Packing Fraction

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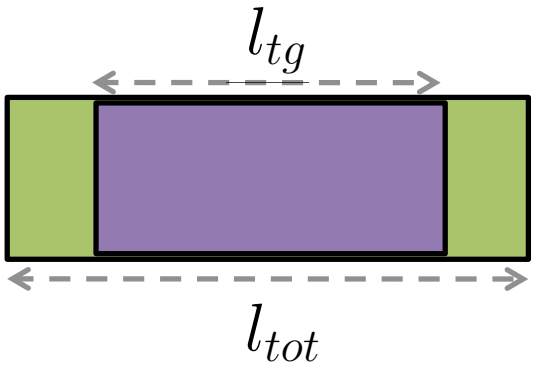
3/4/15

Method

$$Y_{prod} = Y_{He}^{out} + (1 - p_f) Y_{He}^{full} + p_f Y_{NH_3}^{full}$$



$$\left[\begin{array}{l} Y_{He}^{out} = \left(\dfrac{l_{tot} - l_{tg}}{l_{tot}} \right) Y_{dummy} \\ Y_{He}^{full} = \left(\dfrac{l_{tg}}{l_{tot}} \right) Y_{dummy} \end{array} \right]$$

$$p_f = \left(\frac{l_{tot}}{l_{tg}} \right) \left(\frac{Y_{prod}}{Y_{dummy}} - 1 \right) \left(\frac{Y_{NH_3}^{full}}{Y_{He}^{full}} - 1 \right)^{-1}$$

Method

$$p_f = \left(\frac{l_{tot}}{l_{tg}}\right)\underbrace{\left(\frac{Y_{prod}}{Y_{dummy}} - 1\right)}_{\text{Obtained from Data}}\underbrace{\left(\frac{Y^{full}_{NH_3}}{Y^{full}_{He}} - 1\right)^{-1}}_{\text{Need input from cross section models}}$$

$$Y_x \sim \sigma_x \cdot \rho_x \cdot A_x$$

$$\rho_x = \frac{\rho_{mass-x} \cdot l_x \cdot A_v}{M_x}$$

$$p_f = \left(\frac{l_{tot}}{l_{tg}}\right)\left(\frac{Y_{prod}}{Y_{dummy}} - 1\right)\left(\frac{\sigma_N \cdot \frac{\rho_{mass,N}}{M_N} \cdot A_N}{\sigma_{He} \cdot \frac{\rho_{mass,He}}{M_{He}} \cdot A_{He}}\right)^{-1}$$

