Weekly Meeting

2020/03/11

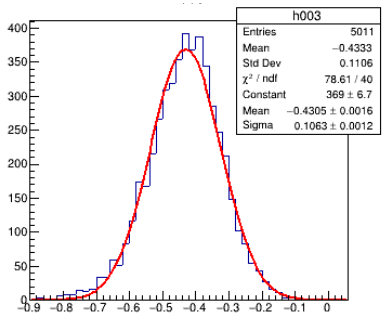
ByungChan Lee

Time Resolution 5cm vs 10cm

Calculation Method

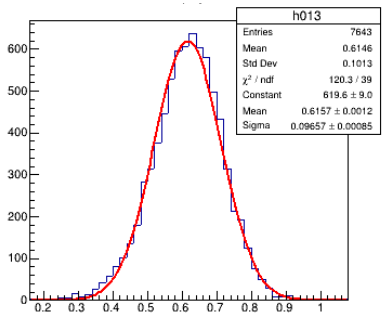
- t_avg(top) – t_avg(mid) …
- $\sigma_1 = \sqrt{(\sigma_a^2 - \sigma_b^2 + \sigma_c^2)/2}$ …

top - mid



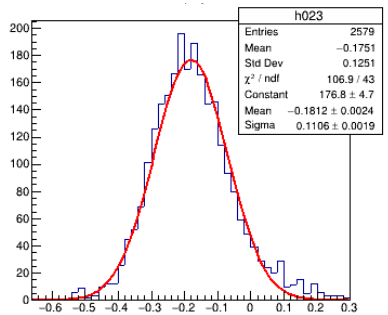
σ_a

mid - bot



σ_b

top - bot



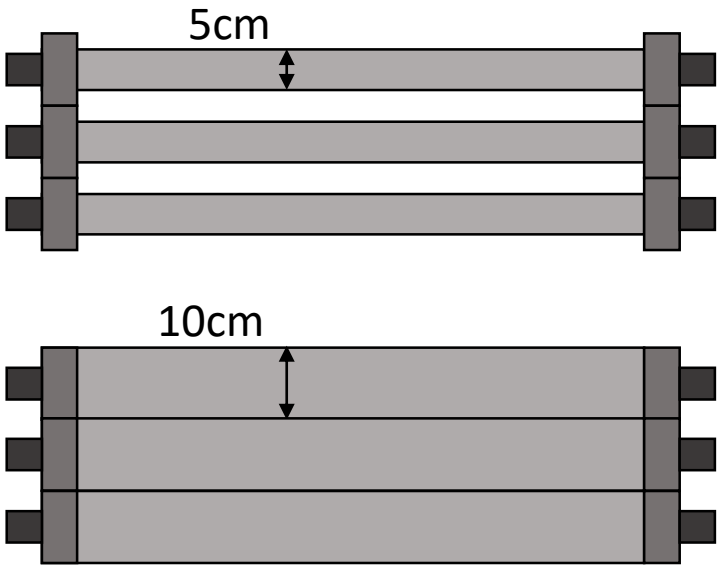
σ_c

Configuration and Event selection

- Bar : G, H, F
- # of events : 100,000
- Coincidence : 3 Bars
- Threshold : 100 ADC counts (~ 3MeV) → 200 (~ 5MeV)
- Position : -80cm ~ 80cm, 8 divisions (20cm each)
- Angle : $\Delta x/\Delta y < 0.75$ ($\cos\theta > 0.8$)

offline analysis

mistake in code

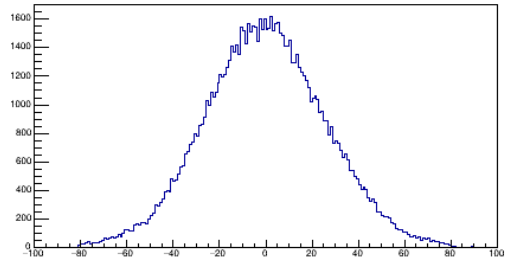


Calculating Angle

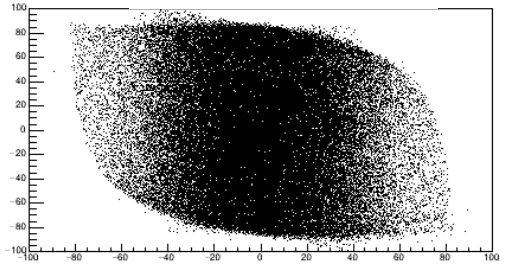
Angle Cut : ~~$\Delta x/\Delta y < 0.75$~~ → Linear Fitting

