Status of Mainz-Simulations

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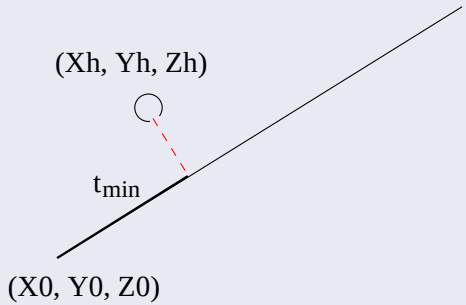
Changes in track-fit

Least-squares method



$$x = p_0 + p_1 t,\ y = p_2 + p_3 t,\ z = Z0 + t.$$

$$t_{min} = \frac{p_1(X_h - p_0) + p_3(Y_h - p_2) + (Z_h - Z0)}{p_1^2 + p_3^2 + 1}$$

New χ^2-function

$$\chi^2 = \frac{(X_h - (p_0 + p_1 t_{min}))^2}{\sigma_x^2} + \frac{(Y_h - (p_2 + p_3 t_{min}))^2}{\sigma_y^2} + \frac{(Z_h - (Z0 + t_{min}))^2}{\sigma_z^2}$$

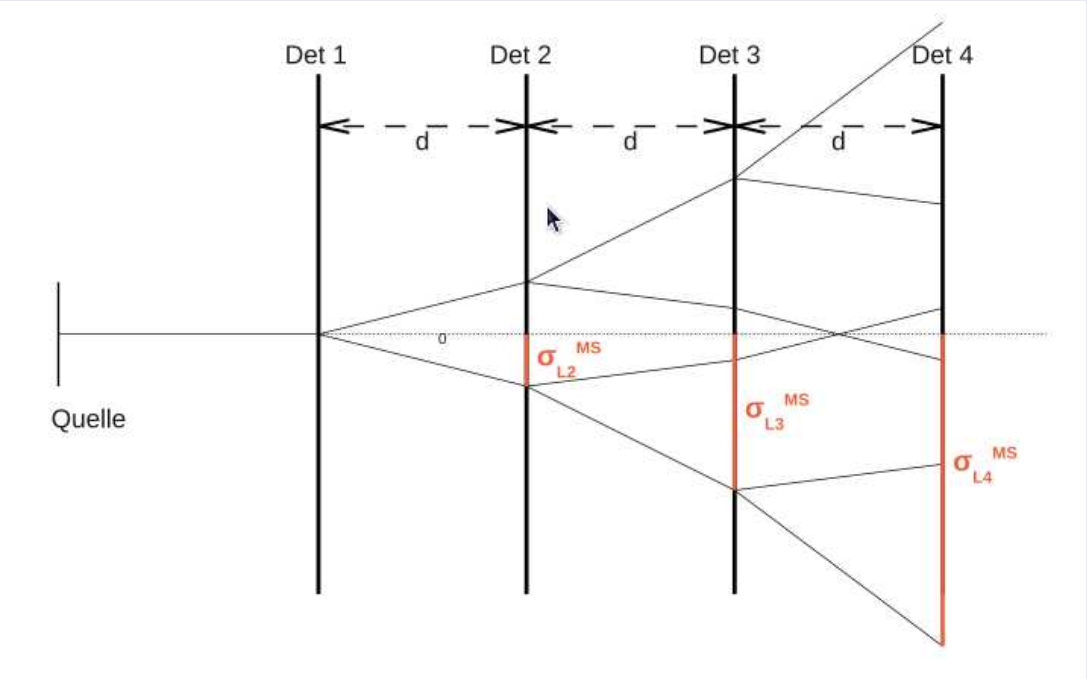
Instead of old χ^2-function

$$\chi^2 = \frac{(x - (p_0 + p_1 z))^2}{\sigma_x^2} + \frac{(y - (p_2 + p_3 z))^2}{\sigma_y^2}$$

