K-Koto Meeting

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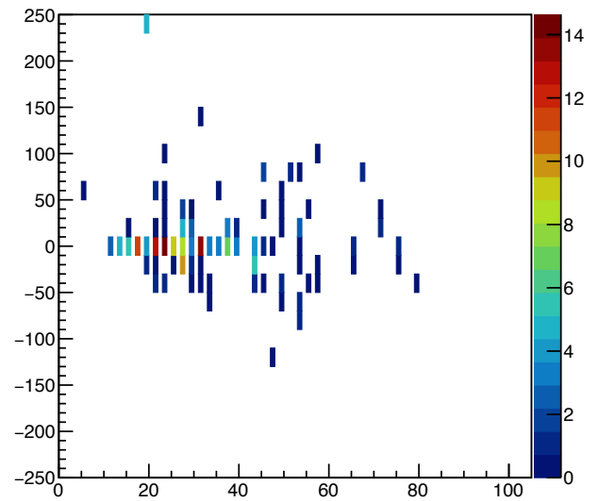
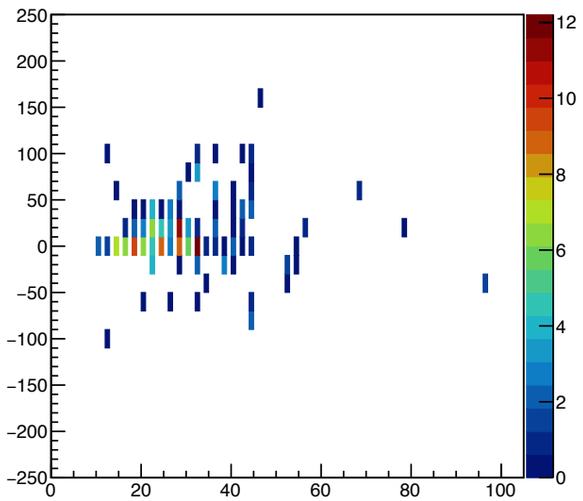
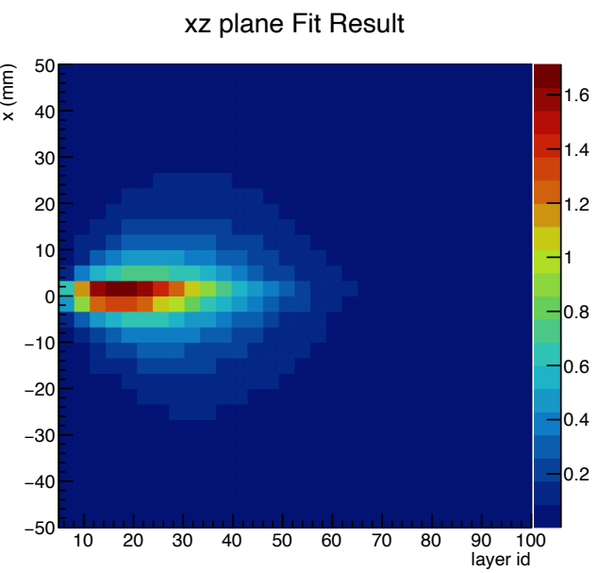
Hadron & Nuclear Physics Lab

