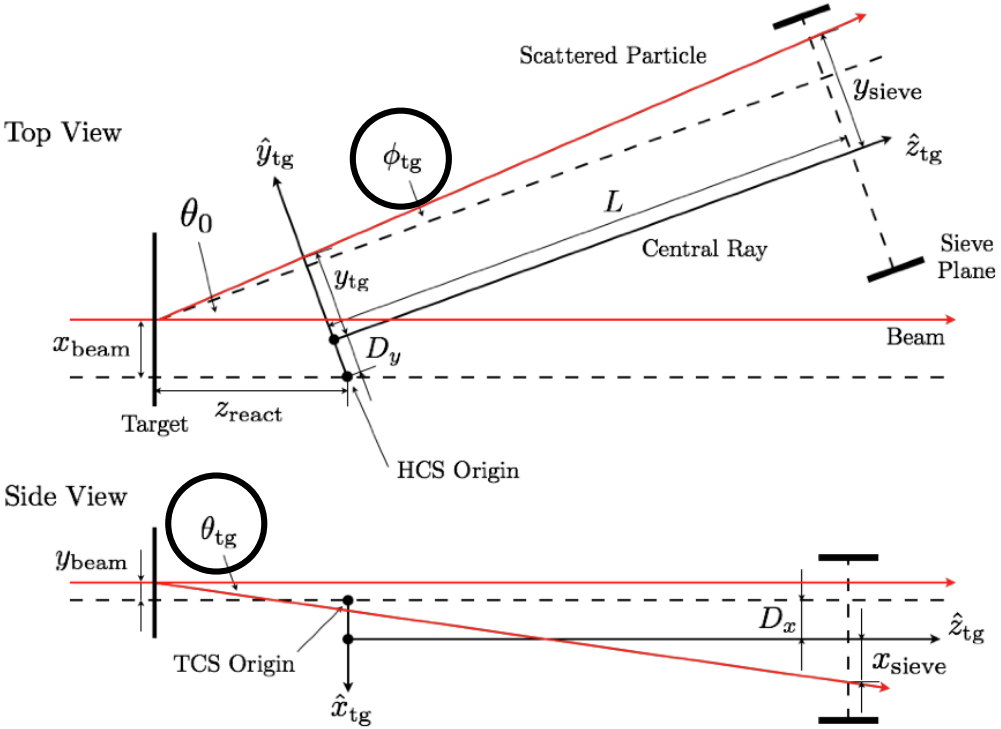
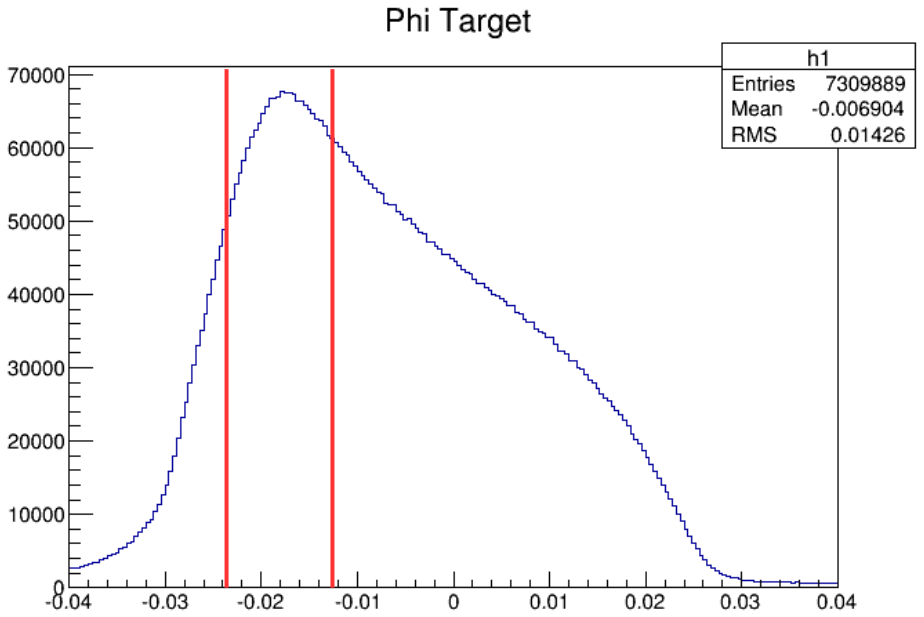