Changes in track-fit

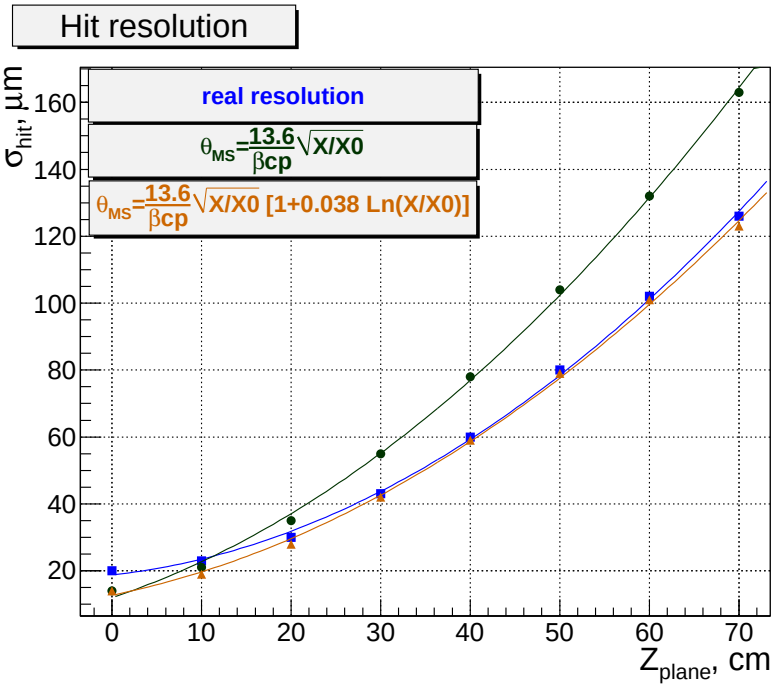
Taking into account multiple scattering in hit errors

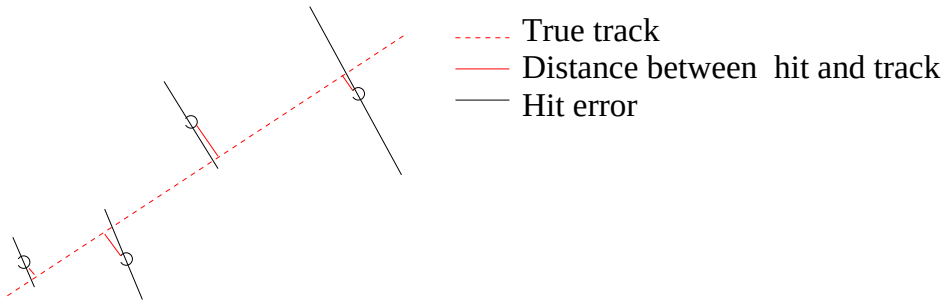
$$\sigma_{L2} = d \cdot \theta_{MS},$$
$$\sigma_{L3} = \sqrt{5} d \cdot \theta_{MS},$$
$$\sigma_{L4} = \sqrt{14} d \cdot \theta_{MS}.$$



