Acceptance/Angle Correction and Updated Dilution Results

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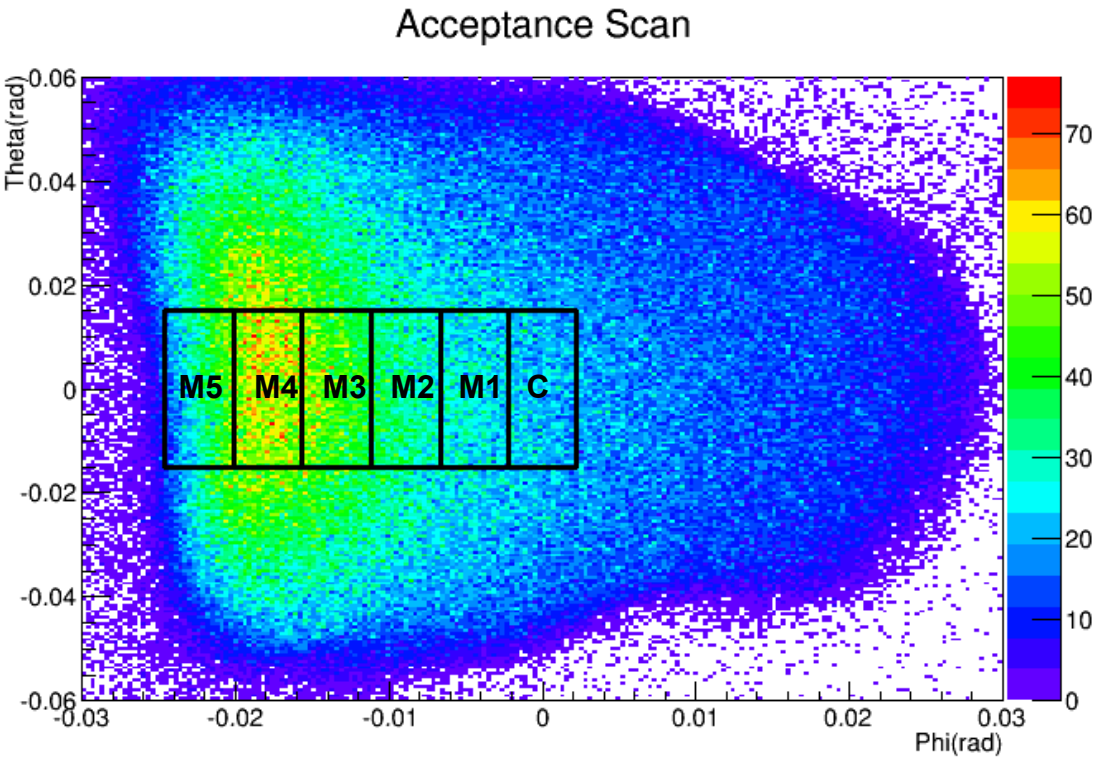
Acceptance and Scattering angle Study

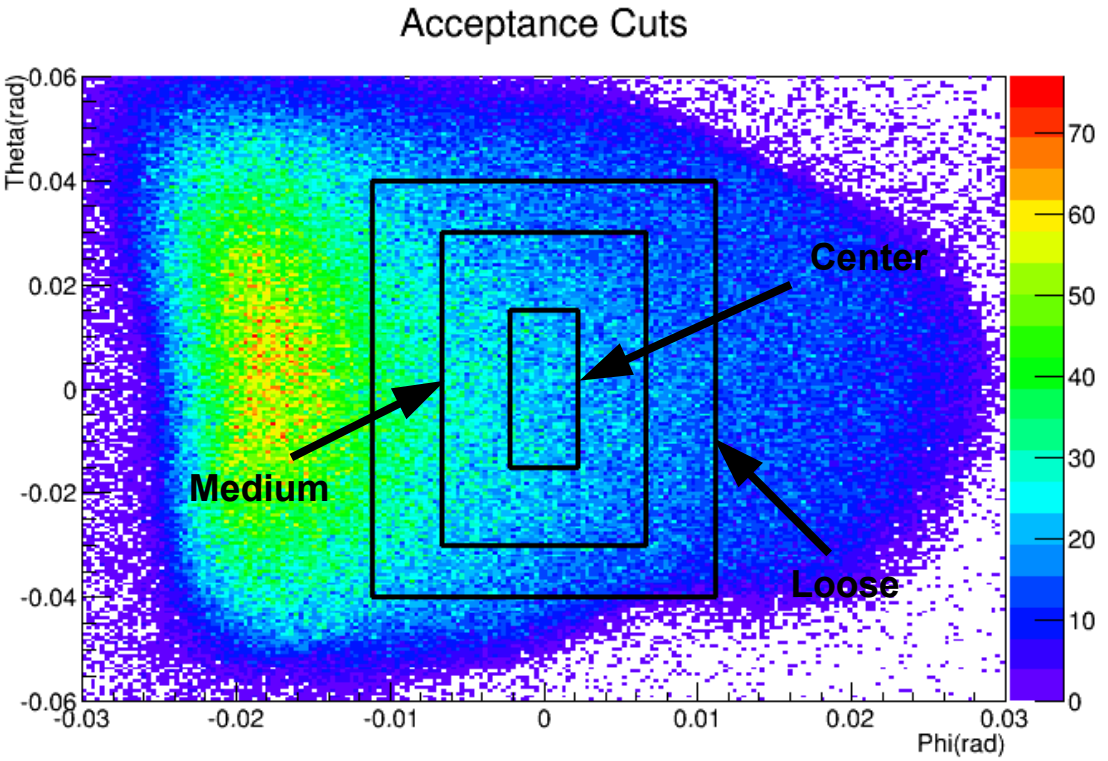
Goal:

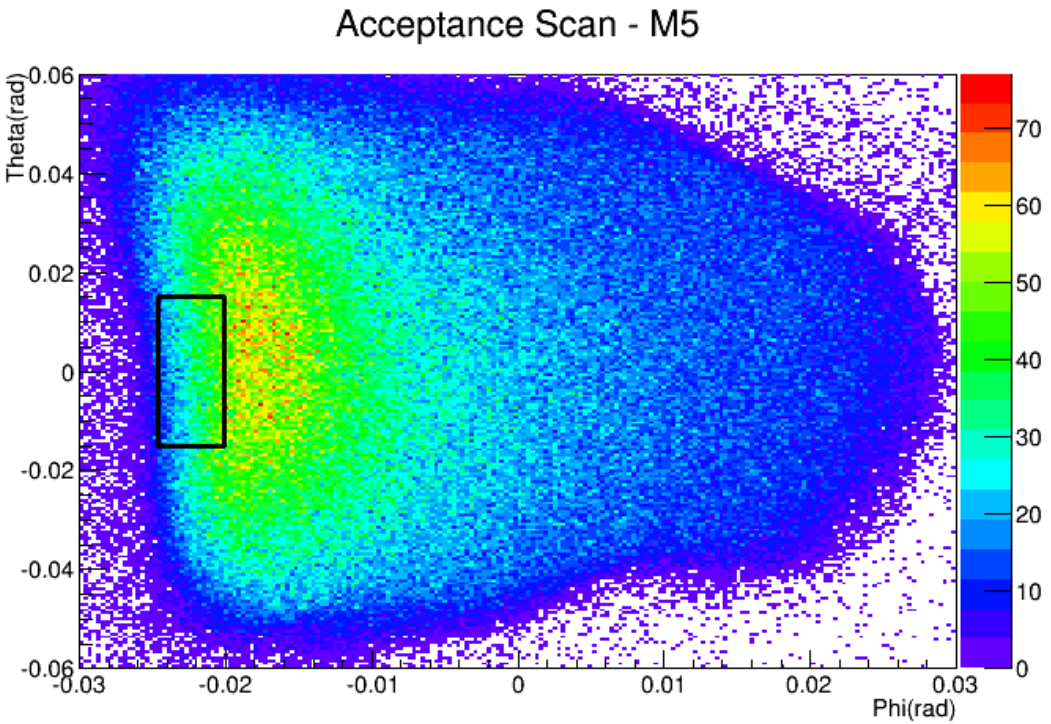
- Perform several cuts on reconstructed theta and phi at the target, with varying levels of strictness.
- For each cut (loose, medium, strict, extreme) calculate the real scattering angle using theta/phi before and after scattering (from BPM and optics, respectively).
- Run P.Bosted XS model using the resulting scattering angles from each cut (using a bin weighting method).
- Compare the resulting XS model to yield data.
- *The idea is to find a region that will eliminate acceptance effects in the yield, so that the generated model (using the real scattering angle) best represents our data and can be used in the dilution.*

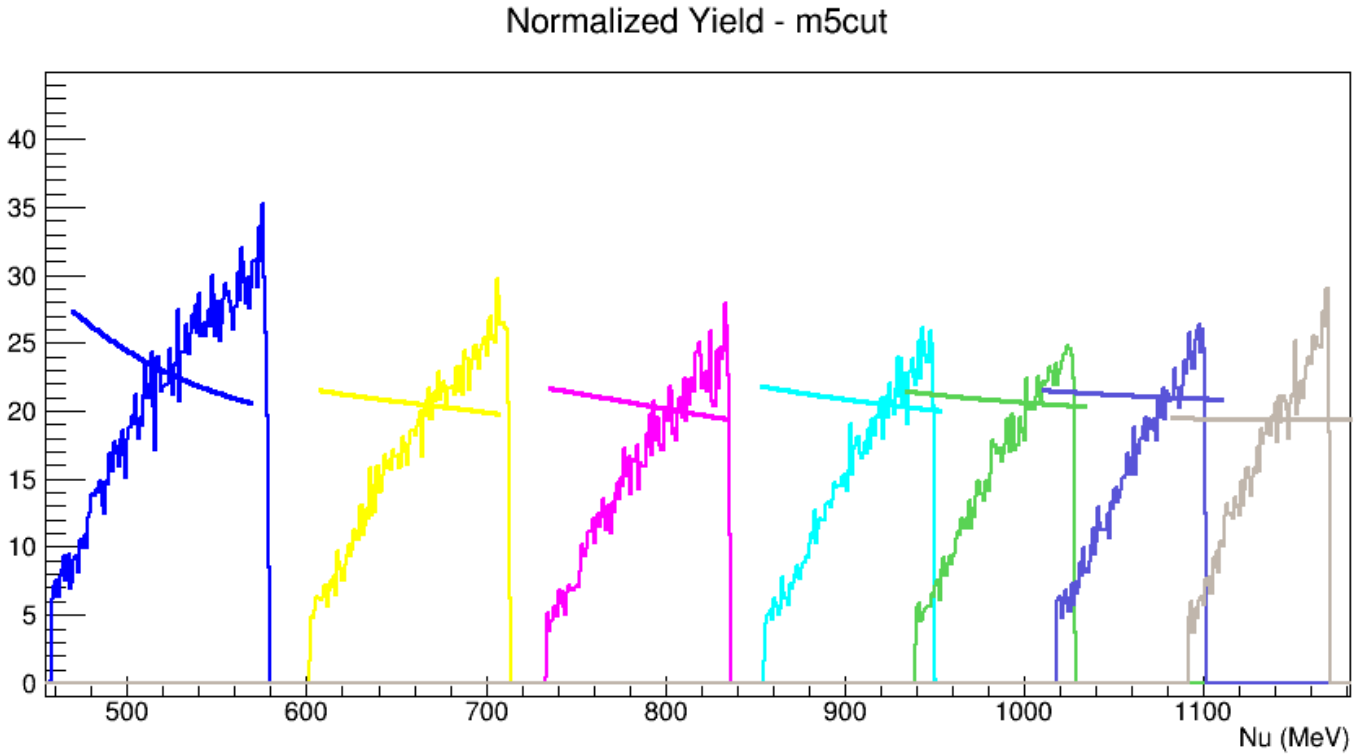
Finding a good (temporary) acceptance cut:

- First look at a scan of theta v phi cuts to see how the acceptance effects the scattering angle and resulting yields (top plot).
- Find a region where the normalized yield agrees with Bosted sim.
- Expand acceptance cut to increase statistics without losing yield/XS agreement (bottom plot).
- Temporary because even with a loose acceptance cut, statistics are not very good. (need a correction)

