Packing fraction update

11/30/16

Reminder

$$pf = \left(\frac{L_{total}}{L_{tg}}\right)\left(\frac{Y_{production}}{Y_{dummy}} - 1\right)\left(\frac{\frac{\rho_N}{M_N}\sigma_N + \frac{\rho_H}{M_H}\sigma_H}{\frac{\rho_{He}}{M_{He}}\sigma_{He}} - 1\right)^{-1}$$

$Y_{production/dummy}$ → Obtained from integrating elastic peak from production/dummy runs

$\sigma_{N/H/He}$ → Ratios obtained from integrating elastic peak in g2psim

Sources of uncertainty:

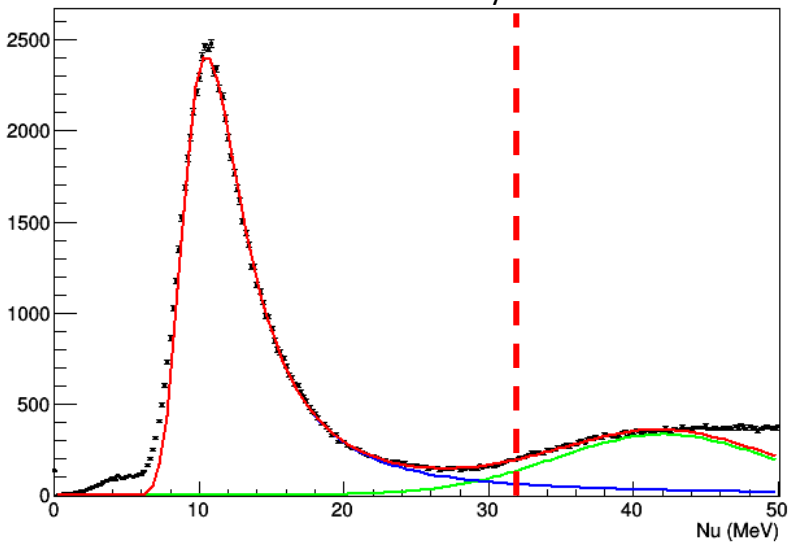
- Production yield integral (small, statistical) (<1%)
- Sensitivity of data to fit method for QE subtraction (5-10%)
- Spread in inputs to elastic g2psim model (1%)
- Uncertainty in model output (3-5%)
- Target length uncertainty (<1%)