$$\sigma_{xi} = \sqrt{\sigma_{digi}^2 + \sigma_{Li}^2}$$

θ_{MS} calculation



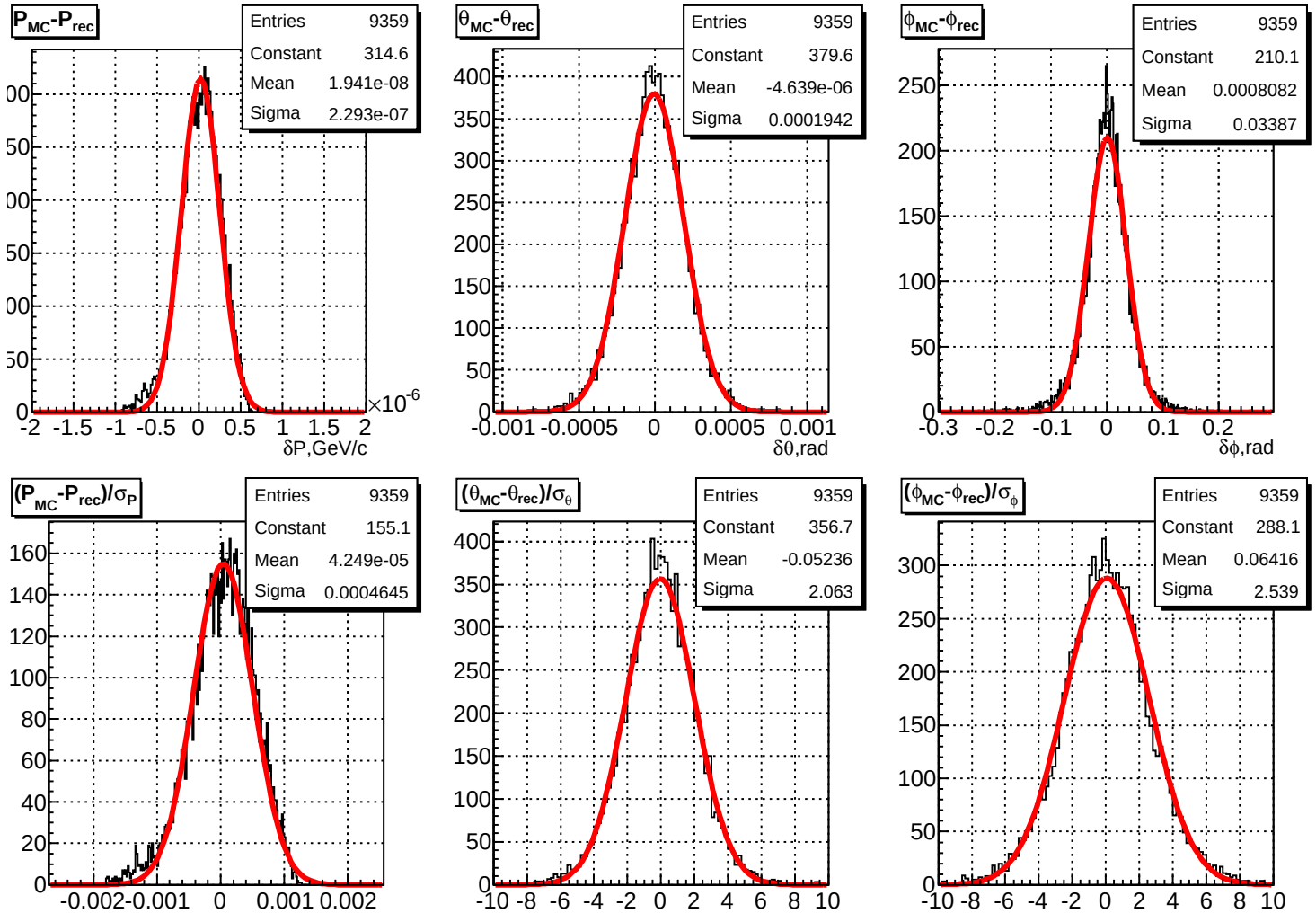


Estimation of hit errors with

$$\theta_{MS}=\frac{13.6}{\beta cp}\sqrt{\frac{X}{X0}}[1+0.038Ln(\frac{X}{X0})]$$

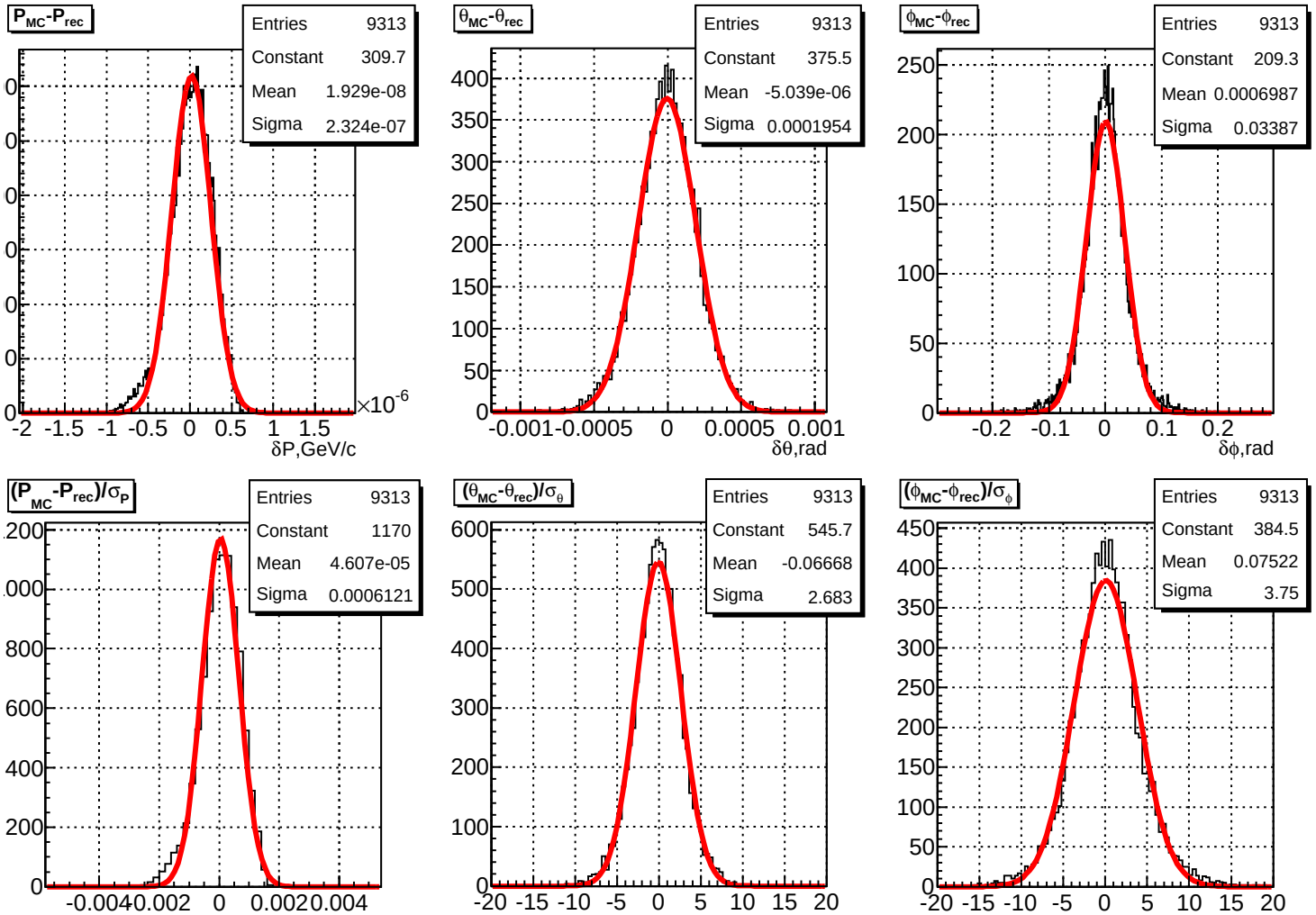
is in agreement with real resolution.