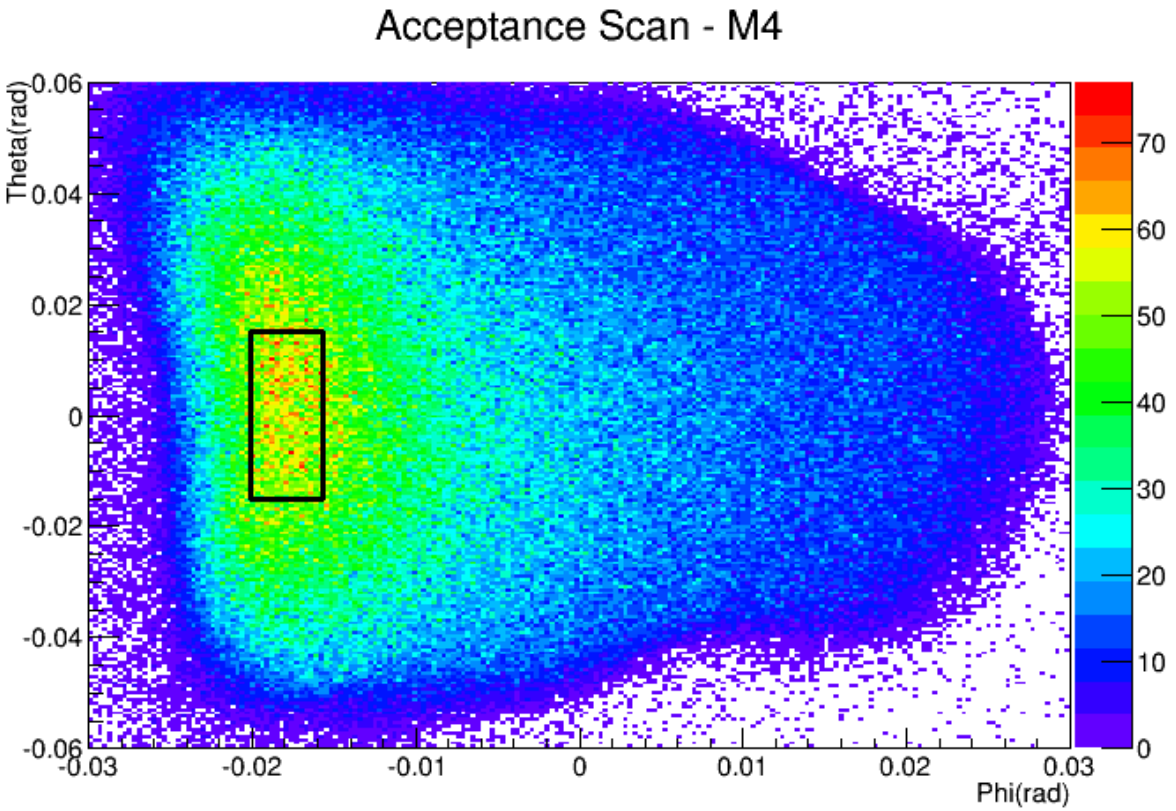


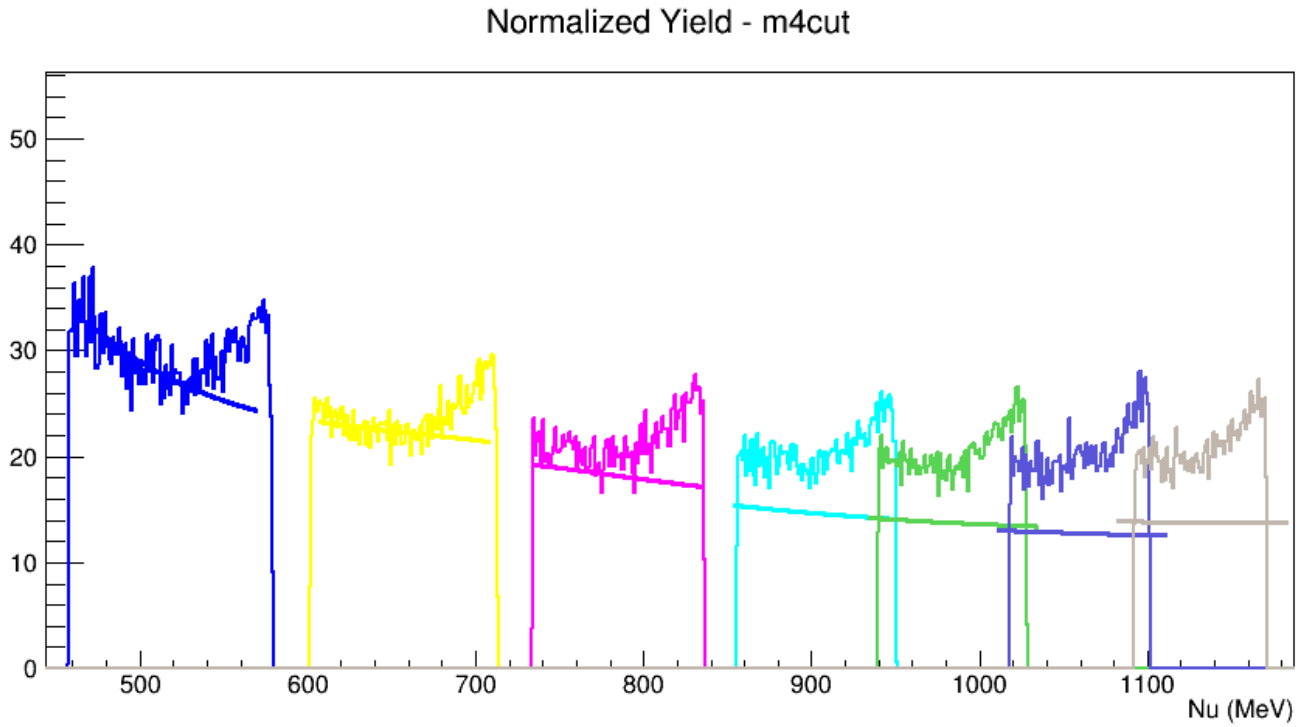




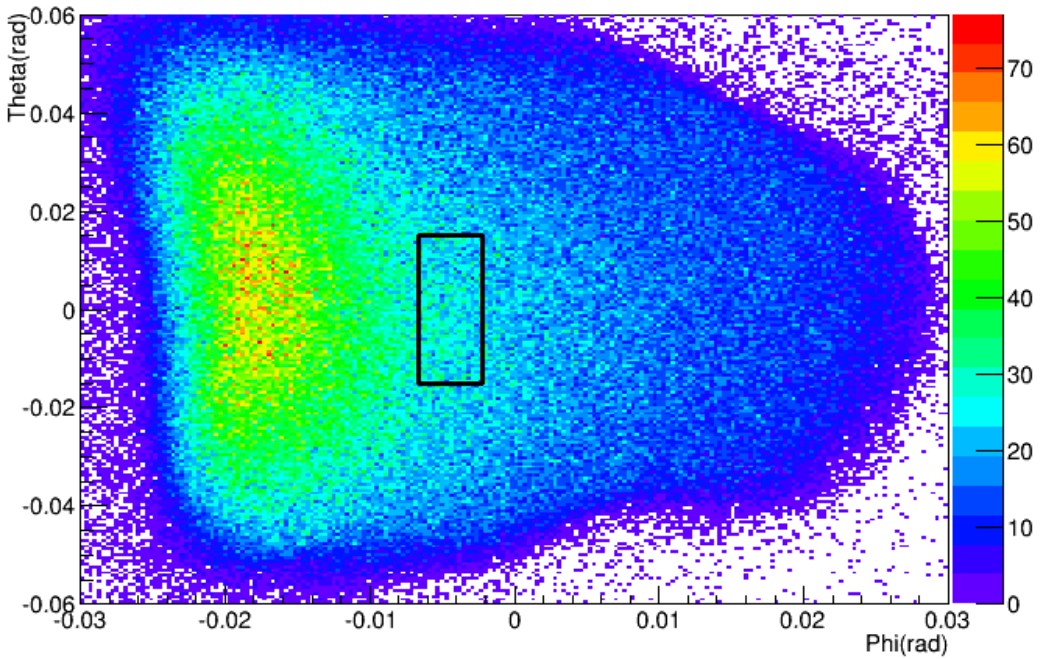


- Solid lines are fully radiated Bosted sim which have been scaled for comparison to normalized yields.
