Packing Fraction

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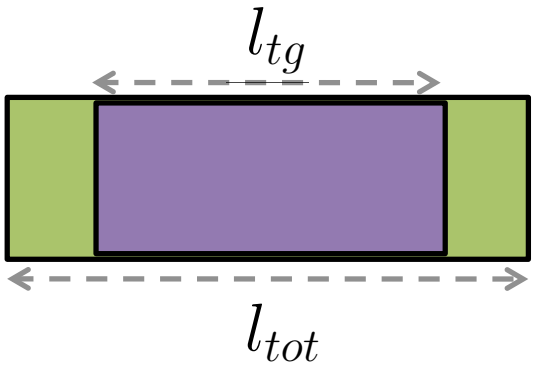
12/17/14

Method

$$Y_{prod} = Y_{He}^{out} + (1 - p_f) Y_{He}^{in} + p_f Y_N + p_f Y_H$$



$$Y_{tg} = Y_{prod} - Y_{He}^{out}$$

Yield from materials within the target cell

$$Y_{He}^{out} = \frac{(l_{tot} - l_{tg})}{l_{tot}} Y_{dummy}$$

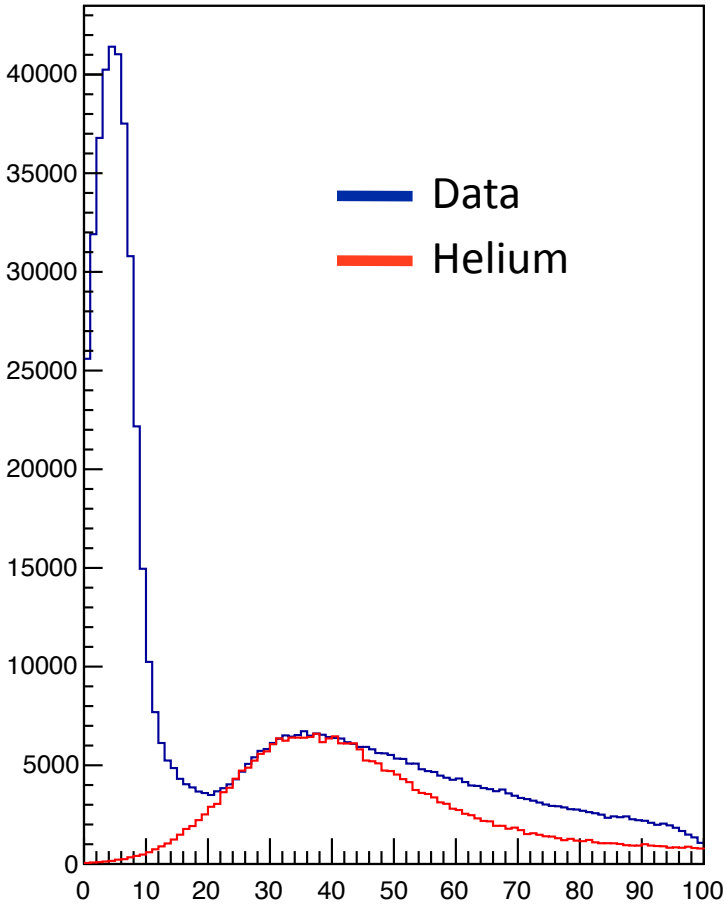
$$Y_{He}^{in} = \frac{l_{tg}}{l_{tot}} Y_{dummy}$$

Assumes uniform acceptance throughout

$$(1 - p_f) = \frac{Y_{He}^{in}}{Y_{tg}}$$

Using QFS to Model Data

Dummy Dilution Run (3448)



5 adjustable parameters for using QFS Model in g2psim:

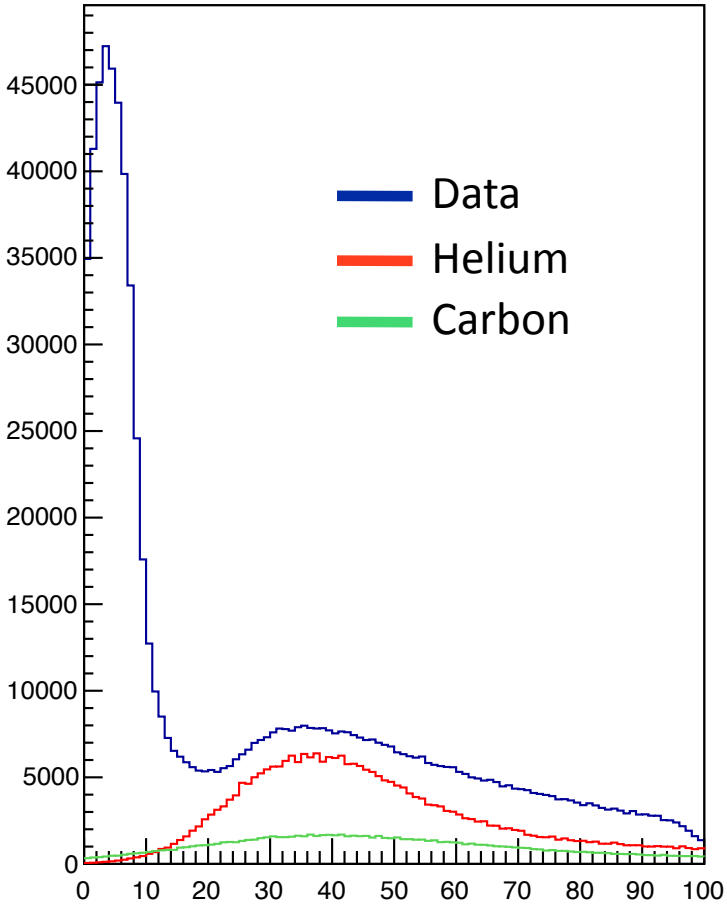
par[0] = Nucleon Separation Energy
par[1] = Delta Separation Energy
par[2] = Fermi Momentum of Target Nucleus
par[3] = T_B: Radiation thickness before scattering
par[4] = T_A: Radiation thickness after scattering

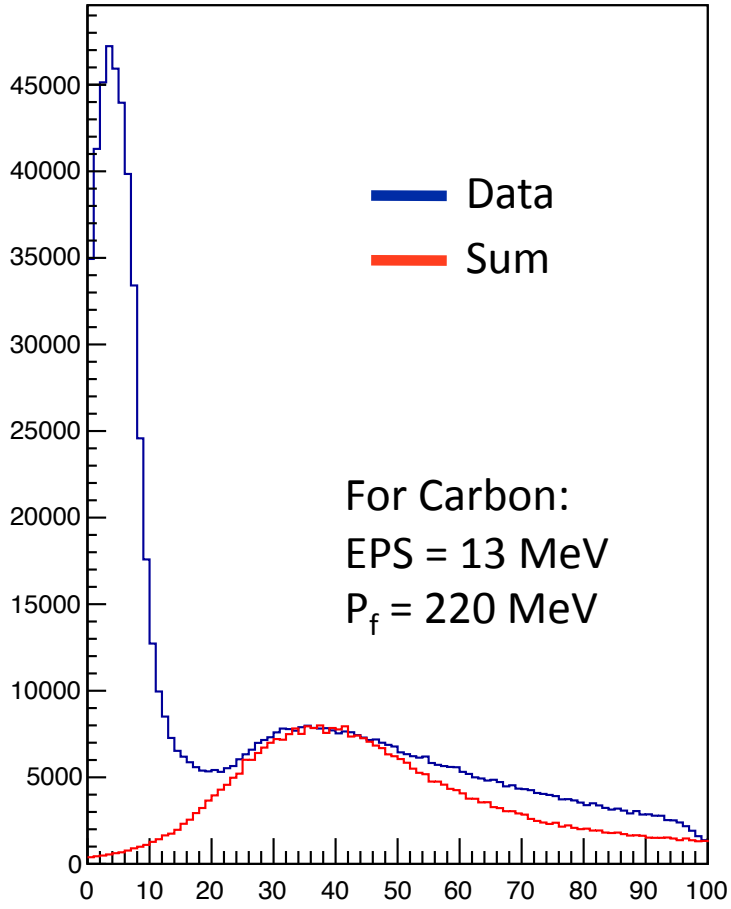
For Helium:
Nucleon Separation Energy (EPS) = 13 MeV
Fermi Momentum (P_f) = 120 MeV

