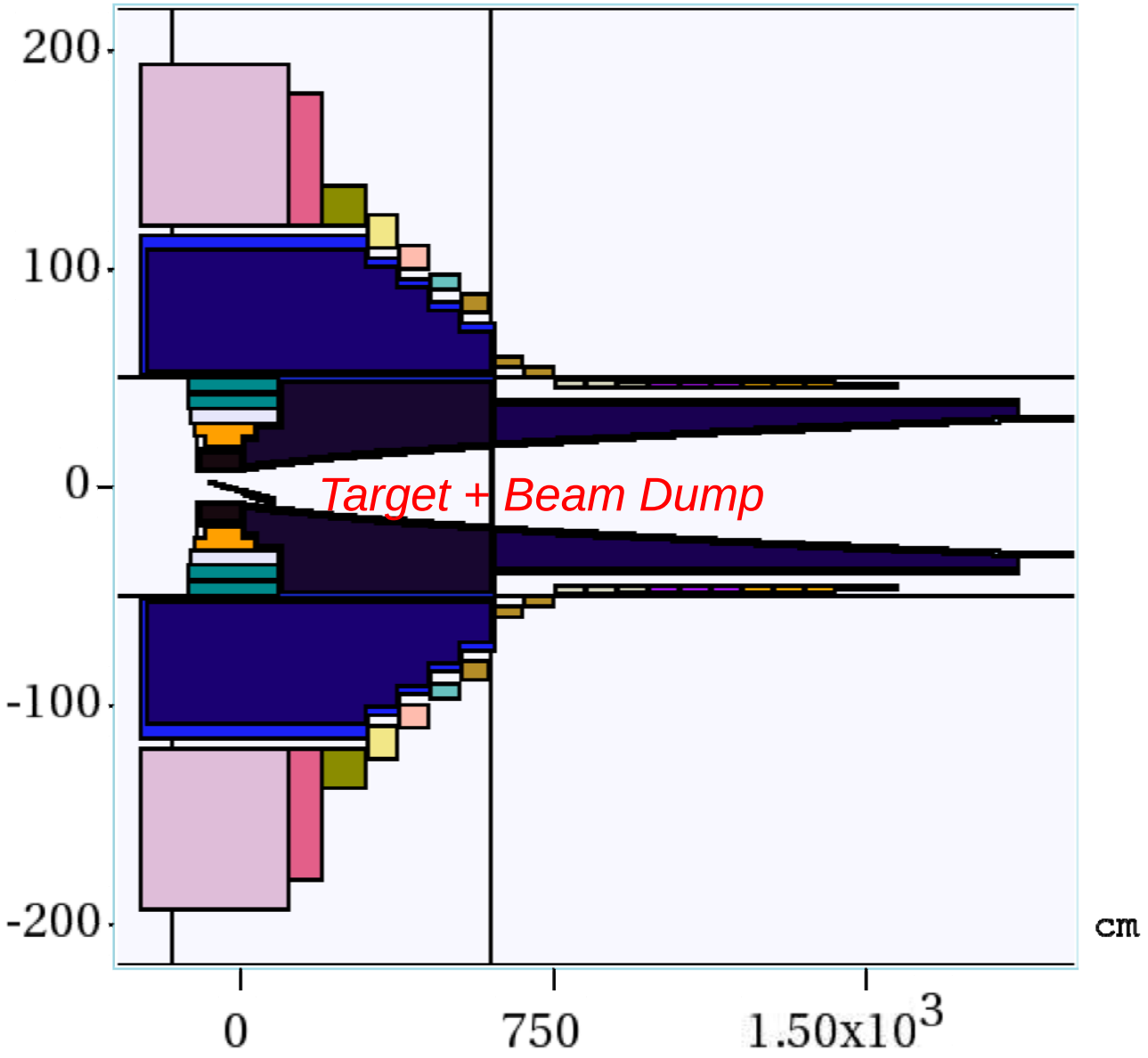
Beam Dump for Carbon Target with IDS120h Configuration at 6.75 GeV (Updated)

