Particle Production of Carbon Target with 20Tto2T5m Configuration at 6.75 GeV (Updated)

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Target Studies
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Target Setting

• 20Tto2T5m Configuration (initial beam pipe radius of 13 cm) and Fieldmap (20T→2T);
• Code: MARS15(2014) with ICEM 4=1;
• Proton beam: 6.75 GeV (KE) and launched at z = -100 cm, Focal beam with waist at z=0 m and emittance of 5μm;
• Production Collection: (1.2 m and 5 m downstream, 40 MeV < KE < 180 MeV).
• Graphite density = 1.8
Energy Card Setting

- **ENRG E0 EM EPSTAM EMCHR EMNEU EMIGA EMIEL**

  - **E0**: The incident particle kinetic energy;
  - **EM**: The hadron threshold energy (Default: 0.0145 GeV);
  - **EPSTAM**: The star production threshold kinetic energy (Default: 0.03 GeV);
  - **EMCHR**: The threshold energy applied collectively to muons, heavy ions and charged hadrons (Default: 0.001 GeV);
  - **EMNEU**: The threshold energy for neutrons (Default: $10^{-4}$ GeV);
  - **EMIGA**: The threshold energy for $\gamma$ (Default: $10^{-4}$ GeV);
  - **EMIEL**: The threshold energy for $e^{\pm}$ (Default: $5*10^{-4}$ GeV)

  *Use non-default setting: ENRG 1=6.75 2=0.02 3=0.3 4=0.01 5=0.05 6=0.01 7=0.01*
Particle Production vs. Target Length

(10^6 events, no beam dump)

With beam angle = 130 mrad, the dump rod may conflict with the target containment vessel, so compare with beam angle = 65 mrad.

Co-linear target and beam. TR/BR=4
Particle Production vs. Beam Angle
(10^6 events, no beam dump)

Co-linear target and beam. TR/BR=4
Particle Production vs. Target Radius

(10^6 events, no beam dump)

Co-linear target and beam. TR/BR=4
Energy Spectra of $\pi^\pm$, $K^\pm$, $\mu^\pm$
(10^5 events, no beam dump)

Target length: 80 cm
Target radius: 0.72 cm
Beam angle: 65 mrad
Co-linear target and beam
TR/BR=4
Remaining Protons
(10^5 events, no beam dump)

Target length: 80 cm
Target radius: 0.72 cm
Beam angle: 65 mrad
Co-linear target and beam
TR/BR=4
Target length: 80 cm, Target radius: 0.72 cm, Beam angle: 65 mrad
Co-linear target and beam, TR/BR=4
Z=40 cm, x=-0.4 cm; Z=120 cm, x=-3.097 cm
X=-tan(0.0337)*(z-40)-0.4
Single Particle Tracking in YZ plane (no target and beam dump)

Target length: 80 cm, Target radius: 0.72 cm, Beam angle: 65 mrad
Co-linear target and beam, TR/BR=4
Z=40 cm, y=-2.562 cm; Z=120 cm, y=-6.909 cm
Y=-\tan(0.05428)*(z-40)-2.562
Remaining Protons with Beam Dump (10^5 events)

Target length: 80 cm
(z=-40 cm to z=40 cm)
Target radius: 0.72 cm
Beam angle: 65 mrad
Co-linear target and beam
TR/BR=4

Beam dump is 80 cm long
(z=40 cm to z=120 cm)

Beam dump and target have same radius
Remaining Protons with Beam Dump

(10^5 events)

Target length: 80 cm
(z=-40 cm to z=40 cm)
Target radius: 0.72 cm
Beam angle: 65 mrad
Co-linear target and beam
TR/BR=4

Beam dump is 80 cm long
(z=40 cm to z=120 cm)

The radius of beam dump is twice that of the target
Yield Comparison at $z = 5 \text{ m}$

(10^5 events)

<table>
<thead>
<tr>
<th>No beam dump</th>
<th>Beam dump (same as target radius)</th>
<th>Beam dump (twice target radius)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14941</td>
<td>15203</td>
<td>14815</td>
</tr>
</tbody>
</table>

Target length: 80 cm, Target radius: 0.72 cm, Beam angle: 65 mrad
Co-linear target and beam, TR/BR=4