σ_x = cross section

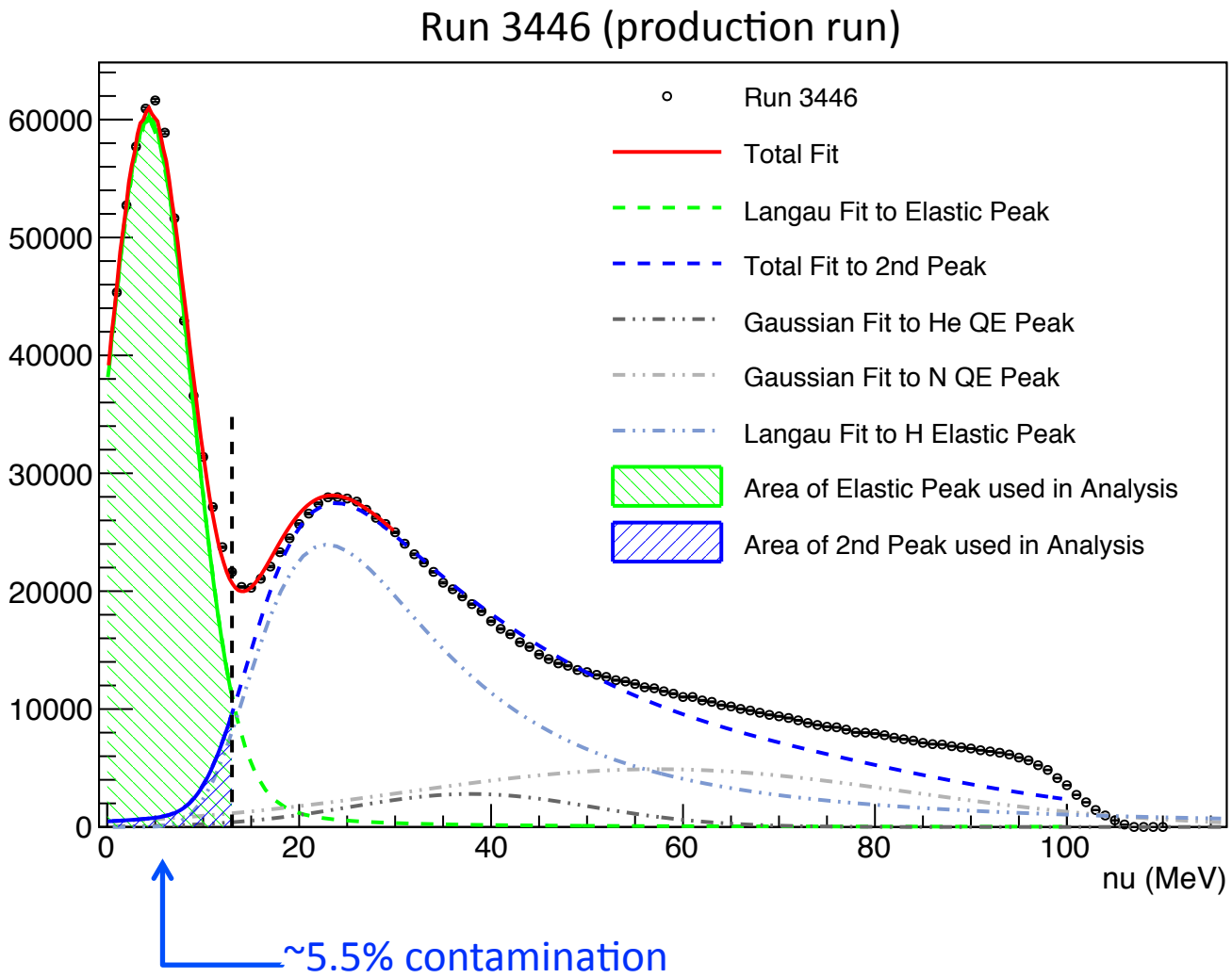
ρ_x = target number density

$\rho_{mass,x}$ = mass density

