

Pointing Update

Min Huang

01/24/2014

Pointing

- Determine the center scattering angle
- Elastic scattering off a target of mass M_t

$$E' = \frac{(E - E_{loss})}{1 + \frac{2(E - E_{loss})\sin^2(\frac{\theta}{2})}{M_t}} - E_{loss}$$

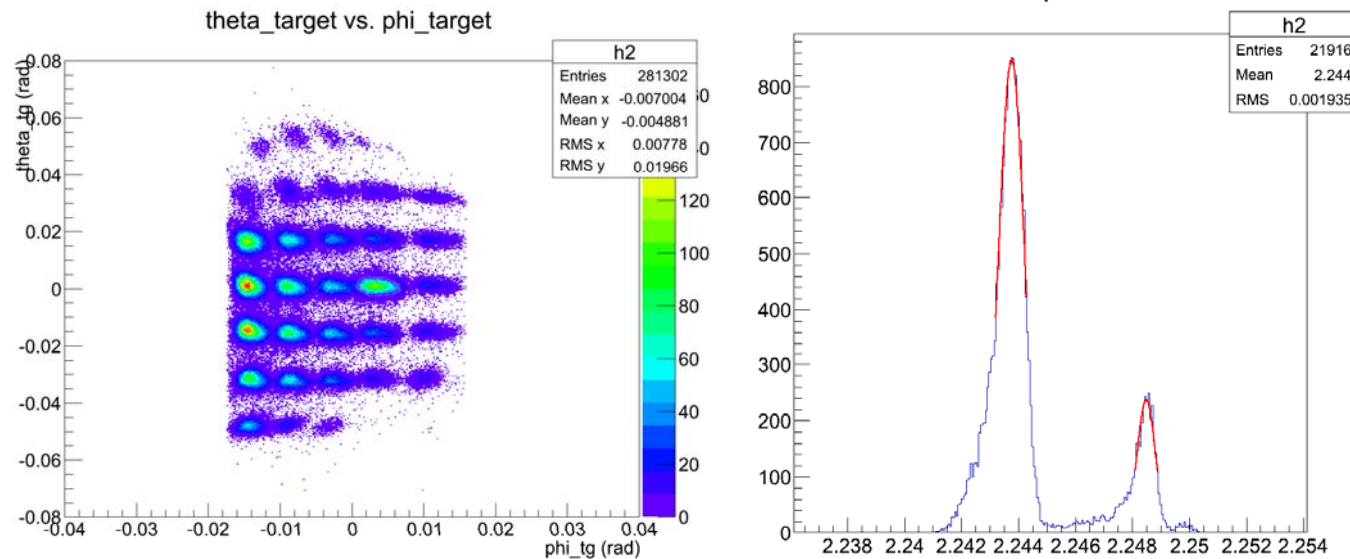
- Use the difference in E' between two nuclei

$$\Delta E' = E'_1 - E'_2 = \frac{E}{1 + \frac{E}{M_1}(1 - \cos \theta)} - \frac{E}{1 + \frac{E}{M_2}(1 - \cos \theta)} - (E_{1loss} - E_{2loss})$$

If two nuclei are in the same target, like CH₂, E_{loss} cancels each other

If not, like C in LHe, need to be considered

Pointing Calculation



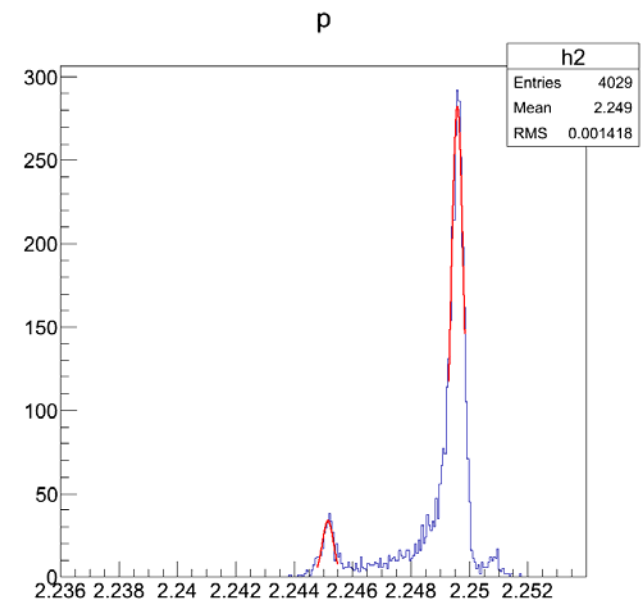
- LHe center determined by weighting the cross section, C foil at -13mm
- beam_x = -3.6mm (from fitting of focal plane data)
beam_y = 1.4mm (from bpm)

Pointing Uncertainty

- Uncertainty calculation – see the document

$$\sin \theta d\theta = -4.9 \times 10^{-3} dE + 1.11 d(\Delta E')$$

- Use C12 ground state and 1st excited state to calibrate $d(\Delta E')$
 - Nominal value is 4.44 MeV
 - LHRS 4.42 MeV, RHRS 4.39 MeV
- $d\theta \sim 0.2\text{mr (L)}, 0.5\text{mr (R)}$
- $d\theta/\theta < 1\%$