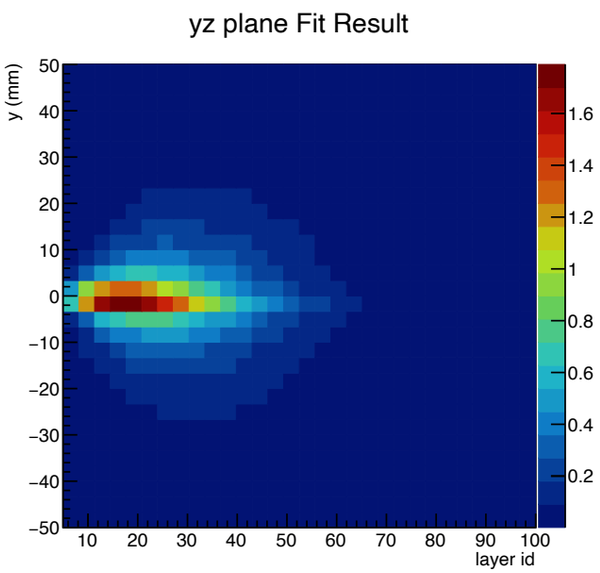
2D Fit on x-z(y-z) plane





ML Fit



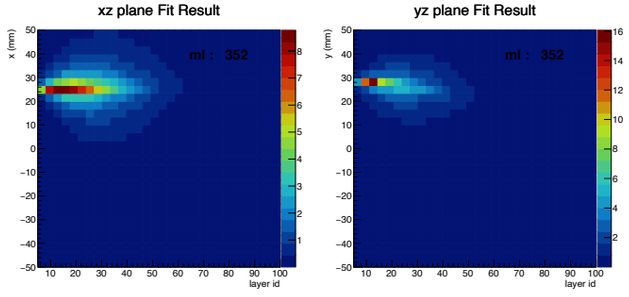


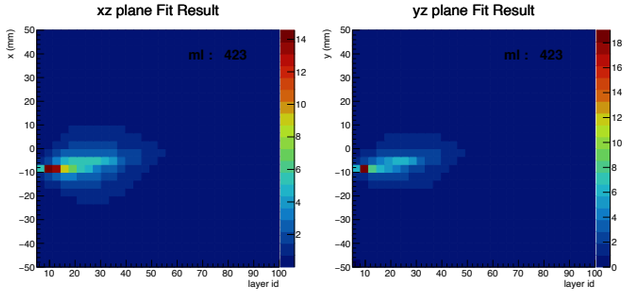
- $PDF(x, t; \alpha(t), \beta(t), a, b)$
- **Fit parameters :**
  - $\alpha(t), \beta(t), a, b \rightarrow$ Fixed
  - θ, x_0 or y_0, height $\rightarrow$ Free parameters

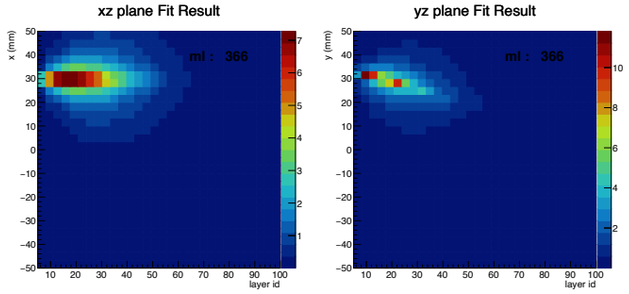
- **1. Position shift**
  - $x' = x - x_0$
- **2. Rotate coordinate (x-z or y-z)**
  - $z'' = z\cos(\theta) - x'\sin(\theta)$
  - $x'' = z\sin(\theta) + x'\cos(\theta)$
- **3. Maximum Likelihood Fit**

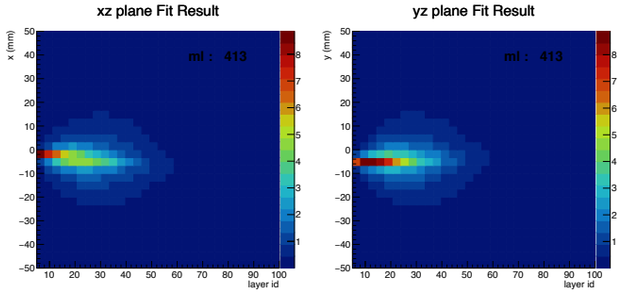
Scanning Maximum log-likelihood

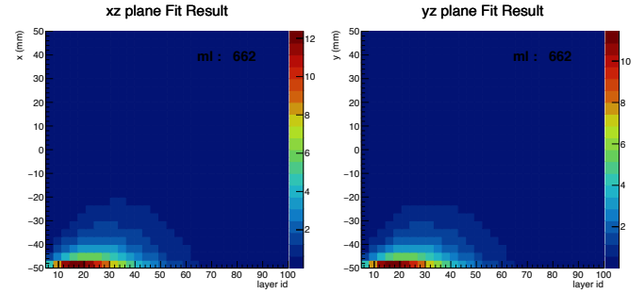
- x_0 parameter limit : $x_{low} < x_0 < x_{low} + 10$
- 10 mm interval