Thickness : 10cm

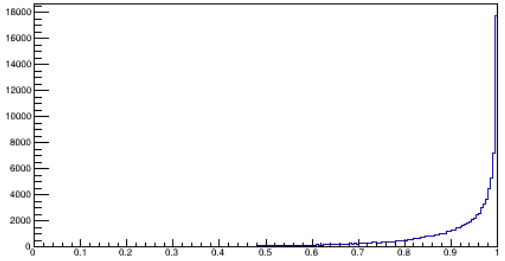
theta



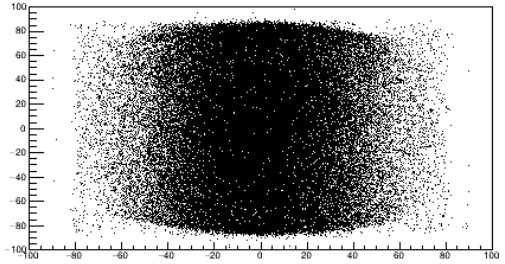
Position[0] : theta



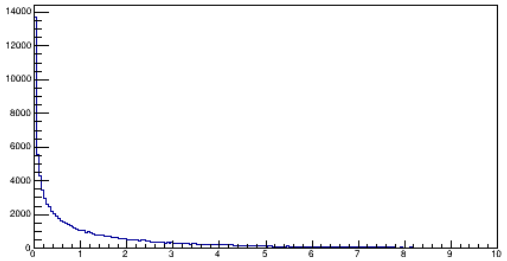
cosine



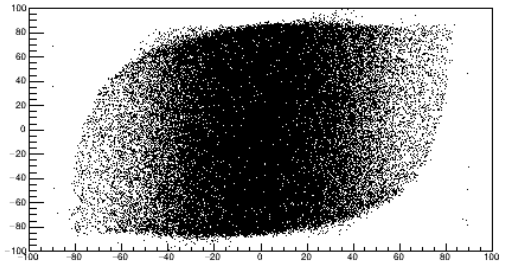
Position[1] : theta



χ^2/NDF

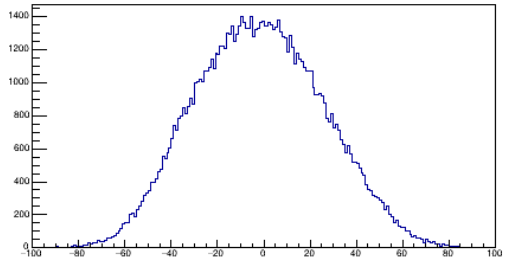


Position[2] : theta

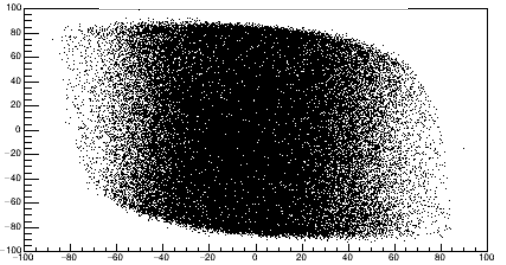


Thickness : 5cm

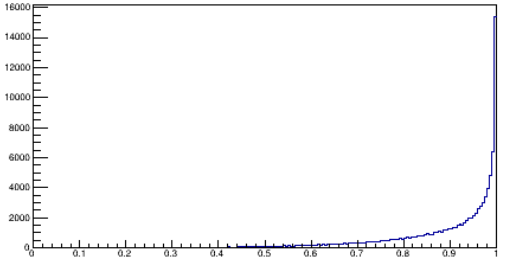
theta



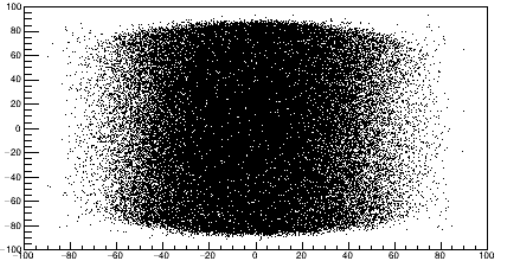
Position[0] : theta



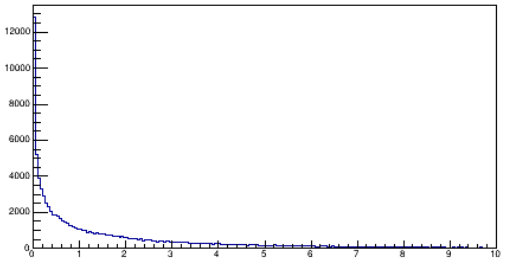
cosine



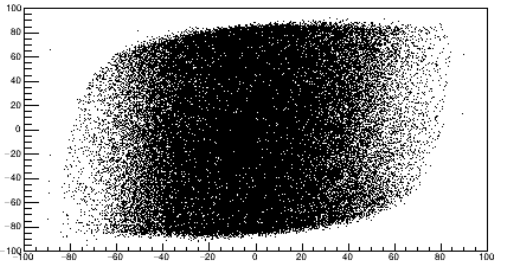
Position[1] : theta



χ^2/NDF



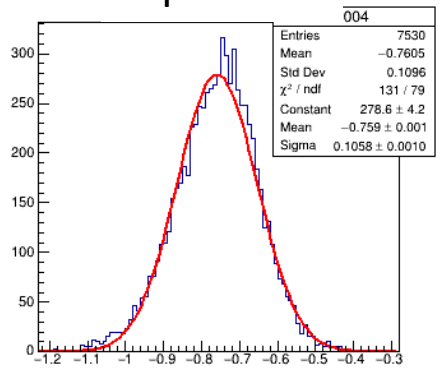
Position[2] : theta



Calculating Time Resolution