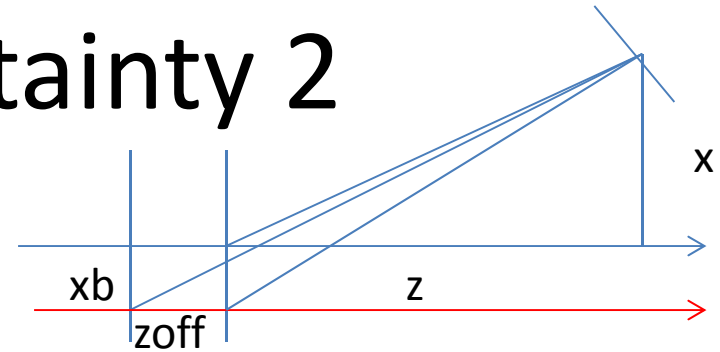


LHe Center

- Along the He $\sim 4.2\text{cm}$ distribution, determine center by weighting cross section
- L. Cardman -1.2mm
- K. Stansfield -1.4mm
- assume $\delta Z_{\text{He}} = 0.2\text{mm}$

Pointing Uncertainty 2

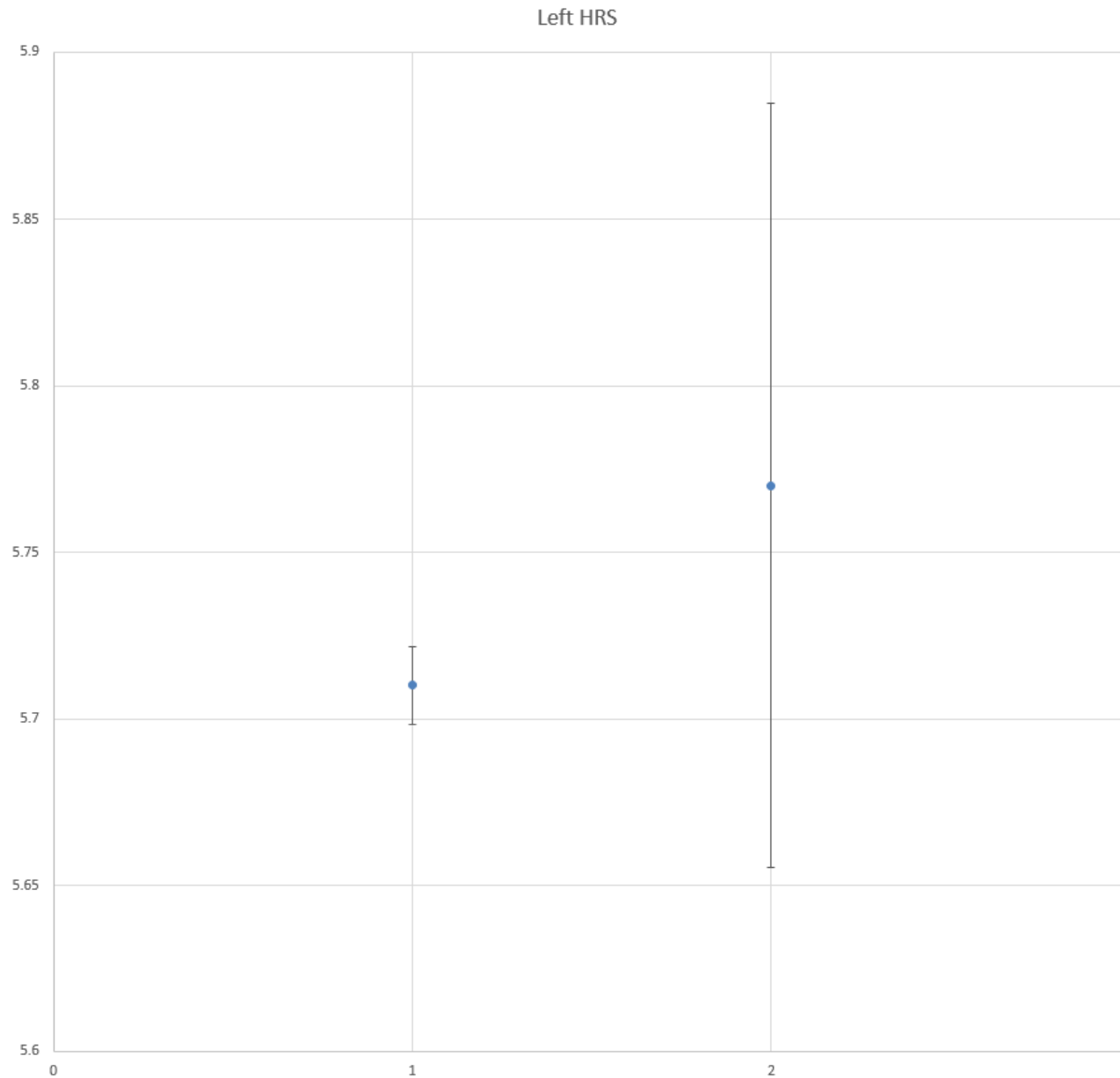
- $\theta_1 = \text{atan}((x - x_b)/z)$
- $\theta_2 = \text{atan}((x - x_b)/(z + z_{\text{off}}))$
- Survey uncertainty $\delta x = 0.15\text{mm}$
- Beam_x uncertainty $\delta x_b = 1.5\text{mm}$
- Target position uncertainty $\delta z = 1.5\text{mm}$
- C relative position $\delta z_{\text{off}} = 0.15\text{mm}$
- If just use one elastic scattering to determine the angle, $\delta\theta \sim 2\text{mr}$
- If use θ_1/θ_2 , $\delta\theta \sim 0.2\text{mr}$
- If use $\theta_1 - \theta_2$, $\delta\theta \sim 0.04\text{mr}$!



Energy loss

- Energy loss difference between C and LHe
- 0.247MeV
- Uncertainty?

Results



Need input
of incoming
beam angle

No
uncertainty
from Eloss
yet

Next

- Finish RHRS
- Need input of incoming beam angle
- Carbon foil in LHe is not ideal to do pointing calculation
- CH2 run in longitudinal target field setting
- After optics calibration done with that, will do pointing again