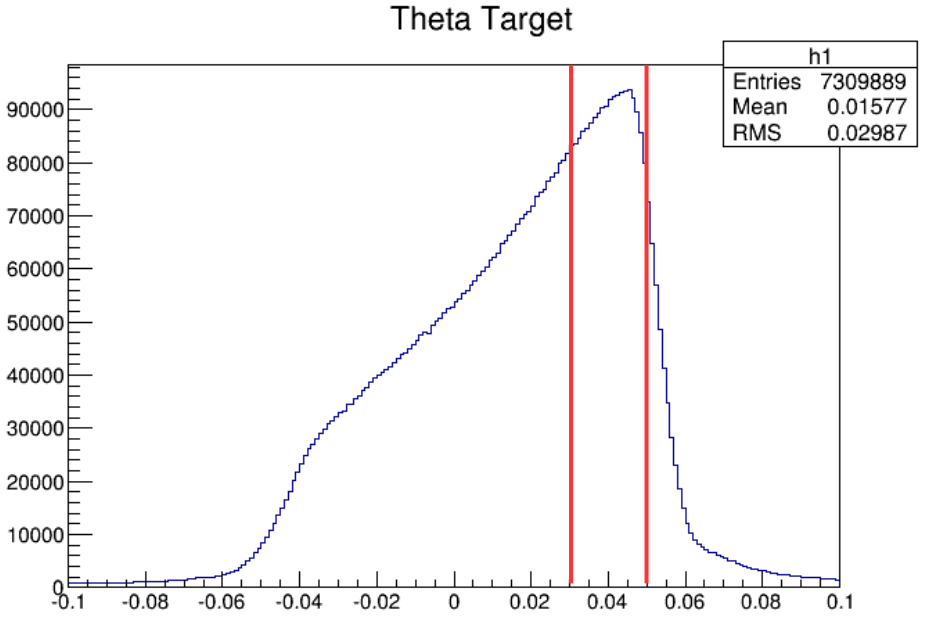
Tight acceptance cut (for XS model weighting)

