Measurements of the Attenuation Length of Scintillators

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Outline

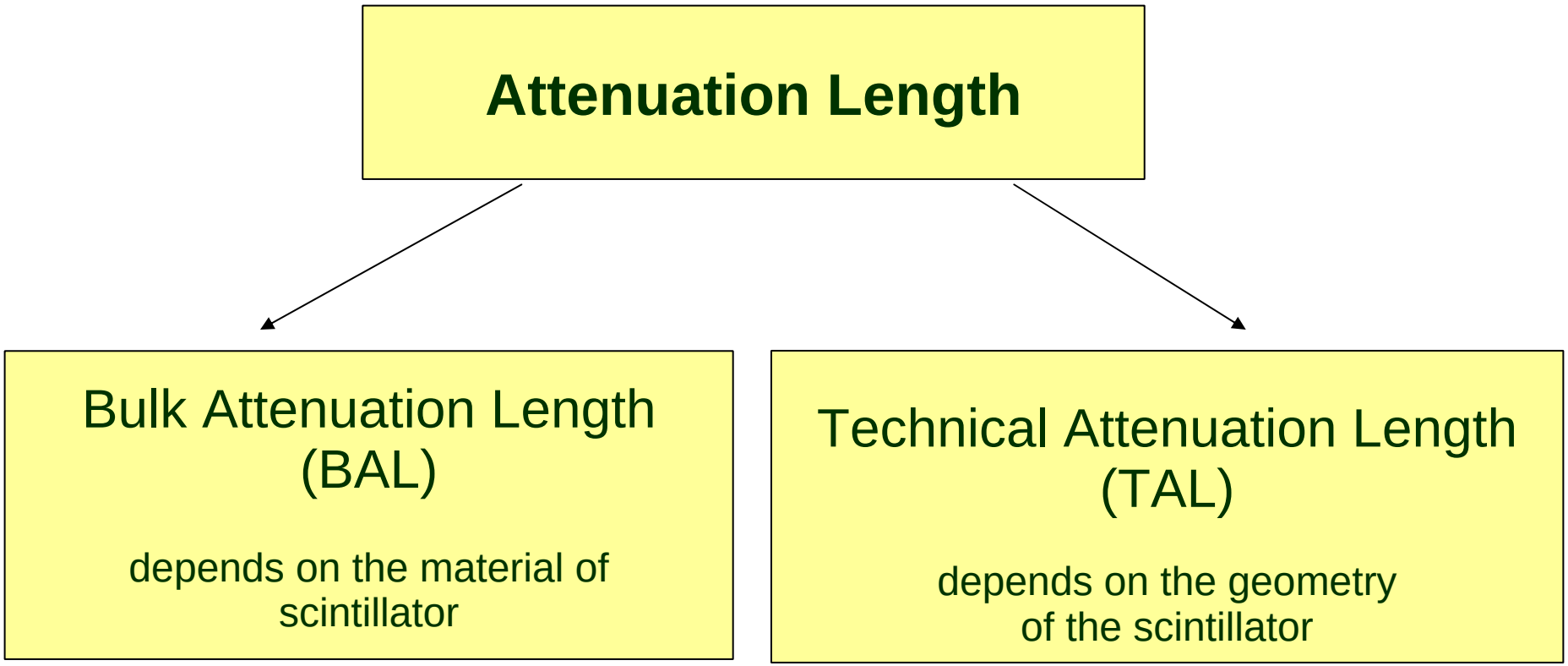
- Why ?
- Experimental setup and method
- Experimental data and results
- Conclusion and outlook

Why ?

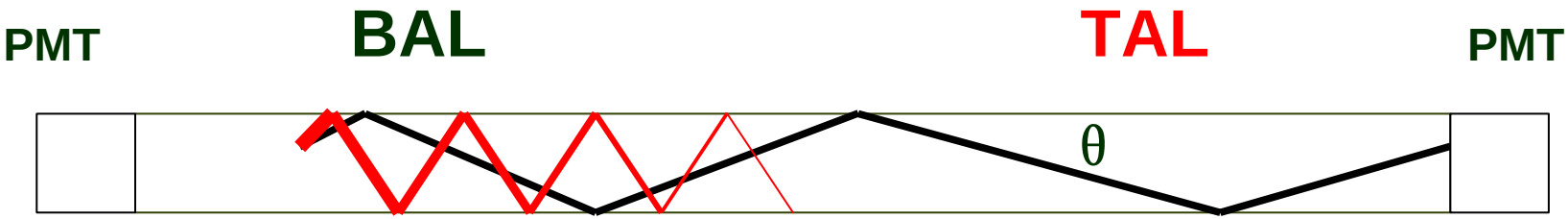
The scintillation material for the TOF system must have an attenuation length of at least the same order as the length of the scintillator.

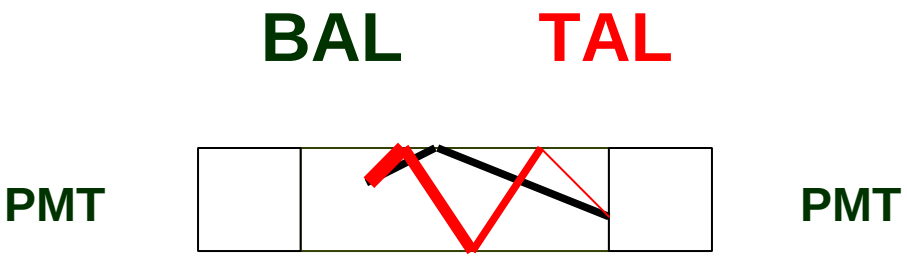
Verify that the attenuation length of each scintillator meets the required specifications.

