Dilution Analysis

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- Dilution factor (df) defined as $df = 1 - \frac{Y_{bg}}{Y_p}$
  - ➔ $Y_{bg} = Y_{foil} + Y_{helium} + Y_{nitrogen}$
- 'Dilution runs' performed at each kinematic setting so we can reconstruct Y_{bg}
  - ➔ “Empty” run: $Y_{empty} = Y'_{helium}$
  - ➔ “Dummy” run: $Y_{dummy} = Y_{empty} + Y_{foil}$
  - ➔ “Carbon” run: $Y_{carbon} = Y'_{carbon} + Y''_{helium}$
- To relate dilution runs to the background we need
  - ➔ Dilution run yields
  - ➔ Material lengths (including packing fraction – all data in this talk assumes f ~ 0.55)
  - ➔ Scaling factor to scale carbon yield to nitrogen yield
  - ➔ Scaling method for radiation lengths

Backgrounds

$$N_o \frac{\rho_{He}(1-f)\,l_{tg}}{m_{He}} \sigma_{He} \;=\; Y_{He} \;=\; Y_{empty}\left(1-f\,\frac{l_{tg}}{l_{total}}\right)$$

$$N_o \frac{\rho_f\, l_f}{m_f} \sigma_f \;=\; Y_f \;=\; Y_{dummy} - Y_{empty}$$

$$N_o \frac{\rho_N\, f\, l_N}{m_N} \sigma_N \;=\; Y_N \;=\; f\,a(k)\left(\frac{\rho_N\, l_{tg}\, m_C}{\rho_C\, l_C\, m_N}\right) Y_C - f\,a(k)\left(1-\frac{l_C}{l_{total}}\right)\left(\frac{\rho_N\, l_{tg}\, m_C}{\rho_C\, l_C\, m_N}\right) Y_{empty}$$

Backgrounds

$$N_o \frac{\rho_{He}(1-f)\,l_{tg}}{m_{He}}\sigma_{He} = Y_{He} = Y_{empty}\left(1-f\frac{l_{tg}}{l_{total}}\right)$$