Can use this to constrain helium fit

Using QFS to Model Data

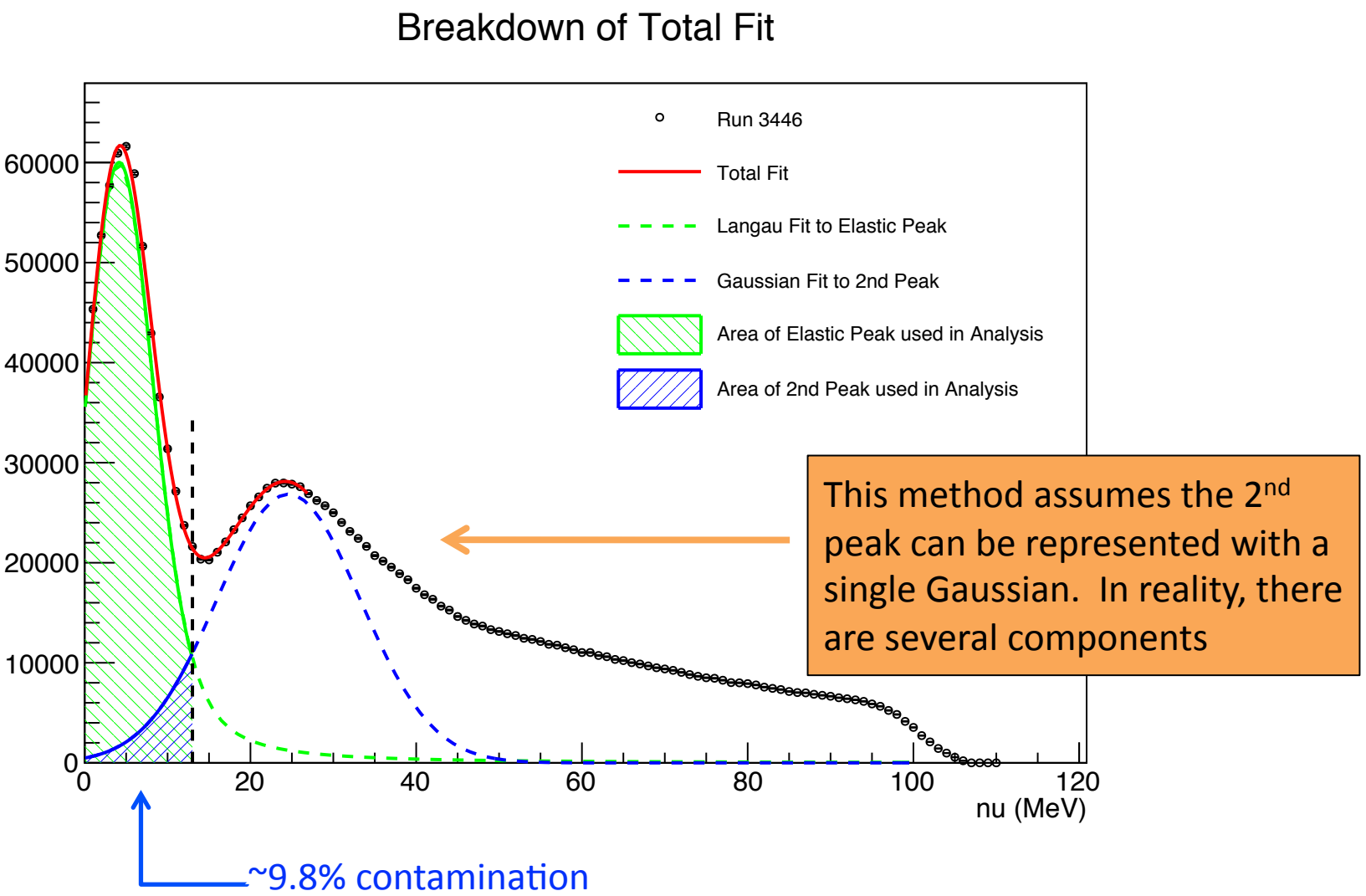
Carbon Dilution Run (3447)