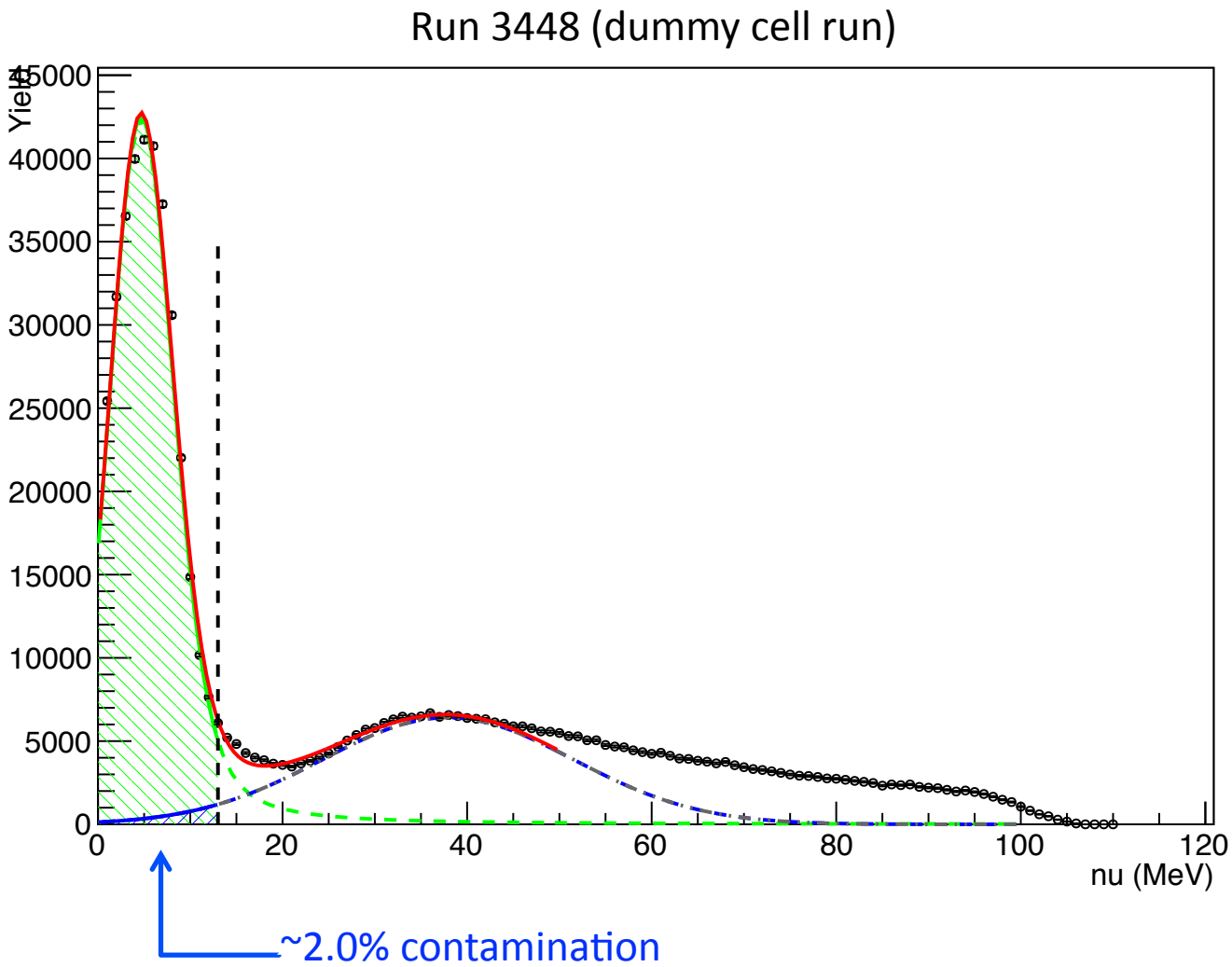
l_x = length of material

$A_x = \frac{\#\text{ of counts in cut}}{\text{total }\#\text{ of counts in fit}}$

