Dilution Update
10/01/14

Current Method

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

$$\sigma_{df} = \sqrt{df^2\left(\left(\frac{\sigma_{bg}}{Y_{bg}}\right)^2 + \left(\frac{\sigma_{total}}{Y_{total}}\right)^2\right)}$$

Production yields, contributes only to statistical uncertainty.

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

Where...

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

$L_c = carbon\ disk\ length$

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

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

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

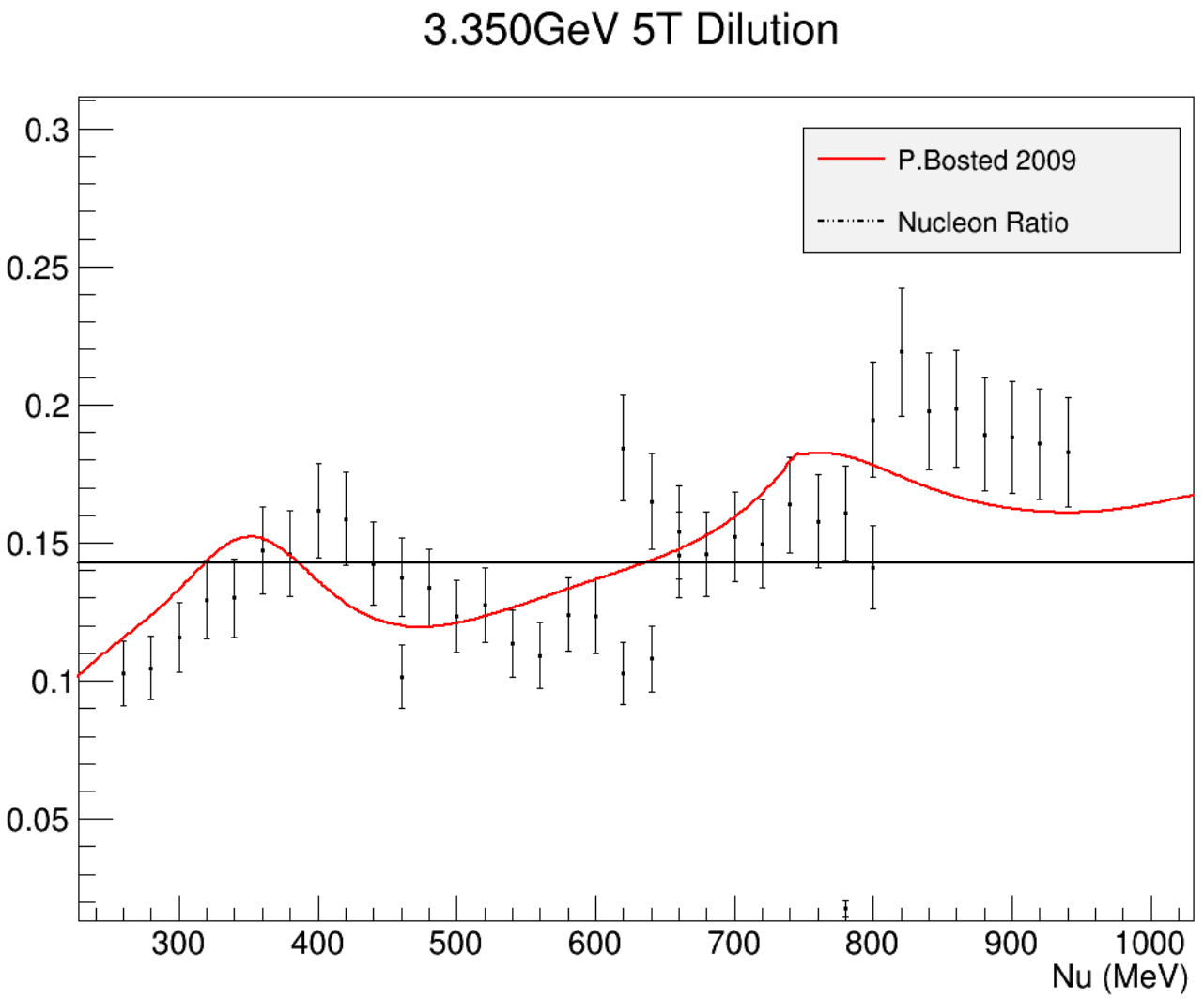
$\gamma = Radiation\ length\ scaling\ factor / Nucleon\ scaling\ factor\ for\ Carbon \rightarrow Nitrogen$

$pf = packing\ fraction$

} These 2 contribute to systematic uncertainty

Using:

- $PF = 0.542 \pm 0.053$
- $\sigma_{\gamma} \approx 10\,\%$



New Method?

