Particle Production with Carbon Target and IDS120j Configuration at 3 GeV

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Target Studies
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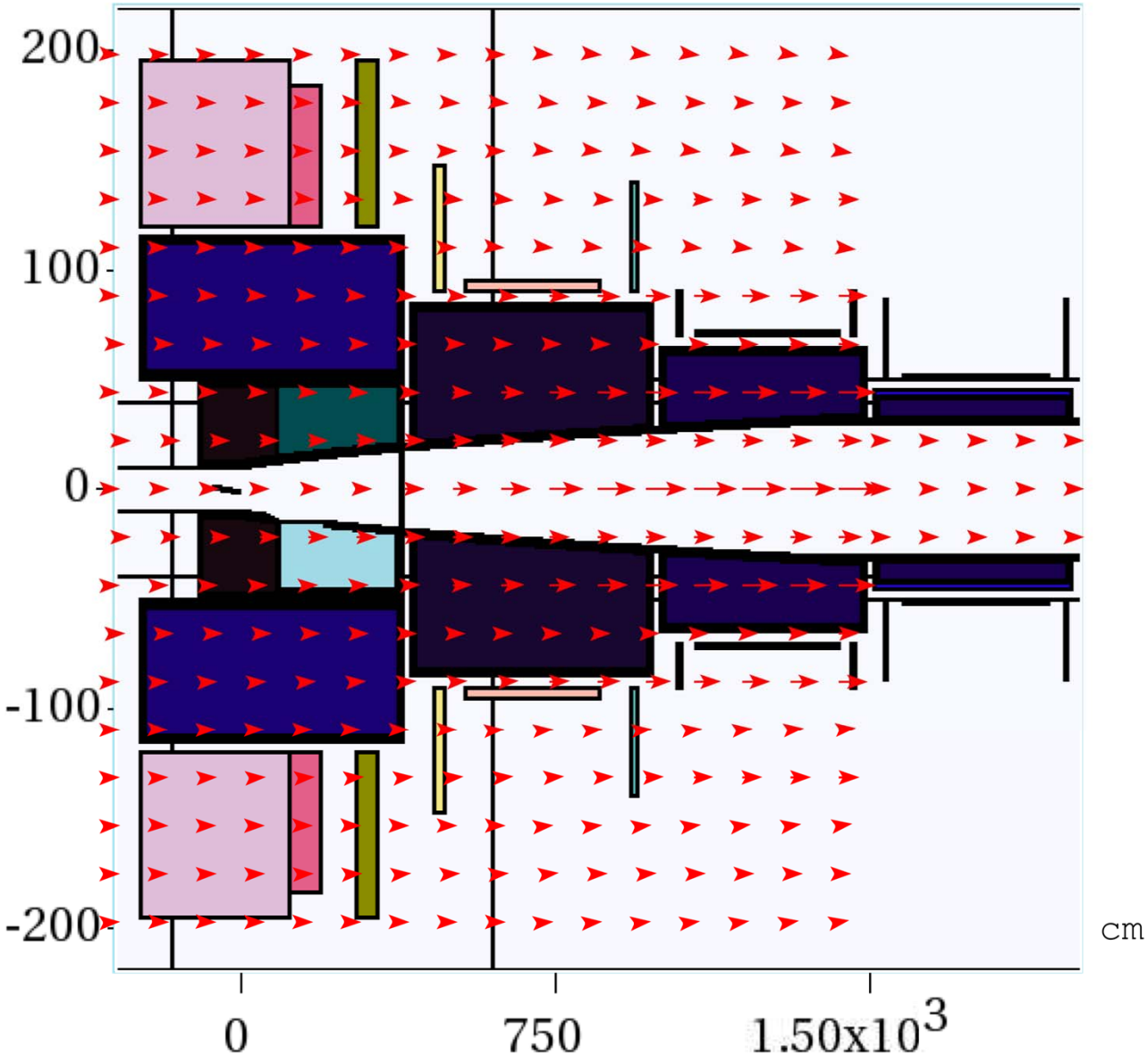
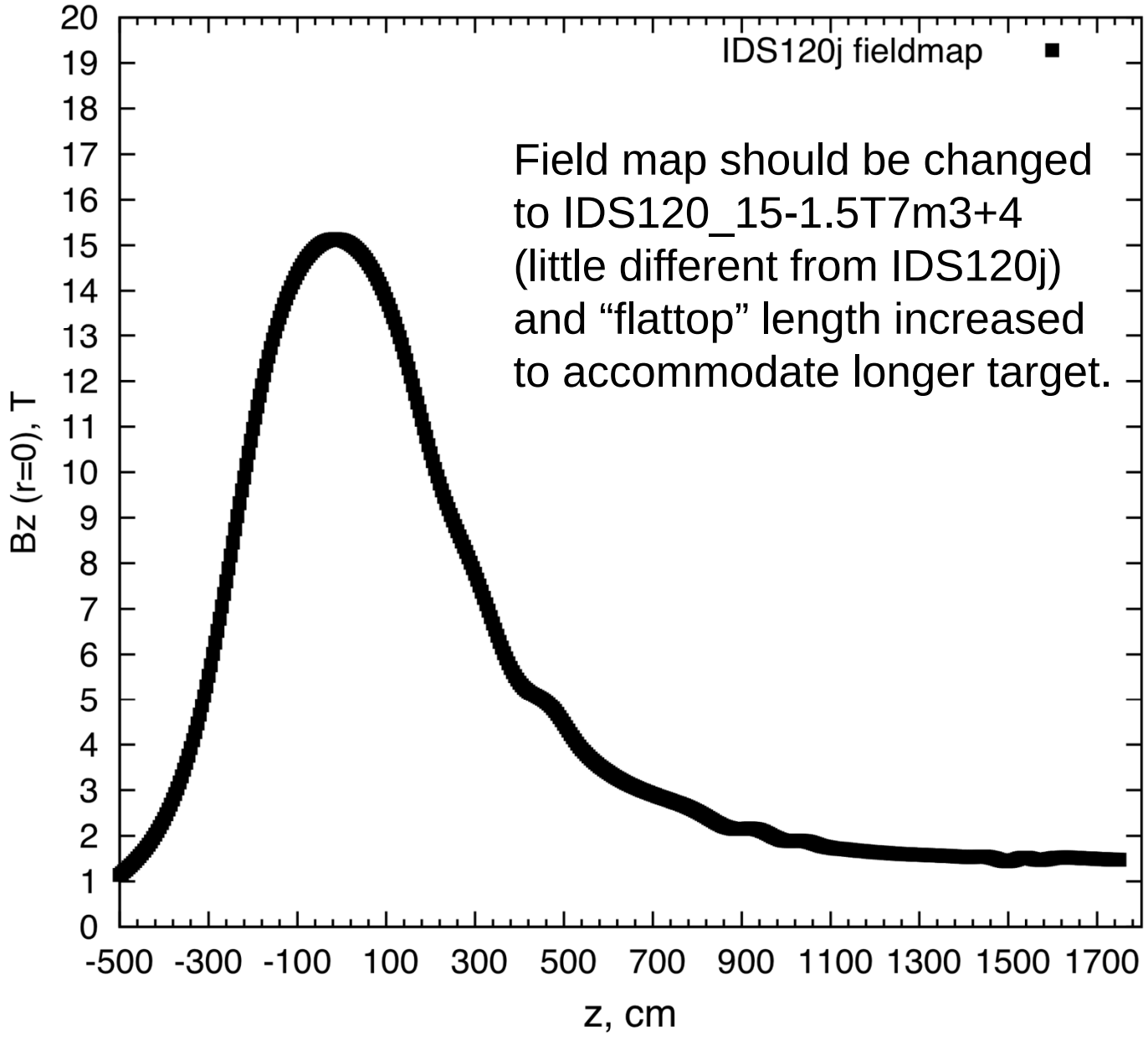
IDS120j Geometry



