Optics simulation

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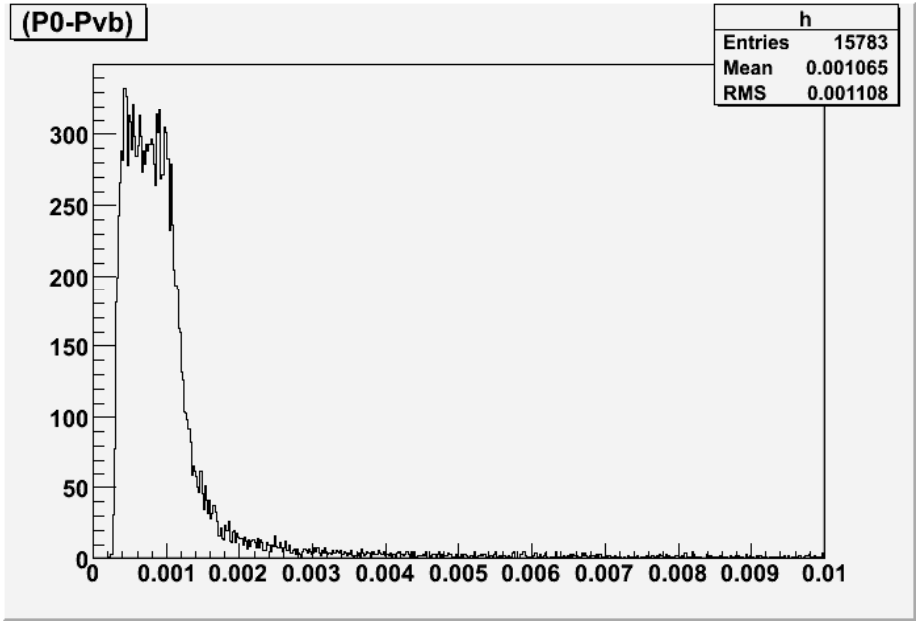
Goals & Requirements

- dxs ~ $1/Q^4$. -> dxs ~ θ_e^{-4}, E'^{-2}.
- If dxs wants to reach 2% uncertainty, θ_e needs to reach 0.5% -> $d\theta_e$ = 0.5mr when θ_e=5.69 deg.
- E' reconstruction at a few x 10^{-4} is good enough here.

Momentum (No target field)

- C12, elastic, no LHe, 1.159 GeV e- beam, 1.158 GeV @ 5.69 deg.
- Eloss: Mean 1.065 MeV, FWMH 1MeV, δE’ = 1/2.3548=0.425 MeV



$$E' = \frac{E}{1 + E/M\,(1-\cos\theta)}$$

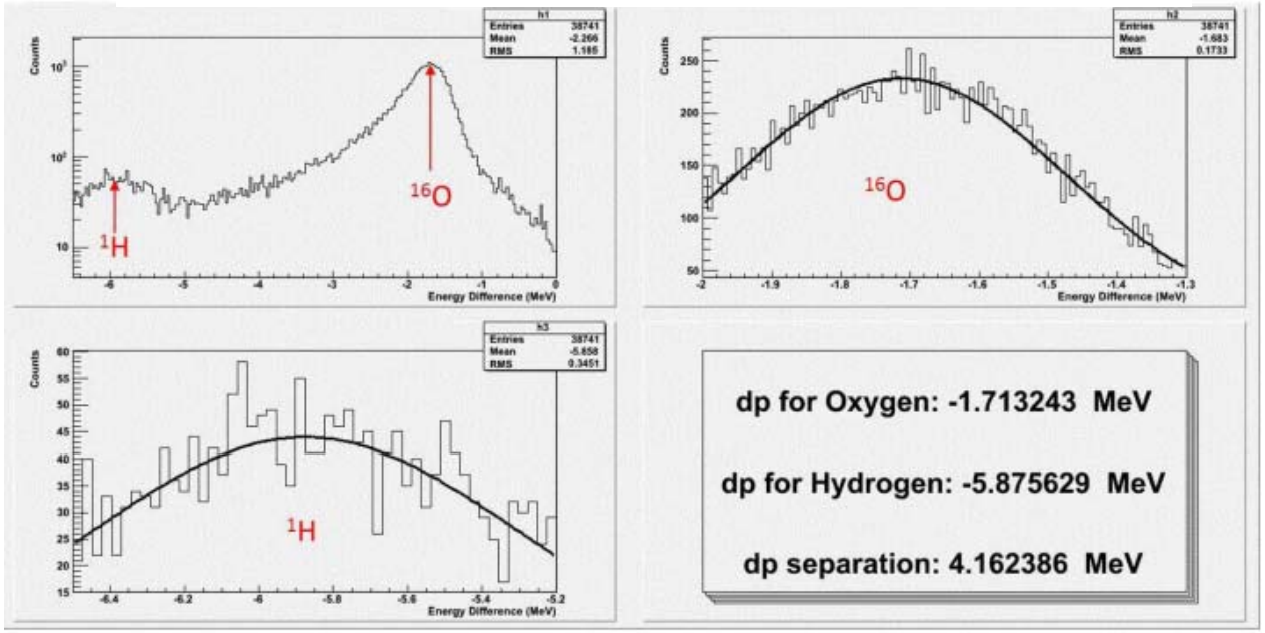
$$\sin\theta d\theta = \frac{M}{E'}\frac{dE'}{E'}$$