QE and Elastic fits

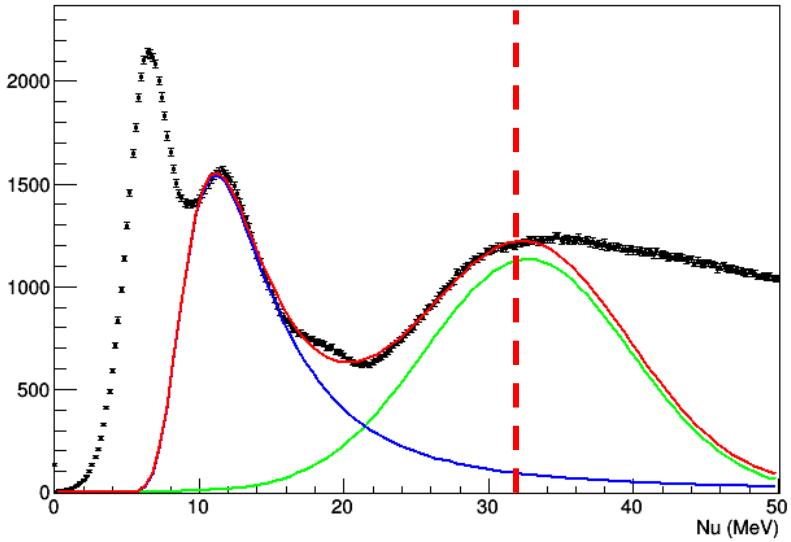
Materials 19 and 20

2.254GeV 5T Transverse

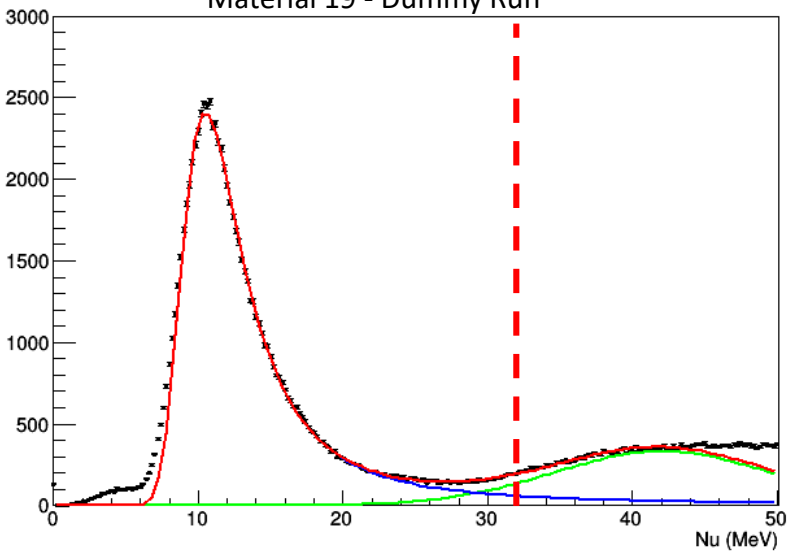
Material 20 - Dummy Run



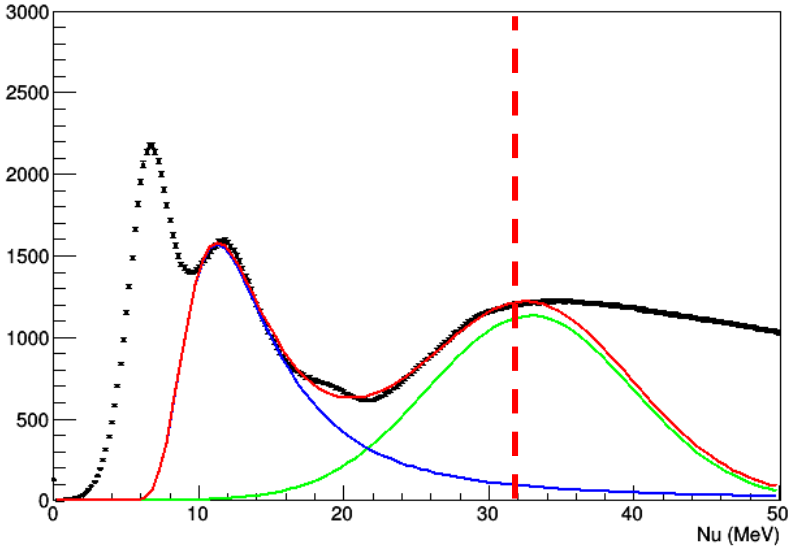
Material 20 - Production Run



Material 19 - Dummy Run



Material 19 - Production Run