Fieldmap


IDS120j fieldmap
Field map should be changed to IDS120_15-1.5T7m3+4 (little different from IDS120j) and “flattop” length increased to accommodate longer target.
Bz (r=0), T
z, cm
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-500 -300 -100 100 300 500 700 900 1100 1300 1500 1700

Target Station Setting

- IDS120j Configuration and Fieldmap (15T➔1.5T);
- MARS15(2012) in LAQGSM mode (IQGSM=1);

Installation of New version of MARS15 is expected!

Dr. N. Mokhov is planning to upgrade MARS15 worldwide, with many new developments and features implemented. Among other things, the energy ranges controlled by IQGSM of the ICEM card will be changed.

- Proton beam: 3 GeV (KE) and launched at z = -100 cm;
- Carbon Target setting: with or without 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);

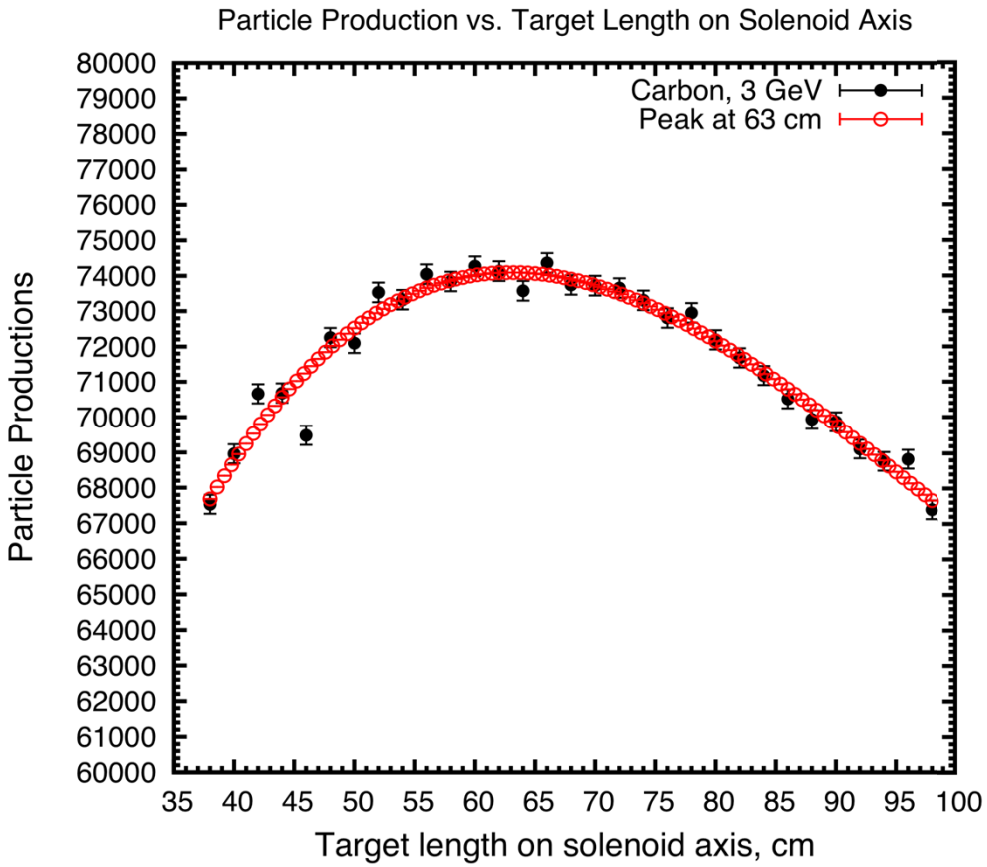
  EMNEU: The threshold energy for neutrons (Default:10^{-4} GeV)