- Simulation and data both use acceptance cut defined above.

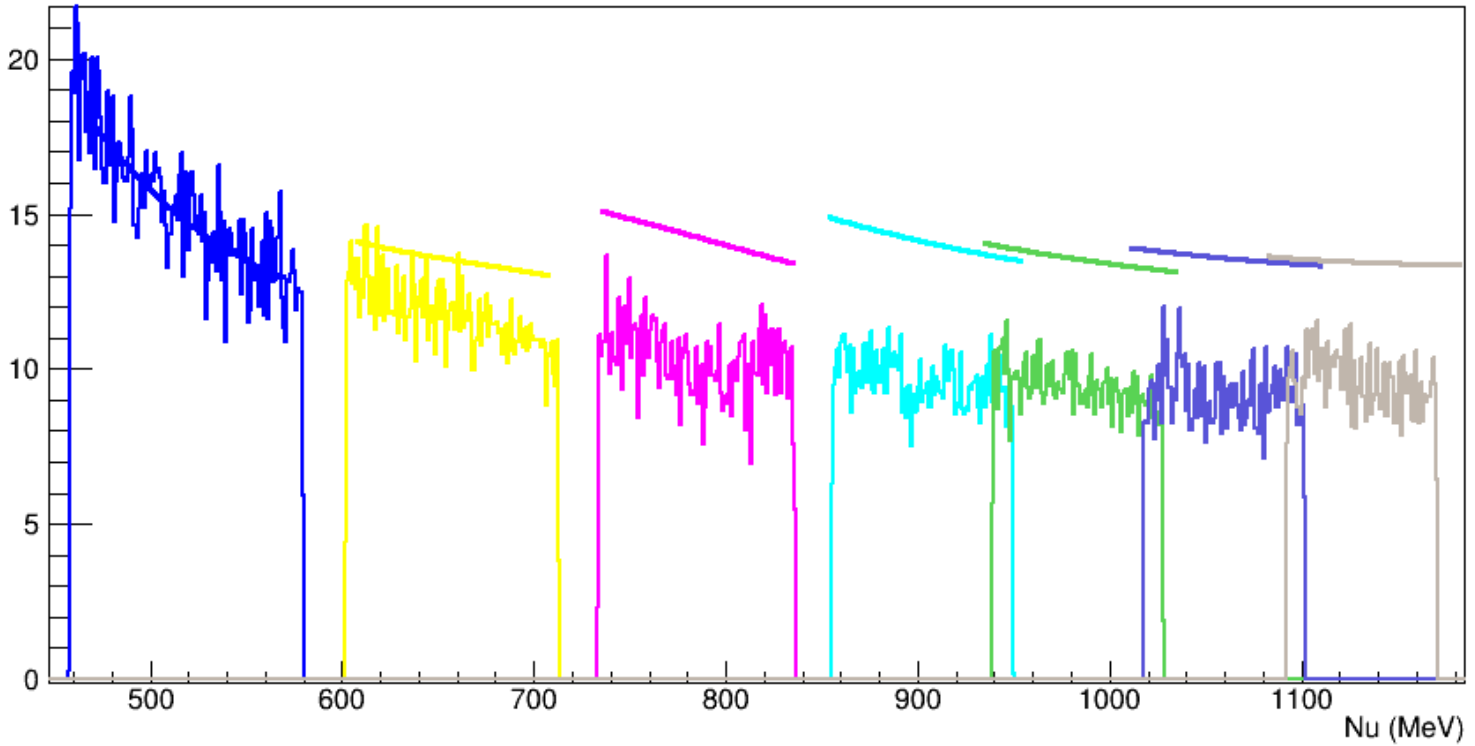

Acceptance Scan - M4
Theta(rad)
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.03
-0.02
-0.01
0
0.01
0.02
0.03
Phi(rad)
70
60
50
40
30
20
10
0