|P|, θ, ϕ resolution for $p_{beam} = 4.06$ GeV/c



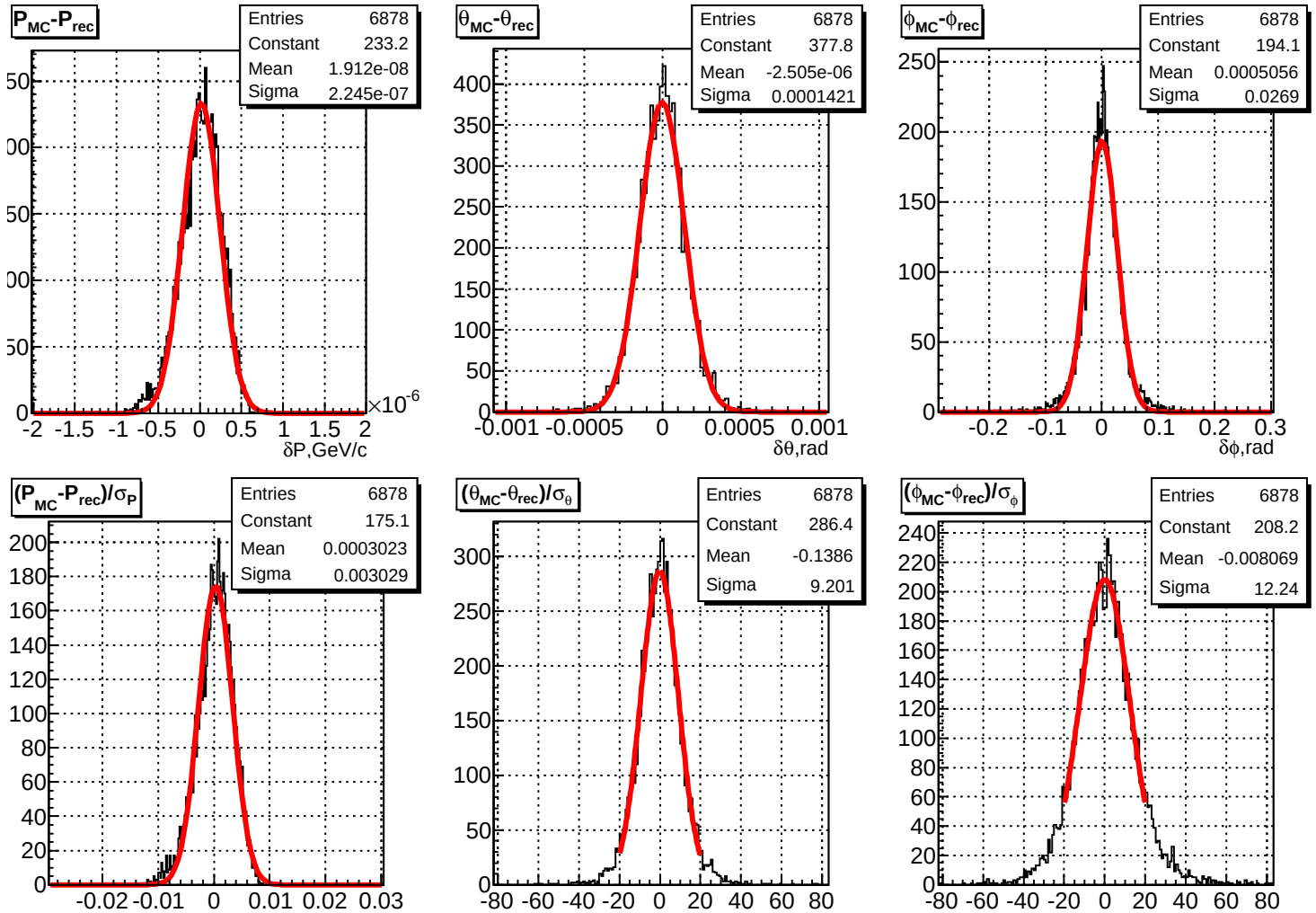
$\sigma_P = 230\ keV/c, \sigma_\theta = 194\ \mu rad, \sigma_\phi = 34\ mrad \quad (\sigma_x = \sqrt{\sigma^2_{digi} + \sigma^2_{MS}})$