X. Ding, UCLA

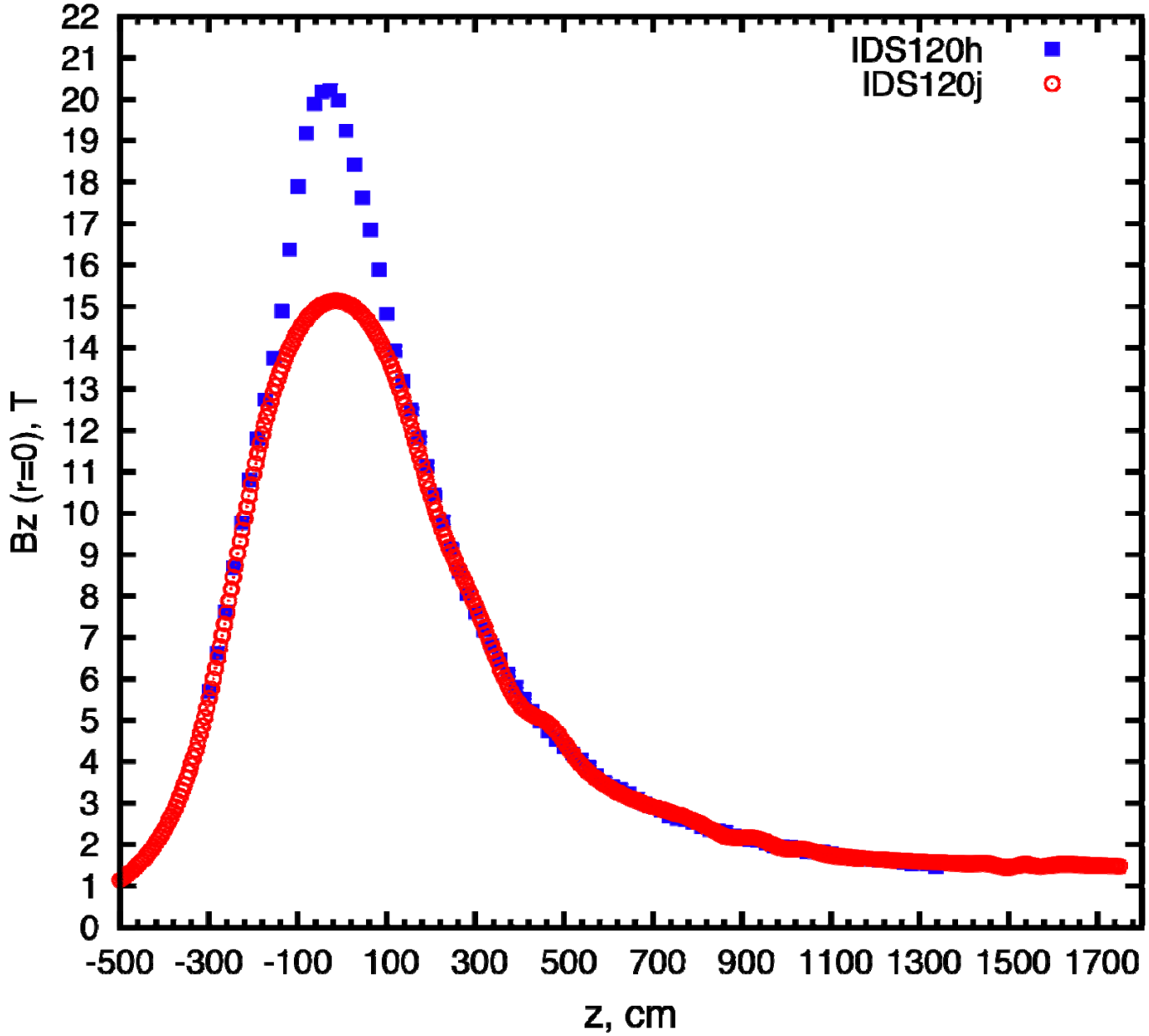
Target Studies
Jan. 24, 2014

IDS120h Geometry



Fieldmap

(IDS120h: peak at 20 T)



Target and Beam Dump Setting

- IDS120h Configuration (initial beam pipe radius of 7.5 cm) and Fieldmap (20T➔1.5T);
- Code: MARS15(2014) ICEM 4=1;
- Proton beam: 6.75 GeV (KE) and launched at z = -100 cm,

  Simple Gaussian Beam ($\sigma x=\sigma y=0.145$cm),

  Focal beam with waist ($\sigma x=\sigma y=0.145$cm) at z=-37.5 cm (beam size at z=0 is $0.145*\sqrt{1+L^2/\beta x^2}=0.194$ cm) and emittance ($\sigma x*\sigma x/\beta x$, $\beta x=42.05$ cm) of 5μm;
- Optimized Target Parameters:

  target from z = -75 cm to z = 0 cm with center at z = -37.5 cm, target radius of 0.58 cm, beam radius of 0.145 cm, same beam and target angle (to SC axis) of 59 mrad.

Target and Beam Dump Setting (cont'd)

- Production Collection: (50 m downstream, 40 MeV < KE < 180 MeV).
- Beam dump (except carbon pool) is located immediately downstream the target and co-linear with each other.

Case 1: Carbon Pool

Case 2: Rod from z = 0 cm to z = 75 cm, tilt angle of 59 mrad to SC axis and radius of 0.58 cm.

