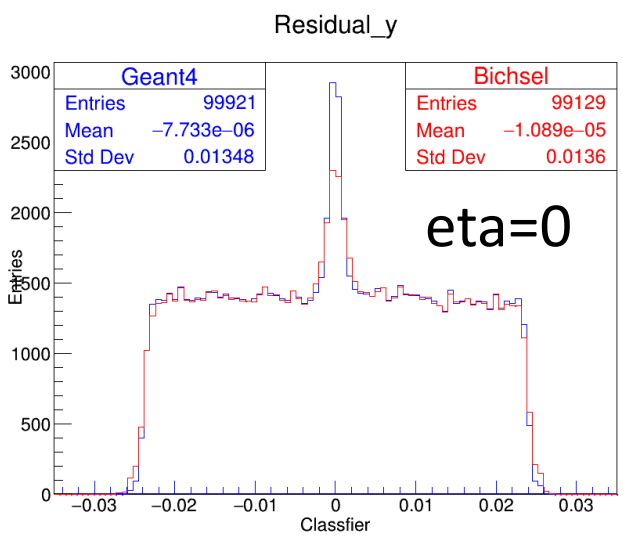


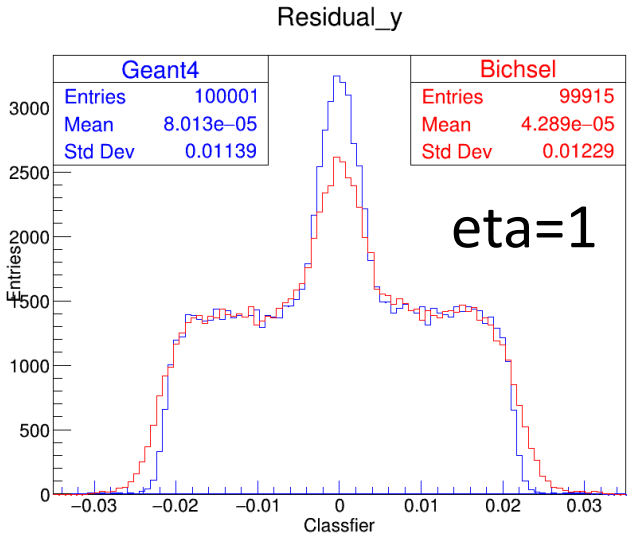


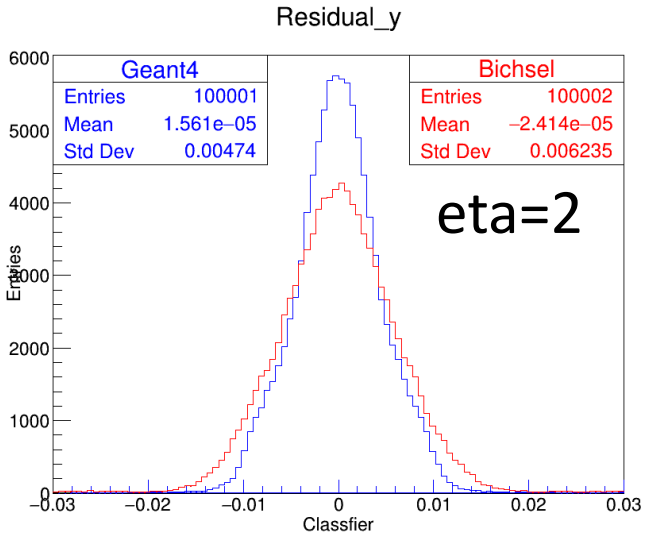



Pixel module
$\eta = 0$
$\eta = 1$
$\eta = 2$
Y

10 um

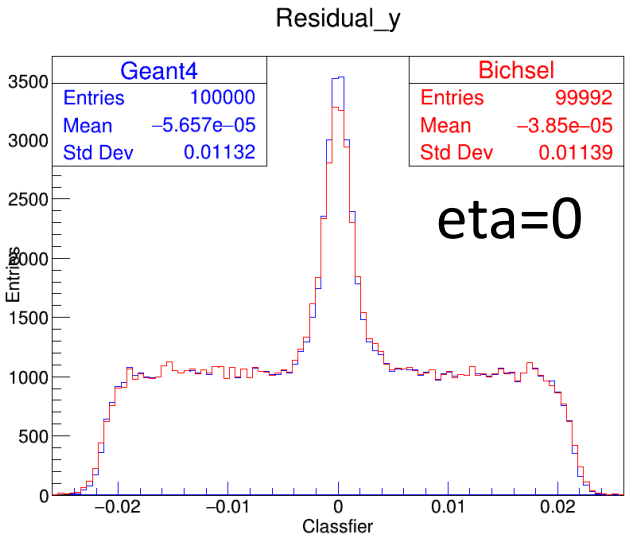

Residual_y
Geant4
Entries 99921
Mean −7.733e−06
Std Dev 0.01348
Bichsel
Entries 99129
Mean −1.089e−05
Std Dev 0.0136
eta=0
Entries
Classfier

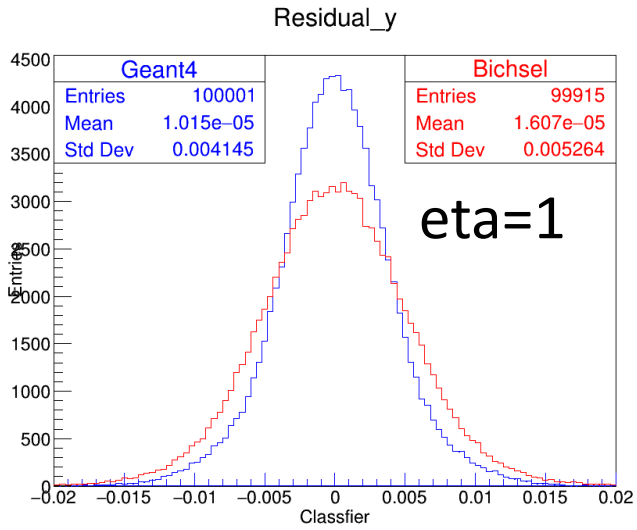

Residual_y
Geant4
Entries 100001
Mean 8.013e−05
Std Dev 0.01139
Bichsel
Entries 99915
Mean 4.289e−05
Std Dev 0.01229
eta=1
Entries
Classfier


Residual_y