|P|, θ, ϕ resolution for $p_{beam} = 4.06$ GeV/c



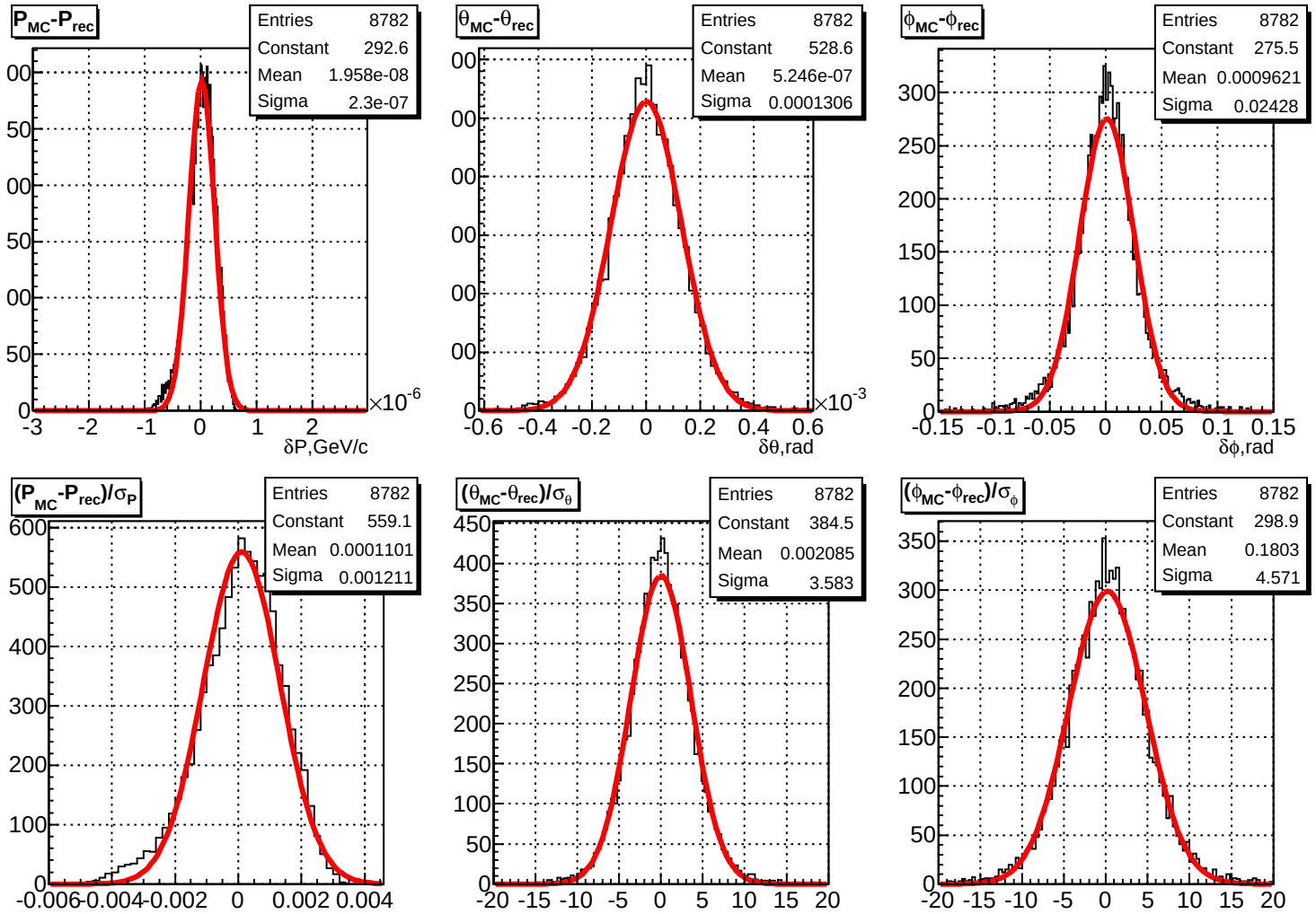
$\sigma_P = 230\ keV/c, \sigma_\theta = 195\ \mu rad, \sigma_\phi = 34\ mrad \quad (\sigma_x = \sigma_{digi})$