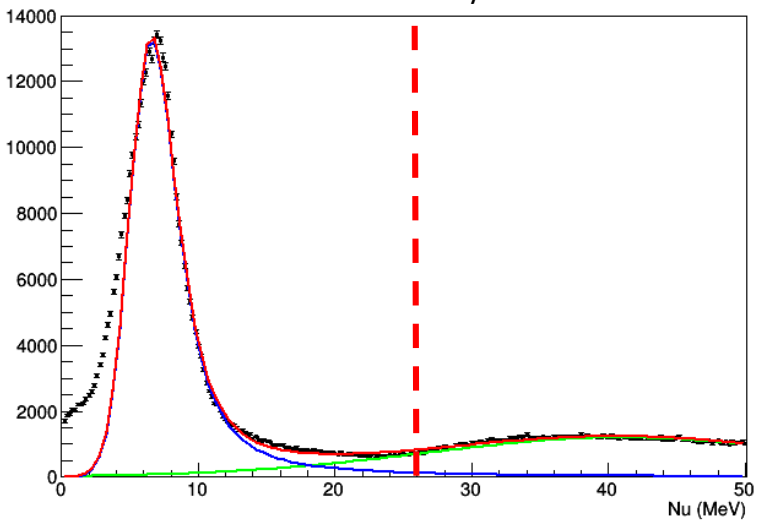


QE and Elastic fits

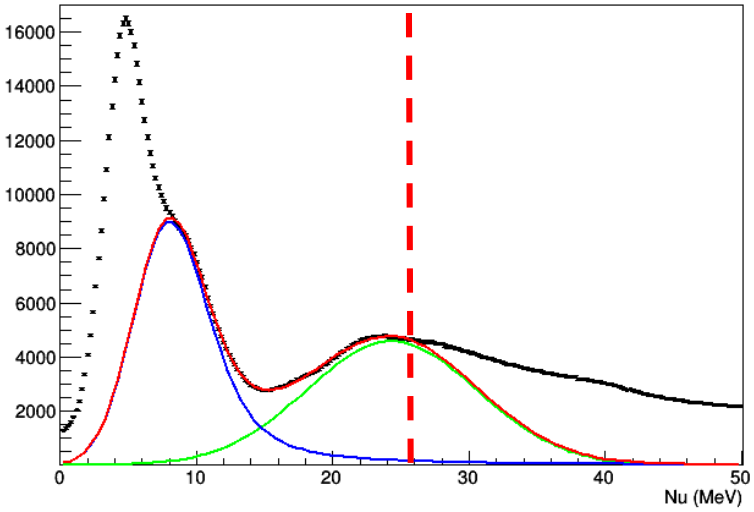
Materials 17 and 18

2.254GeV 5T Longitudinal

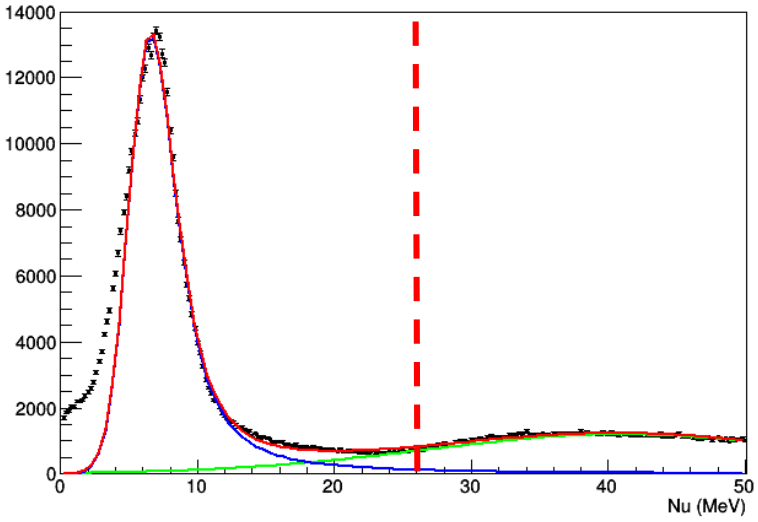
Material 18 - Dummy Run



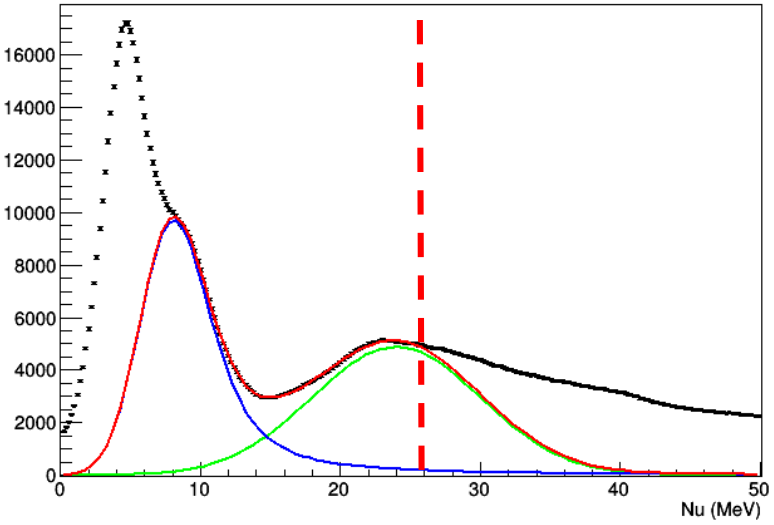
Material 18 - Production Run



Material 17 - Dummy Run