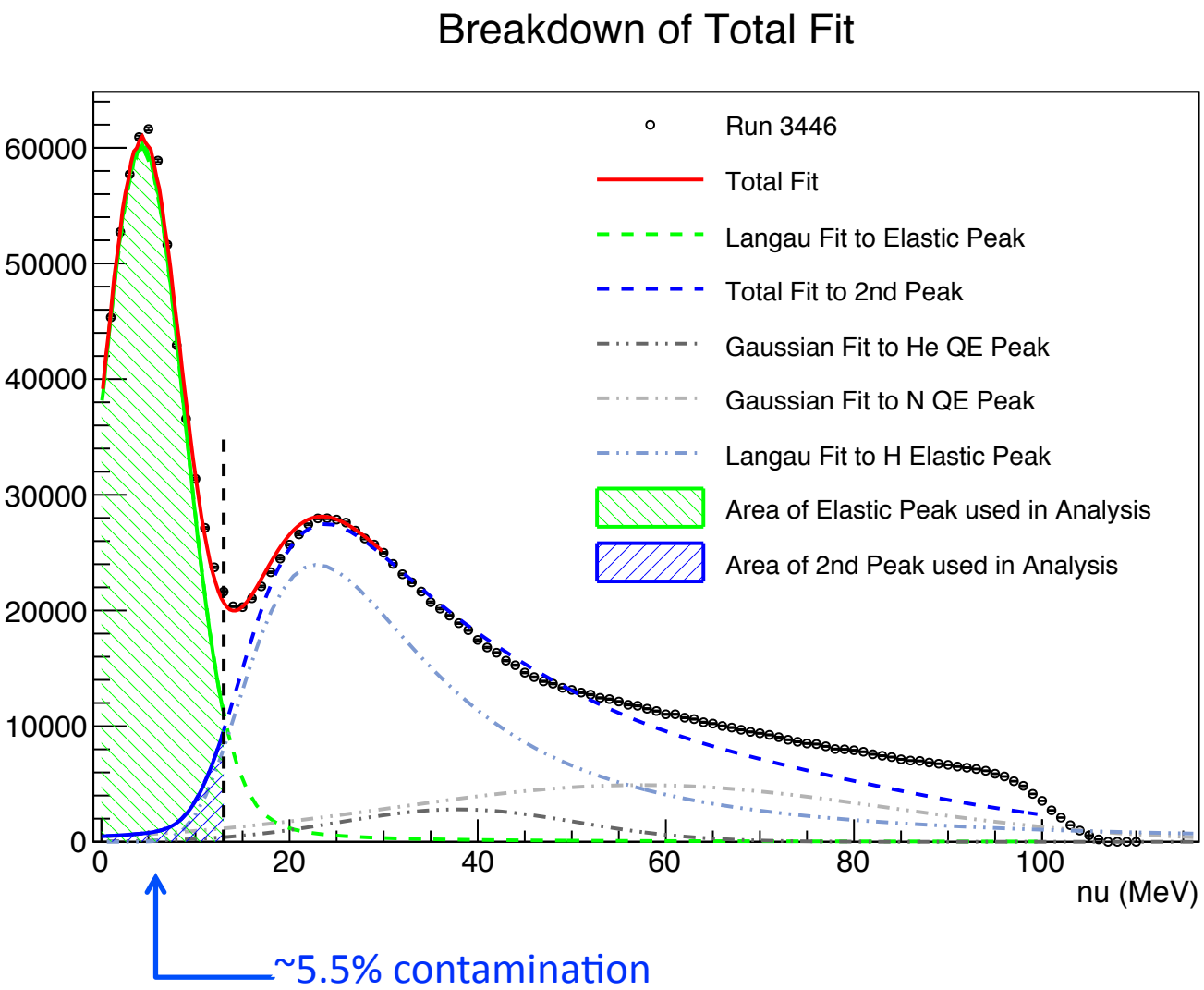
Similarly, can use carbon run to determine QFS parameters for carbon