… quality assurance


Attenuation Length
Bulk Attenuation Length (BAL)
depends on the material of scintillator
Technical Attenuation Length (TAL)
depends on the geometry of the scintillator

Attenuation Length





Attenuation Length

$$N = N_0 \exp(-x/\lambda)$$

N: Number of photons

linear

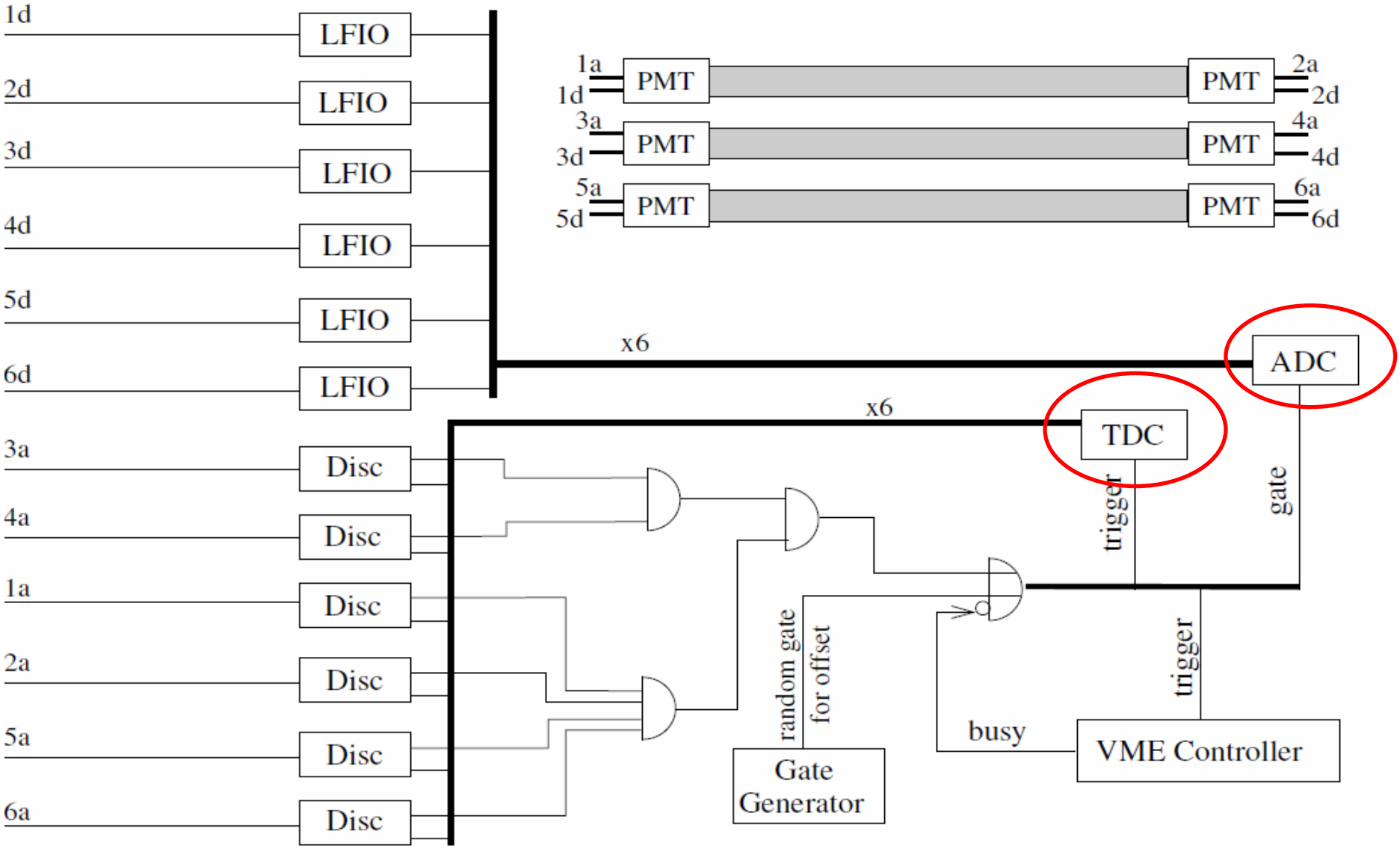
ADC Value

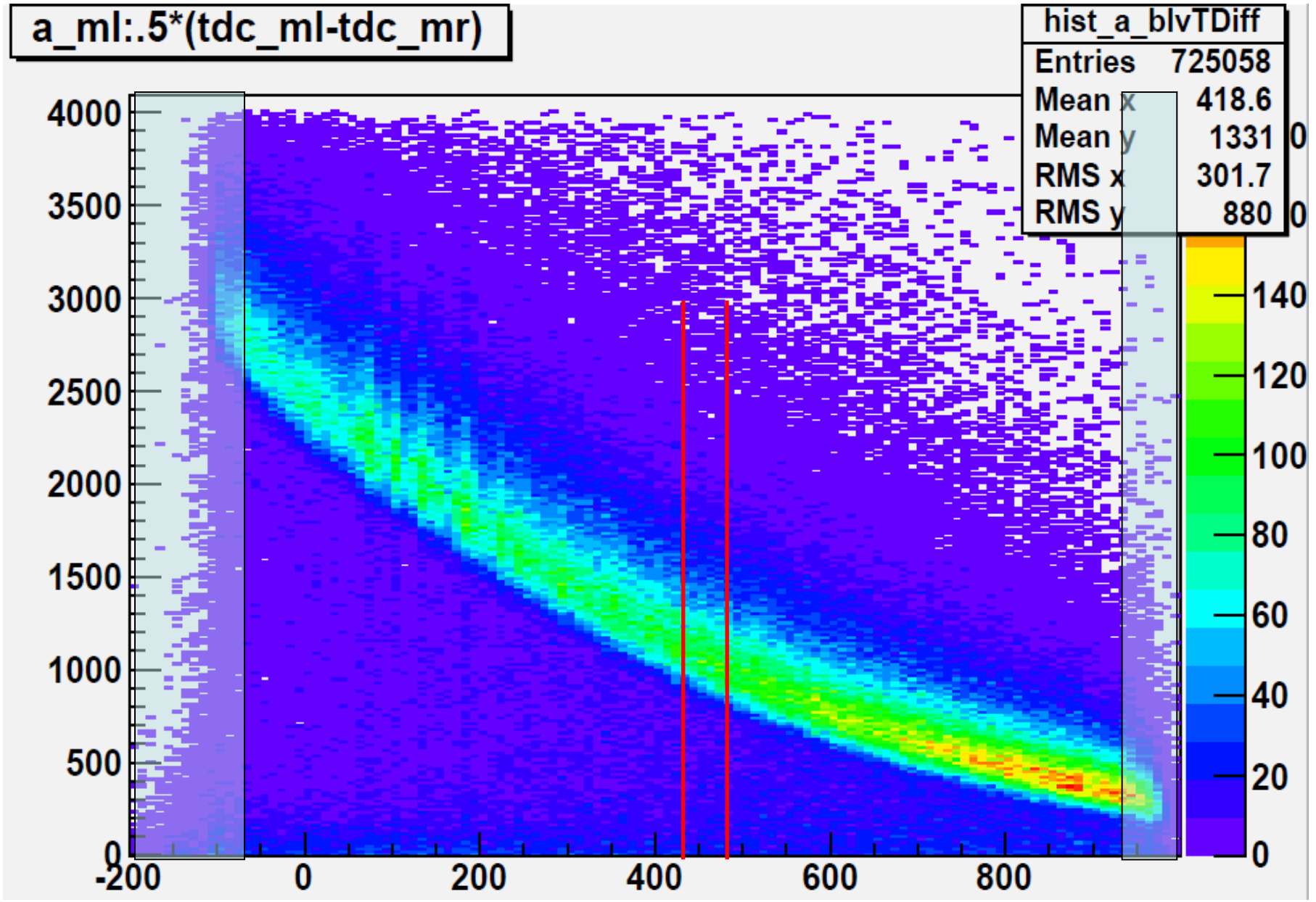
Distance X

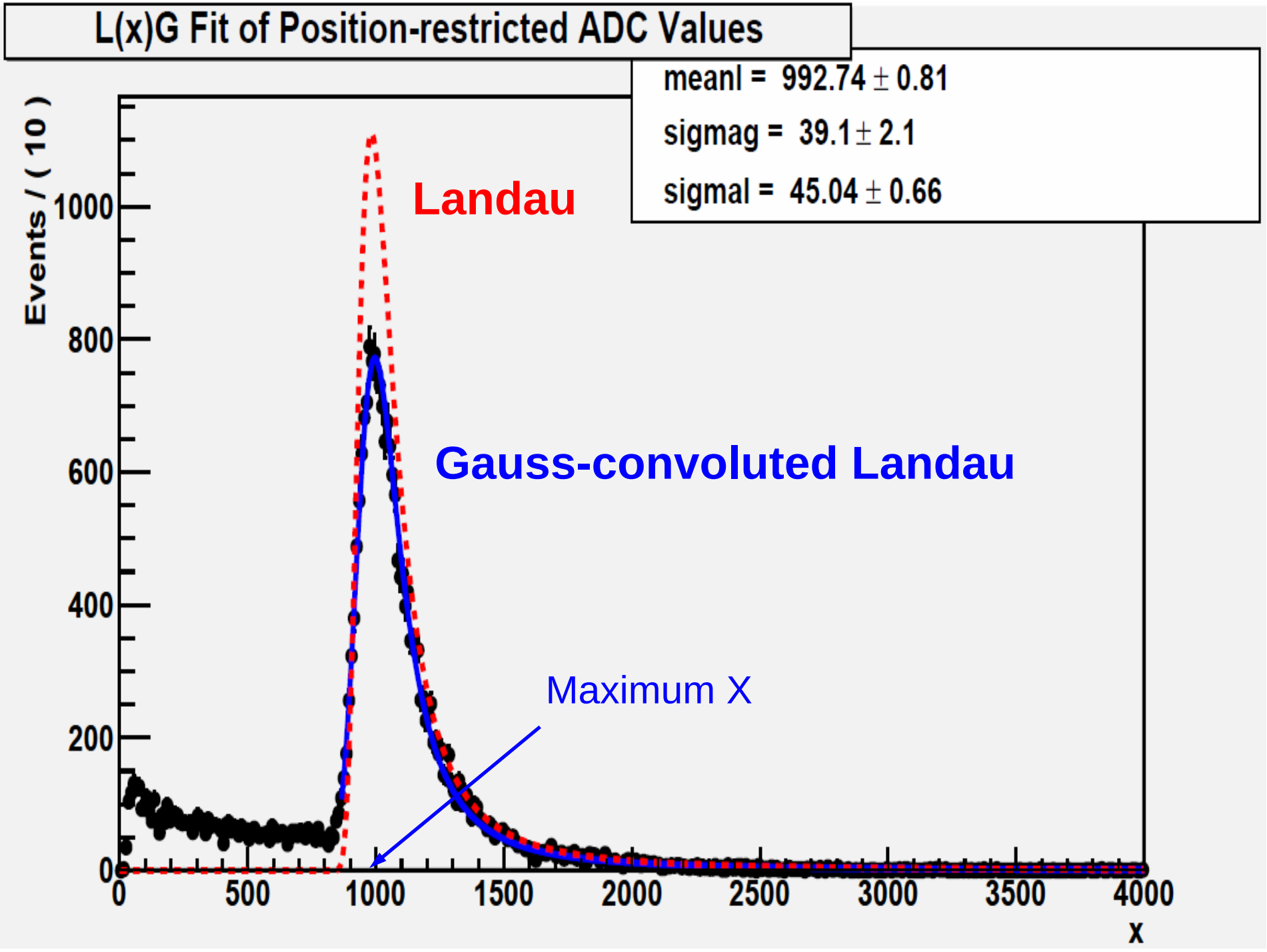
effective speed of light

TDC Value

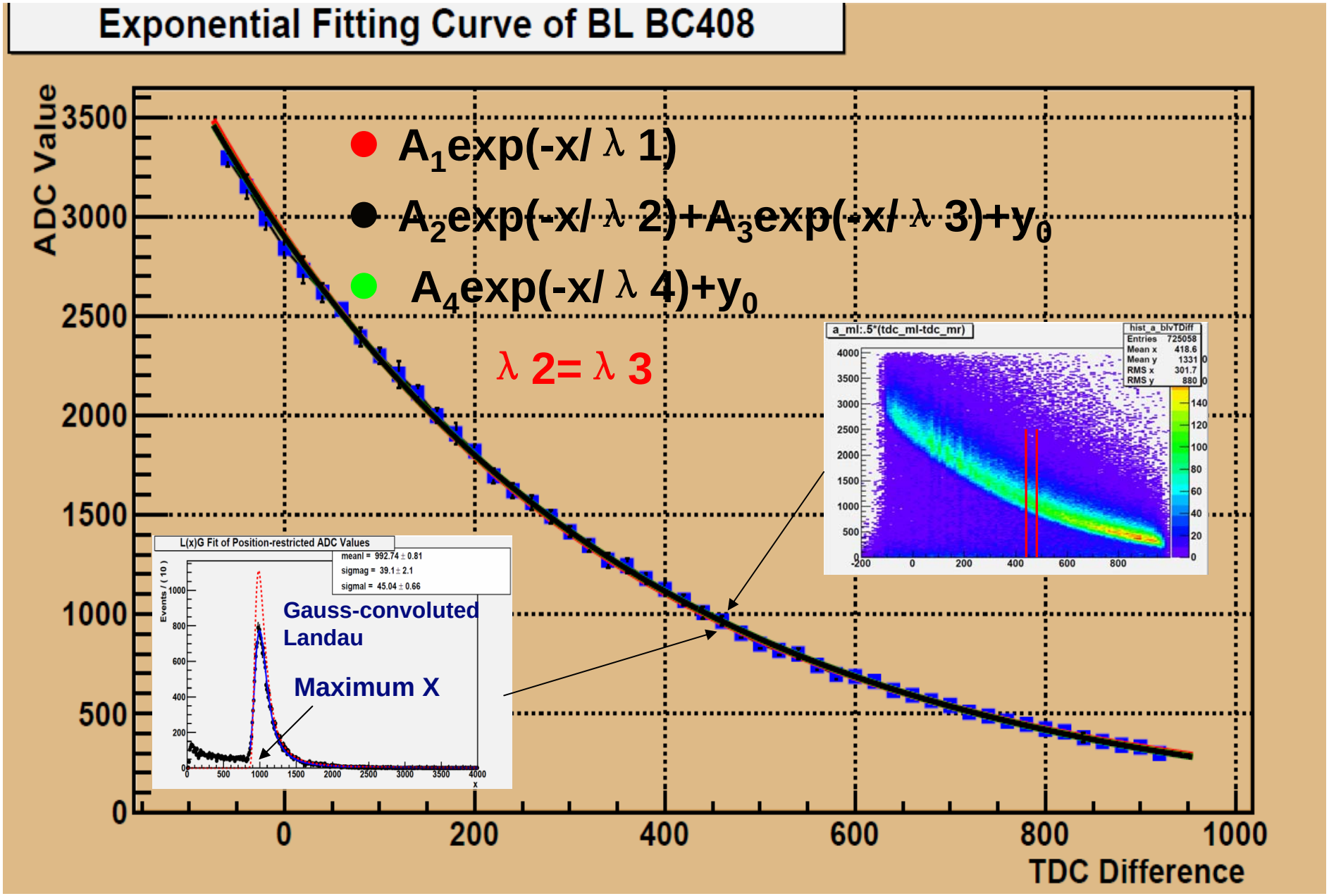
Experimental Setup