- Diagram on the right is from Chao's optics technote.
- Phi target is in plane angle.
- Theta target is out of plane angle.
- I cut on these (since the spread is always the same/centered on zero regardless of kinematic).
- Calculate scattering angle with extremely strict theta and phi cut.







Method to calculate scattering angle (from Elog 191):

$$\theta_{P1} = \arctan\left(\sqrt{\theta_{bpm}^2 + \phi_{bpm}^2}\right)$$

$$\phi_{P1} = \arctan\left(\frac{\tan(\theta_{bpm})}{\tan(\phi_{bpm})}\right)$$

Incident theta/phi from BPM information (usually a very small correction)

$$\theta_{P2} = \theta_{rec,1}$$

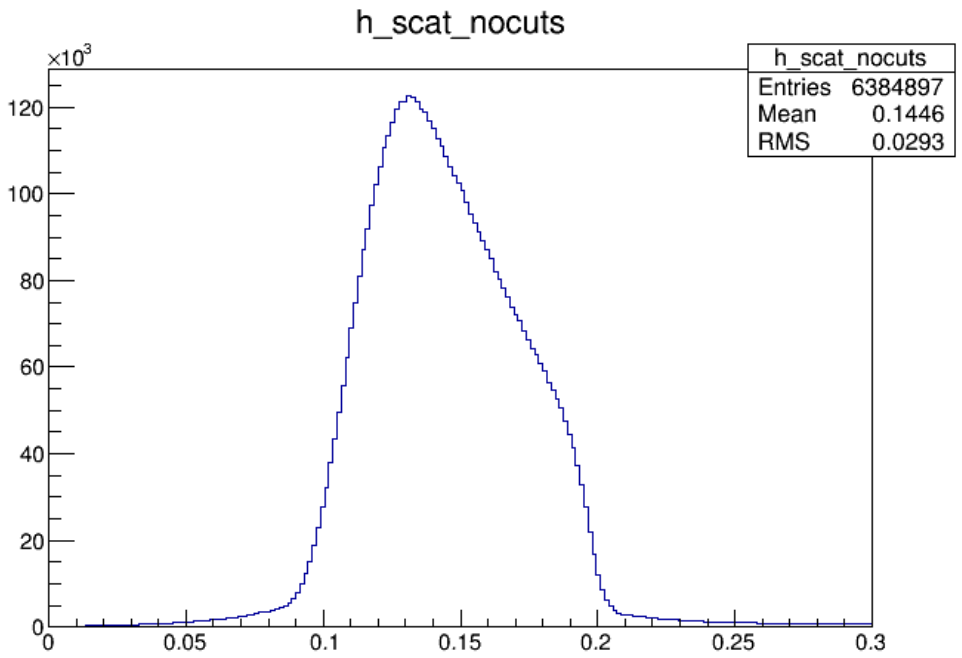
$$\phi_{P2} = \phi_{rec,1}$$

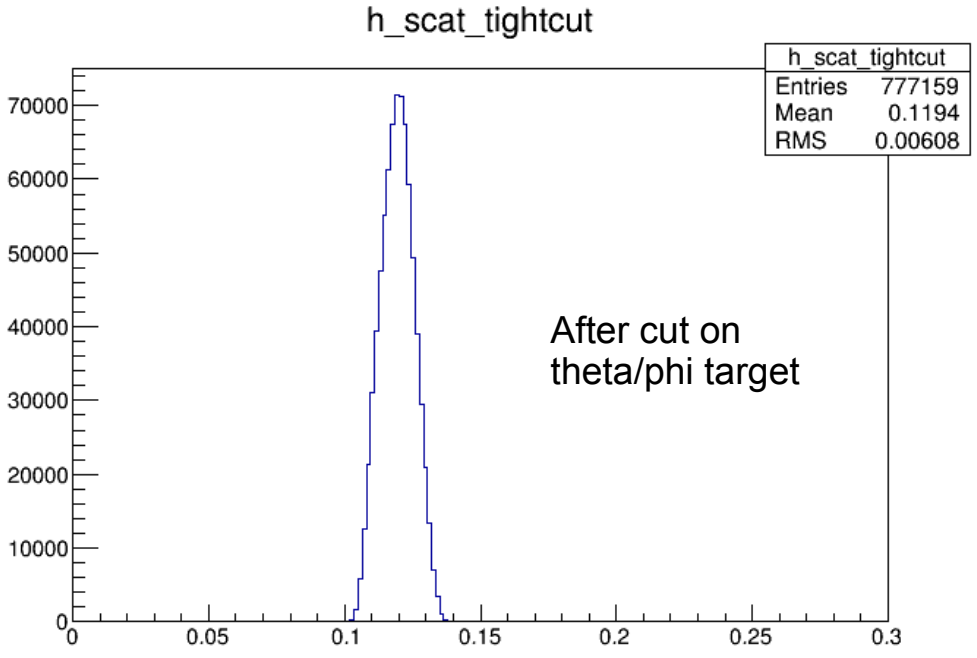
Scattered theta/phi from optics reconstruction (in the lab frame).

$$eb = [\sin(\theta_{P1})\cos(\phi_{P1}), \sin(\theta_{P1})\sin(\phi_{P1}), \cos(\theta_{P1})]$$

$$ef = [\sin(\theta_{rec,1})\cos(\phi_{rec,1}), \sin(\theta_{rec,1})\sin(\phi_{rec,1}), \cos(\theta_{rec,1})]$$

