Packing fraction update

11/30/16
Reminder

\[ pf = \left( \frac{L_{total}}{L_{tg}} \right) \left( \frac{Y_{production}}{Y_{dummy}} - 1 \right) \left( \frac{\rho_N \sigma_N}{M_N} + \frac{\rho_H \sigma_H}{M_H} - 1 \right)^{-1} \]

- \( Y_{production/dummy} \) → 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 8 - Dummy Run

Material 7 - Production 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
QE and Elastic fits
1.154GeV 2.5T Transverse

- 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:

\[
\text{relative uncertainty} = \frac{A_{bosted}}{A_{bosted} + A_{g2psim}}
\]

where \( A_{bosted/g2psim} \) is the integrated XS area from 0-30MeV
Adding back in proton elastic

Material 20 - Carbon Run

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

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

<table>
<thead>
<tr>
<th>setting</th>
<th>material ID</th>
<th>pf</th>
<th>total unc (%)</th>
<th>Prod fit unc</th>
<th>dummy fit unc</th>
<th>model unc</th>
<th>length unc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1GeV 2.5T</td>
<td>11</td>
<td>???</td>
<td>???</td>
<td></td>
<td></td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>1.1GeV 2.5T</td>
<td>12</td>
<td>???</td>
<td>???</td>
<td></td>
<td></td>
<td>3-5%</td>
<td>0.45%</td>
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<tr>
<td>1.1GeV 2.5T</td>
<td>13</td>
<td>???</td>
<td>???</td>
<td></td>
<td></td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>1.1GeV 2.5T</td>
<td>14</td>
<td>???</td>
<td>???</td>
<td></td>
<td></td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>1.7GeV 2.5T</td>
<td>7</td>
<td>0.564</td>
<td>16.25</td>
<td>10.20%</td>
<td>1.60%</td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>1.7GeV 2.5T</td>
<td>8</td>
<td>0.524</td>
<td>15.15</td>
<td>9.10%</td>
<td>1.60%</td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>2.2GeV 2.5T</td>
<td>7</td>
<td>0.719</td>
<td>8.35</td>
<td>3.20%</td>
<td>0.70%</td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>2.2GeV 2.5T</td>
<td>8</td>
<td>0.377</td>
<td>11.95</td>
<td>6.80%</td>
<td>0.70%</td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>2.2GeV 5T long</td>
<td>17</td>
<td>0.713</td>
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<td>1.30%</td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
<tr>
<td>2.2GeV 5T long</td>
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<td>0.625</td>
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<td>1.30%</td>
<td>3-5%</td>
<td>0.45%</td>
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<tr>
<td>2.2GeV 5T trans</td>
<td>19</td>
<td>0.623</td>
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<tr>
<td>2.2GeV 5T trans</td>
<td>20</td>
<td>0.63</td>
<td>7.55</td>
<td>2.80%</td>
<td>0.30%</td>
<td>3-5%</td>
<td>0.45%</td>
</tr>
</tbody>
</table>

### 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?