Old Fitting Routine



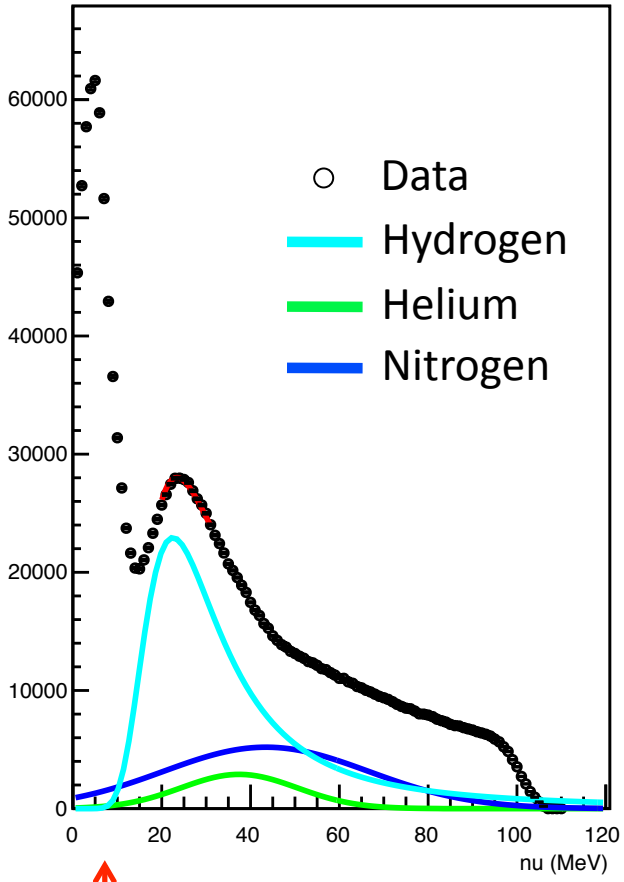
This method assumes the 2nd peak can be represented with a single Gaussian. In reality, there are several components