Material 17 - Production Run

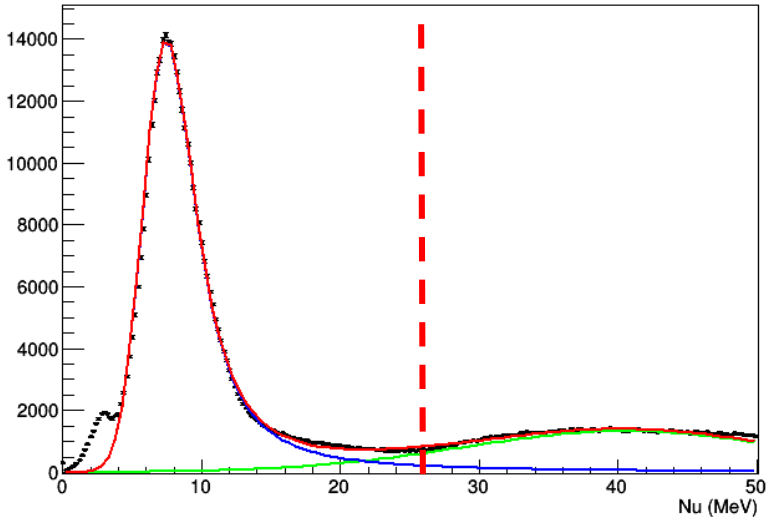


QE and Elastic fits

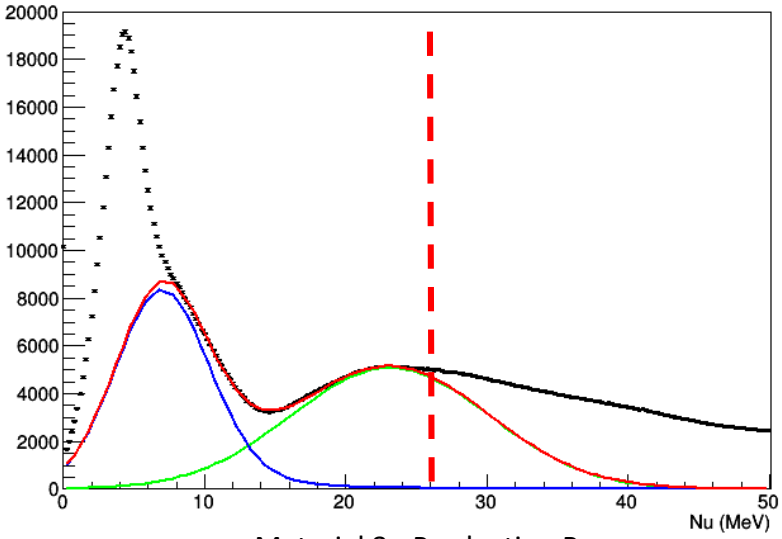
Materials 7 and 8

2.254GeV 2.5T Transverse

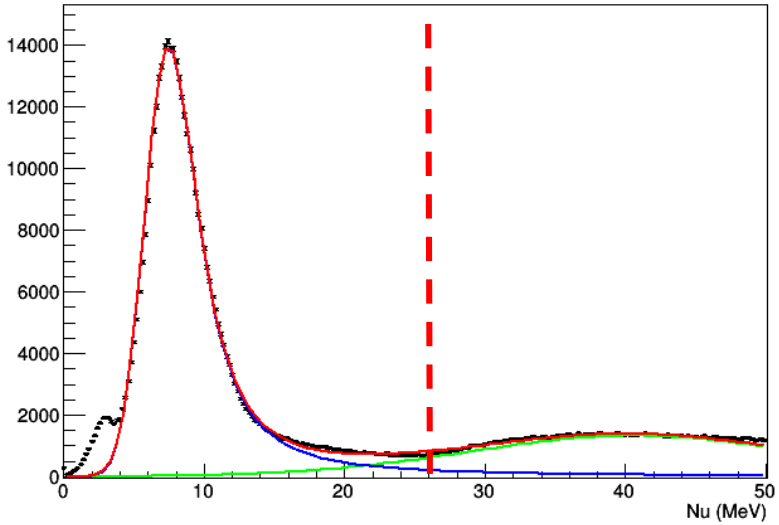
Material 7 - Dummy Run



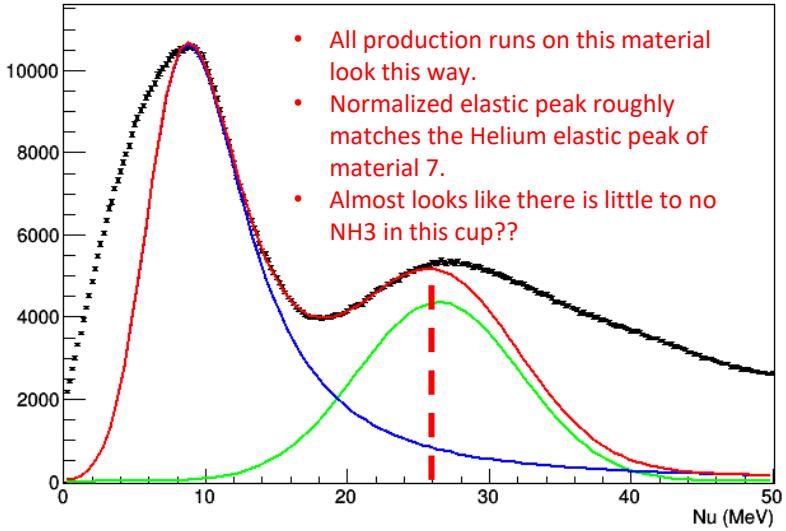
