

# Optics

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# delta (momentum) calibration

- Target field OFF, elastic scattering off C12
- Delta scan 3% 1.5% 0 -1.5% -3%

PREX

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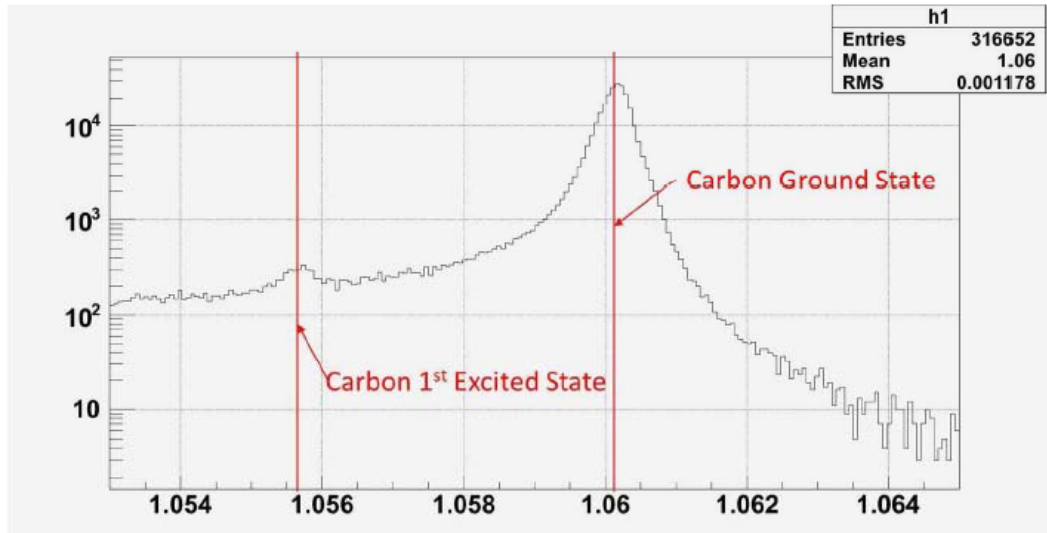