Geant4
Entries 100001
Mean 1.561e−05
Std Dev 0.00474
Bichsel
Entries 100002
Mean −2.414e−05
Std Dev 0.006235
eta=2
Entries
Classfier

Y

50 um


Residual_y
Geant4
Entries 100000
Mean −5.657e−05
Std Dev 0.01132
Bichsel
Entries 99992
Mean −3.85e−05
Std Dev 0.01139
eta=0
Entries
Classfier


Residual_y
Geant4
Entries 100001
Mean 1.015e−05
Std Dev 0.004145
Bichsel
Entries 99915
Mean 1.607e−05
Std Dev 0.005264
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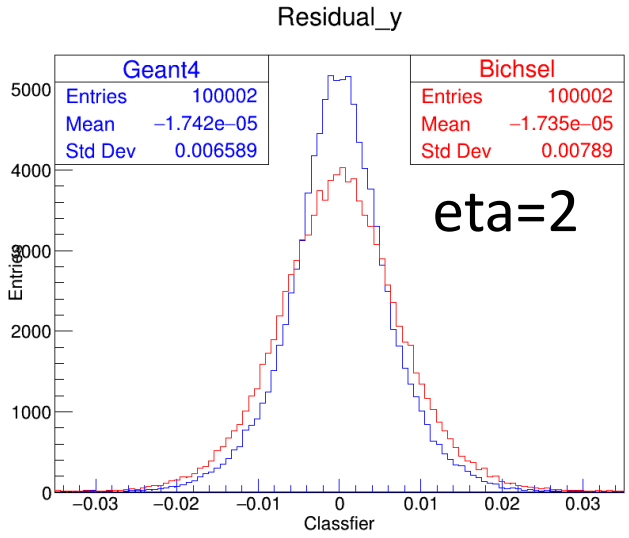
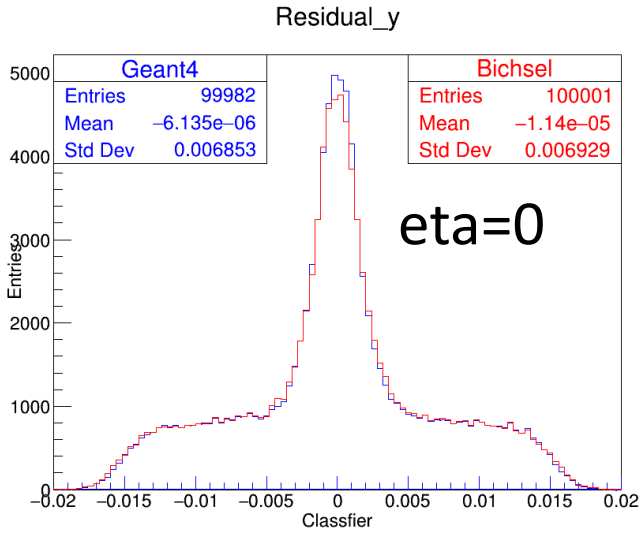
Entries
Classfier


