Dilution Update

Feb. 10, 2015

Reminder

Method:

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

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

$$Y_{bg} = \underbrace{[Y_{dummy} - Y_{empty}]}_{\text{Parameterized foil contribution}} + \underbrace{[(1 - pf\frac{L_{tg}}{L_{total}})\alpha Y_{empty}]}_{\text{Parameterized helium contribution}} + \underbrace{[\gamma(pf)\frac{\rho_N L_{target} M_C}{\rho_C L_C M_N}(Y_{carbdil} - (1 - \frac{L_c}{L_{total}})\beta Y_{empty})]}_{\text{Parameterized nitrogen contribution}}$$

Where...

$L_{total} = L_{target} + L_{outside}$

$L_c = carbon\ disk\ length$

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

$M_{N/C} = Nitrogen/Carbon\ mass$

$\alpha/\beta = radiation\ length\ scaling\ parameters\ (using\ P.\ Bosted\ simulation)$

$\gamma = Radiation\ length\ scaling\ factor\ /\ Nucleon\ scaling\ factor\ for\ Carbon \rightarrow Nitrogen$

$pf = packing\ fraction$

} Found using simulation

To do

- Tune P.Bosted Carbon and Helium simulation to xs data.
  - Find an uncertainty in each tune to be propagated to dilution.
  - Currently using UVa quasi-elastic XS database (next slide)
- Radiate simulations using g2p parameters and take ratios to find scaling constants.
- Apply scaling constants to calculated background yield and dilution.

Model Tuning

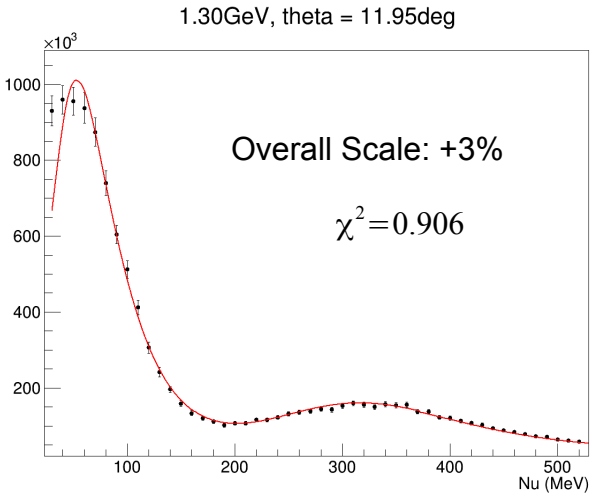
XS data taken from UVa quasi-elastic database. Systematics are all ~3.5%

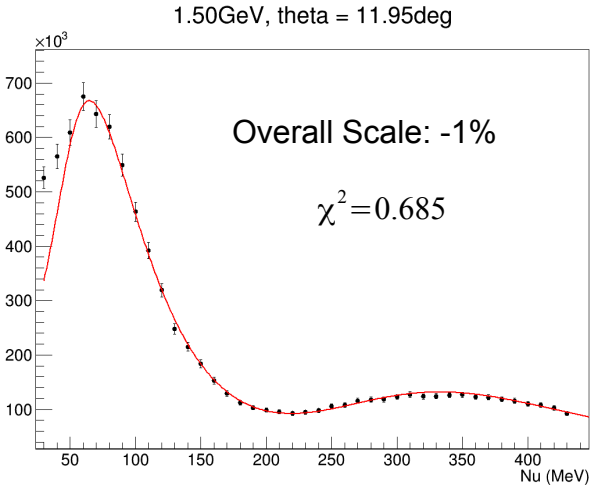
Material	E0 (MeV)	Theta (deg)	Source
C12	1300	11.95	Baran:1988
C12	1300	13.54	Baran:1988
C12	1500	11.95	Baran:1988
C12	1500	13.54	Baran:1988
C12	1650	11.95	Baran:1988
C12	1650	13.54	Baran:1988
He4	2700	15	Meziani:1992
He4	3300	15	Meziani:1992