Figure 1: Carbon momentum spectrum after calibration

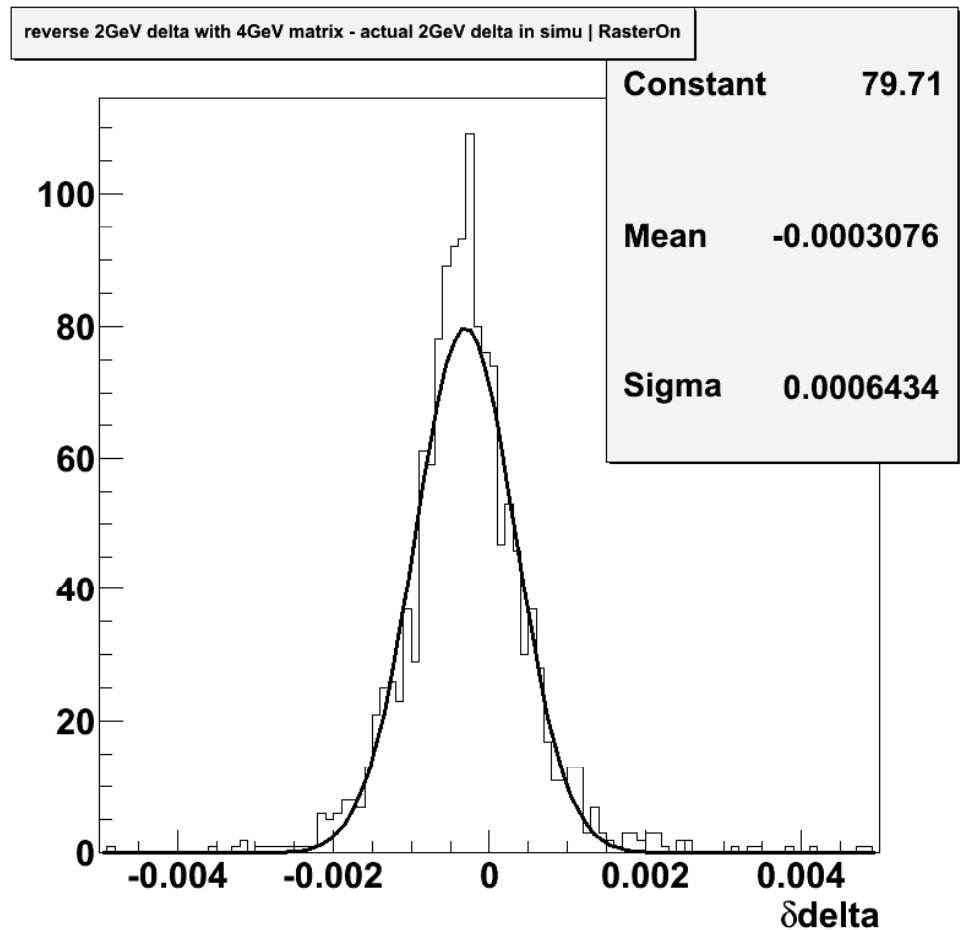
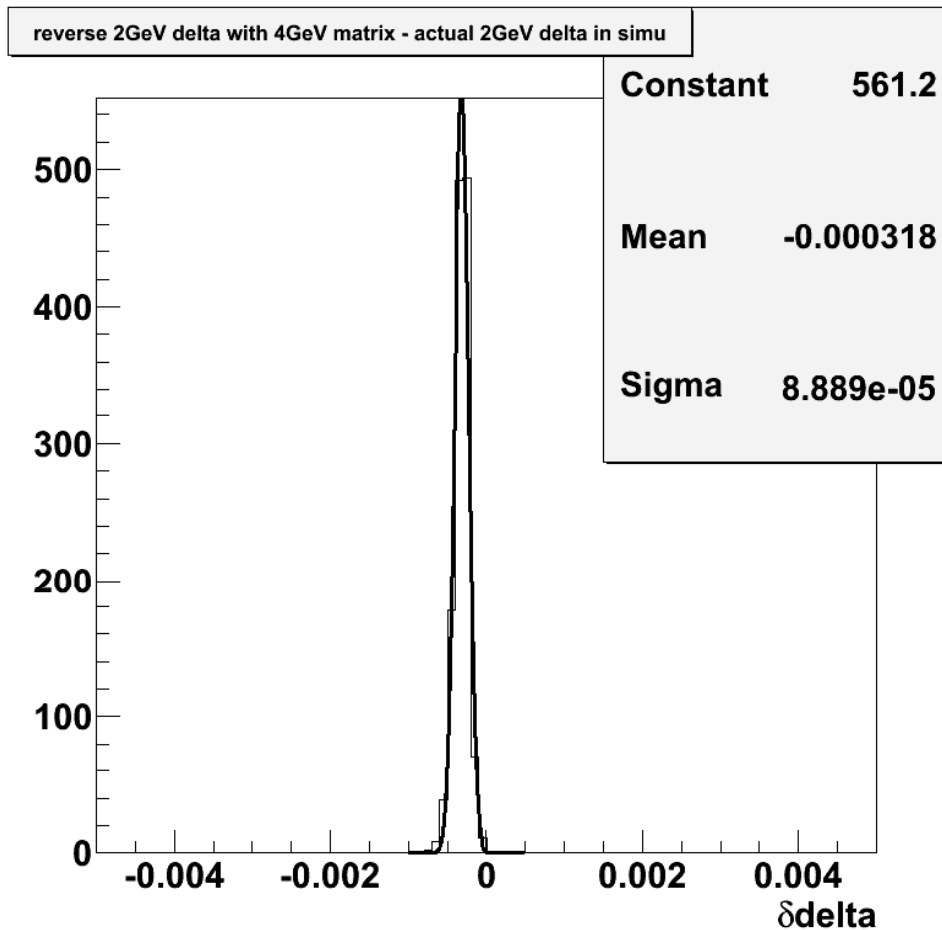
Run	Momentum Setting ( $P_0$ )	$E_0 - E'$ (MeV)
6274	1.063	4.41
6279	1.058	4.50
6289	1.047	4.45

Table 3:  $E_0 - E'$  for carbon target on right HRS

4.44 MeV nominal  
value

# delta (momentum) calibration

- 5T or 2.5T target B field
- Does not affect momentum



# Angular calibration

- Target field OFF, elastic

–  $E' = \frac{E}{1 + E/M(1 - \cos \theta)}$  is known from previous calibration ->

$\theta$  ( $\theta_{\text{scat}}$ )

– The middle point should correspond to  $\theta_{\text{HRS}}$ .