$$N_o \frac{\rho_f\, l_f}{m_f}\sigma_f = Y_f = Y_{dummy} - Y_{empty}$$

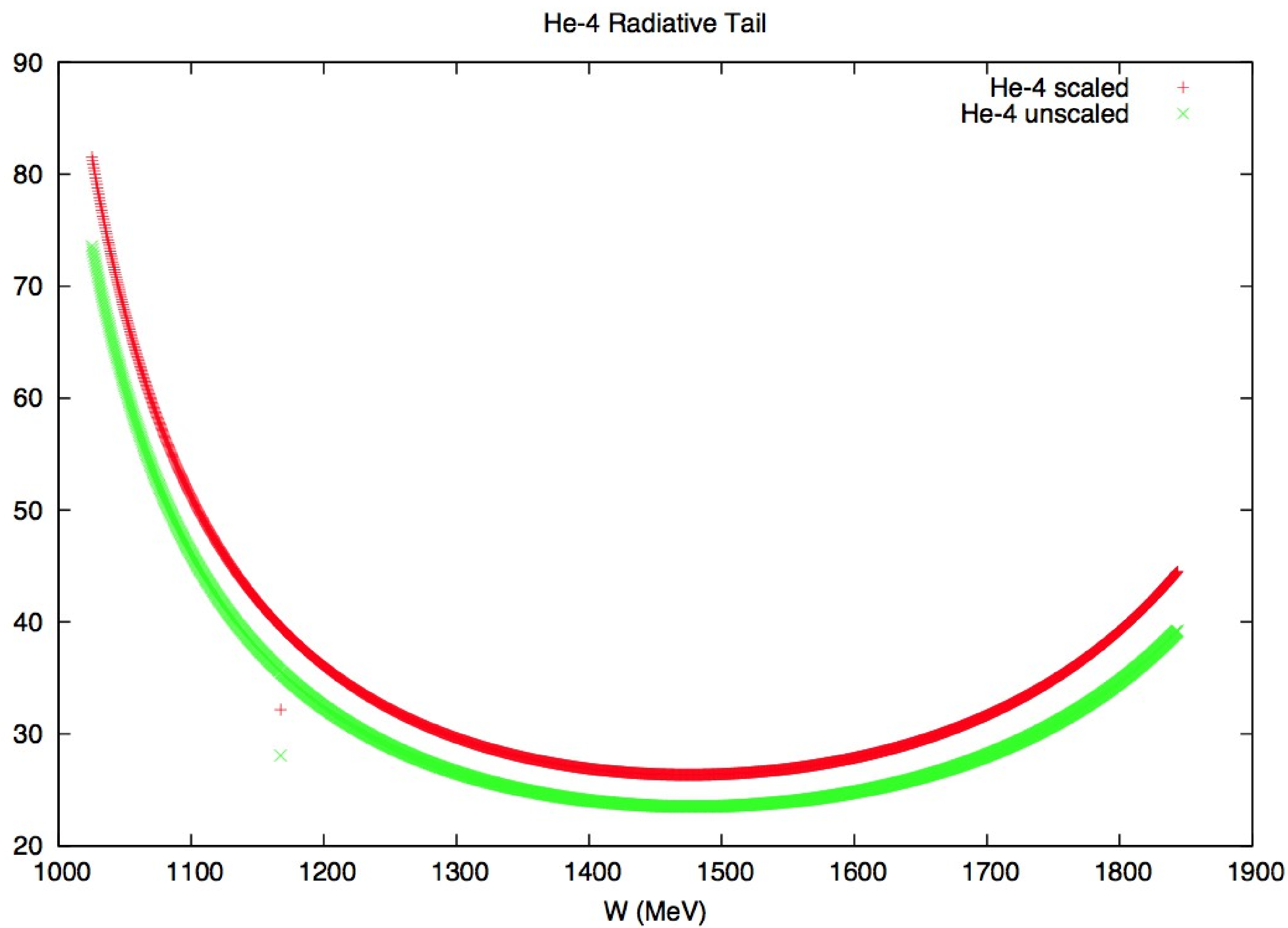
$$N_o \frac{\rho_N\, f\, l_N}{m_N}\sigma_N = Y_N = f\,a(k)\left(\frac{\rho_N\, l_{tg}\, m_C}{\rho_C\, l_C\, m_N}\right)Y_C - f\,a(k)\left(1-\frac{l_C}{l_{total}}\right)\left(\frac{\rho_N\, l_{tg}\, m_C}{\rho_C\, l_C\, m_N}\right)Y_{empty}$$

Different radiation lengths!