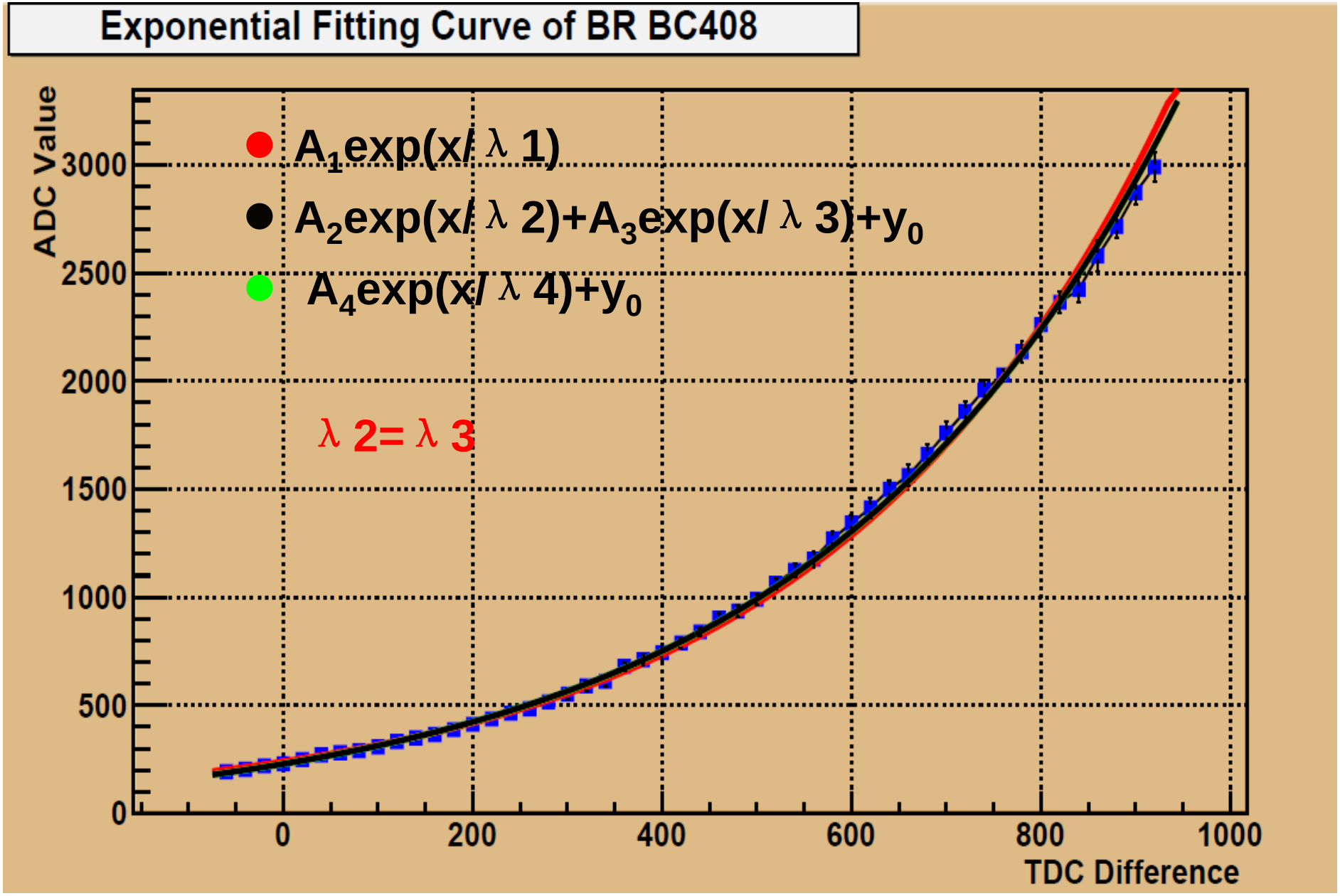

a_ml:.5*(tdc_ml-tdc_mr)
hist_a_blvTDiff
Entries 725058
Mean x 418.6
Mean y 1331
RMS x 301.7
RMS y 880
ADC Value
TDC Difference
4000
3500
3000
2500
2000
1500
1000
500
0
-200
0
200
400
600
800
140
120
100
80
60
40
20
0