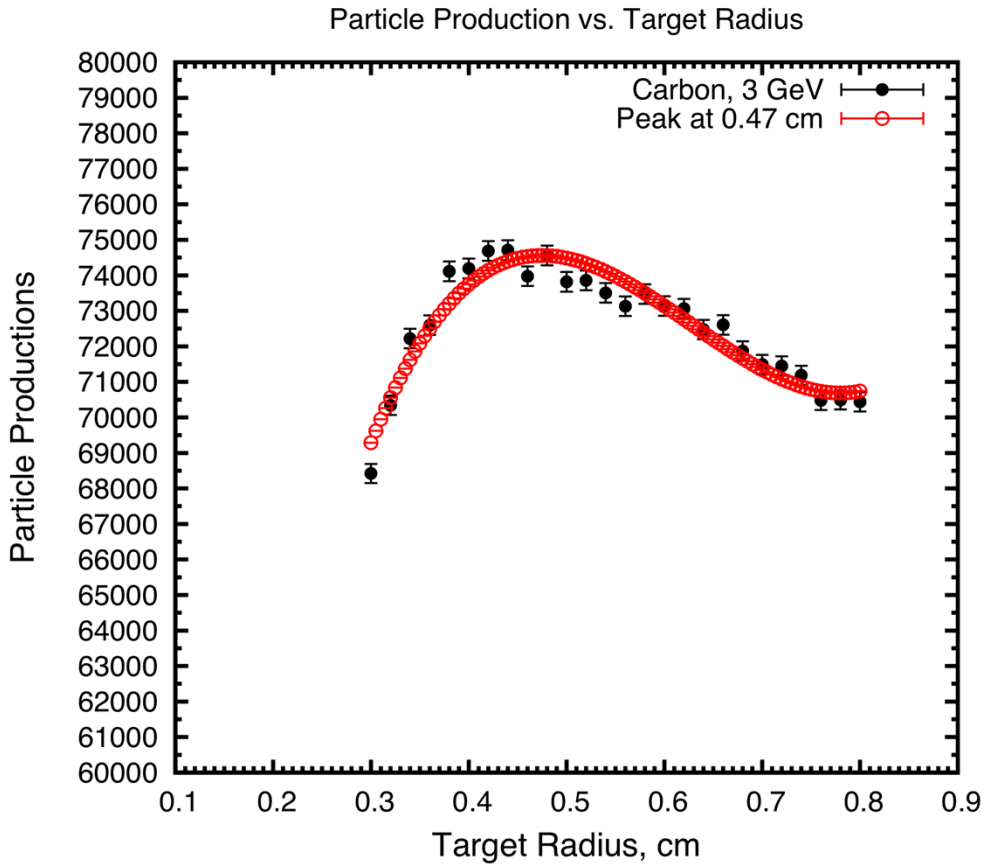
  EMIGA: The threshold energy for γ (Default:10^{-4} GeV);

  EMIEL: The threshold energy for $e^{\pm}$ (Default: $5*10^{-4}$ GeV)

  Non-default setting: ENRG 1=3 2=0.02 3=0.3 4=0.01 5=0.05 6=0.01 7=0.01

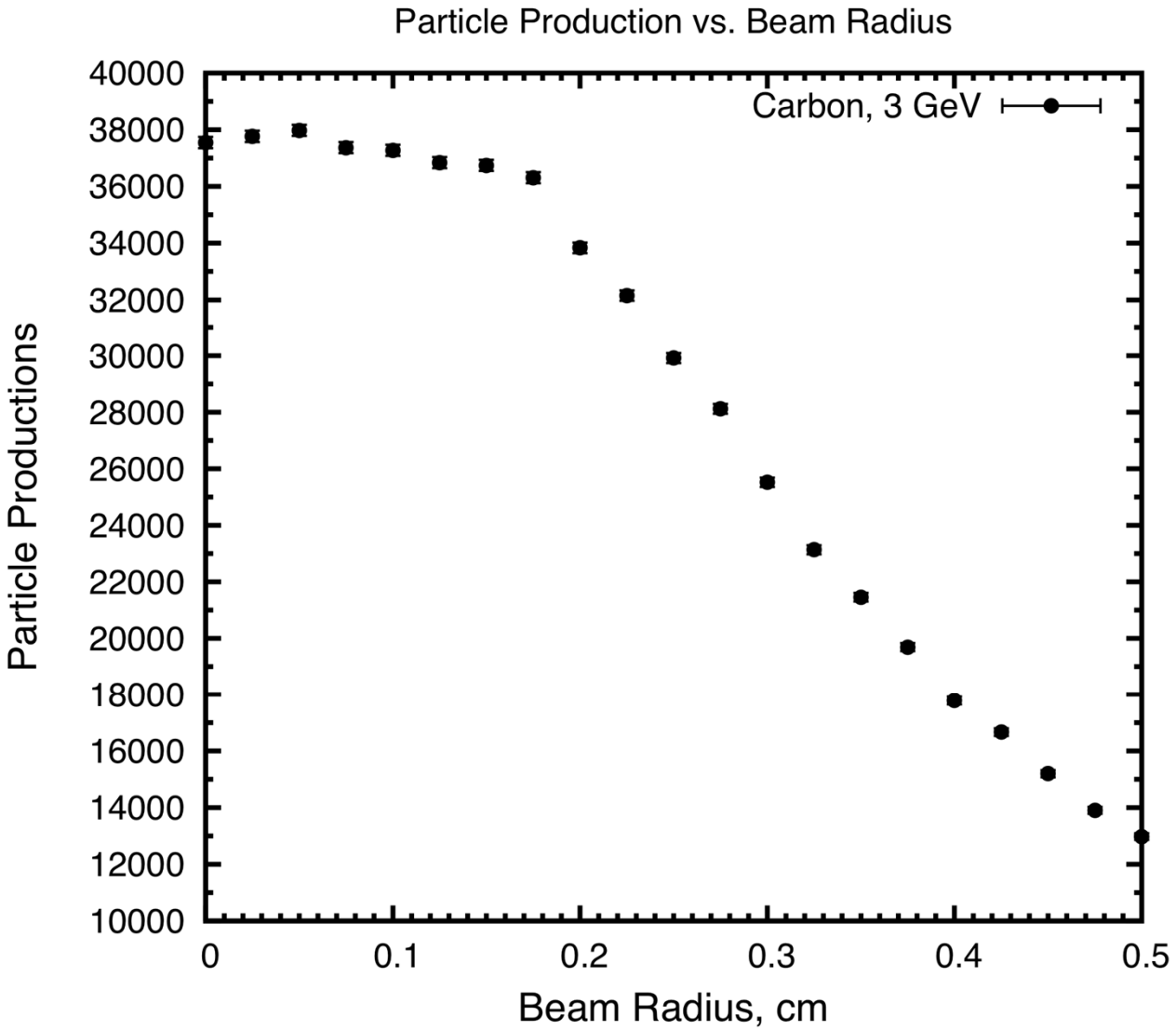
Carbon Target without Tilt Angle (10^6 events)