New Fitting Routine



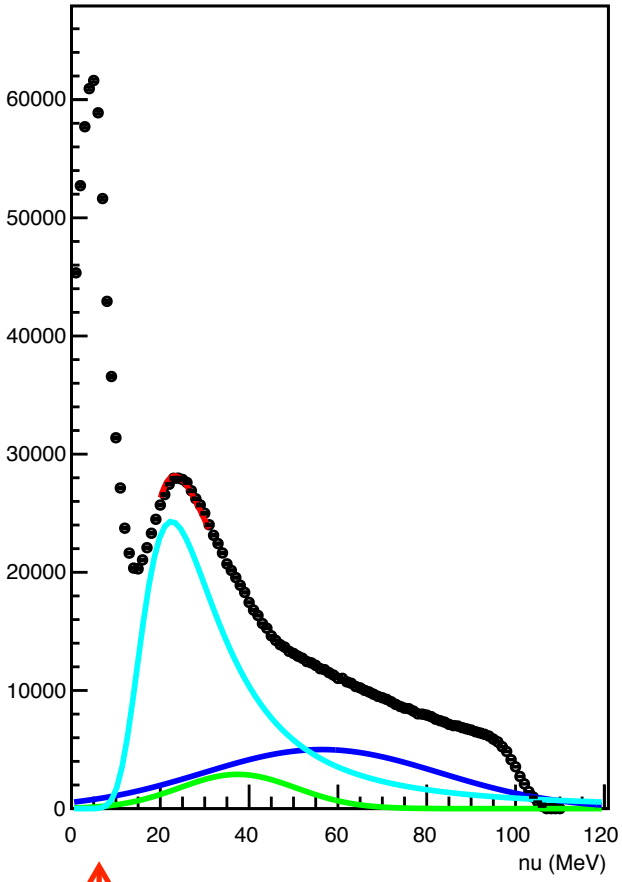
Adjusting Fit of Nitrogen Peak

EPS = 13 MeV, P_f = 240 MeV



Total Contamination from 2nd Peak ~6.85%

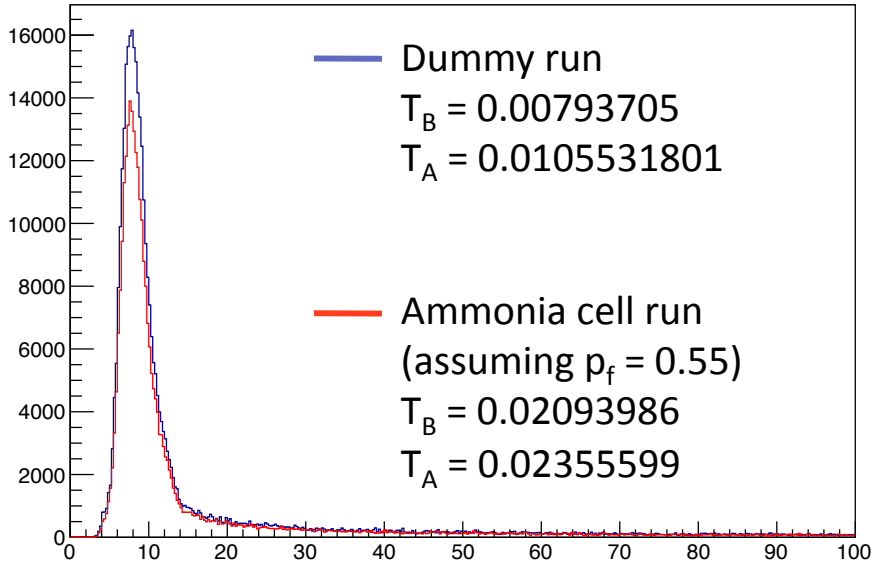
EPS = 30 MeV, P_f = 240 MeV



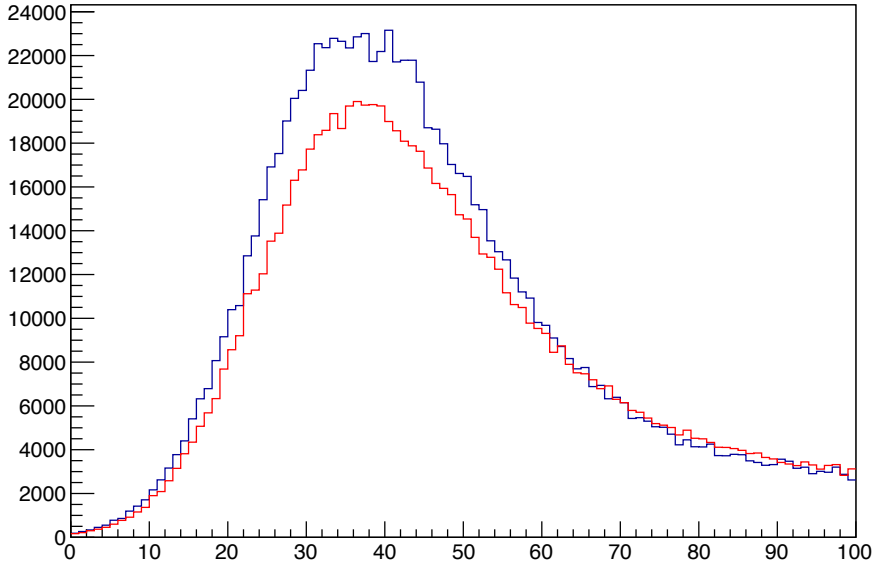
Total Contamination from 2nd Peak ~5.46%

Rad Length Scaling

Elastic Peak



Quasi-Elastic Peak



Purpose: Scale radiation length in dummy run to production run

Method: Yields generated using g2psim for 2 different radiation lengths. The ratio is used to scale Y_{dummy} rad length to match Y_{prod}

For p_f = 0.55:
Scale (elastic) = 0.833
Scale (QE) = 0.858

Adjusting Fit of Nitrogen Peak

How much does changing the nitrogen parameters affect the overall packing fraction?

Fermi Momentum	Nucleon Separation Energy	% QE	Packing Fraction
240 MeV	13 MeV	6.85	0.585
240 MeV	20 MeV	6.09	0.588
240 MeV	25 MeV	5.20	0.594
240 MeV	30 MeV	5.46	0.591

Using original fitting routine: $p_f = 0.572$

P_f ~0.59, so I need to adjust the rad length scaling parameters to reflect this…can iterate until they converge.