Material 7 - Production Run



Material 8 - Dummy Run



Material 8 - Production Run



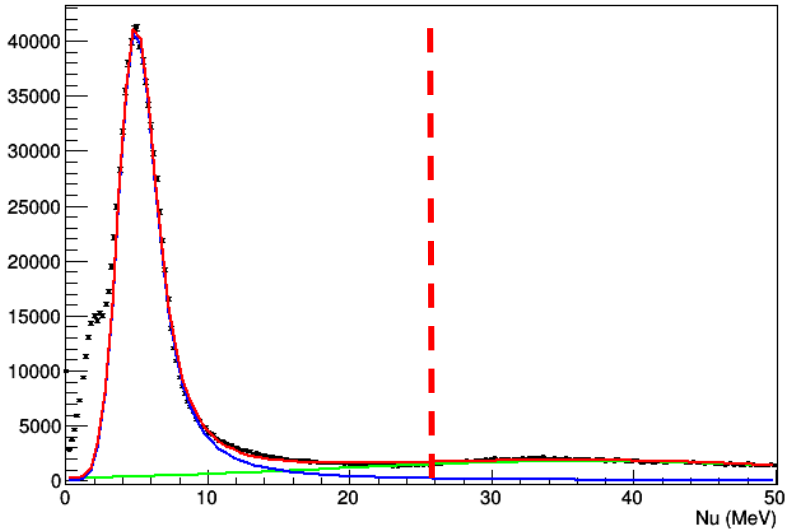
- All production runs on this material look this way.
- Normalized elastic peak roughly matches the Helium elastic peak of material 7.
- Almost looks like there is little to no NH3 in this cup??