- Target field ON, elastic, sieve ON

– Relation:  $\theta_{\text{scat}} = \arccos\left(\frac{\cos(\theta_{\text{HRS}}) - \phi_{\text{tg}} \sin(\theta_{\text{HRS}})}{\sqrt{1 + \theta_{\text{tg}}^2 + \phi_{\text{tg}}^2}}\right)$

– Target field does not affect  $\phi_{\text{tg}}$ , so  $\theta_{\text{scat}} \rightarrow \theta_{\text{tg}}$ .

- The delta resolution is  $1 \times 10^{-4}$  at best, not good enough for angular resolution

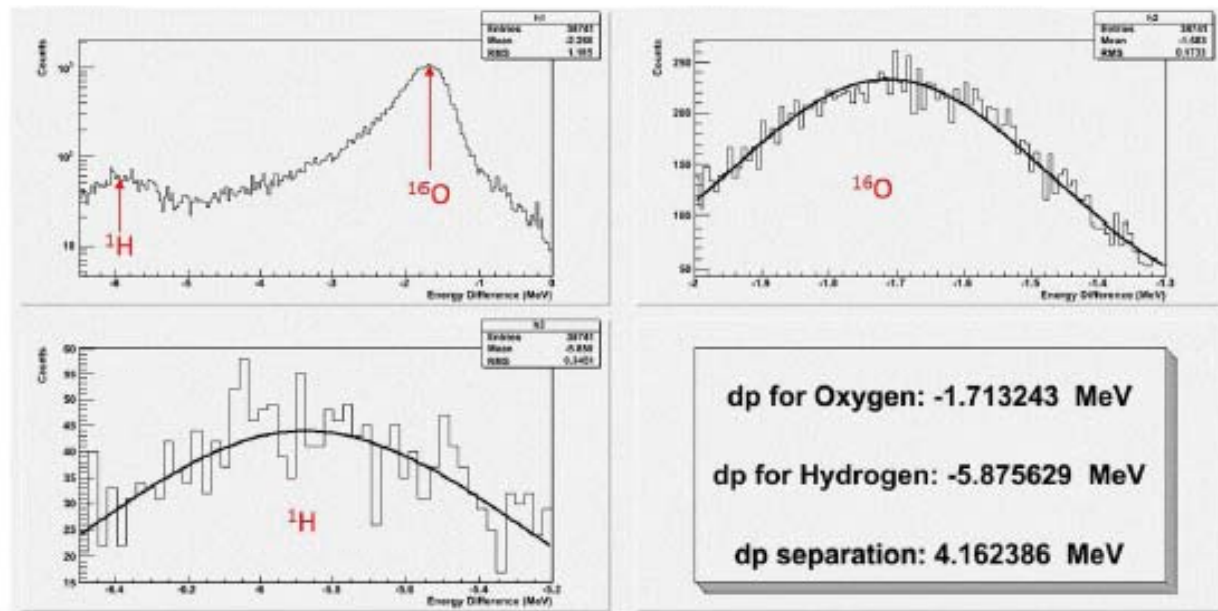
– 2 GeV e- beam, 6 deg. angle, C12 target,  $\delta\theta$  is about 6 mrad

# Angular calibration

-----Two peaks pointing method

- CH<sub>2</sub> target
- Two separate elastic peaks with energies well known
- Get to as good as 0.3mrad resolution in PREX

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



Cancel the  $E_{\text{loss}}$  uncertainty

Arm	$\sigma_{\theta}$ (°)	$\sigma_{\theta}/\theta$ (%)
Left	0.024	0.49
Right	0.021	0.43

Table 8: Errors of scattering angles

Figure 2: Watercell target momentum spectrum

# Questions to look into

- Rate
  - Tilting incident angle
  - Sieve (central hole for  $\theta_{\text{HRS}}$ )
- Raster ON/OFF option