- Central angle: sieve hole size sigmas -> $\delta\theta_{tg}$=1.5mr, $\delta\phi_{tg}$=1.4mr -> $\delta\theta_{scat}$ = 2.05 mr -> δE’ ~ 10^{-4} GeV
- Total: 0.525 MeV -> δE’/E’ = 4.5×10^{-4}
- acceptable

Pointing- θ_{HRS} (No target field)

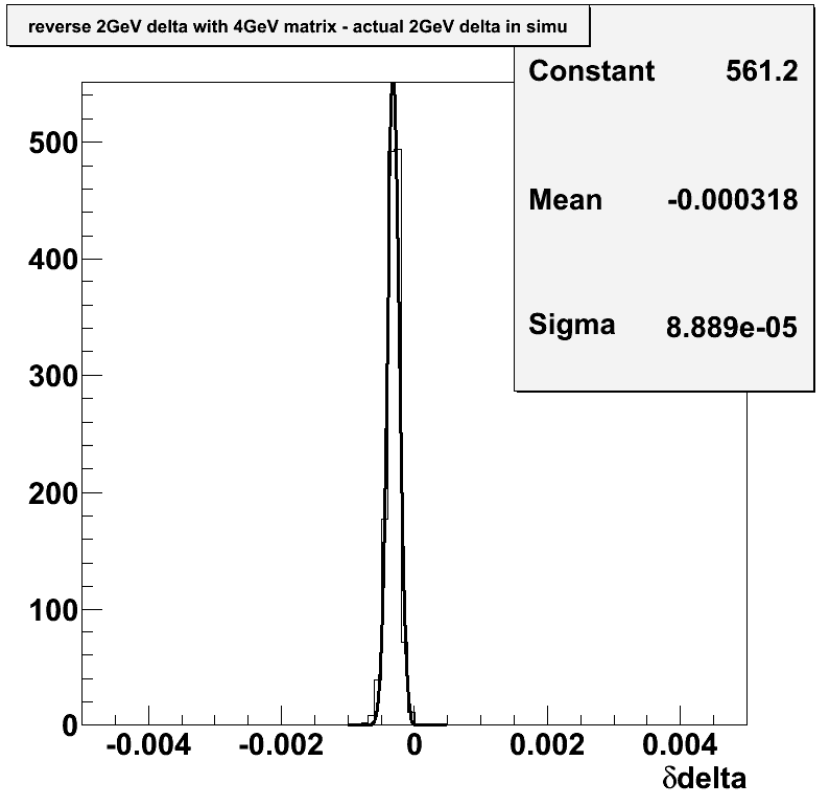
- CH2, elastic for H, 1.152 GeV @ 5.69 deg.
- Will need 5×10^{-6} precision of momentum mean values to reach angular goal
- Working on G4 to get the width of quasi-elastic (like the H peak below)