L(x)G Fit of Position-restricted ADC Values
meanl = 992.74 ± 0.81
sigmag = 39.1 ± 2.1
sigmal = 45.04 ± 0.66
Landau
Gauss-convoluted Landau
Maximum X
Events / (10)
0
200
400
600
800
1000
0
500
1000
1500
2000
2500
3000
3500
4000
x

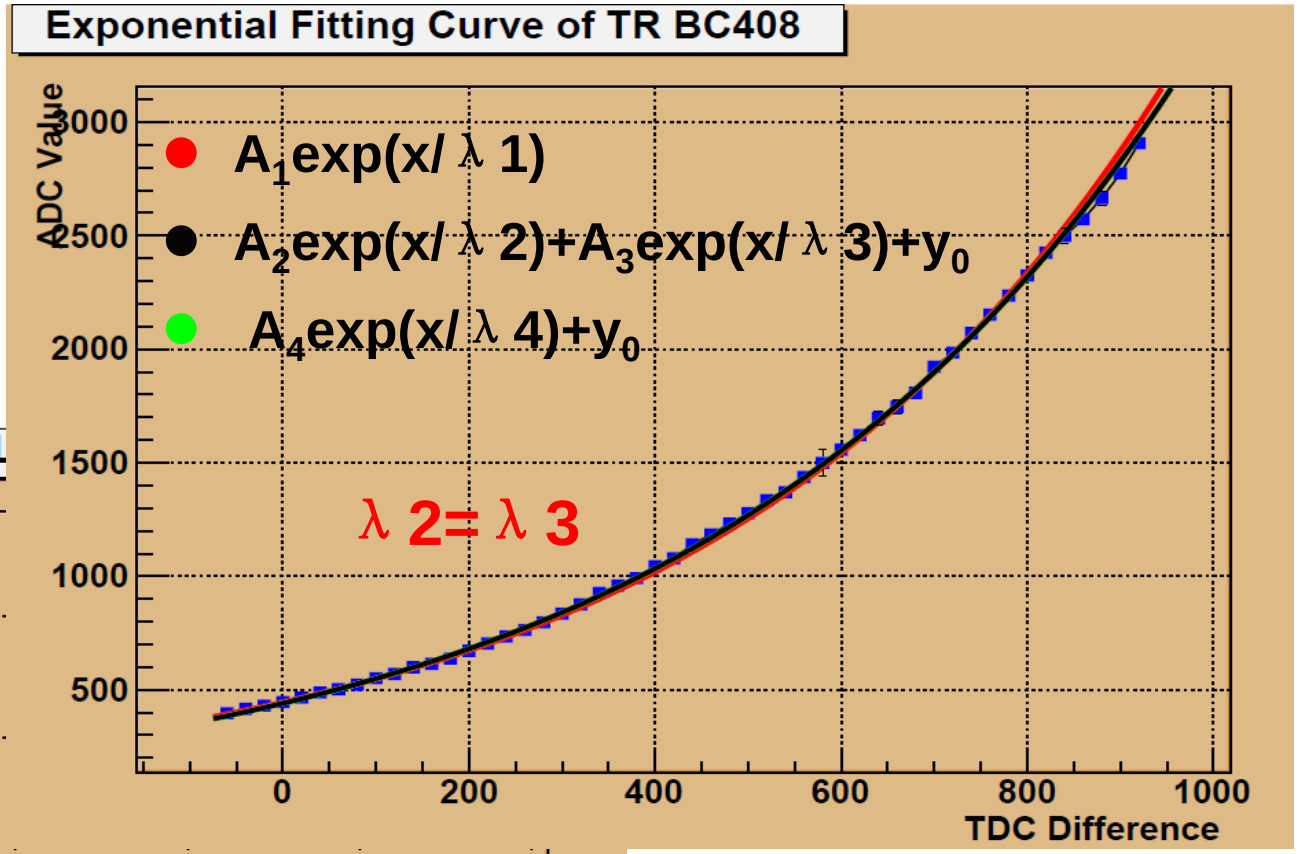
Bottom Left (400×5×5 cm^3)