Reminder: Fitting Routine

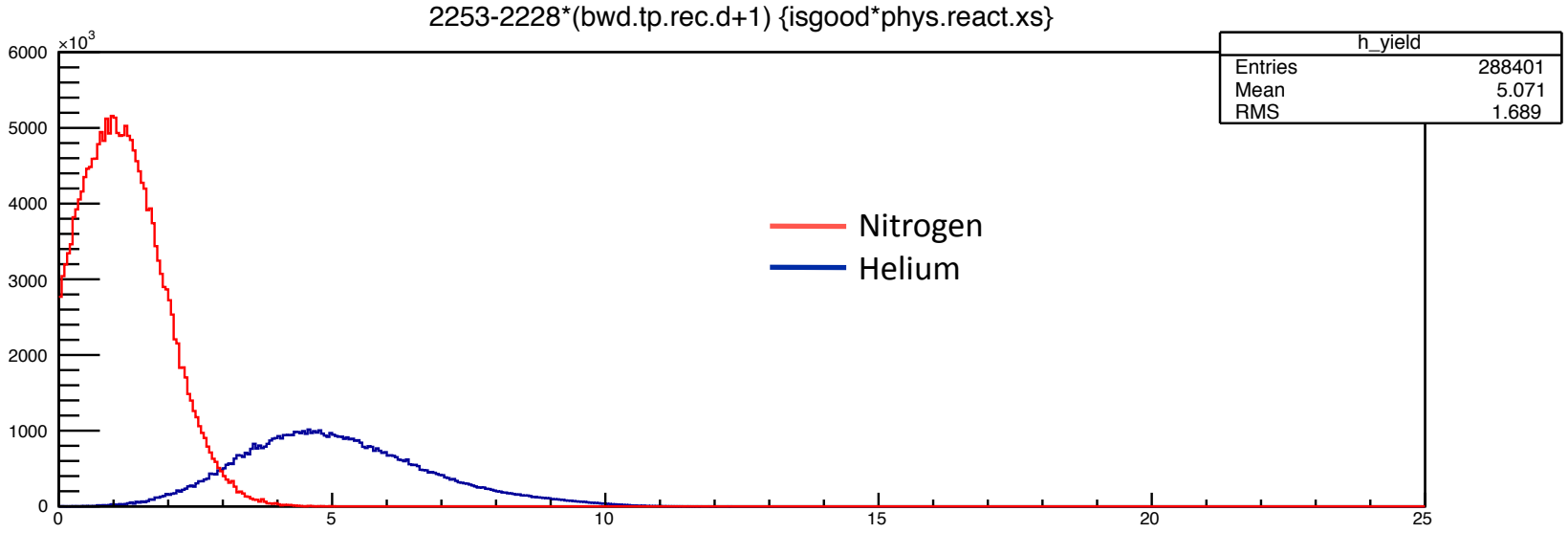


Reminder: Fitting Routine



Determining σ_N/σ_{He}

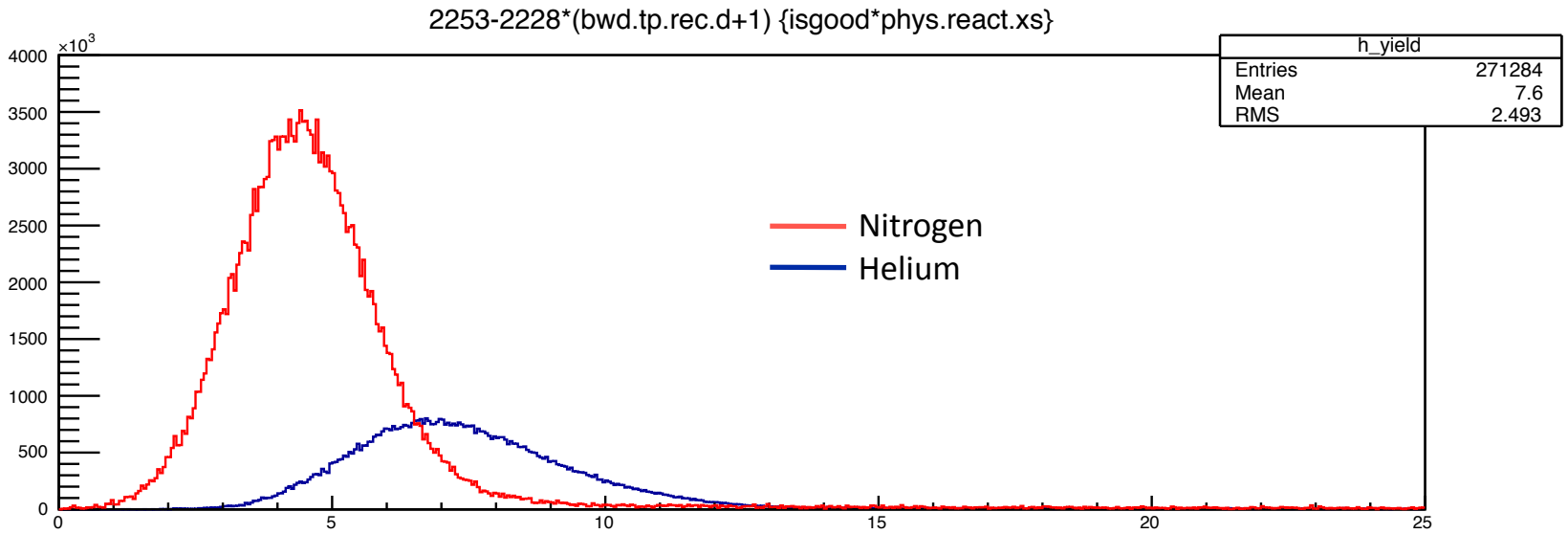
- Start with Elastic Form Factors:
  - H_1 : Form factors from S. Venkat et al., Phys. Rev. C, 83(2011)015203
  - He_4: Charge and magnetization densities from De Jager, At. Data Nucl. Data Tables, 14(1974)
  - N_{14}: Charge and magnetization densities from De Jager, At. Data Nucl. Data Tables, 14(1974)