- Normalize P.Bosted simulation to carbon dilution data.
- Generate several models of NH3 + He for various amounts of LHe in the cup and compare to total production yields.
- Interpolate to find packing fraction (model yield is linearly dependant on PF).
- Then use PF as an input to simulation and find the dilution as:

$$DF = \frac{Y_H}{Y_{NH3} + Y_{He} + Y_{Al}}$$

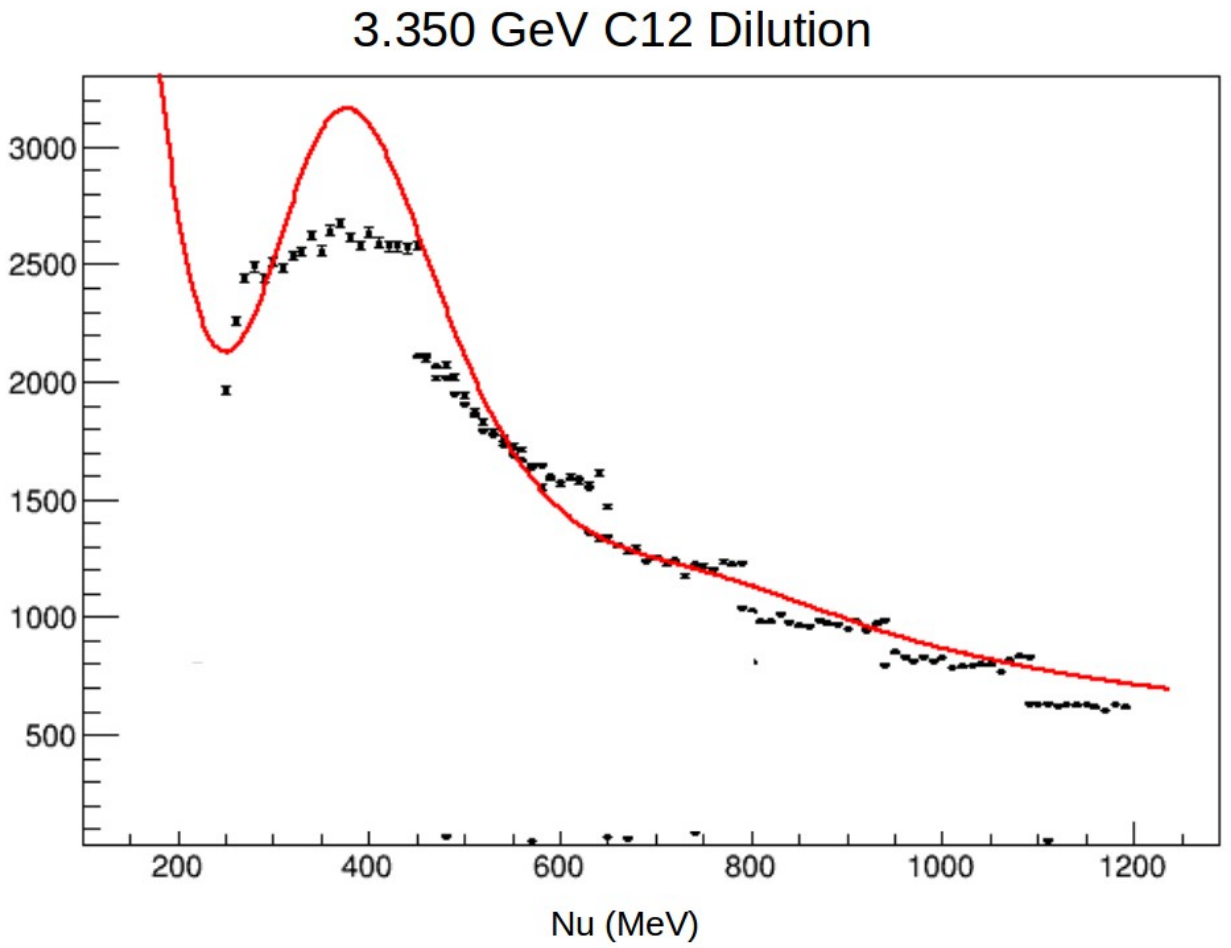
Where all yields are generated using simulation! (Data used only to find P.F.)

- This method allows systematics to cancel in the DF ratio.

Method used for RSS and SANE.

Issue with new method:

- Requires the ratio simulation/data to be kinematically independent (the only free parameter should be the PF).



Fit a 0^{th} order line to the most linear portion of the ratio to find the scaling parameter?