Case 3: Rod from z = 0 cm to z = 75 cm, tilt angle of 59 mrad to SC axis and radius of 2*0.58 cm.

Target and Beam Dump Setting (cont'd)

Case 4: Rod from z = 0 cm to z = 75 cm, tilt angle of 59 mrad to SC axis and radius of 3* 0.58 cm.

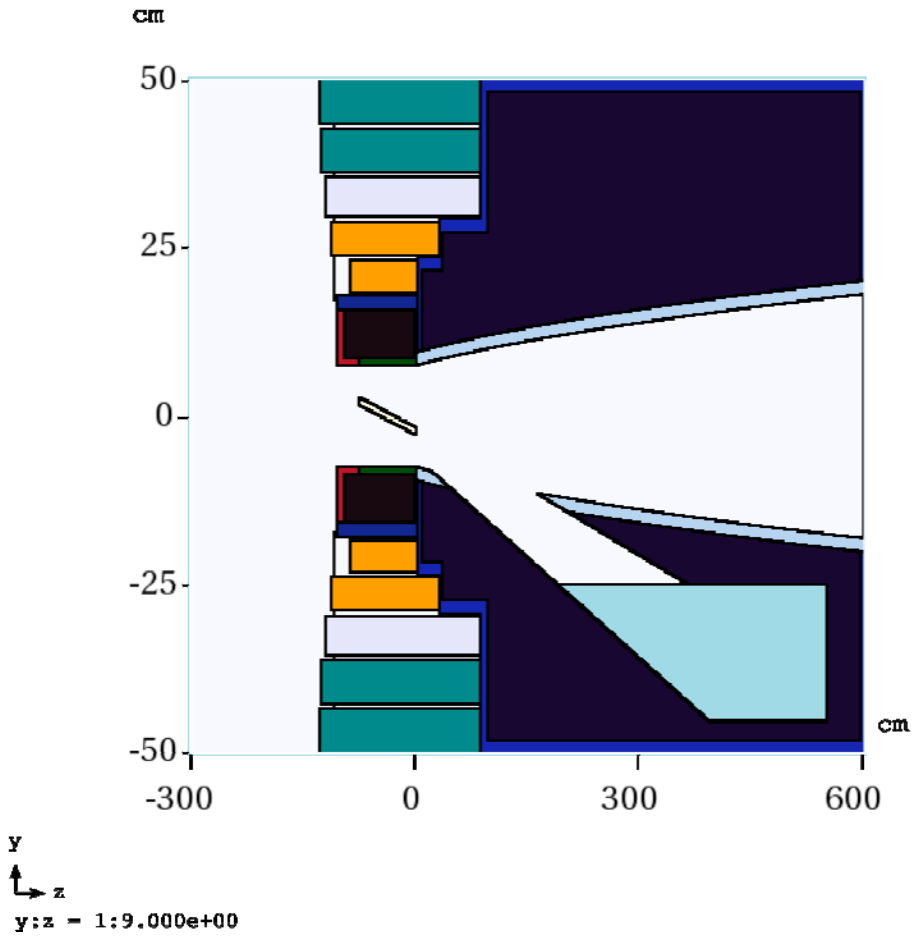
Case 5: Rod from z = 0 cm to z = 75 cm, tilt angle of 59 mrad to SC axis in the yz plane and tilt angle of 0.5238*59= 30.9 mrad in the xz plane and radius of 0.58 cm.