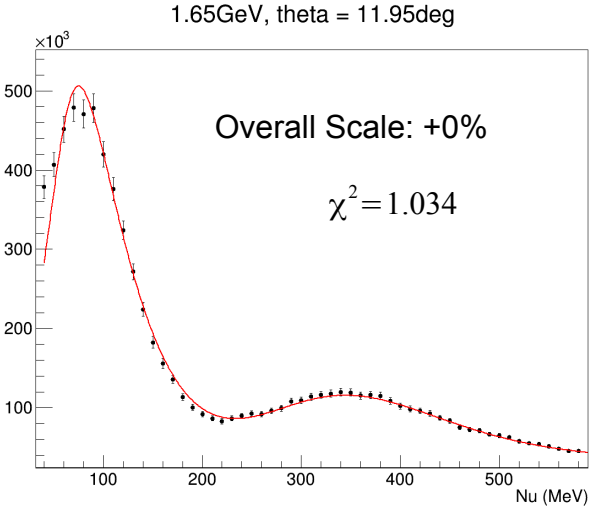
Model Tuning - Carbon

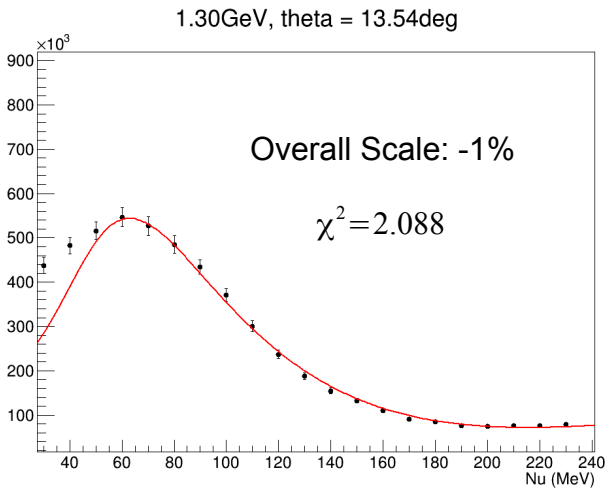
Scaling Parameters:

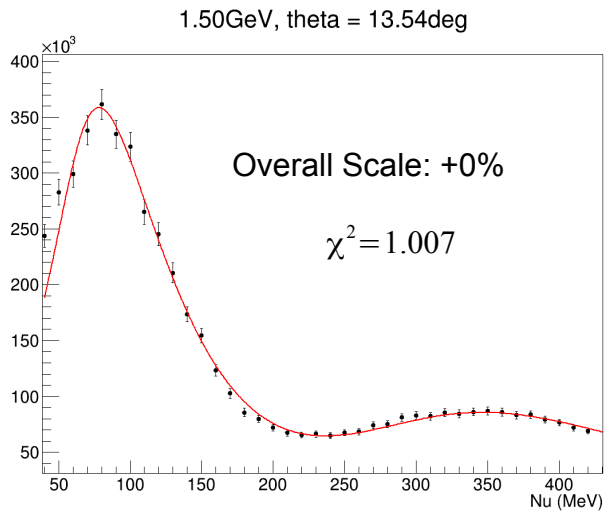
Q.E. Scale	Q.E. Kf (GeV)	Q.E. Es (GeV)	I.E. Scale	I.E. Kf (GeV)	I.E. Es (GeV)
-3%	0.2	0.017	-2%	0.32	0.008