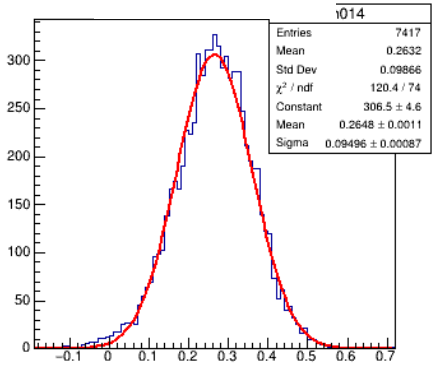
- $\sigma_1 = \sqrt{(+\sigma_a^2 - \sigma_b^2 + \sigma_c^2)/2}$
- $\sigma_2 = \sqrt{(+\sigma_a^2 + \sigma_b^2 - \sigma_c^2)/2}$
- $\sigma_3 = \sqrt{(-\sigma_a^2 + \sigma_b^2 + \sigma_c^2)/2}$

top - mid



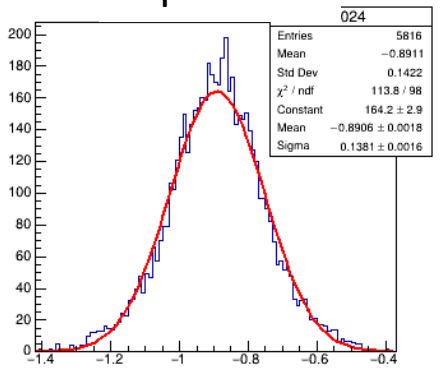
σ_a

mid - bot



σ_b

top - bot



σ_c

- Time Resolutions of each bar are somewhat misleading..
- Too low σ_2

- Adding correction $\frac{\Delta y}{c \cos\theta}$ term make it worse

- Thickness : 10cm
- χ^2/NDF < 3, cosine > 0.8
- Position : 0 ~ 20cm

- $\sigma_a = 0.1058$
- $\sigma_b = 0.09496$
- $\sigma_c = 0.1381$

→

- $\sigma_1 = 103$ [ps]
- $\sigma_2 = 24$ [ps]
- $\sigma_3 = 92$ [ps]