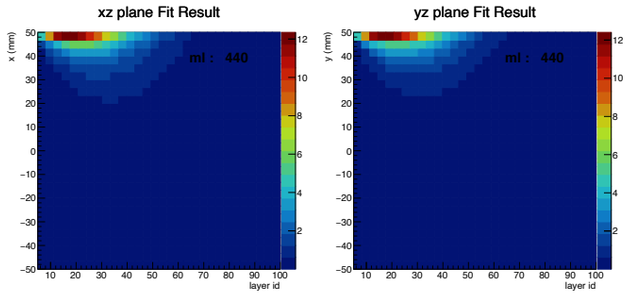


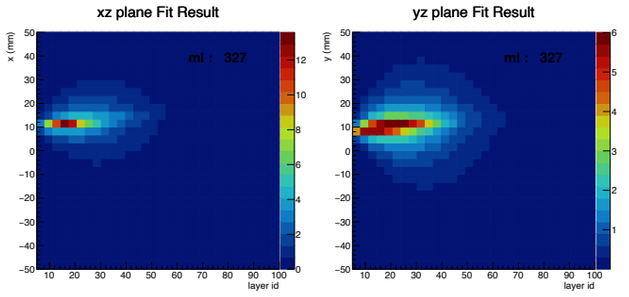


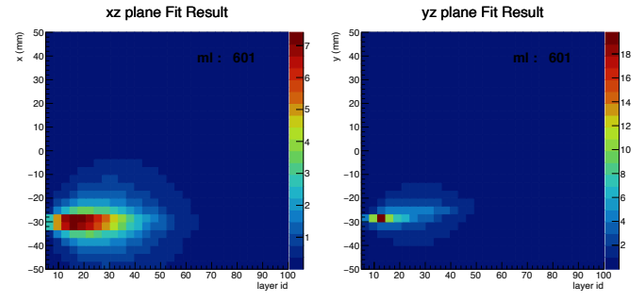


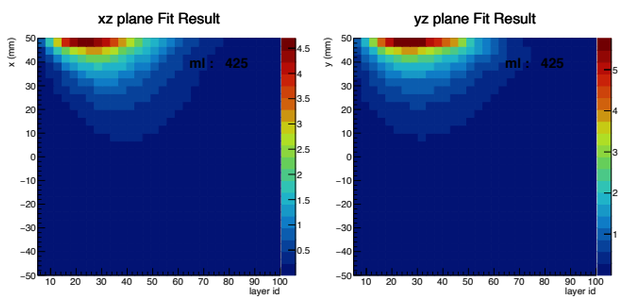


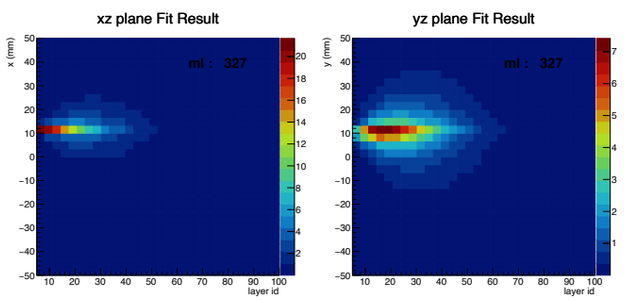


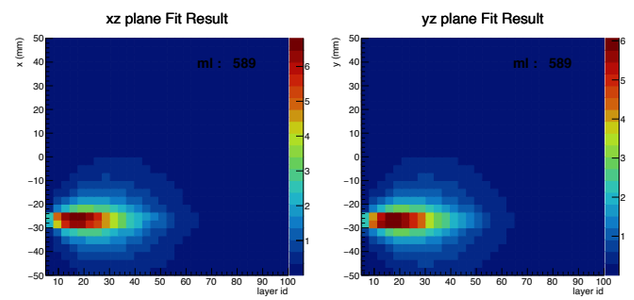












Incident angle estimation

- $x = x_0 + a_1 z,\ a_1 = \tan\theta_{xz}$
- $y = y_0 + b_1 z,\ b_1 = \tan\theta_{yz}$