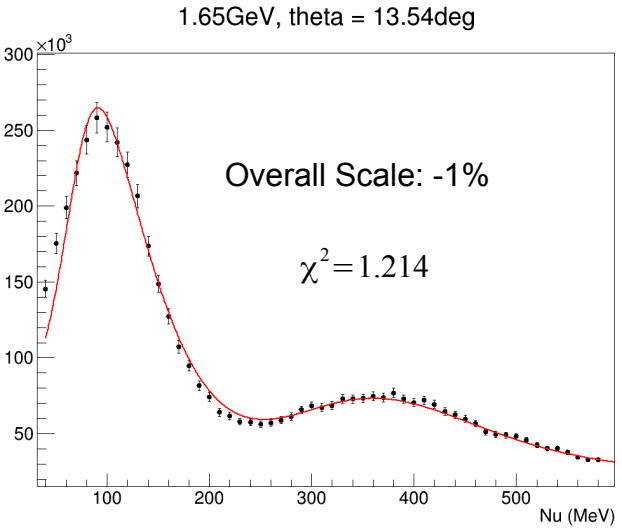










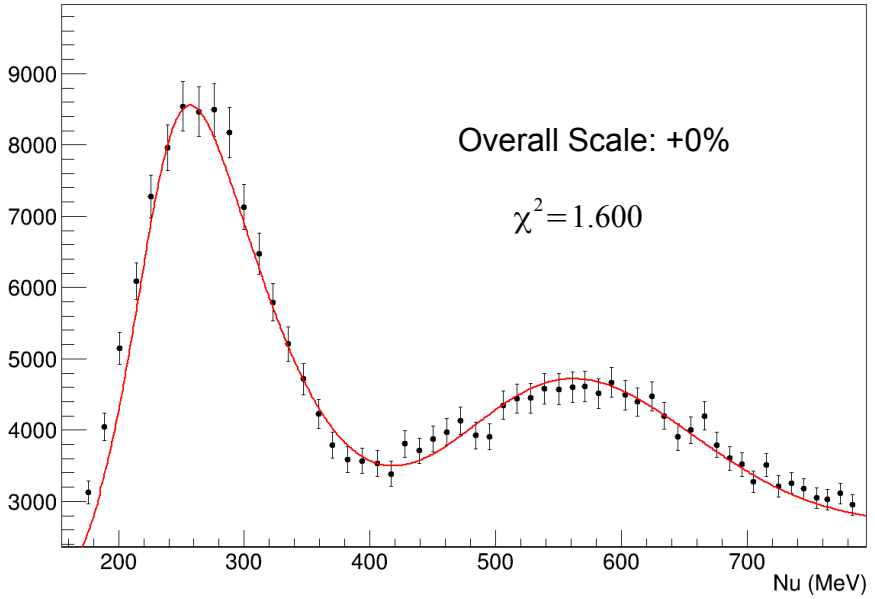


Model Tuning - Helium

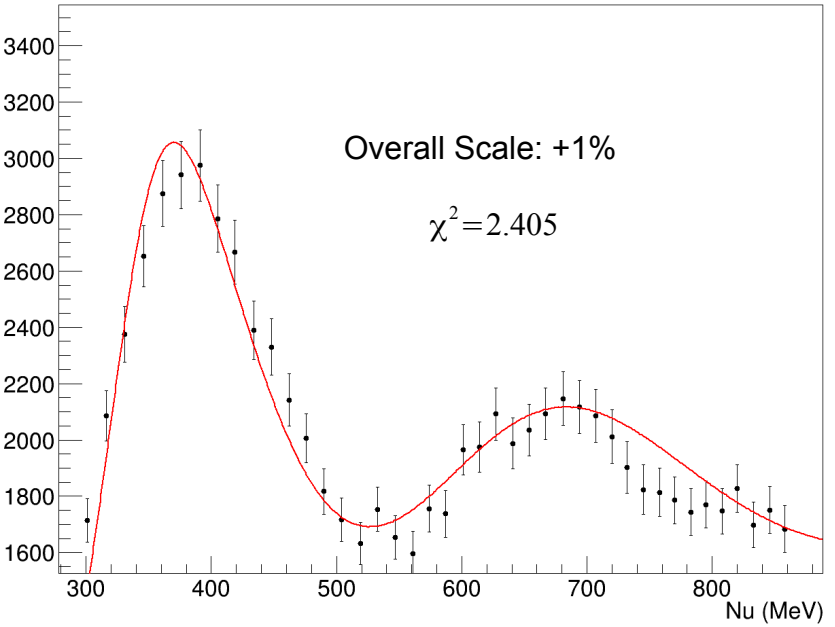
Scaling Parameters:

Q.E. Scale	Q.E. Kf (GeV)	Q.E. Es (GeV)	I.E. Scale	I.E. Kf (GeV)	I.E. Es (GeV)
+0%	0.15	0.018	-5%	0.21	0.023

2.70GeV, theta = 15deg

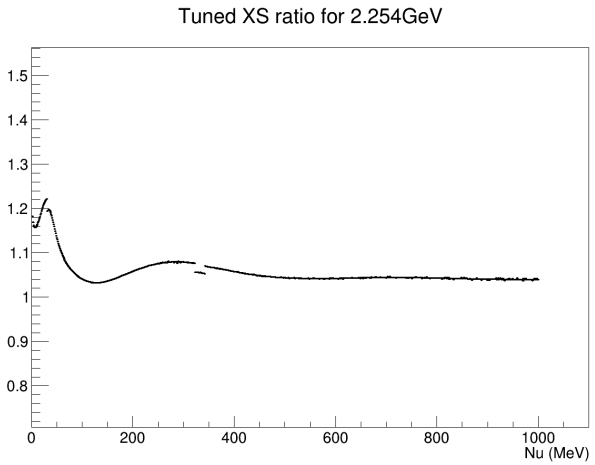


3.30GeV, theta = 15deg

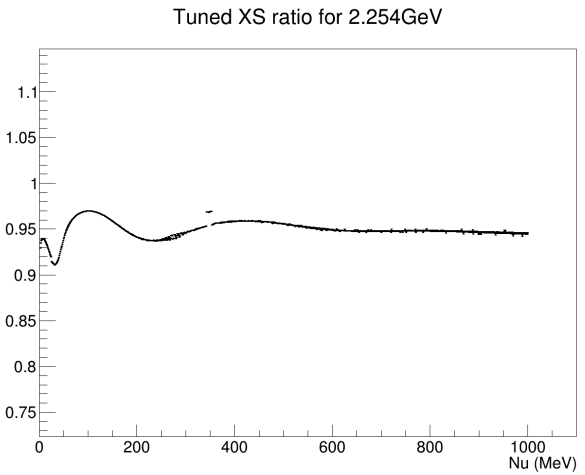


Need more data at low Q^2. Wait for g2p Helium XS to improve tune?

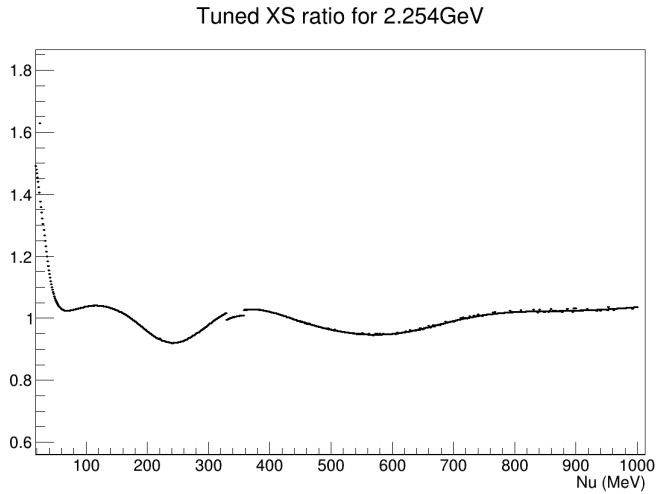
XS Ratios



α - for radiation length scaling of Helium (from empty dilution) to Helium (from carbon dilution).



β - for radiation length scaling of Helium (from empty dilution) to Helium (from production).



γ - for radiation length and nucleon scaling of Carbon (from carbon dilution) to Nitrogen (from production).

Whats left:

- Apply XS ratios to dilution yields and calculate production background yield.
- Calculate dilution for 2.254GeV 5T transverse.
- Move to other settings.
- Improve XS model tune (pretty far down the road, after we have g2p cross sections)
- Suggestions from meeting.