Optimized target length is 63 cm and target radius is 0.47 cm.
Yield is 0.0247 per proton and per GeV. Beam radius fixed at 0.125 cm.
$\Rightarrow$ Use target radius/beam radius = 4.

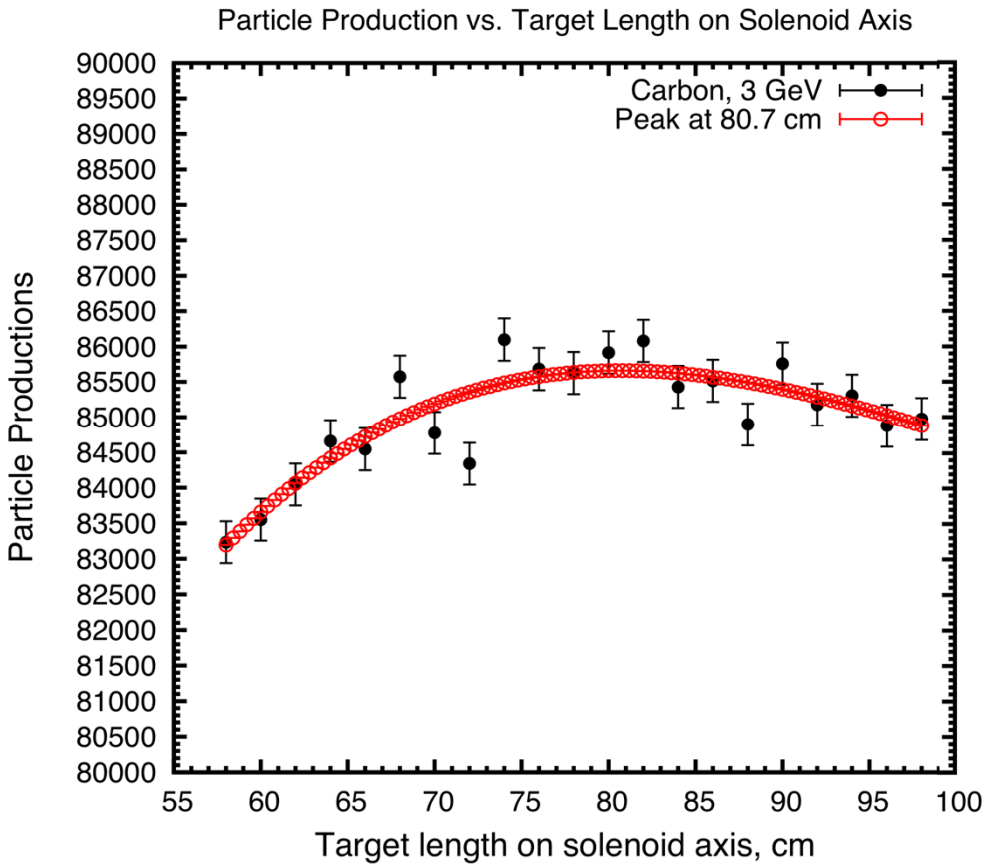
Carbon Target without Tilt Angle (5×10^5 events)