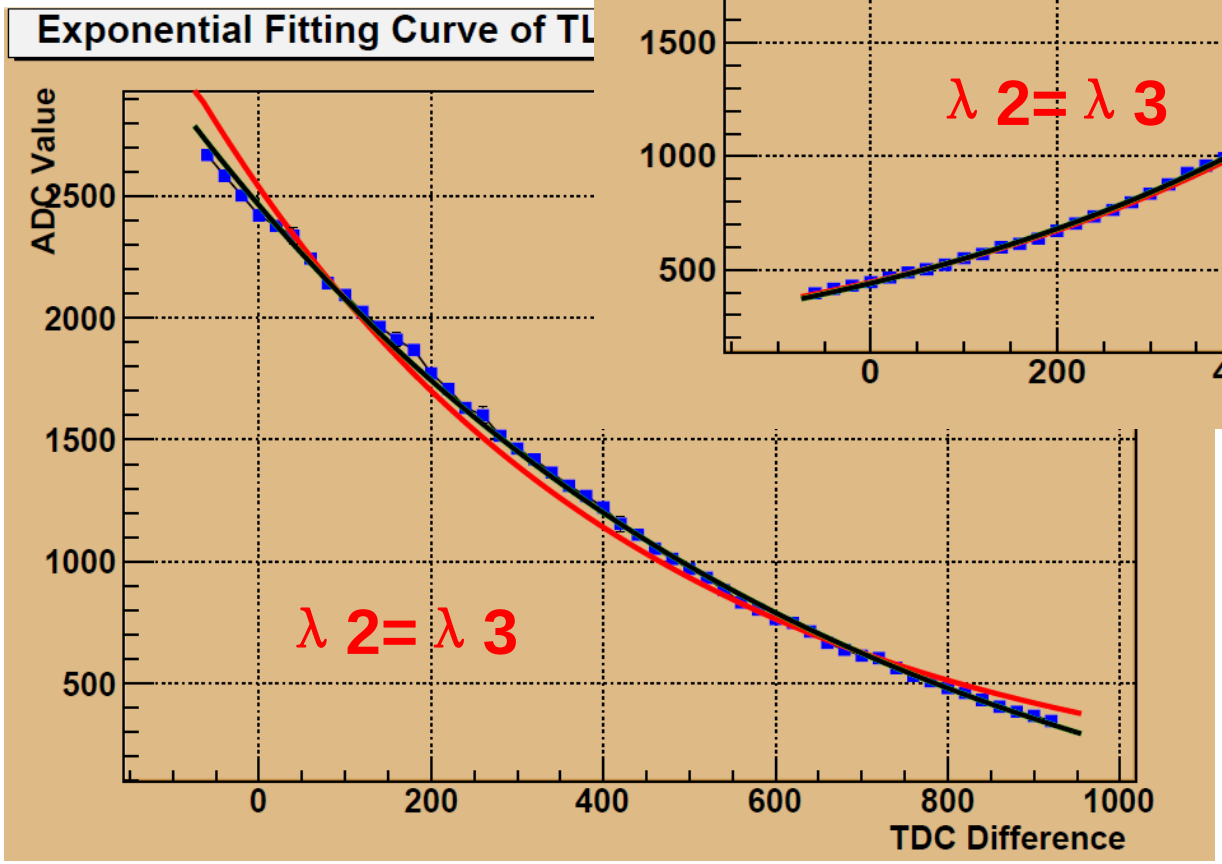


Bottom Right (400×5×5 cm^3)



Top Left and Right (400×5×5 cm^3)



