Comparison of Particle Production between MARS15(2012) ICEM4=0 mode and MARS15(2012) ICEM4=1 mode (Mercury Target and IDS120j Configuration)

X. Ding, UCLA

Target Studies
Dec. 19, 2013
IDS120j Geometry
Fieldmap

The graph shows the variation of $B_z (r=0)$, T, with $z$, cm. The peak value of $B_z (r=0)$ occurs at around $z = 300$ cm, with a value of approximately 12 T. The field gradually decreases as $z$ increases, maintaining a nearly constant value of around 2 T for $z > 1500$ cm.
Target Station Setting

- IDS120j Configuration and Fieldmap (15T ➞ 1.5T);
- MARS15(2012) default mode (ICEM4=0, without either LAQGSM or the MCNP tables) and MARS15(2012) in hybrid mode (ICEM4=1) are used;

  MARS15(2014) will be installed in the following several weeks! MARS15(2014) default mode will be ICEM4=1 (a hybrid mode with LAQGSM)

- Proton beam (below the Hg jet): launched for MARS15(2012) ICEM4=0 mode at z = -75 cm and for MARS15(2012) in ICEM4=1 mode at z = -100 cm;
- Mercury Target setting: with tilt angle to SC axis;
- Production Collection: (50 m downstream, 40 MeV < KE < 180 MeV).
Incident Particle Energy and the threshold in matter for subsequent generated particles

- **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=3 2=0.02 3=0.3 4=0.01 5=0.05 6=0.01 7=0.01
# Target Parameters

<table>
<thead>
<tr>
<th>Target radius cm</th>
<th>Beam angle mrad</th>
<th>Crossing angle mrad</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 GeV, IECM4=0</td>
<td>0.23</td>
<td>137</td>
</tr>
<tr>
<td>3 GeV, IECM4=1</td>
<td>0.26</td>
<td>137</td>
</tr>
<tr>
<td>4 GeV, IECM4=0</td>
<td>0.30</td>
<td>132</td>
</tr>
<tr>
<td>4 GeV, IECM4=1</td>
<td>0.39</td>
<td>132</td>
</tr>
<tr>
<td>5 GeV, IECM4=0</td>
<td>0.36</td>
<td>119</td>
</tr>
<tr>
<td>5 GeV, IECM4=1</td>
<td>0.337</td>
<td>122</td>
</tr>
<tr>
<td>6 GeV, IECM4=0</td>
<td>0.395</td>
<td>117</td>
</tr>
<tr>
<td>6 GeV, IECM4=1</td>
<td>0.365</td>
<td>117</td>
</tr>
<tr>
<td>7 GeV, IECM4=0</td>
<td>0.39</td>
<td>119</td>
</tr>
<tr>
<td>7 GeV, IECM4=1</td>
<td>0.364</td>
<td>117</td>
</tr>
<tr>
<td>8 GeV, IECM4=0</td>
<td>0.404</td>
<td>117</td>
</tr>
<tr>
<td>8 GeV, IECM4=1</td>
<td>0.37</td>
<td>117</td>
</tr>
</tbody>
</table>

Beam radius is set at 30% of target radius.
Comparison of Particle Production

(IECM4=0 vs. IECM4=1)

100,000 protons used for MARS15(2012) IECM4=0;
400,000 protons used for MARS15(2012) in IECM4=1 (but 1000,000 protons for 3 GeV case);
Particle Production vs. Target Radius

(6 GeV, Hg target, IECM4-1 mode)
Particle Production vs. Crossing Angle between Beam and Hg Jet
(6 GeV, IECM4=1 mode)
Particle Production vs. Beam Angle
(6 GeV, Hg target, IECM4=1 mode)