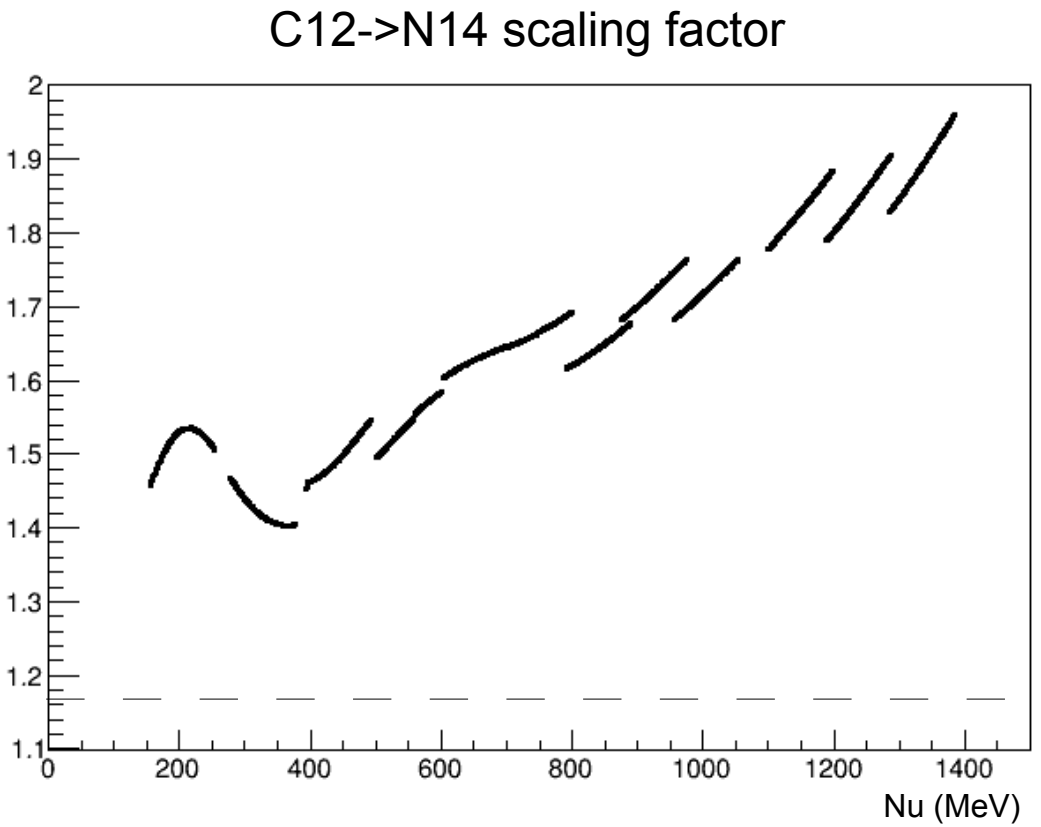
$$\theta_{scattering} = \arccos(eb_0 ef_0 + eb_1 ef_1 + eb_2 ef_2)$$