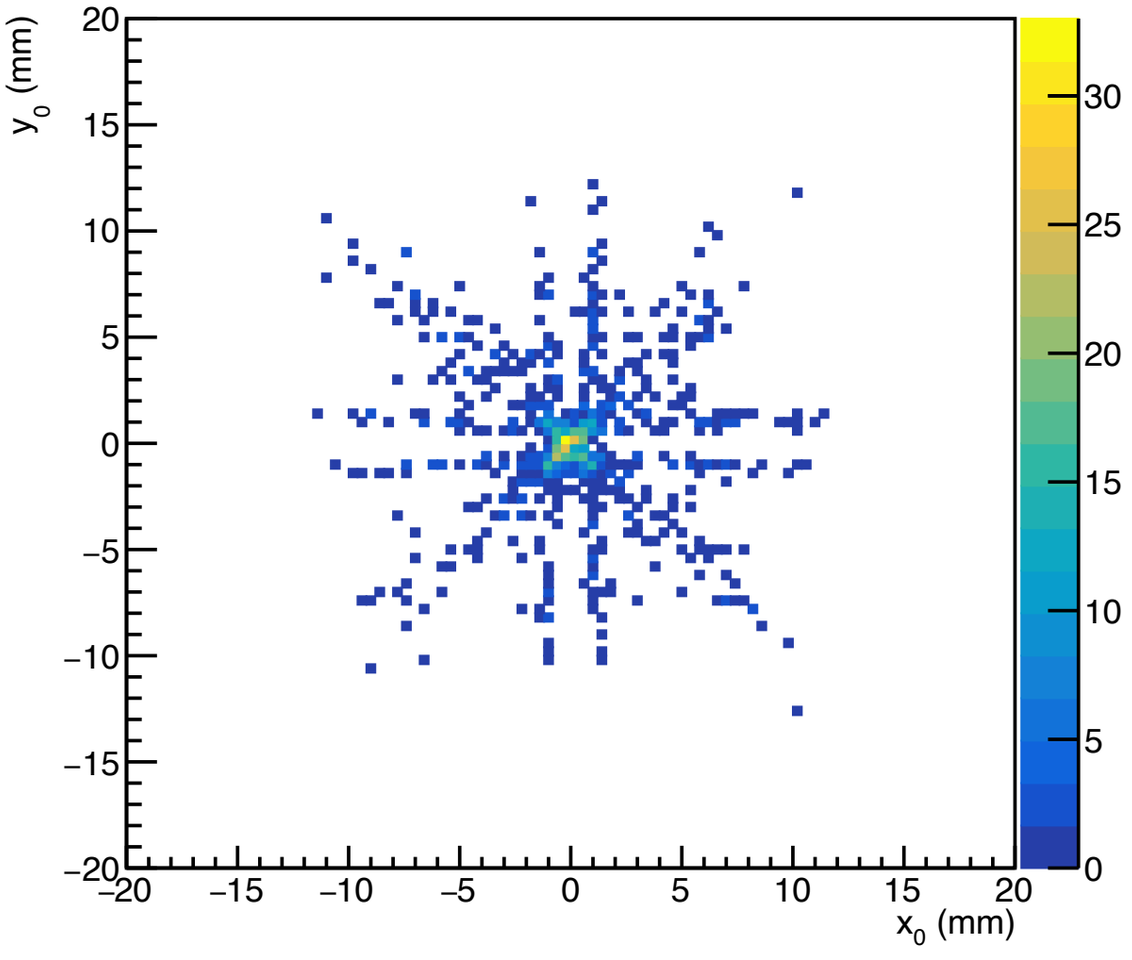
- At z = 0 : $(x_0,\ y_0,\ 0)$
  At z = 1 : $(x_0 + a_1,\ y_0 + b_1,\ 1)$
  - $\vec{l} = (a_1,\ b_1,\ 1)$
  - for the polar angle θ, $\cos\theta = \vec{l}\cdot\hat{z} / |\vec{l}|$