Residual_y
Geant4
Entries 100002
Mean −1.742e−05
Std Dev 0.006589
Bichsel
Entries 100002
Mean −1.735e−05
Std Dev 0.00789
eta=2
Entries
Classfier

150 um


Residual_y
Geant4
Entries 99982
Mean −6.135e−06
Std Dev 0.006853
Bichsel
Entries 100001
Mean −1.14e−05
Std Dev 0.006929
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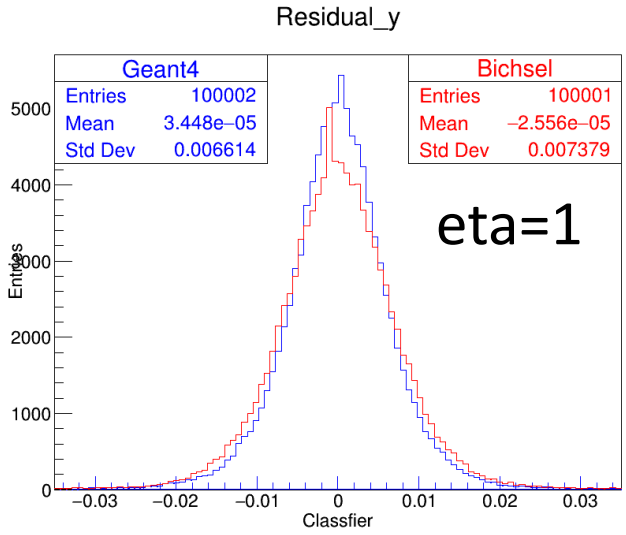
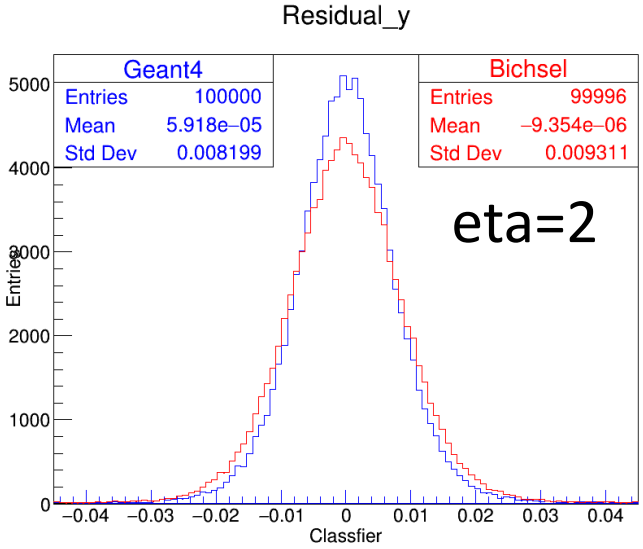
Entries
Classfier


Residual_y
Geant4
Entries 100002
Mean 3.448e−05
Std Dev 0.006614
Bichsel
Entries 100001
Mean −2.556e−05
Std Dev 0.007379
eta=1
Entries
Classfier


Residual_y
Geant4
Entries 100000
Mean 5.918e−05
Std Dev 0.008199
Bichsel
Entries 99996
Mean −9.354e−06
Std Dev 0.009311
eta=2
Entries
Classfier

Thank you