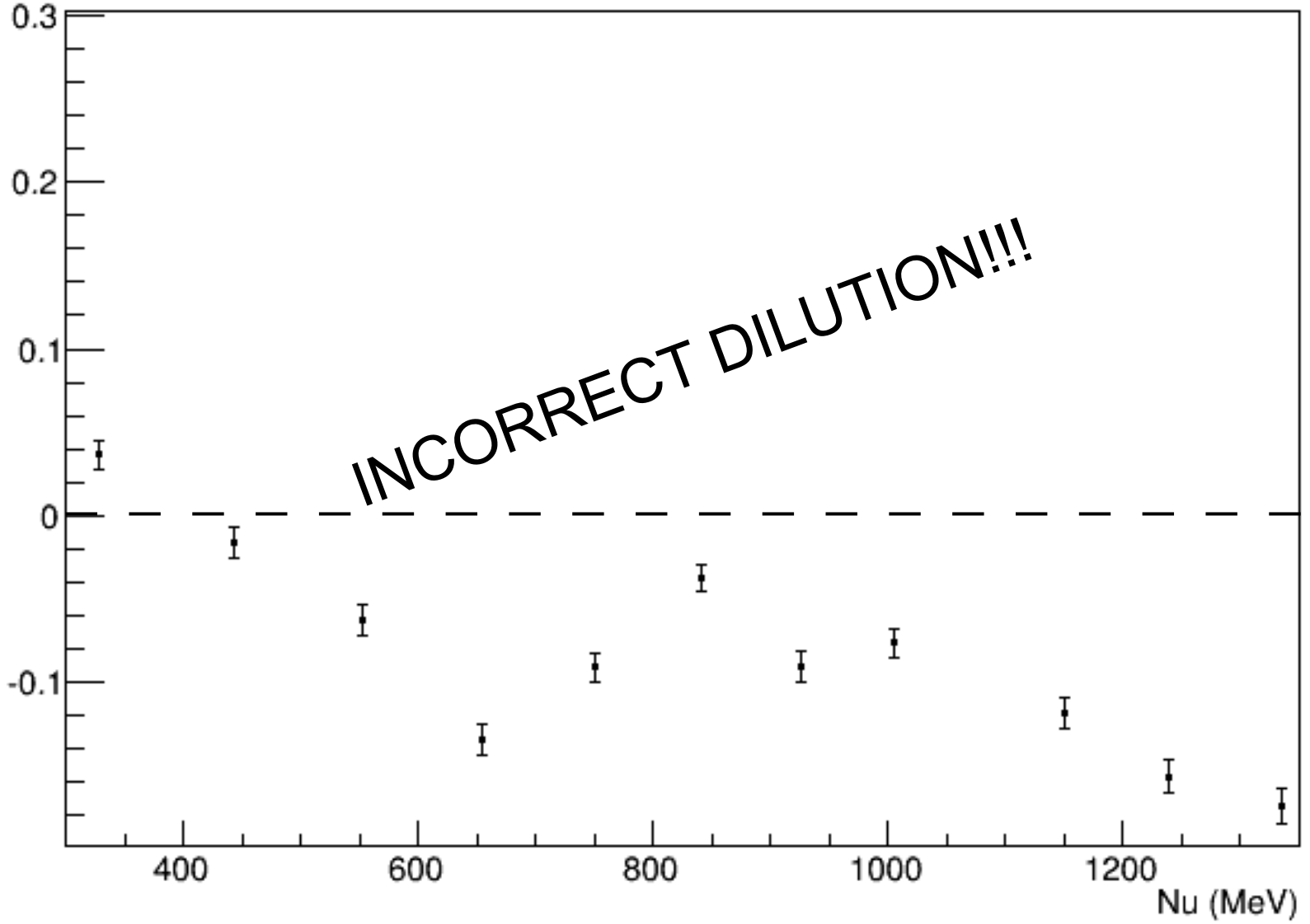
Finding the scaling factors:

- Find a scattering angle for each run type (production, carbon, empty).
- Run P.Bosted XS model for each material and weight by corresponding run type.
  - Ex: in order to scale C12 (from carbon run) to N14 (production background) I weight the C12 XS by the carbon run scattering angle and N14 XS by the production run scattering angle, then take the ratio.