QE and Elastic fits

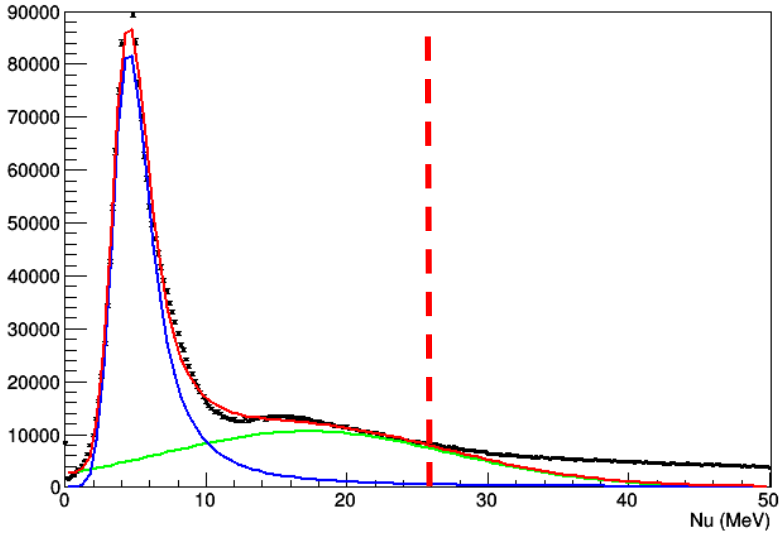
Materials 7 and 8

1.710GeV 2.5T Transverse

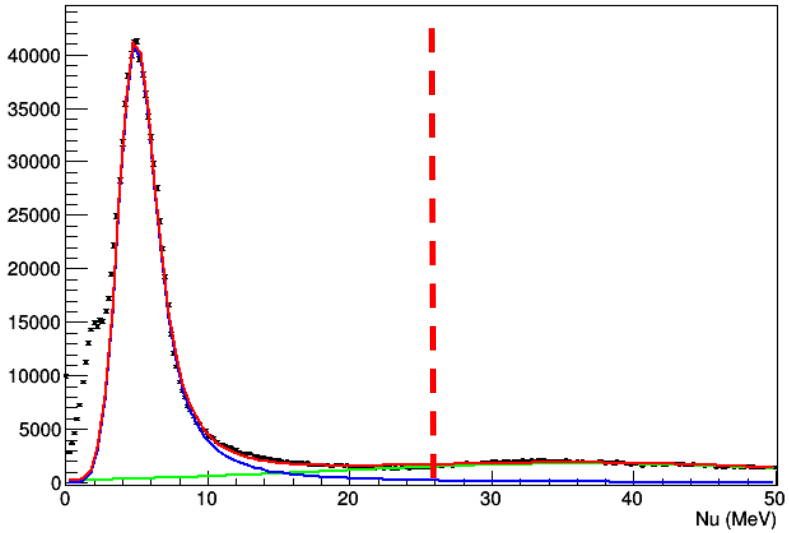
Material 7 - Dummy Run



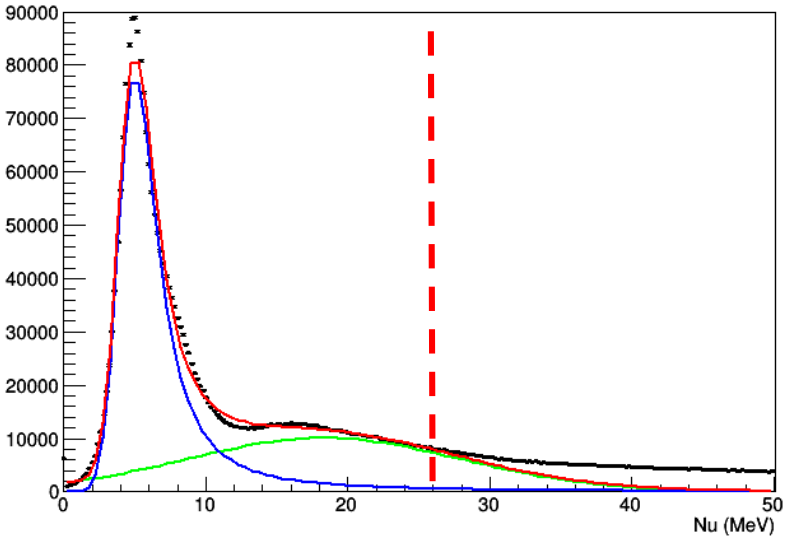
Material 7 - Production Run



Material 8 - Dummy Run



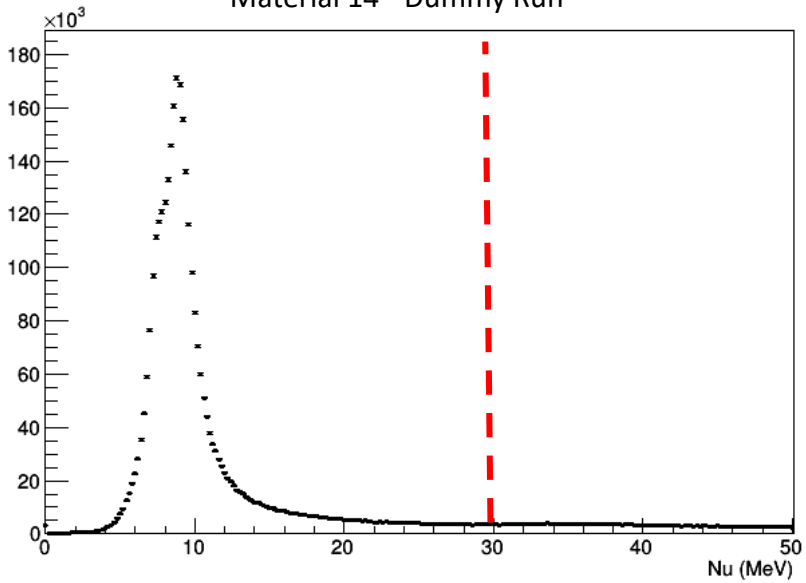
Material 8 - Production Run



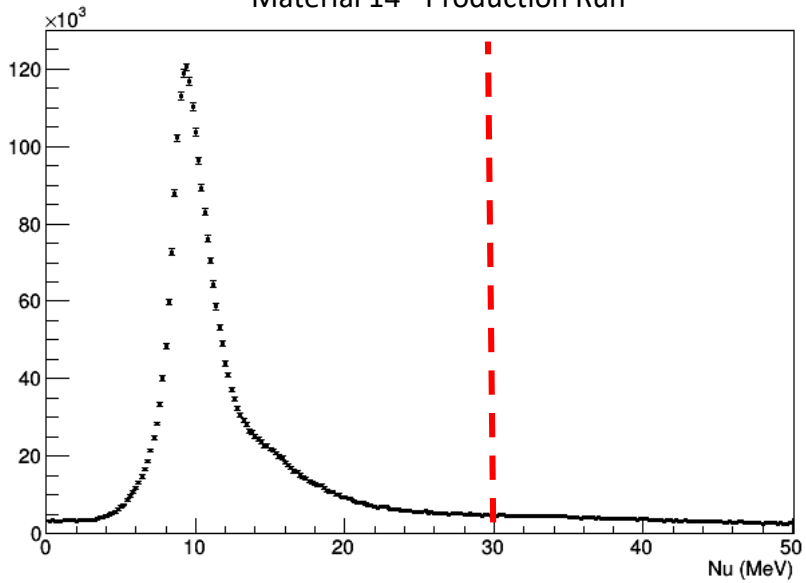
QE and Elastic fits

1.154GeV 2.5T Transverse

Material 14 - Dummy Run



Material 14 - Production Run

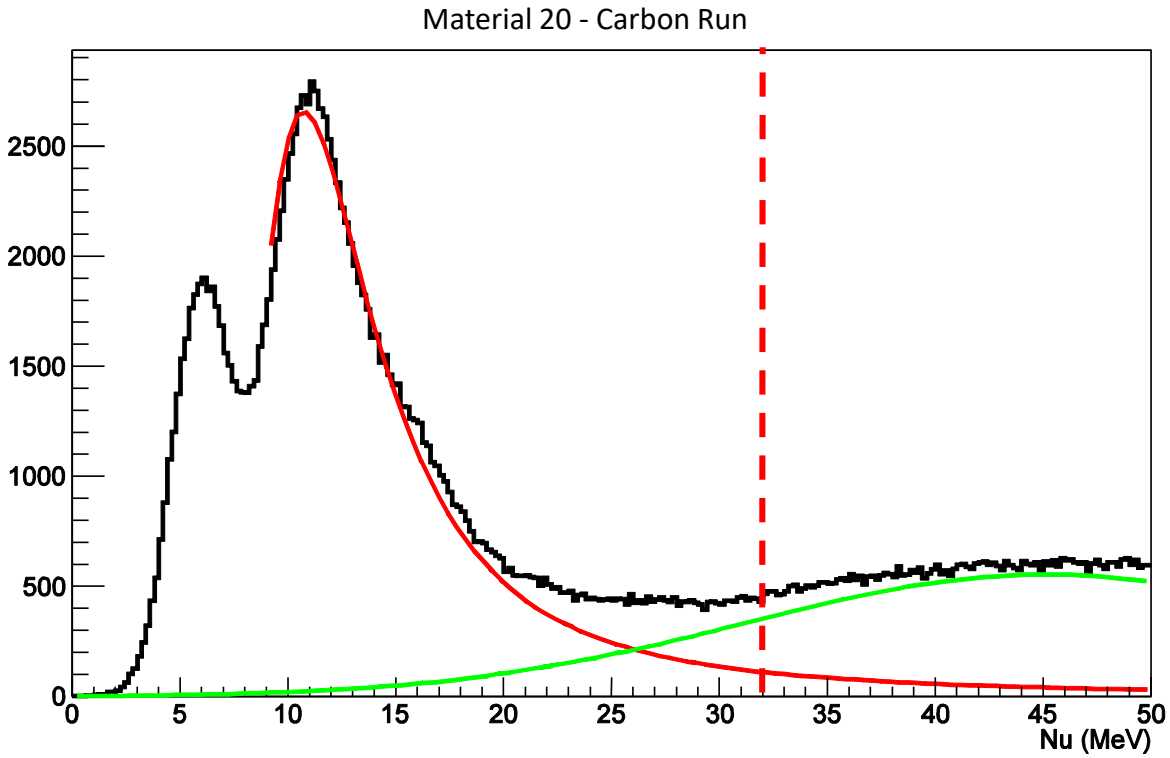


- Difficult (impossible) to fit the quasi-elastic at this setting.
- I am currently integrating the entire peak with no fits or QE subtraction being used.