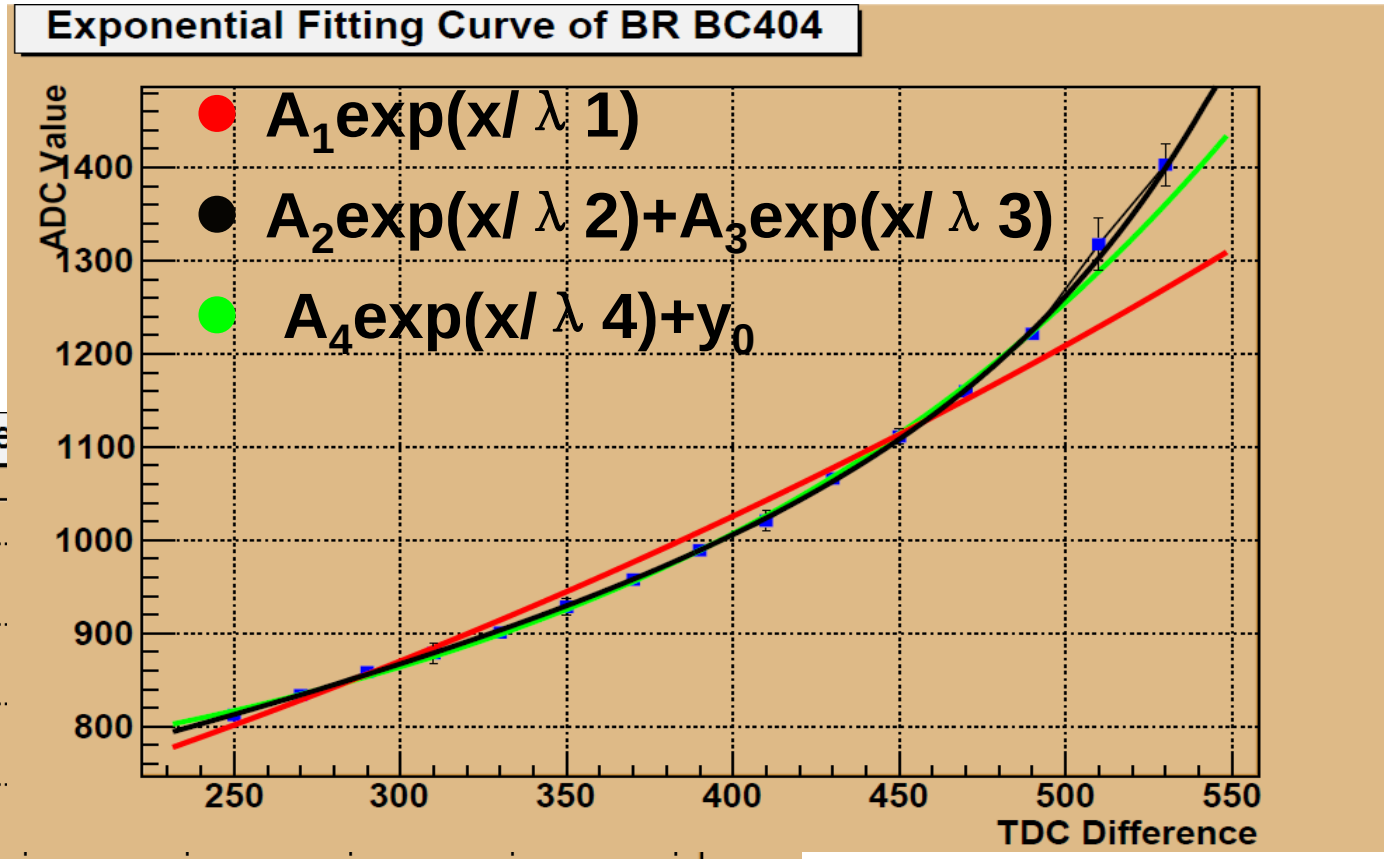


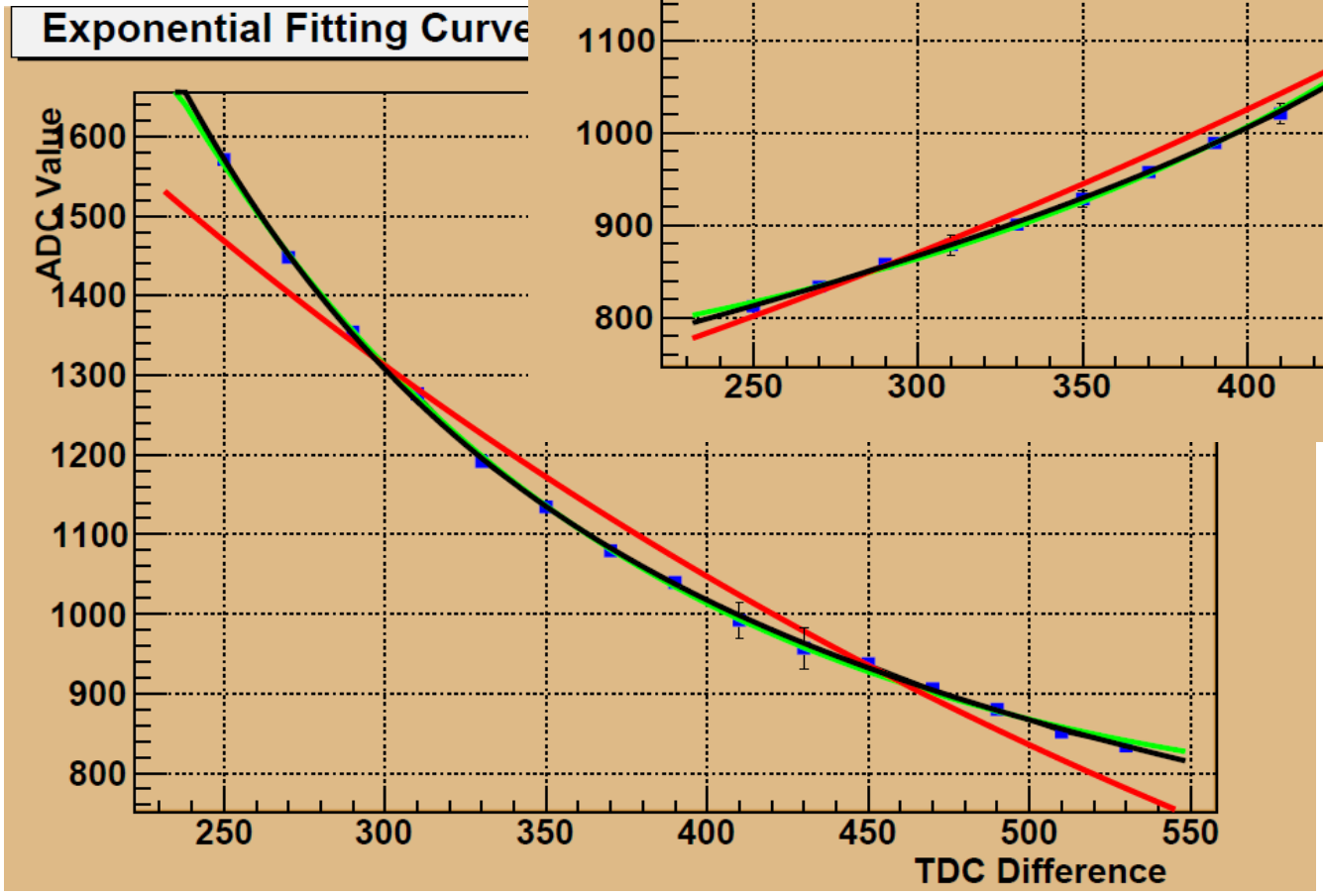
Attenuation Length (400×5×5cm^3)

$A_2\exp(-x/\lambda_2)+A_3\exp(-x/\lambda_3)$	λ_2(cm)	λ_3(cm)
Bottom Left (EJ200 380cm)	212.89±12.78	212.89±12.78
Bottom Right (EJ200 380cm)	191.88±3.00	191.88±3.00
Top Left (BC408 380cm)	317.68±5.86	317.68±5.86
Top Right (BC408 380cm)	230.85±10.23	230.85±10.23