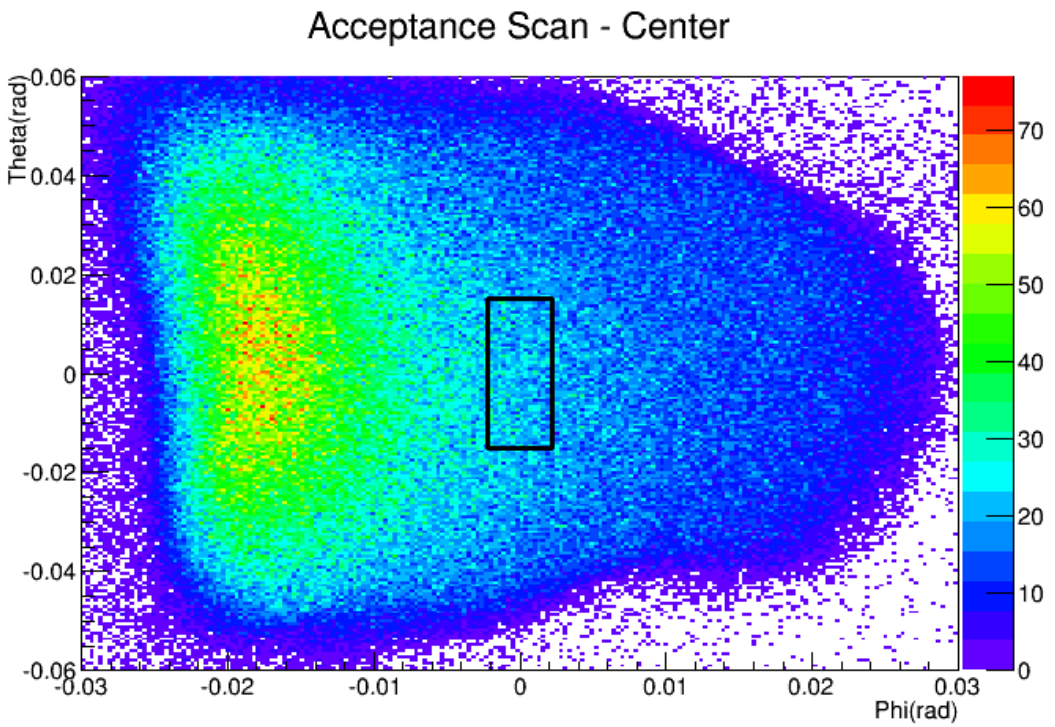

Normalized Yield - m4cut
50
40
30
20
10
0
500
600
700
800
900
1000
1100
Nu (MeV)