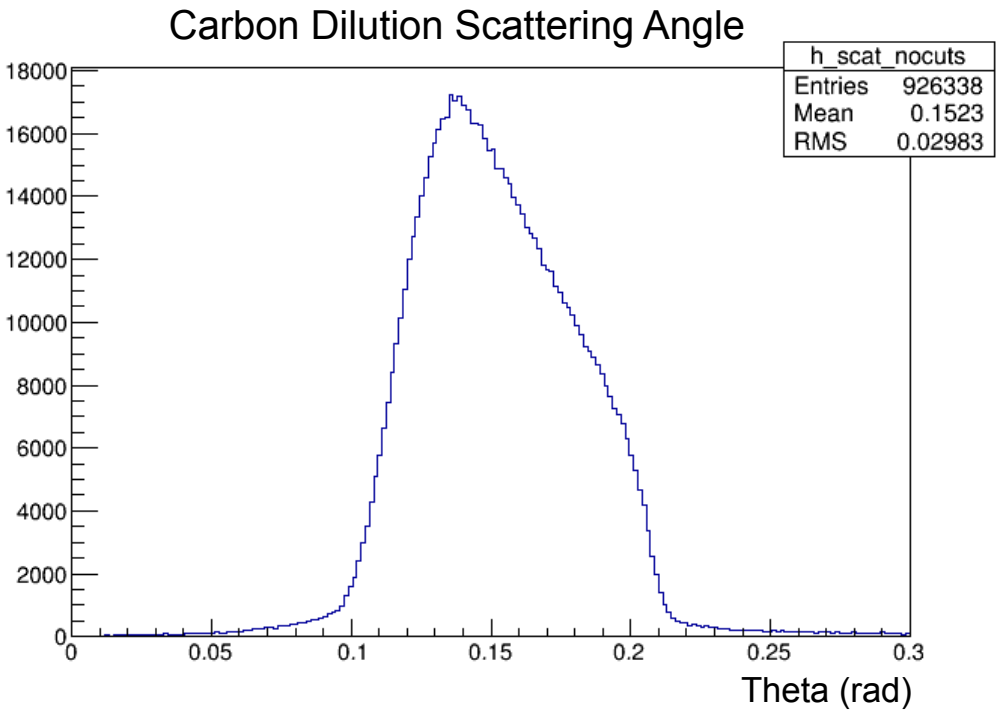


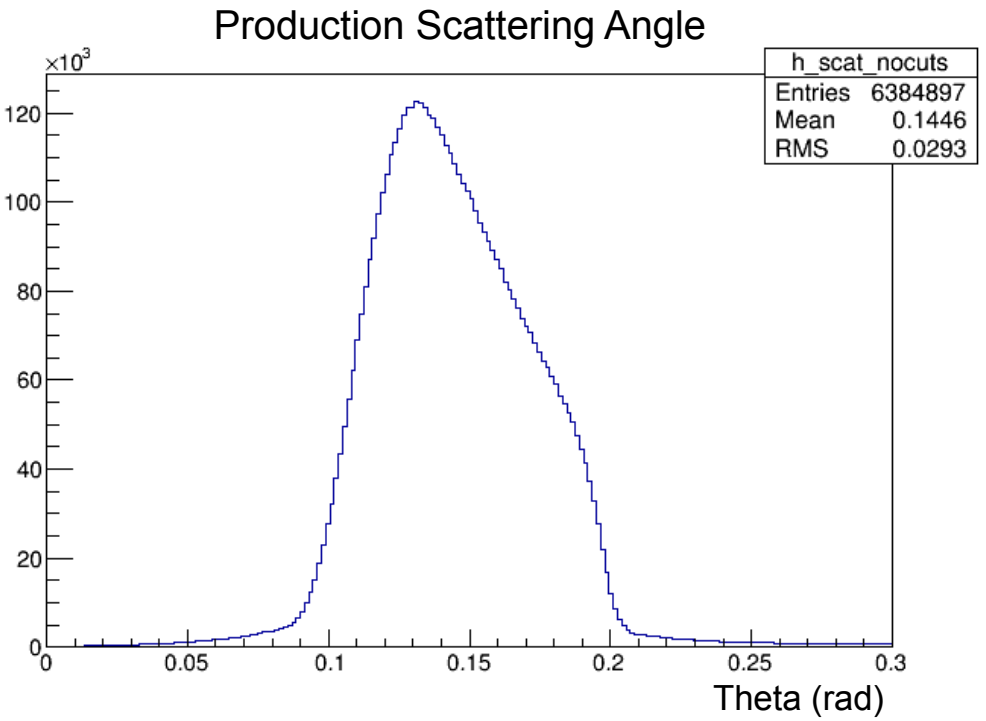
Dashed line is nucleon ratio. (deviation is expected but this is much too large!)

2.254 GeV 5T Transverse Dilution (INCORRECT)



What two scattering angles (from data) are going into the C12->N14 scaling factor?