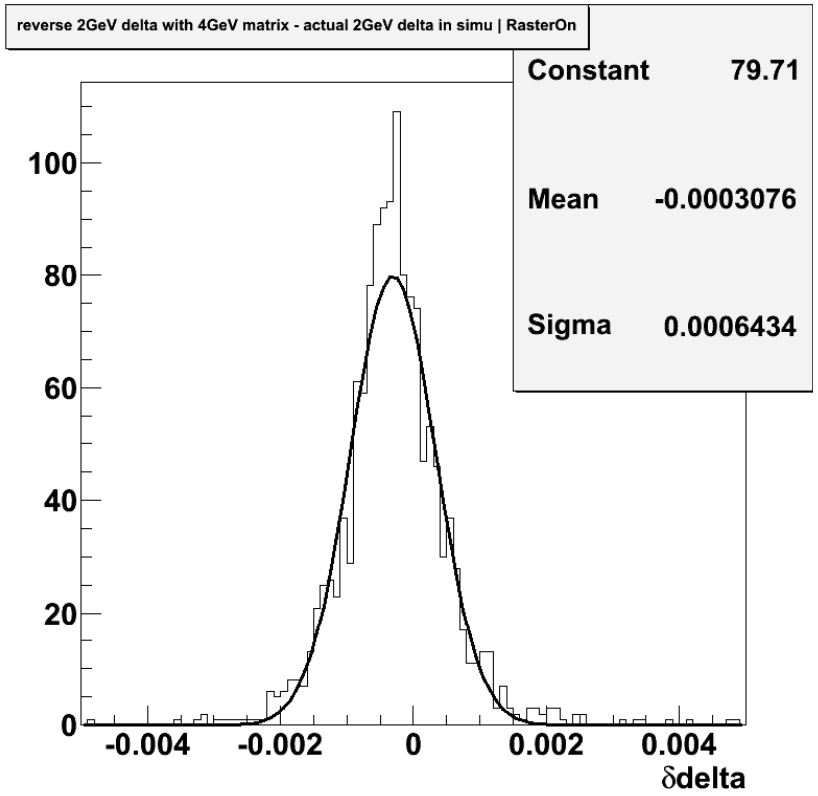
$$\Delta E' = E'_O - E'_H = E\left(\frac{1}{1+\frac{2Esin^2(\frac{\theta}{2})}{M_O}} - \frac{1}{1+\frac{2Esin^2(\frac{\theta}{2})}{M_H}}\right)$$



Momentum (delta, target field)

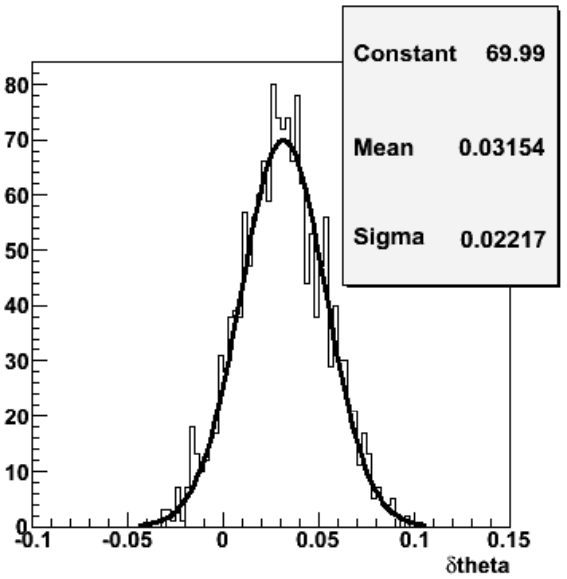
- 5T or 2.5T target B field
- Mean value shift $3x10^{-4}$, not acceptable for angular reconstruction
- Will need additional correction