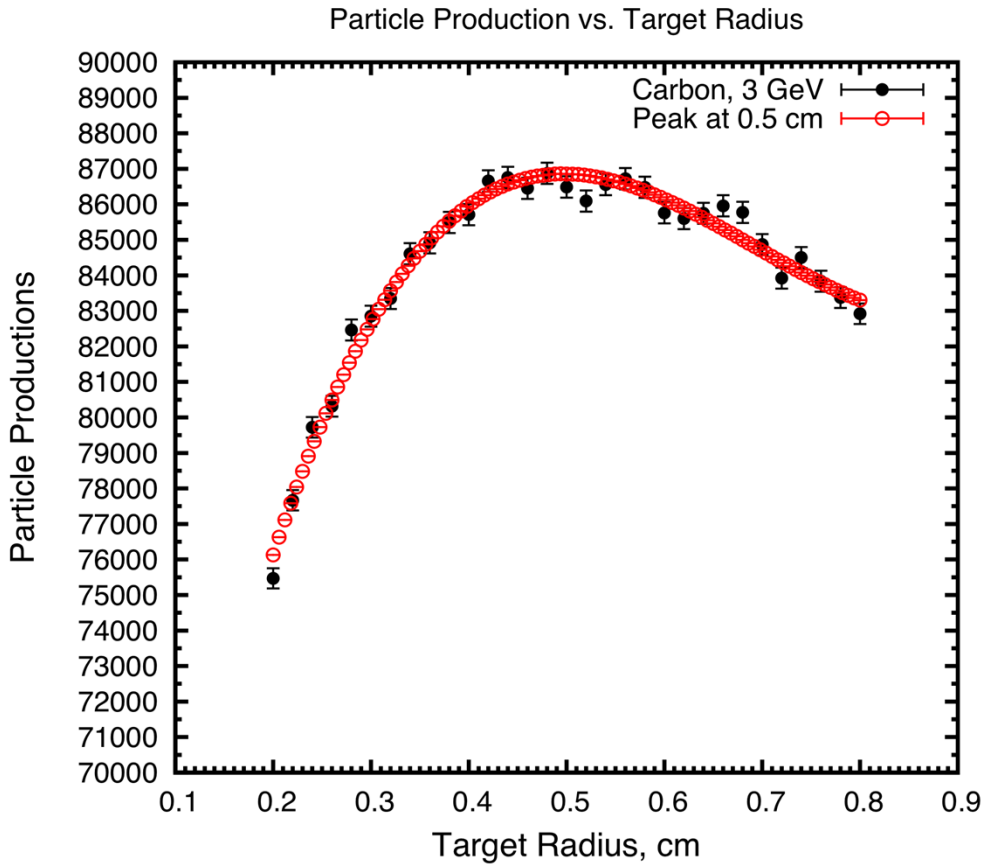


Target radius fixed at 0.5 cm.
Smaller proton beam radius is required to keep higher particle production.
Compare to peak value, only about 2% less in particle production when the beam radius is set to 0.125 cm.

Study should be redone with radii of target and beam in ratio 4:1.