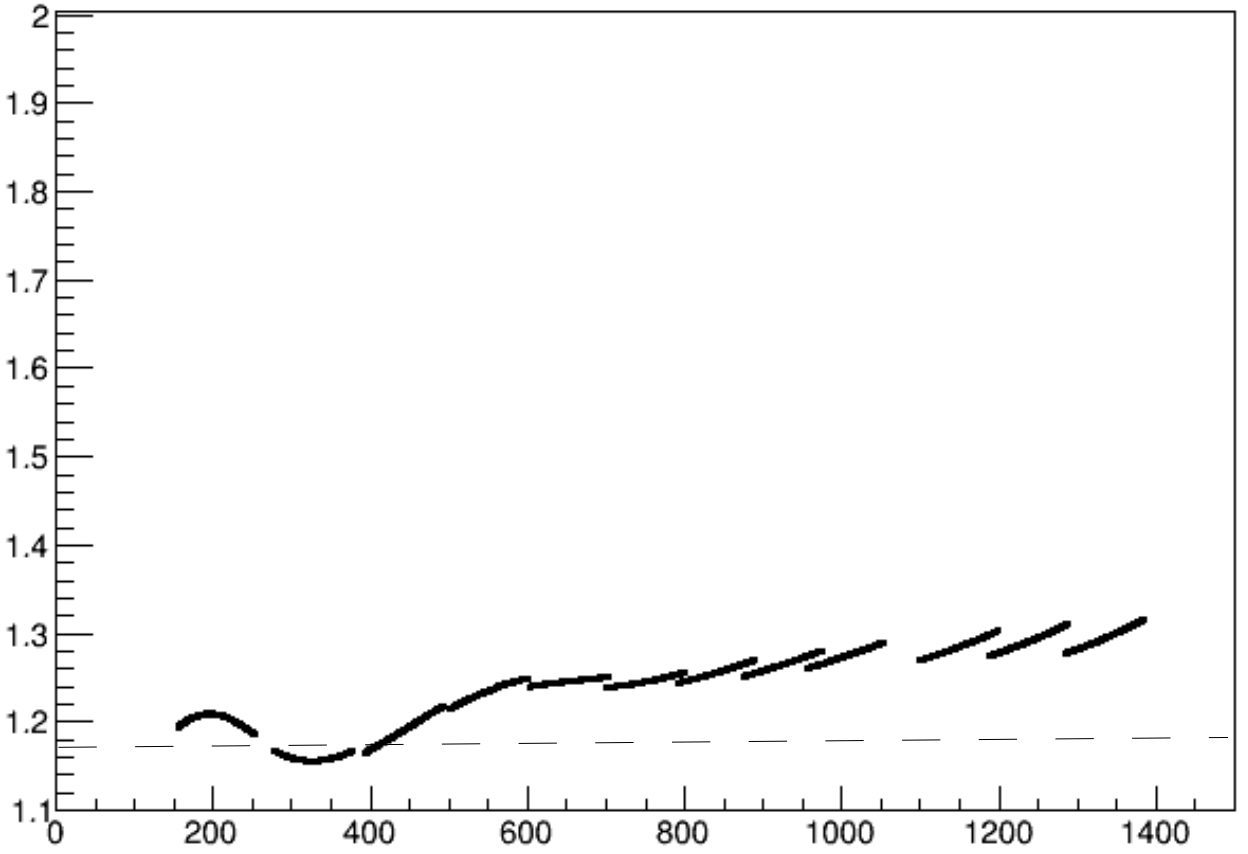
- Carbon dilution scattering angle is larger than production!!! (by ~0.5 degrees)
- We would expect the exact opposite because the carbon disk is upstream of target center.
- Above is one p0 setting, but it is true for all settings.