Contributions to Uncertainty

- Propagation of Uncertainty

- Difference between sum and fit in determining area of elastic peak

- Rad Length Scaling (stdev of scaling parameter)

- Variation in p_f resulting from adjusting nitrogen parameters

Results

Parameters	Packing Fraction	Uncertainty (%)
240,13	0.596	0.0438
240,20	0.599	0.0444
240,25	0.604	0.0442
240,30	0.602	0.0441

$p_f = 0.600 \pm 0.026$

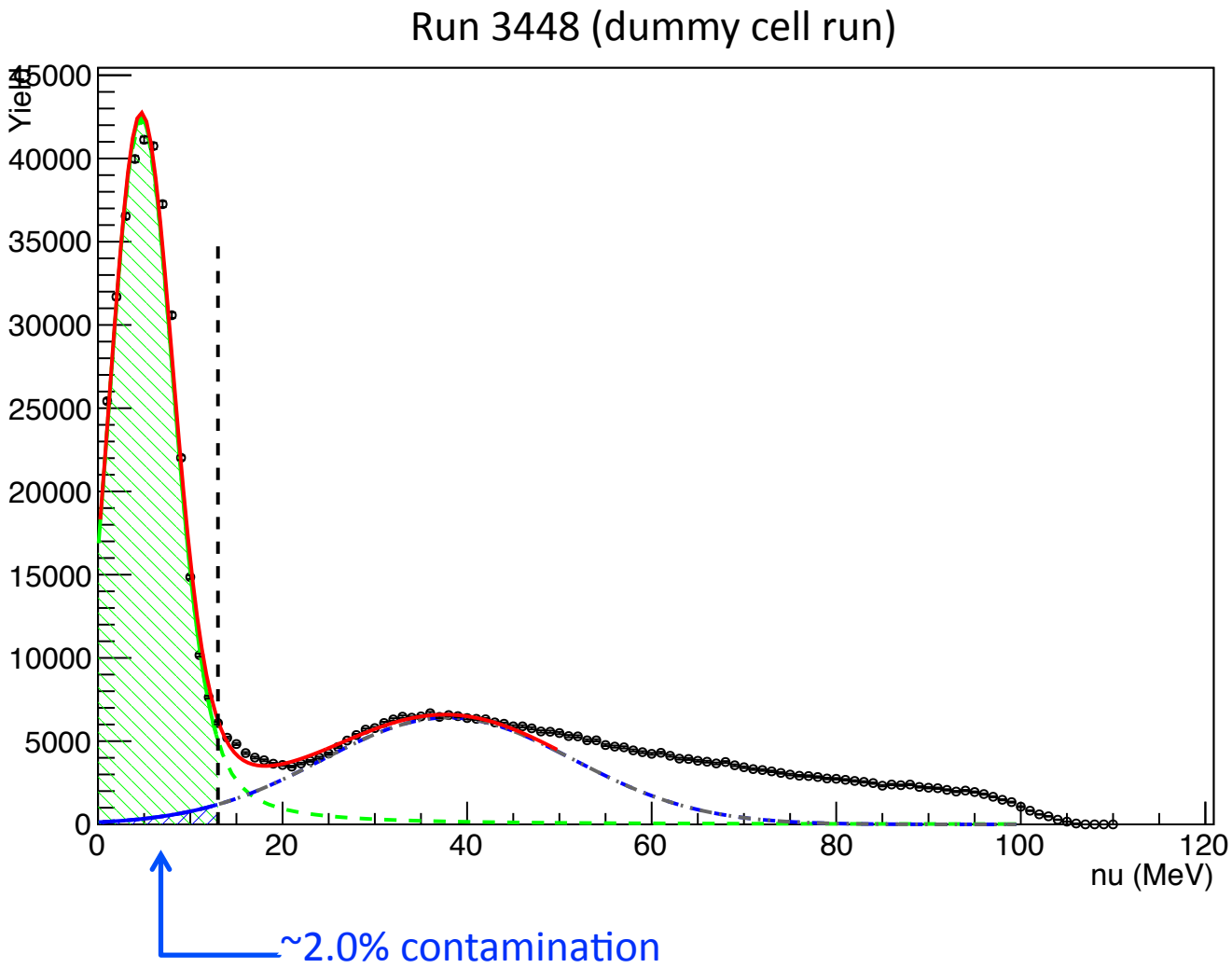
(Using run 3446, 2.2 GeV, 2.5T, Transverse Setting)

Next:

- suggestions from this meeting?
- start working on other materials/settings

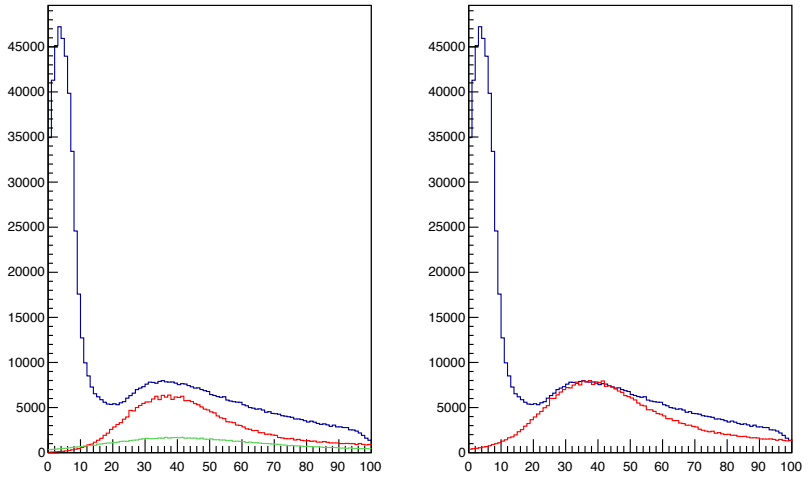
Backup

New Fitting Routine

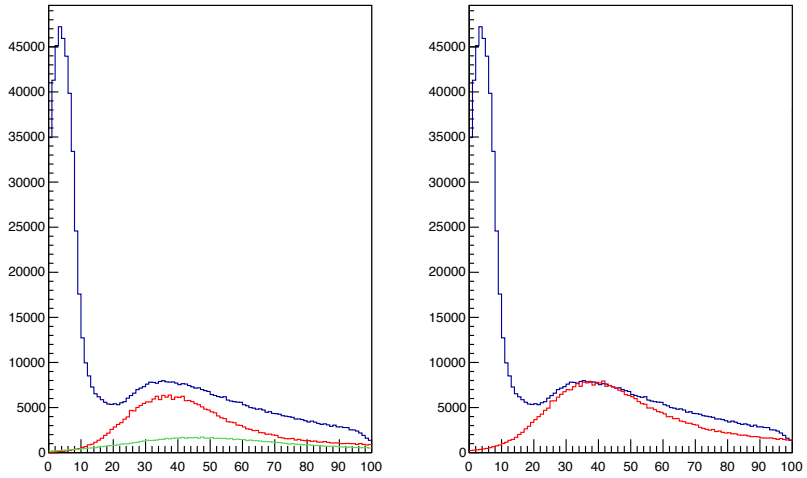


Adjusting QFS Parameters for Carbon

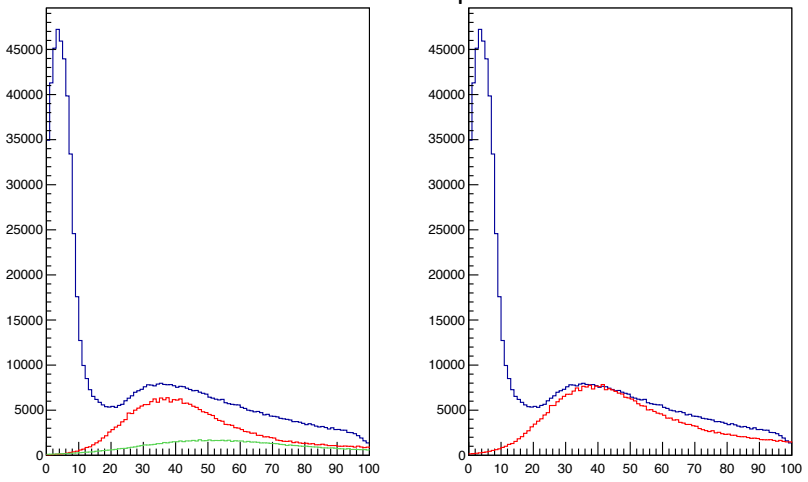
EPS = 13 MeV, P_f = 220 MeV



EPS = 20 MeV, P_f = 220 MeV



EPS = 25 MeV, P_f = 220 MeV



EPS = 30 MeV, P_f = 220 MeV