Time Resolution 5cm vs 10cm

- χ^2/NDF < 3 (~73%)
- **Thickness : 5cm**
- cosine > 0.8
- Time Resolution 0 : 92±1 [ps]
- Time Resolution 1 : 68±2 [ps]
- Time Resolution 2 : 87±2 [ps]
- Time Resolution avg : 83±1 [ps]

- cosine > 0.95
- Time Resolution 0 : 90±2 [ps]
- Time Resolution 1 : 69±2 [ps]
- Time Resolution 2 : 85±2 [ps]
- Time Resolution avg : 82±1[ps]

- cosine > 0.99
- Time Resolution 0 : 89±3 [ps]
- Time Resolution 1 : 68±4 [ps]
- Time Resolution 2 : 85±3 [ps]
- Time Resolution avg : 81±2 [ps]

- χ^2/NDF < 3 (~78%)
- **Thickness : 10cm**
- cosine > 0.8
- Time Resolution 0 : 89±1 [ps]
- Time Resolution 1 : 53±2 [ps]
- Time Resolution 2 : 80±2 [ps]
- Time Resolution avg : 75±1 [ps]

- cosine > 0.95
- Time Resolution 0 : 85±2 [ps]
- Time Resolution 1 : 54±2 [ps]
- Time Resolution 2 : 73±2 [ps]
- Time Resolution avg : 72±1 [ps]

- cosine > 0.99
- Time Resolution 0 : 84±2 [ps]
- Time Resolution 1 : 52±4 [ps]
- Time Resolution 2 : 73±3 [ps]
- Time Resolution avg : 71±2 [ps]

not adding correction $\frac{\Delta y}{c \cos\theta}$

average ratio

1.11

1.14

1.14

Time Resolution Linear interpolation

- χ^2/NDF < 3
- **Thickness : 5cm**
- cosine > 0.8

- Time Resolution 0 : 130±2 [ps]
- Time Resolution 1 : 83±3 [ps]
- Time Resolution 2 : 126±2 [ps]
- Time Resolution avg : 115±1 [ps]

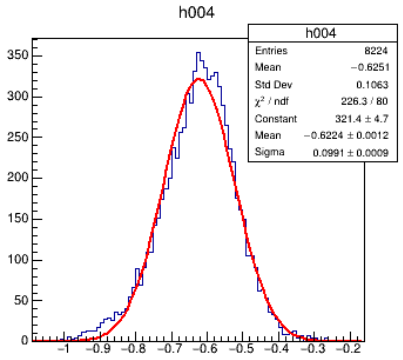
- χ^2/NDF < 3
- **Thickness : 10cm**
- cosine > 0.8

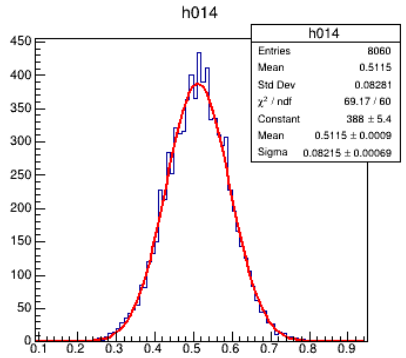
- Time Resolution 0 : 124±2 [ps]
- Time Resolution 1 : 85±3 [ps]
- Time Resolution 2 : 109±2 [ps]
- Time Resolution avg : 107±1 [ps]