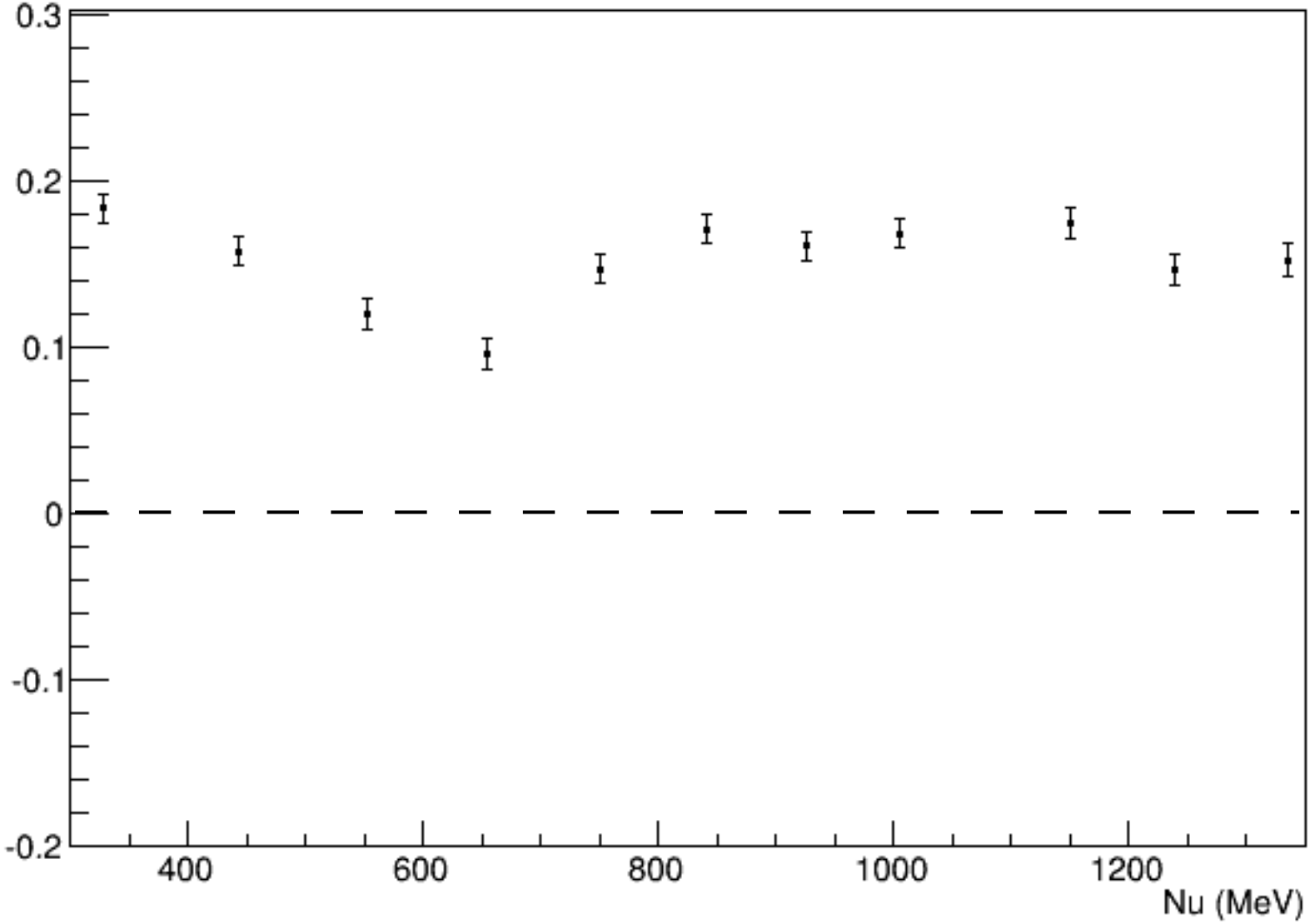
Note: Simulation matches what we would expect. Carbon dilution scattering angle (from data) has good agreement with simulation, but production scattering angle (from data) is a full degree smaller than simulation!!

Temporary solution:

Weight both C12 XS and N14 XS by carbon dilution run scattering angle (so angle between run types is not corrected for).

C12->N14 ratio (weighted by C12 dilution only)




2.254 GeV 5T Longitudinal Dilution
0.3
0.2
0.1
0
-0.1
-0.2
400
600
800
1000
1200
Nu (MeV)

To do:

- **I attempted to use the first method on 2.2GeV 2.5T but the same problem occurred, looks like there might be an issue with rec.l_th?**
- Currently using second method to calculate 2.2GeV and 1.7GeV 2.5T settings, should be done by the end of the week.
- For now I will add a systematic uncertainty to the dilution due to the unscaled scattering angle (will do a quick study on that soon).
- Dust off my asymmetry code and add in dilution results (and polarized radiative corrections?)
- Suggestions from meeting?