- Energy loss NOT included:
  - $\sigma_N/\sigma_{He} = 2.939$

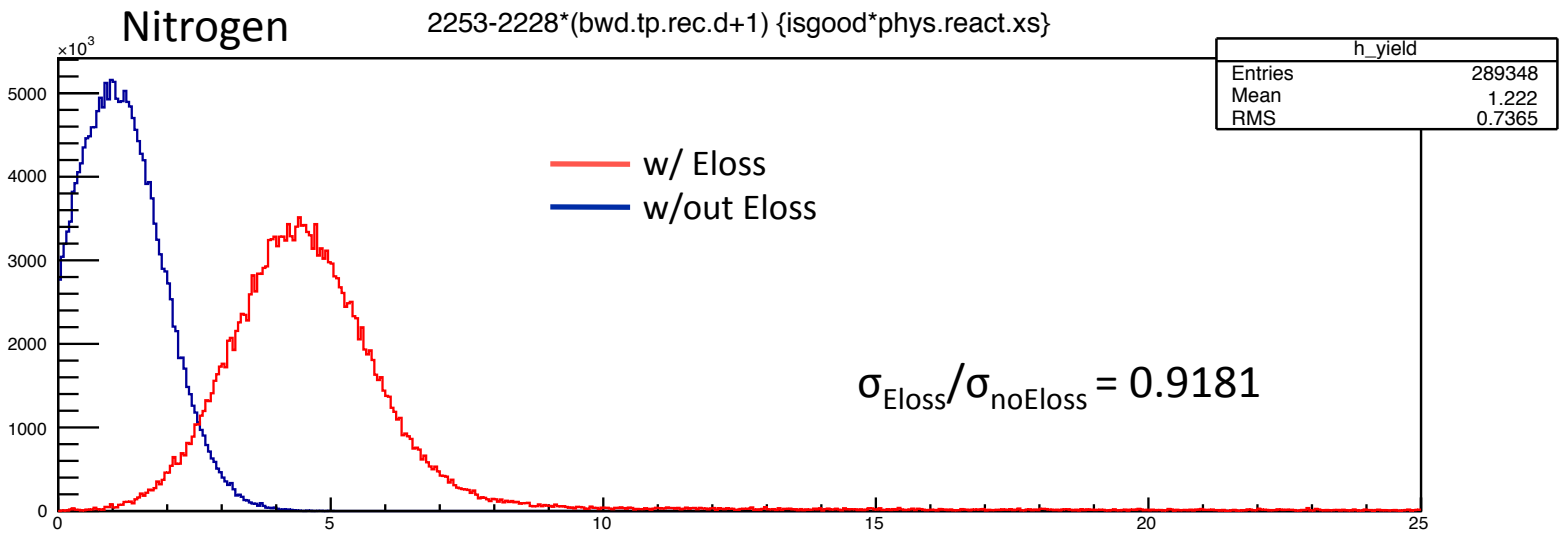
Determining σ_N/σ_{He}

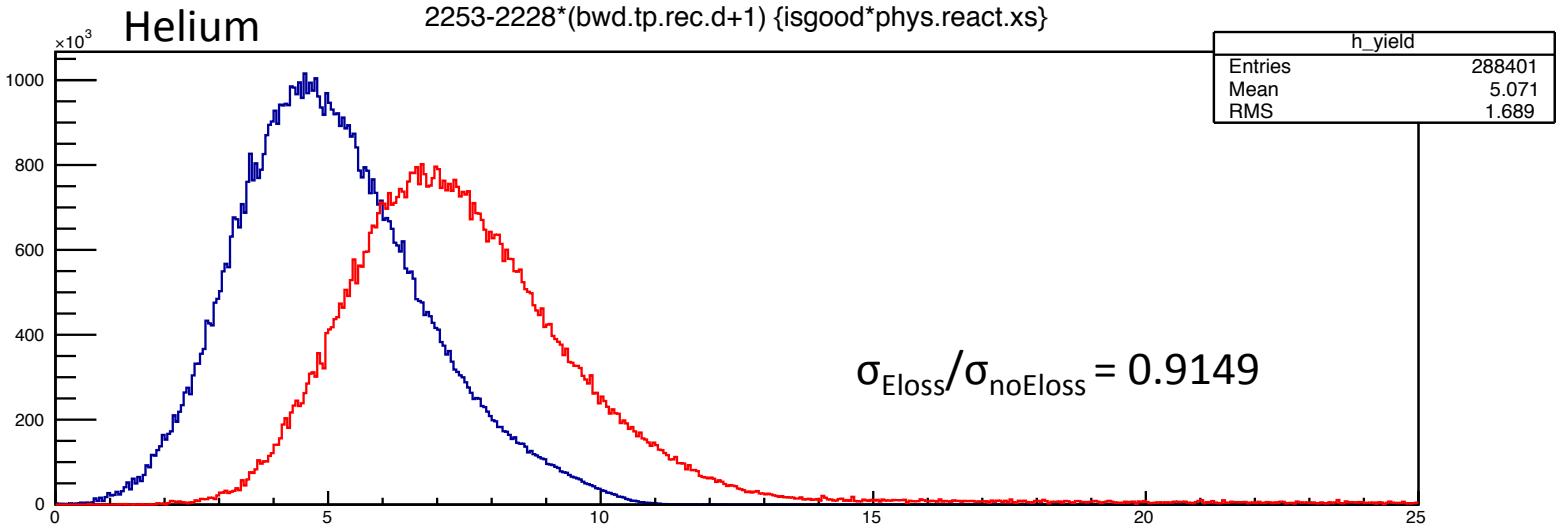
- Need to account for Radiative Effects:
  - Using g2psim:



- Energy loss included:
  - $\sigma_N/\sigma_{He} = 2.949$

Energy Loss Comparison





Determining σ_N/σ_{He}

- Need to account for Radiative Effects:
  - Using Mo/Tsai Formalism:

He (radiation thickness of empty run): $\delta = -0.21021$, $\delta_t = -0.127653$

$e^{(\delta+\delta t)} = 0.713$

N (radiation thickness of pf=1): $\delta = -0.210098$, $\delta_t = -0.489989$

$e^{(\delta+\delta t)} = 0.497$

correction for N/He =0.696

Much larger…

How Does this Effect p_f Calculation?

$$p_f = \left(\frac{l_{tot}}{l_{tg}}\right)\left(\frac{Y_{prod}}{Y_{dummy}} - 1\right)\left(\frac{\sigma_N \cdot \frac{\rho_{mass,N}}{M_N} \cdot A_N}{\sigma_{He} \cdot \frac{\rho_{mass,He}}{M_{He}} \cdot A_{He}}\right)^{-1}$$

(no Eloss) $p_f = 0.297$

(with Eloss – g2psim) $p_f = 0.296$

(with Eloss - calc) $p_f = 0.503$

Uncertainty ~5.2%

To Do

- Working on other energy settings
  - Fitting routine must be adjusted for each setting – takes some time!
- Working on technote
- Next move on to PbPt check