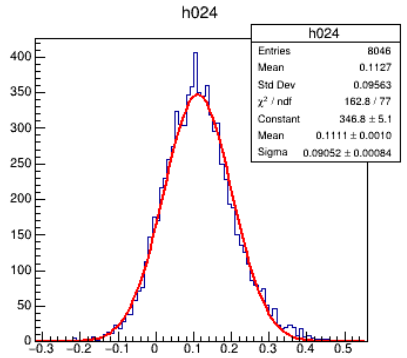
average ratio 1.07

Time Resolution Revised

- t_i : $t_{bar_i} - (\sum_j t_{bar_j} - t_{bar_i})/2 - t_{correction}$
- $\sigma_i = \sqrt{(12\sigma_i^2 - 2\sum_j \sigma_j^2)/9}$
- $t_{correction} = 1.5 * (1 - i) * \Delta y/(c * cos\theta)$







- χ^2/NDF < 3
- Thickness : 10cm
- cosine > 0.8

- Time Resolution 0 : 84.7±0.9 [ps]
- Time Resolution 1 : 53.5±1.4 [ps]
- Time Resolution 2 : 75.9±1.0 [ps]
- Time Resolution avg : 72.2±0.6 [ps]

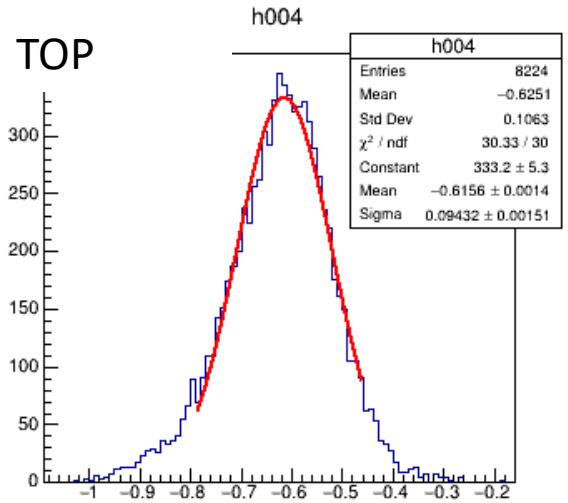
- χ^2/NDF < 3
- Thickness : 5cm
- cosine > 0.8

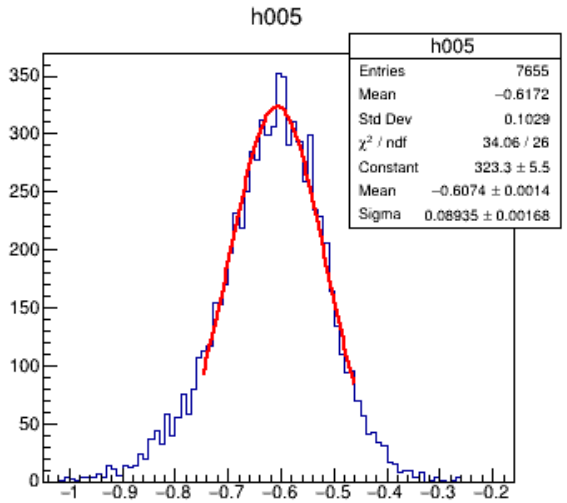
- Time Resolution 0 : 91.1±1.0 [ps]
- Time Resolution 1 : 68.1±1.3 [ps]
- Time Resolution 2 : 86.4±1.0 [ps]
- Time Resolution avg : 82.5±0.6 [ps]