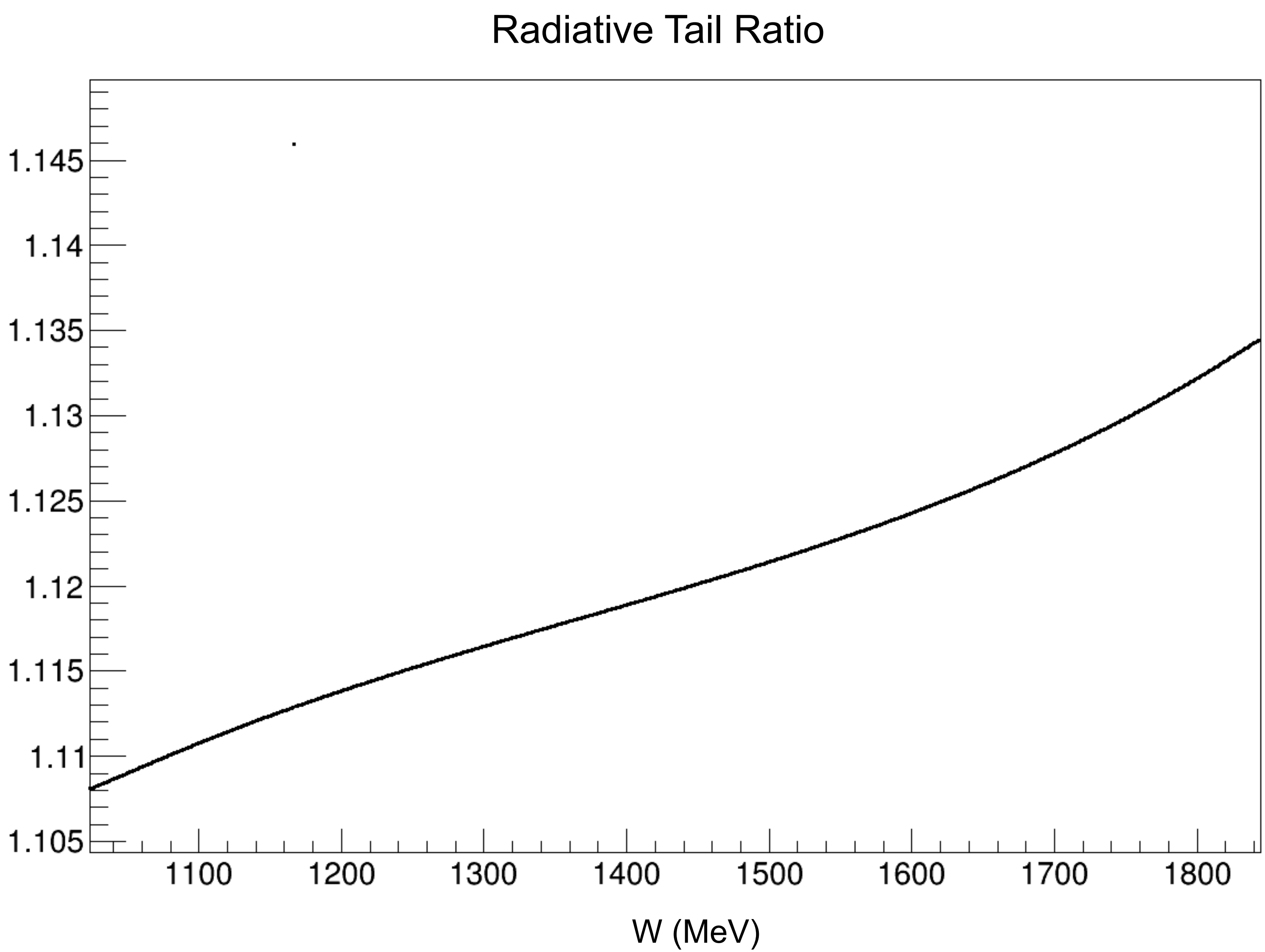
Radiation Lengths

- Radiative tail is calculated for empty dilution run in two ways:
    1. Using the radiation length for 4.2cm of Helium (true radiation length for empty dilution run)
    2. Matching the Helium radiation length to the Carbon radiation length (by extending the Helium target length).
- A ratio is taken between the two resulting radiative tails.
- The final ratio is used to scale the empty dilution run radiation length to match the carbon dilution run radiation length.

Radiation Lengths



Radiation Lengths



Finding the carbon scaling factor

Nitrogen simulation needed for accurate scaling factor

➔ $$Y_{N(simulation)} = a(k)\left(f\left(\frac{\rho_N l_{tg} m_C}{\rho_C l_C m_N}\right) Y_C - f\left(1-\frac{l_C}{l_{total}}\right)\left(\frac{\rho_N l_{tg} m_C}{\rho_C l_C m_N}\right) Y_{empty}\right)$$

$$= a(k) Y'_C$$

➔ $$a(k) = \frac{Y_{N(simulation)}}{Y'_C}$$

➔ Using simulation code provided by Moshe to determine the ratio $\frac{Y_{N(simulation)}}{Y'_C}$

(in progress)

Checking Simulation