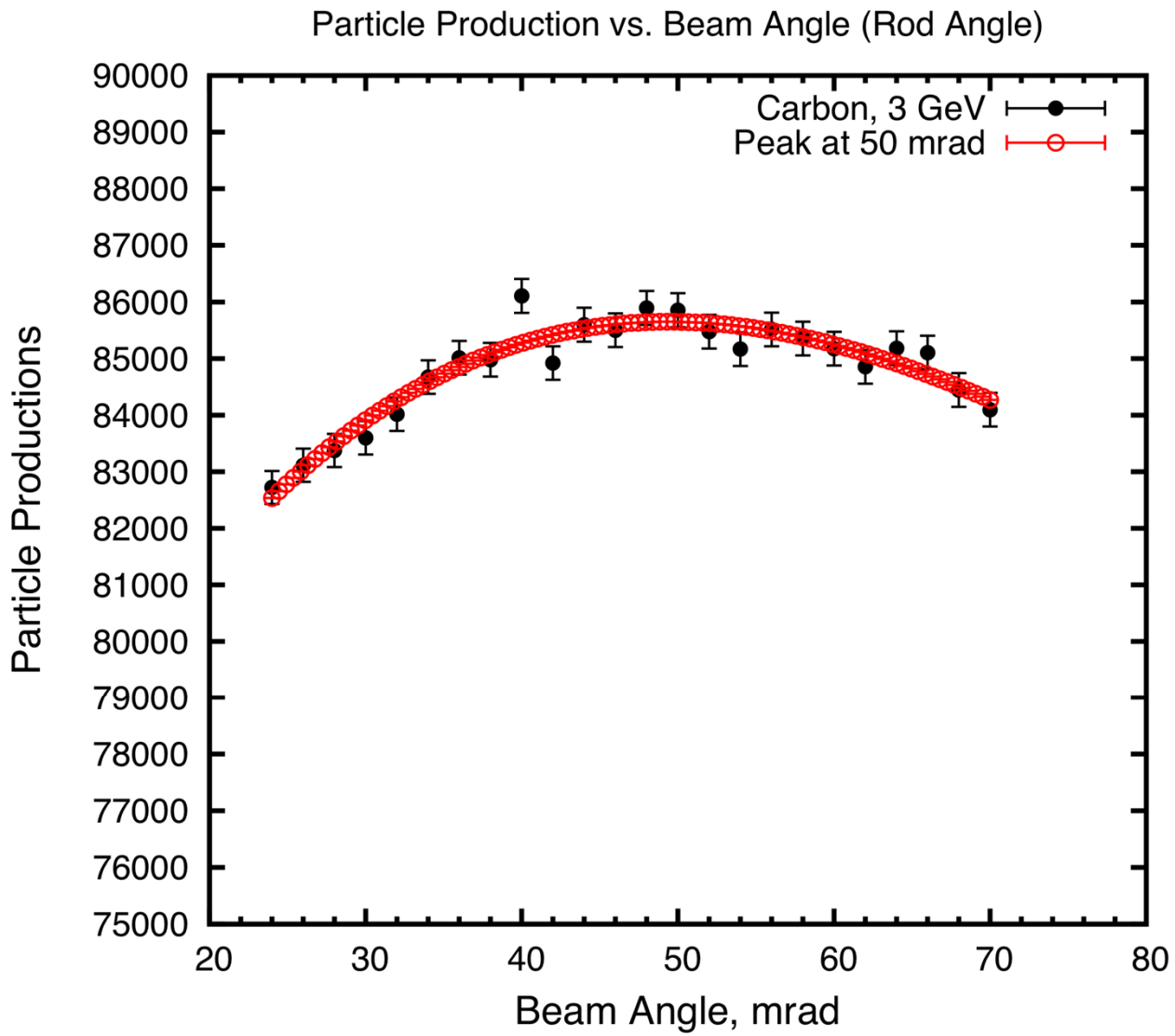
Carbon Target with Tilt Angle (10^6 events)





Beam and target have same angle at z = -37.5 cm, θ = 50 mrad.
Optimized target length is 80.7 cm and target radius is 0.50 cm.
Yield is 0.0287 per proton and per GeV. About 14% higher in particle production than the case without tilt angle.