    for the azimuthal angle ϕ, $\sin\phi = \dfrac{b_1}{\sqrt{(a_1^2 + b_1^2)}}$

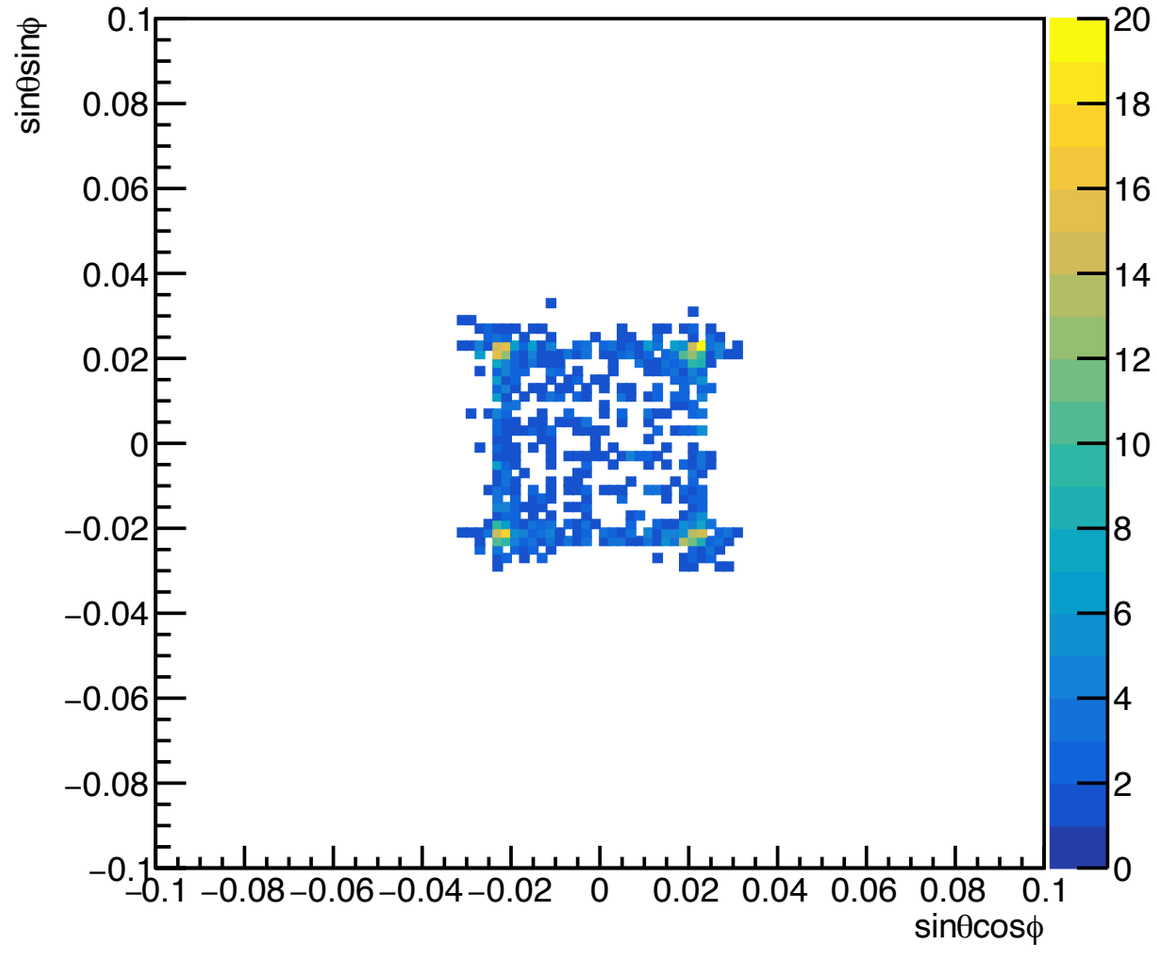
- $\cos\theta = 1/\sqrt{1 + a_1^2 + b_1^2},\ \ \sin\phi = 1/\sqrt{1 + (a_1/b_1)^2}$

Position / Direction Estimation

Position at z = 0



Incident angle



Generated γ beam condition : $x_0,\ y_0 = 0, \theta = 0$ (z direction)

back up

2D Fit

- Longitudinal shower shape : $f(t) = E_{tot} b \frac{(bt)^{a-1} e^{-bt}}{\Gamma(a)}, \ (t = z/X_0)$

  Transverse shower shape : $f(x) = E_0 \frac{\beta}{2\alpha\Gamma(1/\beta)} e^{-(|x-m|/\alpha)^{\beta}}$

  $PDF(x,t) = f(x) = E_{tot} b \frac{(bt)^{a-1} e^{-bt}}{\Gamma(a)} \frac{\beta}{2\alpha\Gamma(1/\beta)} e^{-(|x-m|/\alpha)^{\beta}}$

- **Fix parameters : $\alpha(t), \beta(t), a, b$**