Pointing Update

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02/12/2014

Pointing

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

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

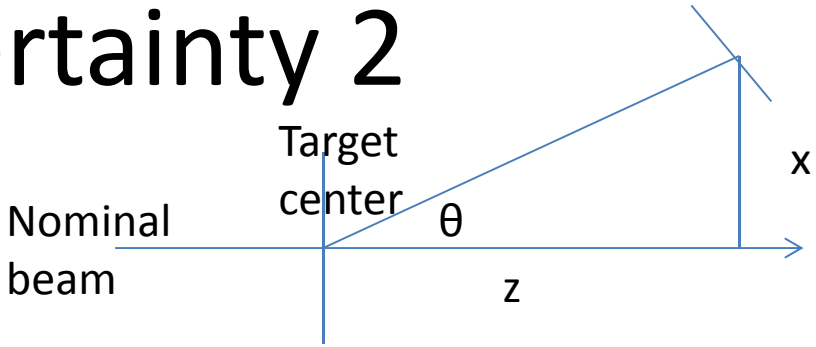
- Use the difference in E' between two nuclei

$$\Delta E^{'} = E^{'}_1 - E^{'}_2 = \frac{E}{1 + \frac{2E\sin^2(\theta_1/2)}{M_1}} - \frac{E}{1 + \frac{2E\sin^2(\theta_2/2)}{M_2}} - (E^{'}_{1loss} - E^{'}_{2loss})$$

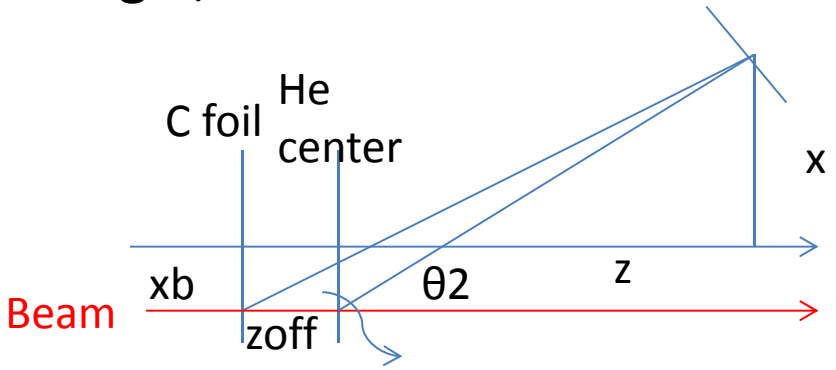
If two nuclei are in the same target, like CH2, θ1=θ2=θ, Eloss cancels each other

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

Pointing Uncertainty 2



- Survey
- θ=atan(x/z)
- If just use survey to determine the angle, δθ~0.7mr



- θ_1=atan((x-xb)/z)
- θ_2=atan((x-xb)/(z+zoff))

$$\Delta E^{'} = E_1^{'} - E_2^{'} = \frac{E}{1+\frac{2E\sin^2(\theta_1/2)}{M_1}} - \frac{E}{1+\frac{2E\sin^2(\theta_2/2)}{M_2}} - (E_{1loss}^{'} - E_{2loss}^{'})$$

- θ1 = θ + (θ1-θ) vs. θ1 = θ * (θ1/θ)
- Do similar substitution for θ2

Obtained from x, xb, z, zoff

Pointing Uncertainty 2

- Survey uncertainty δx=0.5mm
- Beam_x uncertainty δxb=1.5mm
- Target position uncertainty δz=1.8mm
- C relative position $\delta zoff$=0.15mm
- $\theta 1/\theta$, uncertainty~0.2mr
- $\theta 1-\theta$, uncertainty~0.04mr!

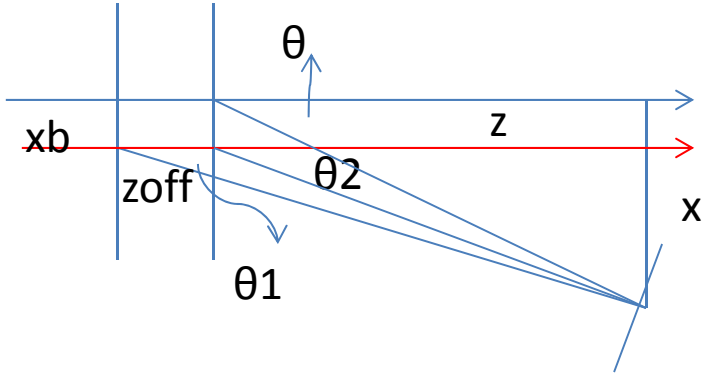
Results

	Pointing values (rad)	Survey values (rad)
LHRS	0.0997 +/- 0.0002	0.1007 +/- 0.0008
RHRS	0.1073 +/- 0.0005	0.1009 +/- 0.0008

$$\Delta E' = E_1' - E_2' = \frac{E}{1+\frac{2E\sin^2(\theta_1/2)}{M_1}} - \frac{E}{1+\frac{2E\sin^2(\theta_2/2)}{M_2}} - (E'_{1loss} - E'_{2loss})$$

0.0046 GeV

0.247/1000 GeV



Doing & todo

- Summary for the pointing study so far
- CH2 run in the longitudinal setting to cross check

Backup

Pointing Uncertainty

- Uncertainty calculation – θ~=6°, E=2.254GeV
  - Two nuclei in the same target

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

- Use C12 ground state and 1st excited state to calibrate d(ΔE')
  - Nominal value is 4.44 MeV
  - LHRS 4.42 MeV, RHRS 4.39 MeV
- dθ~ 0.2mr (L), 0.5mr(R)
- dθ/θ<1%