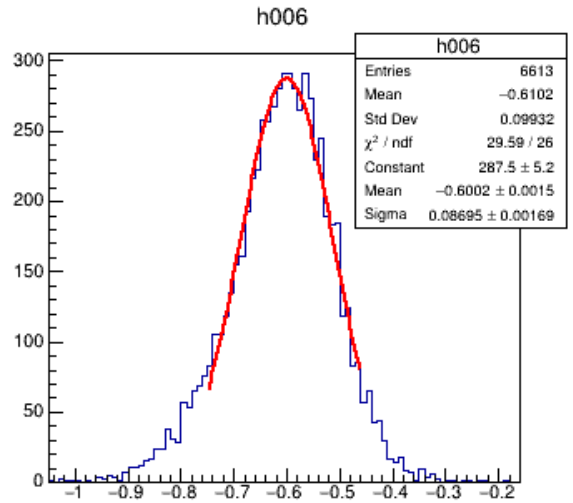
Back up

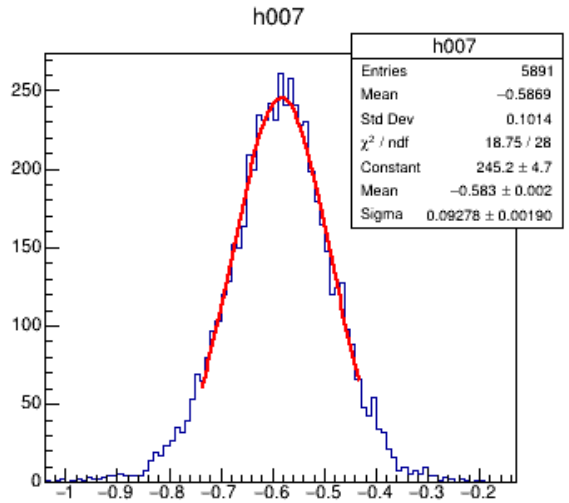
Time Resolution Revised

TOP

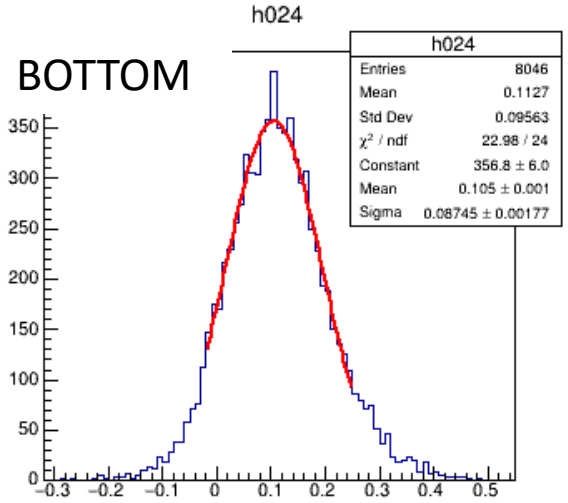


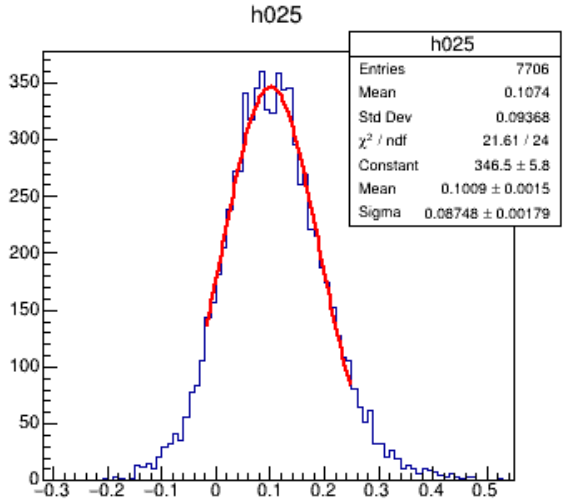


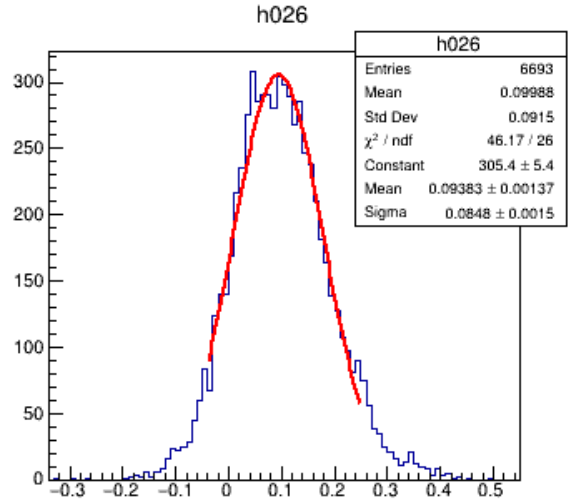


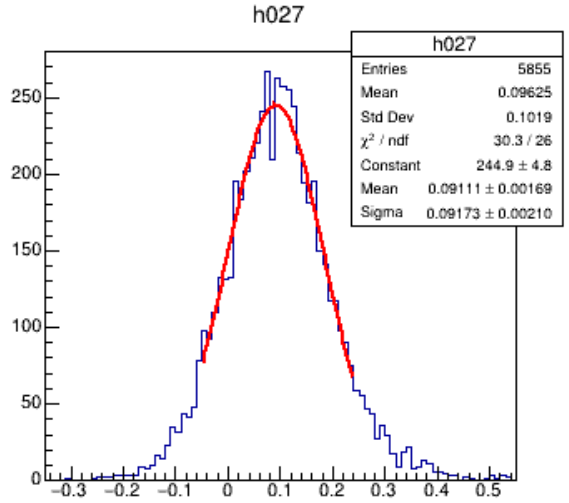


BOTTOM

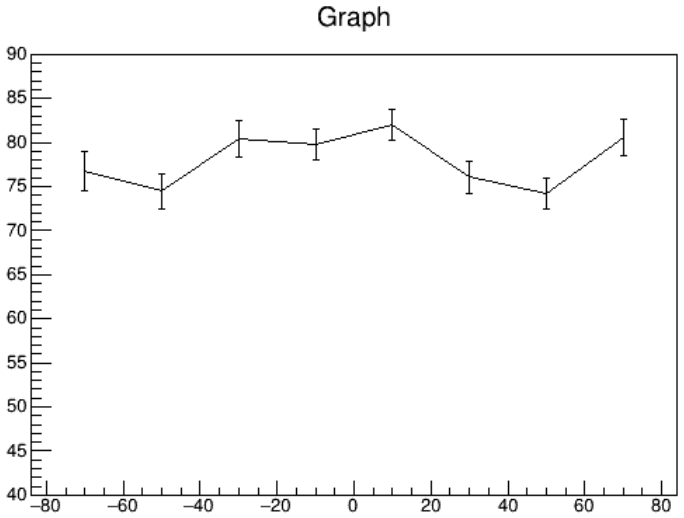


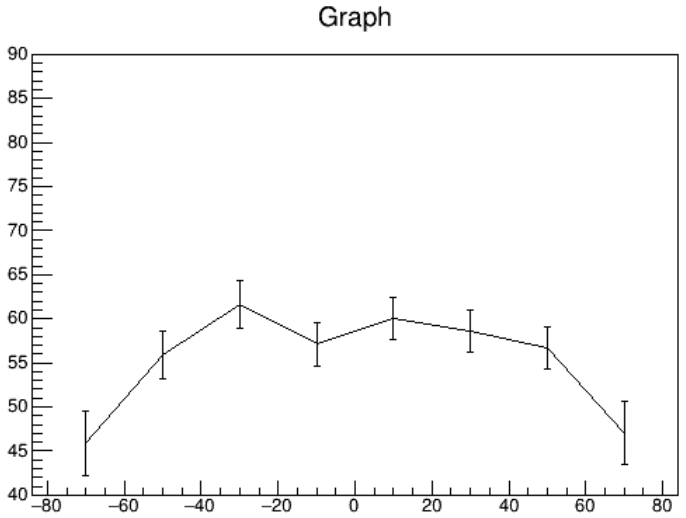


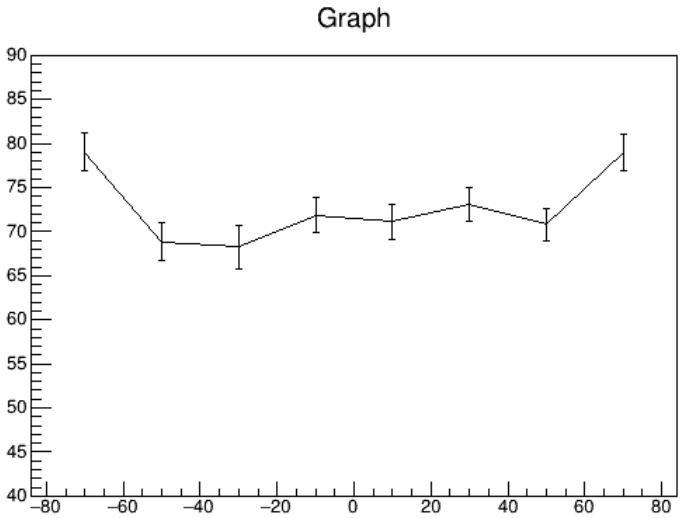




Time Resolution Revised







Time Resolution

- χ^2/NDF < 3 (10cm~78% / 5cm~73%)
- Thickness : 5cm
- cosine > 0.8
- sigma 0 :0.116382
- sigma 1 :0.111723
- sigma 2 :0.125366
- Time Resolution 0 : 92.1713+-1.44511[ps]
- Time Resolution 1 : 68.2672+-1.95112[ps]
- Time Resolution 2 : 87.4318+-1.52345[ps]
- Time Resolution avg : 83.2672+-0.923554[ps]

- cosine > 0.95
- sigma 0 :0.114202
- sigma 1 :0.110486
- sigma 2 :0.122666
- Time Resolution 0 : 89.969+-1.82728[ps]