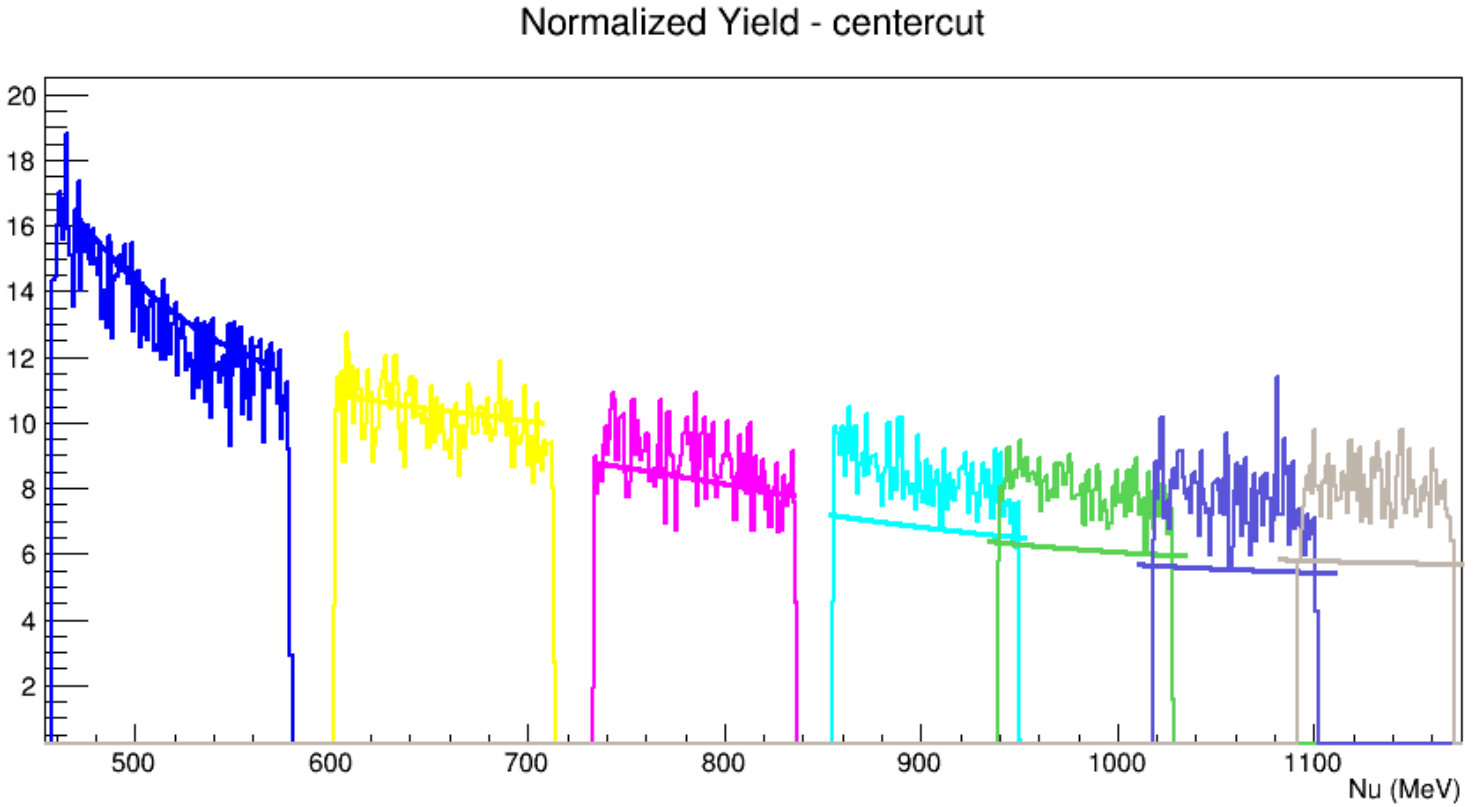
Acceptance Scan - M1



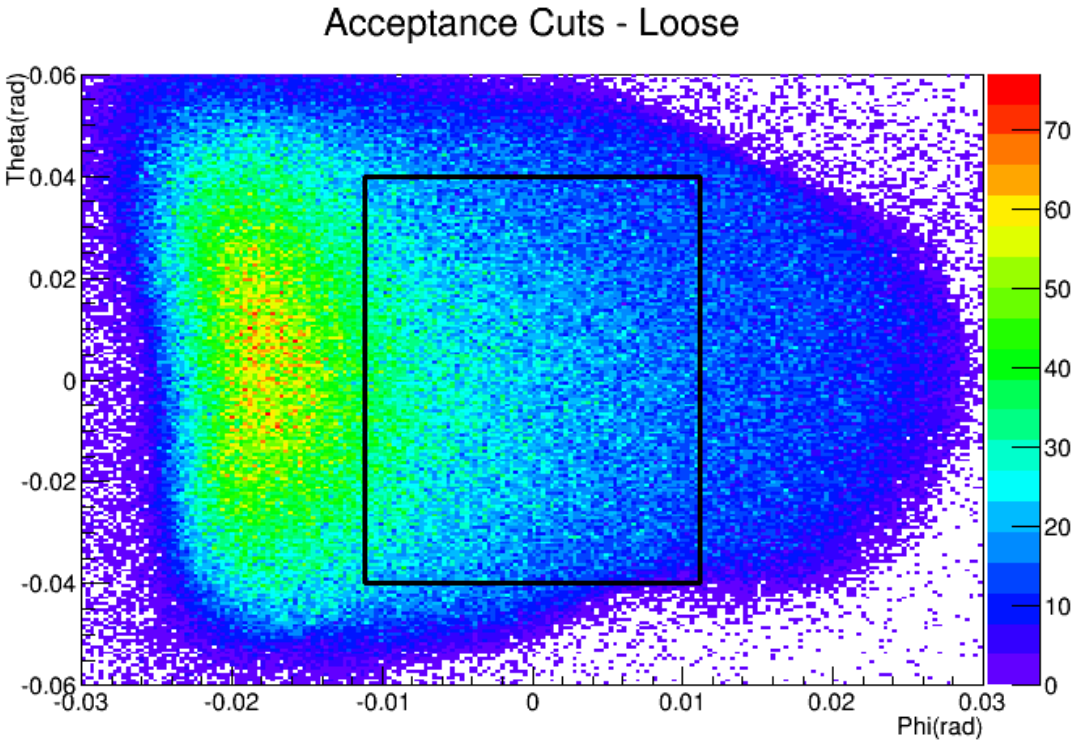
Normalized Yield - m1cut

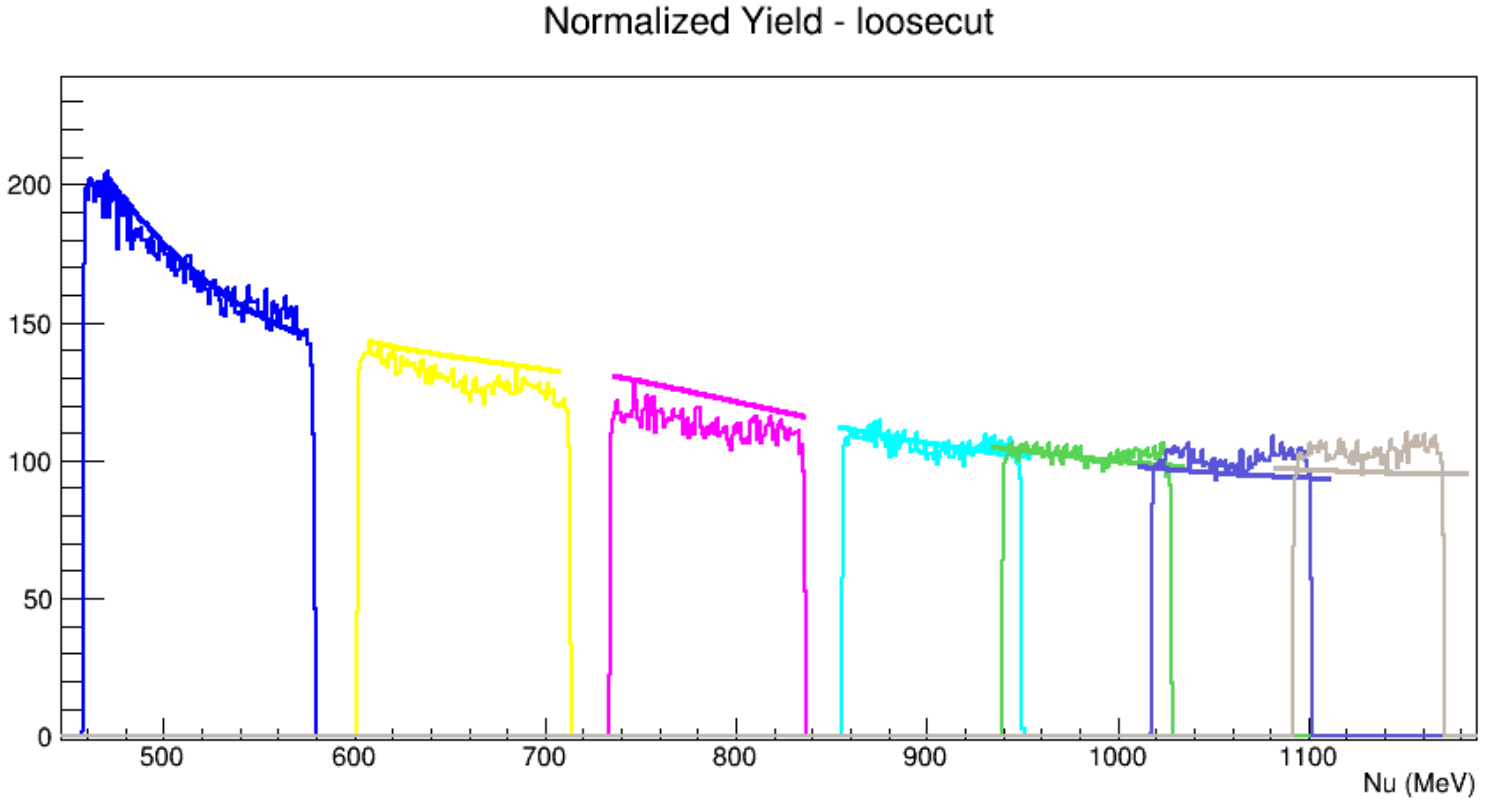






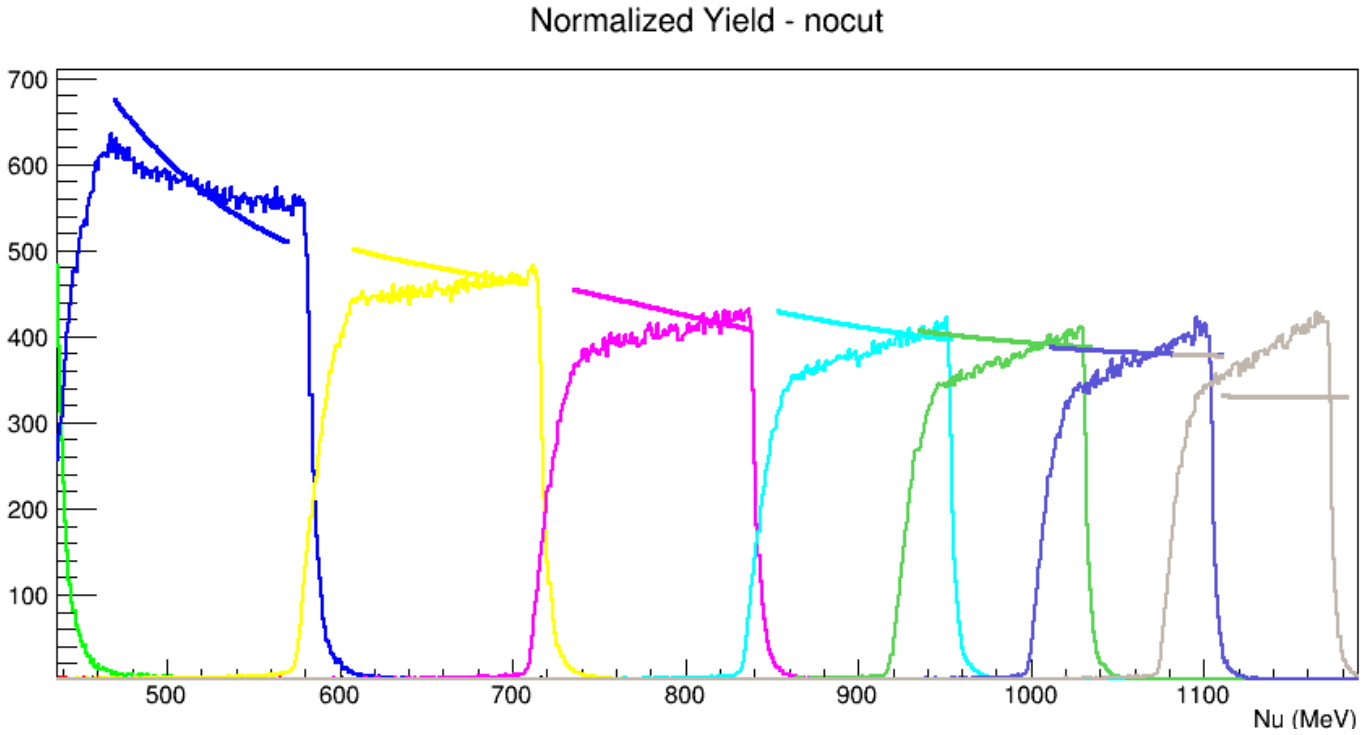
Good agreement here! Although the overall scale isn't consistent. (Shouldn't matter because I'm only using simulation ratios?)

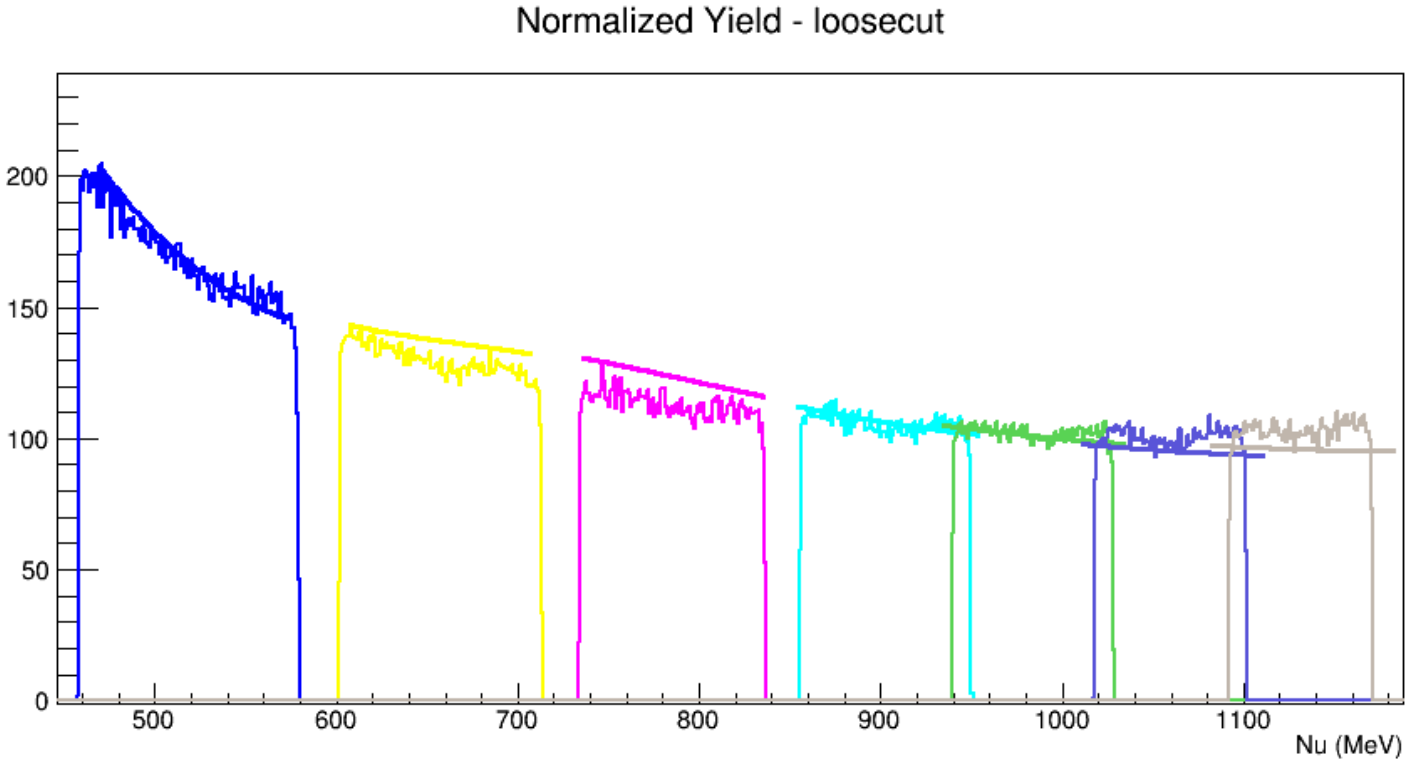




- Expanded acceptance cut to increase statistics, still very good agreement!
- Decided to use this acceptance cut to calculate the dilution

- Comparison of the original 'no acceptance cut' to the final 'loose cut' I used for dilution calculation
- You can see we lose about 60% of statistics, so not a very good solution for asymmetries, but will result in a more accurate dilution.
- Both 'no cut' and 'loose cut' contain standard good electron cuts.