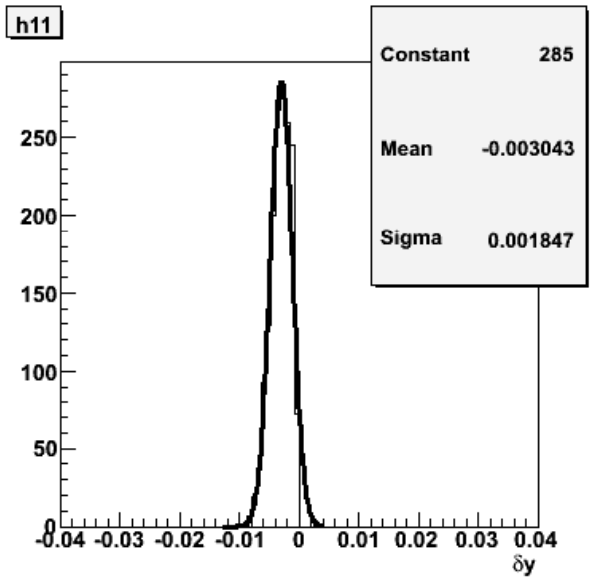


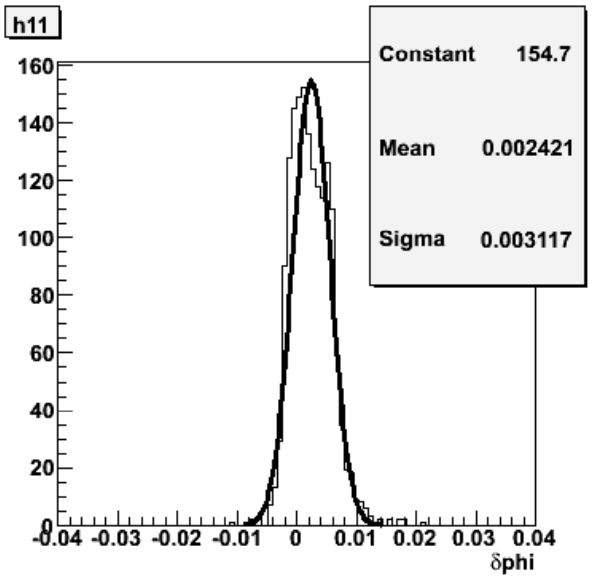


Theta, y, Phi (target field)

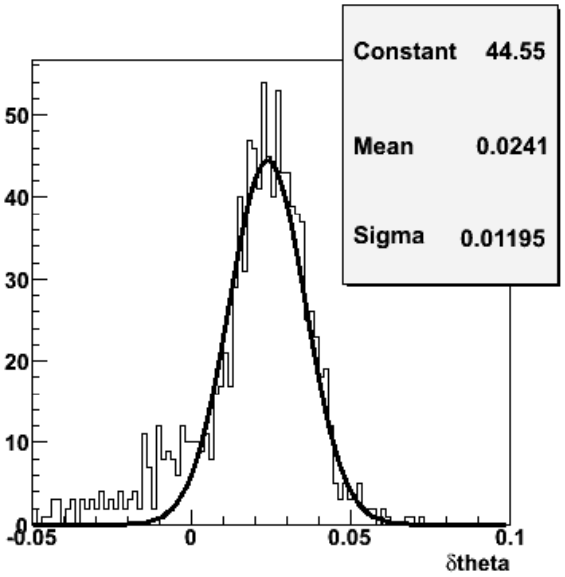
- Fitted a matrix from sieve to target, including 1, 2 and 4 GeV e- trajectories from SNAKE
- Reconstruct 3 GeV trajectories with this matrix
- Will definitely need corrections
- Optics elastic angles can be deduced from momentum reconstruction, use them to correct the matrix

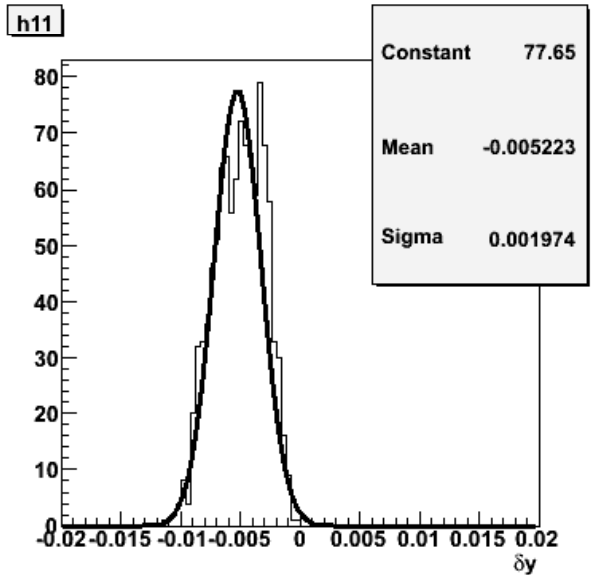


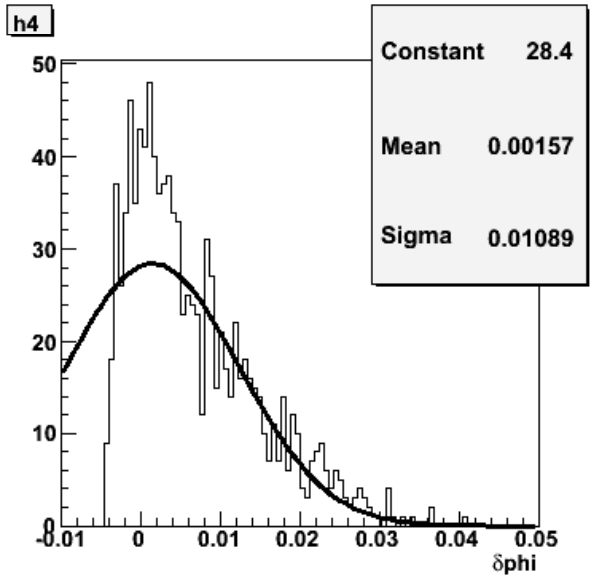




X0 = 4mm







Z0 = -10mm