- Time Resolution 1 : 68.5791+-2.3972[ps]
- Time Resolution 2 : 85.1721+-1.93019[ps]
- Time Resolution avg : 81.7553+-1.16097[ps]

- cosine > 0.99
- sigma 0 :0.117013
- sigma 1 :0.109474
- sigma 2 :0.126704
- Time Resolution 0 : 88.8571+-2.82527[ps]
- Time Resolution 1 : 68.0185+-3.69084[ps]
- Time Resolution 2 : 85.1067+-2.94977[ps]
- Time Resolution avg : 81.1691+-1.78567[ps]

- χ^2/NDF < 3 (10cm~78% / 5cm~73%)
- Thickness : 10cm
- cosine > 0.8
- sigma 0 :0.109505
- sigma 1 :0.0979424
- sigma 2 :0.123778
- Time Resolution 0 : 89.3794+-1.35976[ps]
- Time Resolution 1 : 52.5112+-2.31445[ps]
- Time Resolution 2 : 79.6124+-1.52658[ps]
- Time Resolution avg : 75.4635+-0.929827[ps]

- cosine > 0.95
- sigma 0 :0.106534
- sigma 1 :0.0928853
- sigma 2 :0.115472
- Time Resolution 0 : 84.7783+-1.54713[ps]
- Time Resolution 1 : 53.8124+-2.43741[ps]
- Time Resolution 2 : 73.2617+-1.79033[ps]