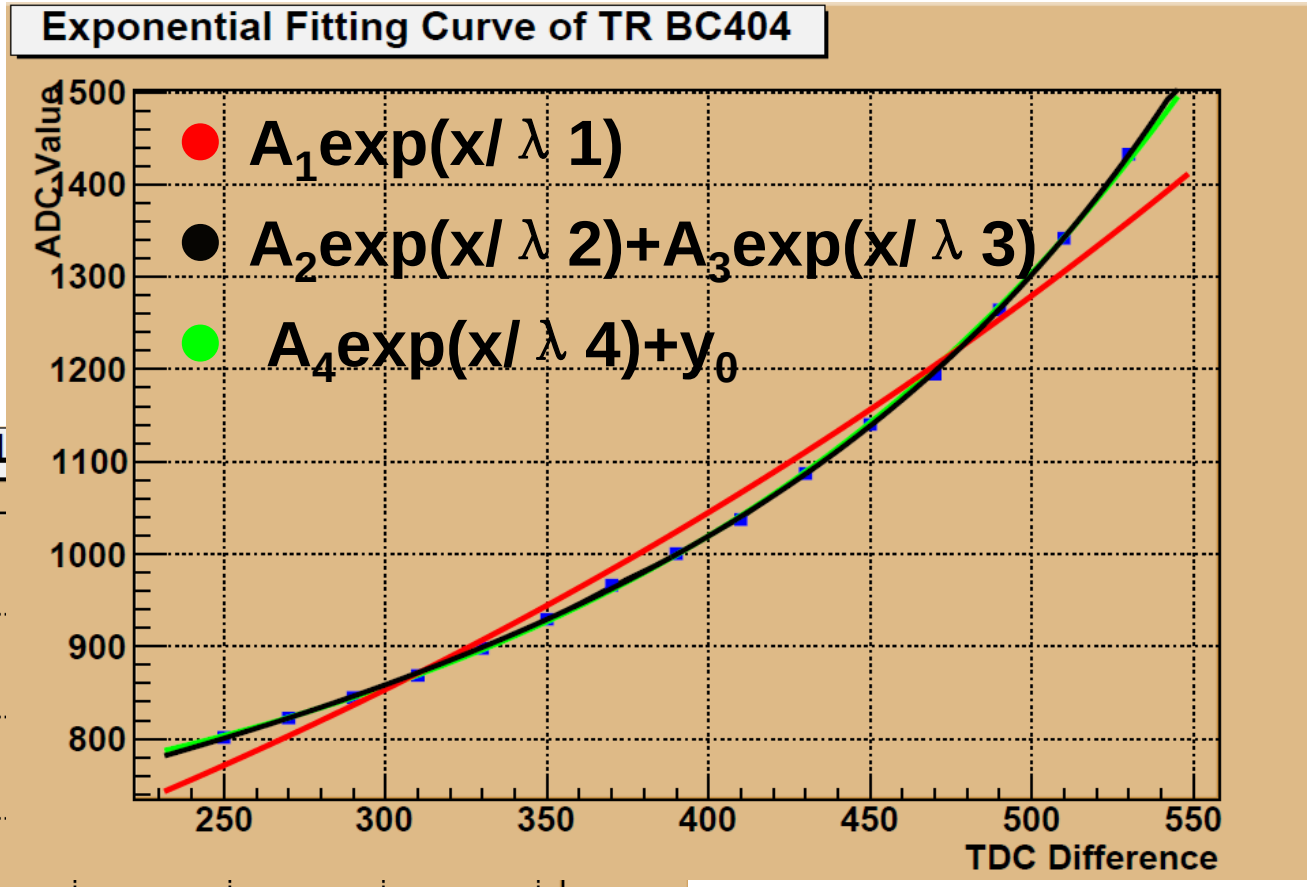
BAL

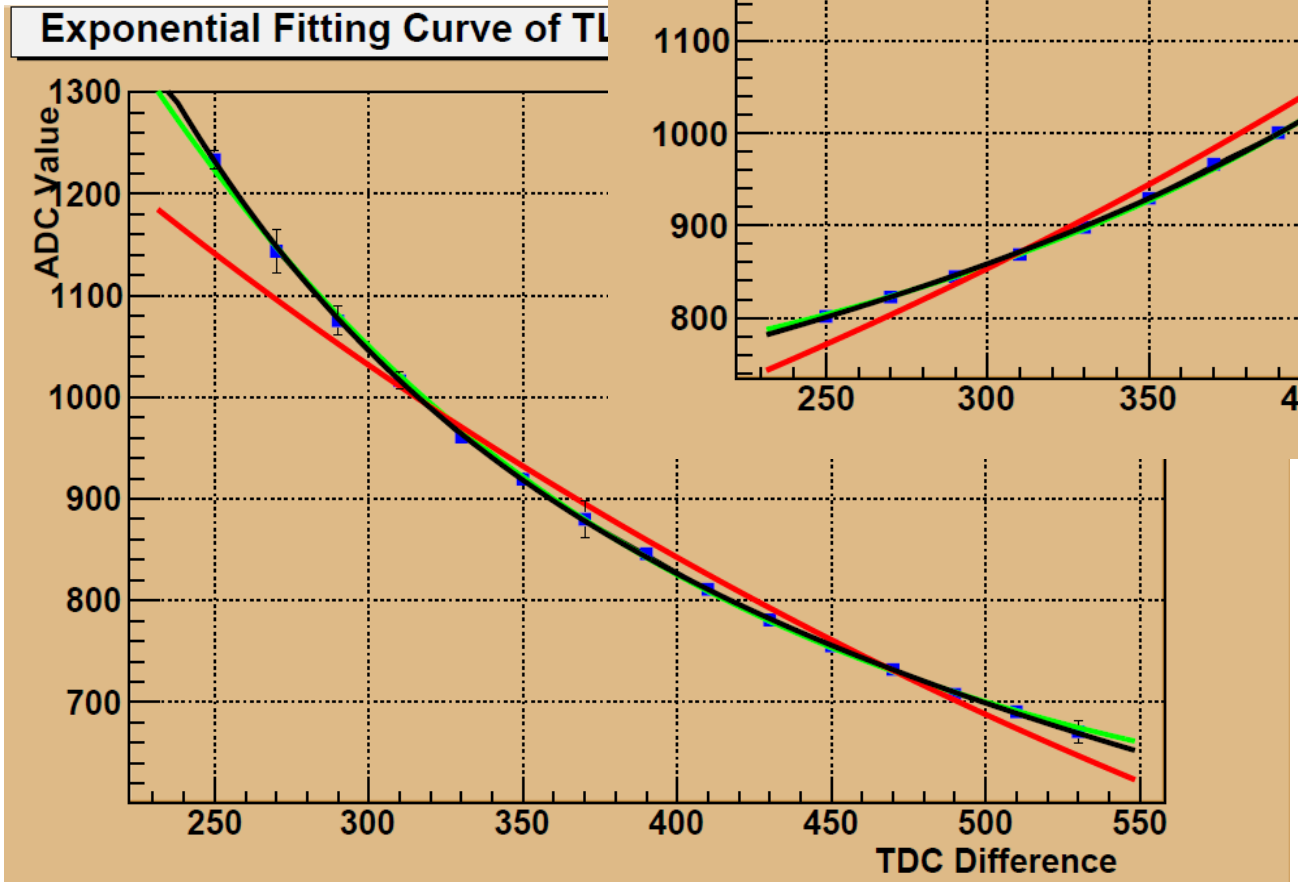
Bottom Left and Right (120×6×6 cm^3)





Top Left and Right (120×6×6 cm^3)





Attenuation Length (120×6×6cm^3)

$A_2exp(-x/\lambda_2)+A_3exp(-x/\lambda_3)$	λ_2 (cm)	λ_3 (cm)
Bottom Left (BC404 160cm)	369.44±99.73	32.42±5.84
Bottom Right (BC404 160cm)	293.87±37.37	23.43±7.30
Top Left (BC404 160cm)	298.18±63.58	32.70±7.31
Top Right (BC404 160cm)	359.12±12.38	39.31±0.65

BAL TAL

Outlook

- **Automate and optimize the attenuation length program to achieve efficient quality control**

- **Run more data to recheck the program to get verified reliable results**

Thanks

I would like to thank Dr. Ralf Gothe, Evan Phelps, Robert Steinman, Jason Giamberadino, Lewis Graham, Haiyun Lu, Zhiwen Zhao, and Dong Xue.

Thank You!