|P|, θ, ϕ resolution for p_{beam} = 4.06 GeV/c, d = 50 cm



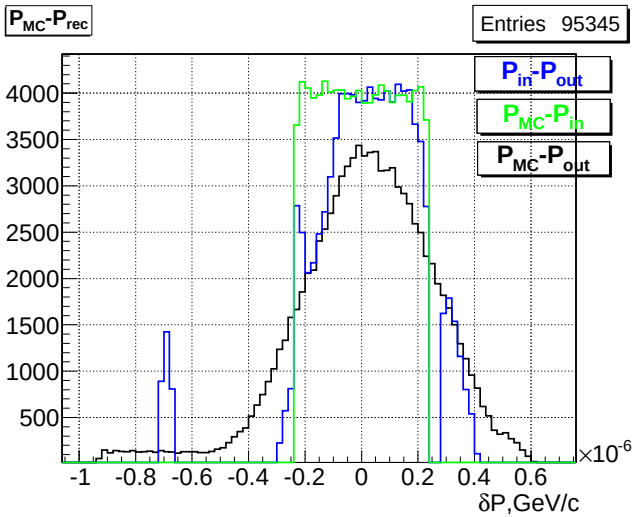
$\sigma_P = 225\ keV/c, \sigma_\theta = 142\ \mu rad, \sigma_\phi = 27\ mrad \quad (\sigma_x = \sigma_{digi})$

|P|, θ, ϕ resolution for p_{beam} = 4.06 GeV/c, d = 50 cm



$\sigma_P = 230\ keV/c, \sigma_\theta = 131\ \mu rad, \sigma_\phi = 24\ mrad \quad (\sigma_x = \sqrt{\sigma^2_{digi} + \sigma^2_{MS}})$

Accuracy of momentum magnitude determination



P_{MC} - true value

$P_{IN} = P_{fit}$,

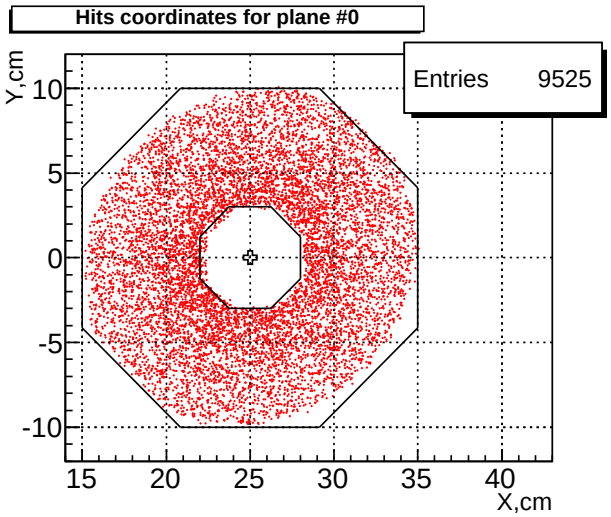
$P_{fit} = |(p1, p3, 1) \cdot \frac{P_{beam}}{\sqrt{p1^2+p3^2+1}}|$

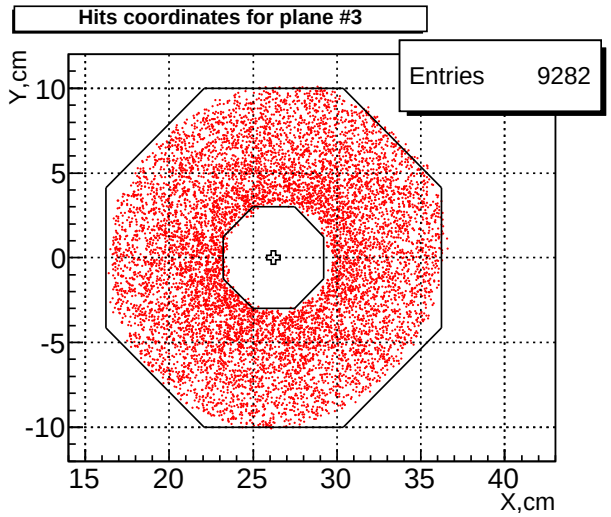
P_{OUT} - momentum magnitude after back-propagation with GEANE

- Tail in momentum distribution appears after back-propagation.
- But error of determination momentum magnitude: $\sigma_P \sim 10^{-3} GeV/c$ (after track-fit), so difference $10^{-6} GeV/c$ **is not considerable**.