(Re)Calculating Dilution - Reminder

$$df = 1 - \frac{Y_{bg}}{Y_{total}}$$

$$Y_{bg} = Y_N + Y_{He} + Y_f$$

$$Y_{He} = \frac{L_{total} - pf \cdot L_{tg}}{L_{total}} \alpha \, Y_{Empty}$$

$$Y_f = Y_{Dummy} - Y_{Empty}$$

$$Y_N = \frac{m_C \rho_N \, pf L_{tg} \beta}{m_N \rho_C L_C} \left(Y_{Carbon} - \frac{L_{total} - L_C}{L_{total}} \gamma \, Y_{Empty} \right)$$

Y_{total} = normalized production yield

$Y_{N/He/f}$ = Nitrogen/ Helium/ foil background contributions

$Y_{Empty/Carbon/Dummy}$ = Respective dilution runs

pf = packing fraction

$L_{total/tg}$ = total nose length/ target cell length

$m_{C/N}$ = Carbon/ Nitrogen molar mass

$\rho_{C/N}$ = Carbon/ Nitrogen density

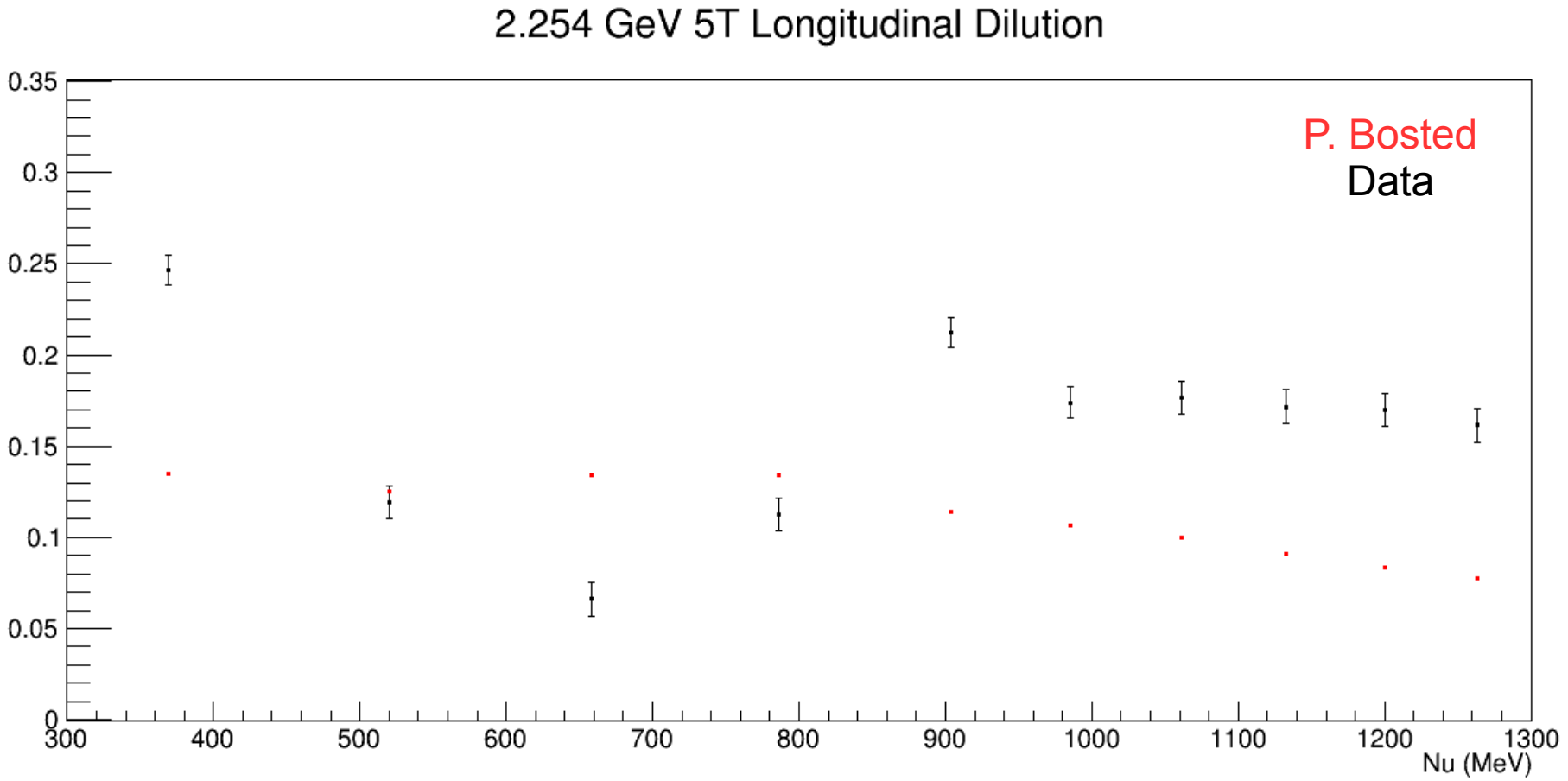
$\rho_{C/N}$ = Carbon/ Nitrogen density

L_C = carbon disk thickness

α = radiative/scattering scaling factor for Helium dilution to Helium (during production)

β = radiative/scattering/nucleon scaling factor for Carbon dilution to Nitrogen (during production)

γ = radiative/scattering scaling factor for Helium dilution to Helium (during carbon dilution)



- Each bin is one momentum setting, if there were multiple runs at a momentum setting the statistically weighted average was taken.
- Using a pf of 0.634 (old?). A different pf will have a large effect on the result.
- Result seems large but not unreasonable? An updated pf may help.
- Suggestions from meeting?