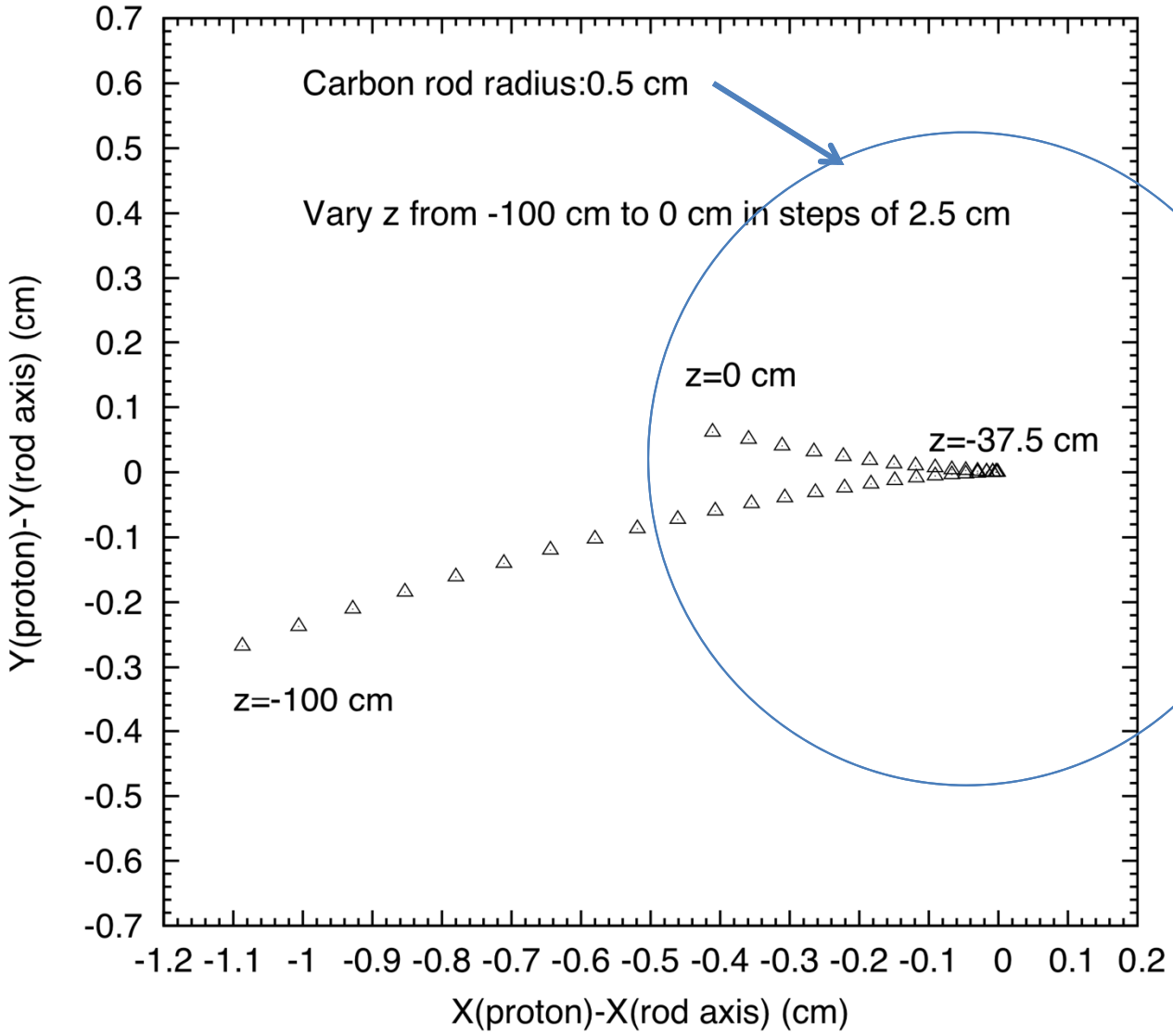
Carbon Target with Tilt Angle (10^6 events)



Target radius is set to 0.5 cm. Beam radius is set to 0.125 cm. Crossing angle between beam/target is set to 0 mrad at center of target.

Optimized beam/target angle is 50 mrad to SC axis.

Single Particle Tracking



IDS120j configuration;
Carbon target at 3 GeV;
Target length along solenoid axis: 76.5 cm;
Target radius: 0.5 cm;
Beam radius: 0.125 cm;
Beam angle: 50 mrad;
Target angle: 50 mrad.

Issue: fate of unscattered protons.

Maybe should offset the beam at the center of the target.