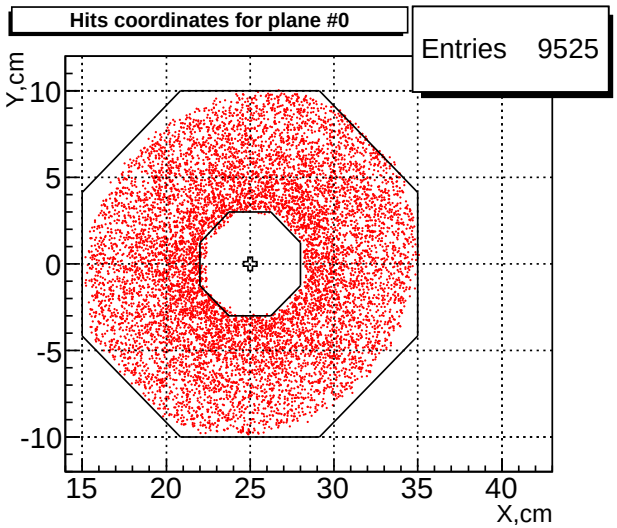
Hits distributions for different distance between planes

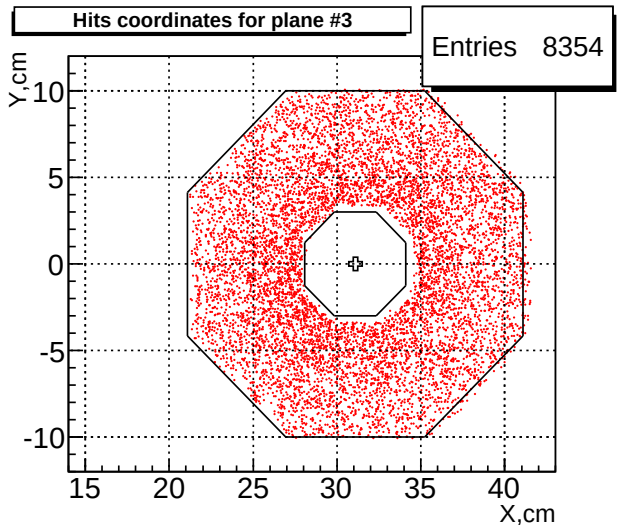
d = 10 cm





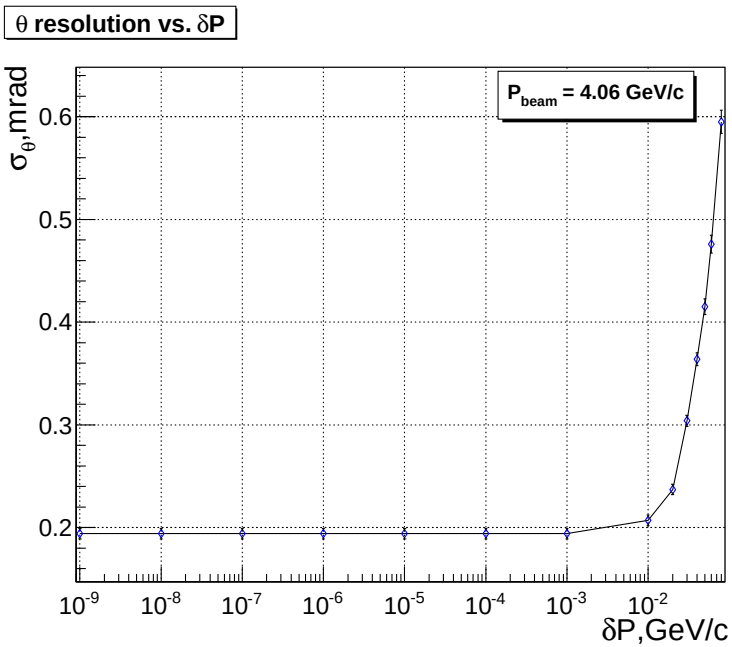
d = 50 cm

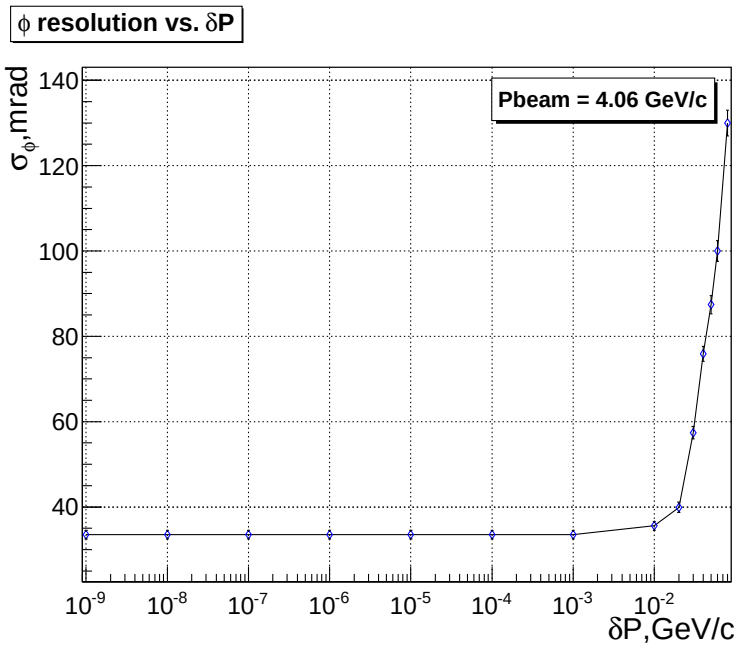




Uncertainties in determination θ and ϕ at IP due to uncertainty in momentum magnitude

$$|P_{IN}| = P_{beam} - \delta P$$

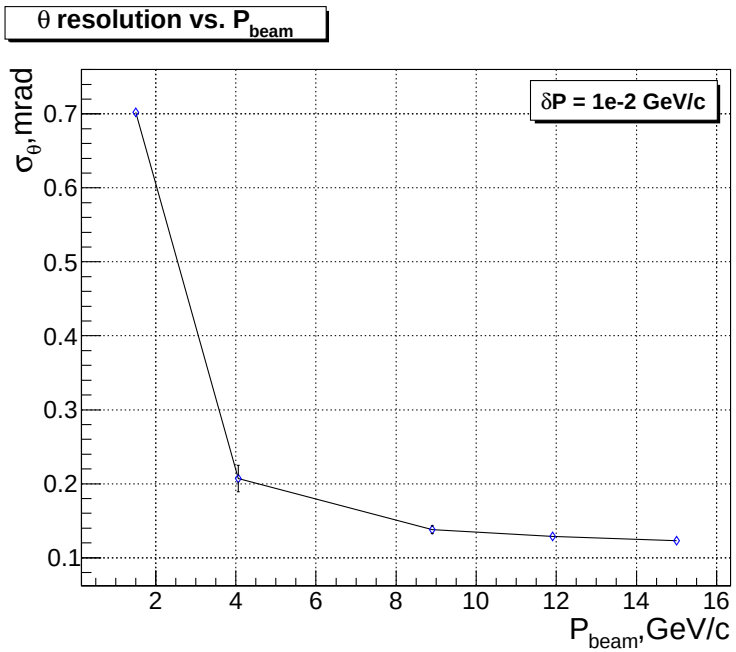


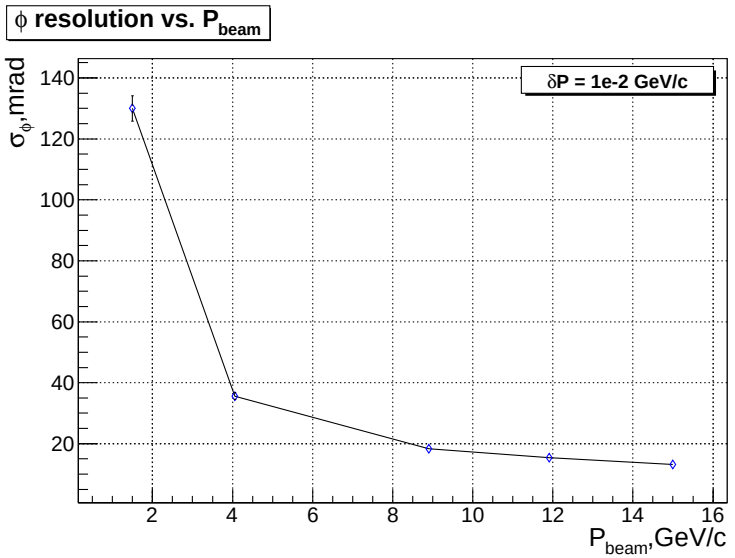


σ_θ and σ_ϕ is insensitive to $\delta P < 10 MeV/c$

Uncertainties in determination θ and ϕ at IP due to uncertainty in momentum magnitude

$$|P_{IN}| = P_{beam} - \delta P$$





Results & Plans

Results

- χ^2 function was changed in Track Fitter.
- Contribution of multiple scattering to hits errors was added and checked in Track Fitter.
- Uncertainties in determination θ and ϕ at IP due to uncertainty in momentum magnitude were studied with SimpleBox generator for:
  - different δP ($P_{beam} = 4.06 GeV/c$).
  - different P_{beam} ($\delta P = 10^{-2} GeV/c$)

Plans

- Optimization of Track-Finder & Track-Fitter procedures
- Study of efficiency (missed tracks, ghost tracks; different number of tracks per event etc.)
- Background study