- Time Resolution avg : 71.7645+-1.05521[ps]

- cosine > 0.99
- sigma 0 :0.107848
- sigma 1 :0.0929757
- sigma 2 :0.114429
- Time Resolution 0 : 84.3527+-2.2547[ps]
- Time Resolution 1 : 52.2442+-3.64041[ps]
- Time Resolution 2 : 72.88+-2.60964[ps]
- Time Resolution avg : 71.0782+-1.54487[ps]

Time Resolution - Revised

- χ^2/NDF < 3 (10cm~78% / 5cm~73%)
- Thickness : 5cm
- cosine > 0.8
- sigma 0 :0.106867
- sigma 1 :0.0951568
- sigma 2 :0.102628
- Time Resolution 0 : 91.113+-0.992502[ps]
- Time Resolution 1 : 68.1263+-1.32739[ps]
- Time Resolution 2 : 86.385+-1.04682[ps]
- Time Resolution avg : 82.4725+-0.633056[ps]

- χ^2/NDF < 3 (10cm~78% / 5cm~73%)
- Thickness : 10cm
- cosine > 0.8
- sigma 0 :0.0990996
- sigma 1 :0.0821456
- sigma 2 :0.0905247
- Time Resolution 0 : 83.7157+-0.90251[ps]
- Time Resolution 1 : 53.4913+-1.41246[ps]
- Time Resolution 2 : 75.8973+-0.99548[ps]
- Time Resolution avg : 72.1804+-0.604337[ps]