- The uncertainty at this setting will most likely be estimated using models.
- Method:

$$relative\ uncertainty = A_{bosted}/(A_{bosted} + A_{g2psim})$$

where $A_{bosted/g2psim}$ is the integrated XS area from 0-30MeV

Adding back in proton elastic



$$\frac{A_{QE(0-32)}}{A_{total(0-32)}} = 10.2\%$$

Since the carbon dilution QE peak is only C12 and He4 quasi-elastic, I think it's a good approximation to assume the same QE contamination during production. The rest is then proton elastic.

Note: I do a crude model scale for C12 to N14, but this does add a systematic uncertainty

Results

Systematics broken down by source

setting	material ID	pf	total unc (%)	Prod fit unc	dummy fit unc	model unc	length unc
1.1GeV 2.5T	11	???	???			3-5%	0.45%
1.1GeV 2.5T	12	???	???			3-5%	0.45%
1.1GeV 2.5T	13	???	???			3-5%	0.45%
1.1GeV 2.5T	14	???	???			3-5%	0.45%
1.7GeV 2.5T	7	0.564	16.25	10.20%	1.60%	3-5%	0.45%
1.7GeV 2.5T	8	0.524	15.15	9.10%	1.60%	3-5%	0.45%
2.2GeV 2.5T	7	0.719	8.35	3.20%	0.70%	3-5%	0.45%
2.2GeV 2.5T	8	0.377	11.95	6.80%	0.70%	3-5%	0.45%
2.2GeV 5T long	17	0.713	9.05	3.30%	1.30%	3-5%	0.45%
2.2GeV 5T long	18	0.625	8.75	3.00%	1.30%	3-5%	0.45%
2.2GeV 5T trans	19	0.623	7.65	2.90%	0.30%	3-5%	0.45%
2.2GeV 5T trans	20	0.63	7.55	2.80%	0.30%	3-5%	0.45%

To Do:

- Still estimating the uncertainty at the 1.1GeV setting, should be done very soon.
- Not sure what to do with 2.2GeV 2.5T material 8, leave it?
- Rerun dilution with new packing fractions.
- Suggestions?