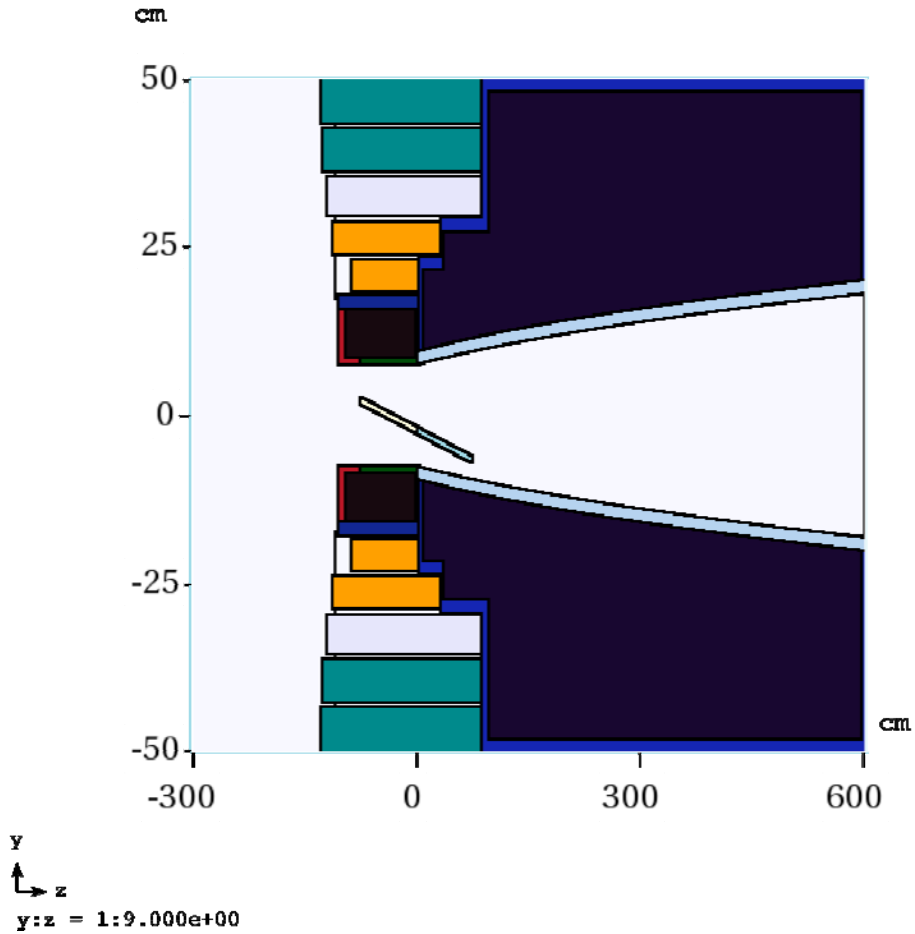
Case 6: Rod from z = 0 cm to z = 75 cm, tilt angle of 59 mrad to SC axis in the yz plane and tilt angle of 0.5238*59= 30.9 mrad in the xz plane and radius of 2*0.58 cm.

Case 7: Rod from z = 0 cm to z = 75 cm, zero tilt angle to SC axis and radius of 6*0.58 cm.

Dump Configuration

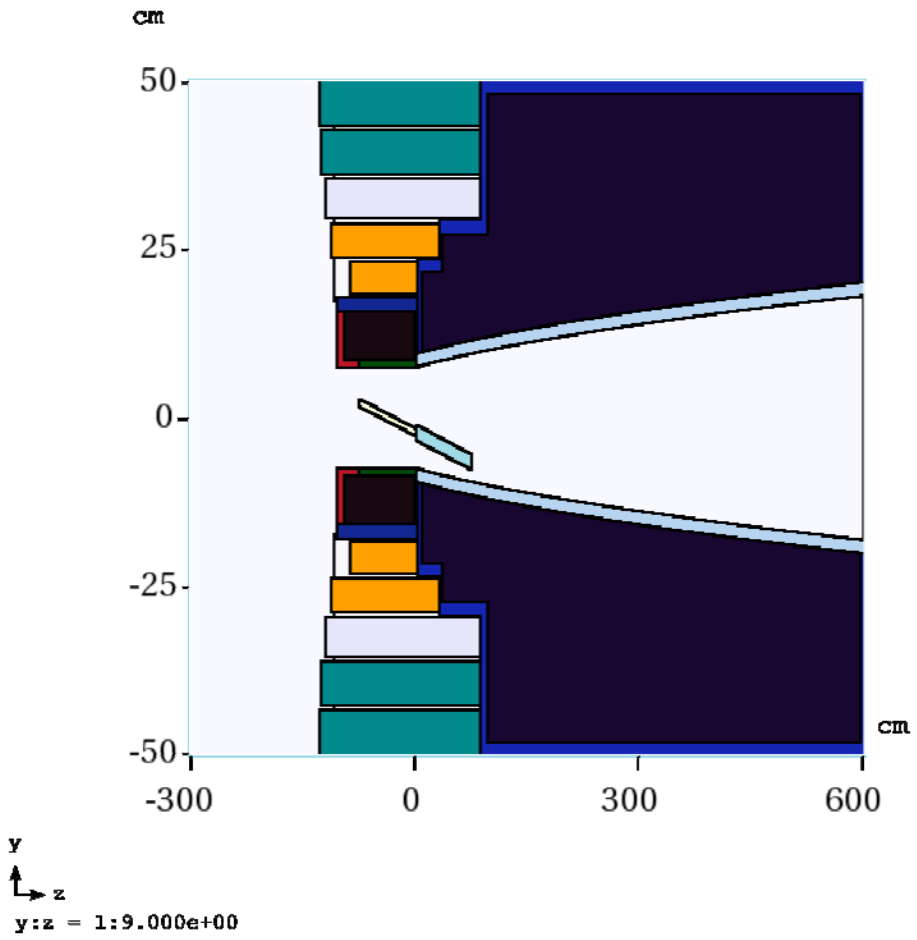
(Case1:left, Case 2: right)

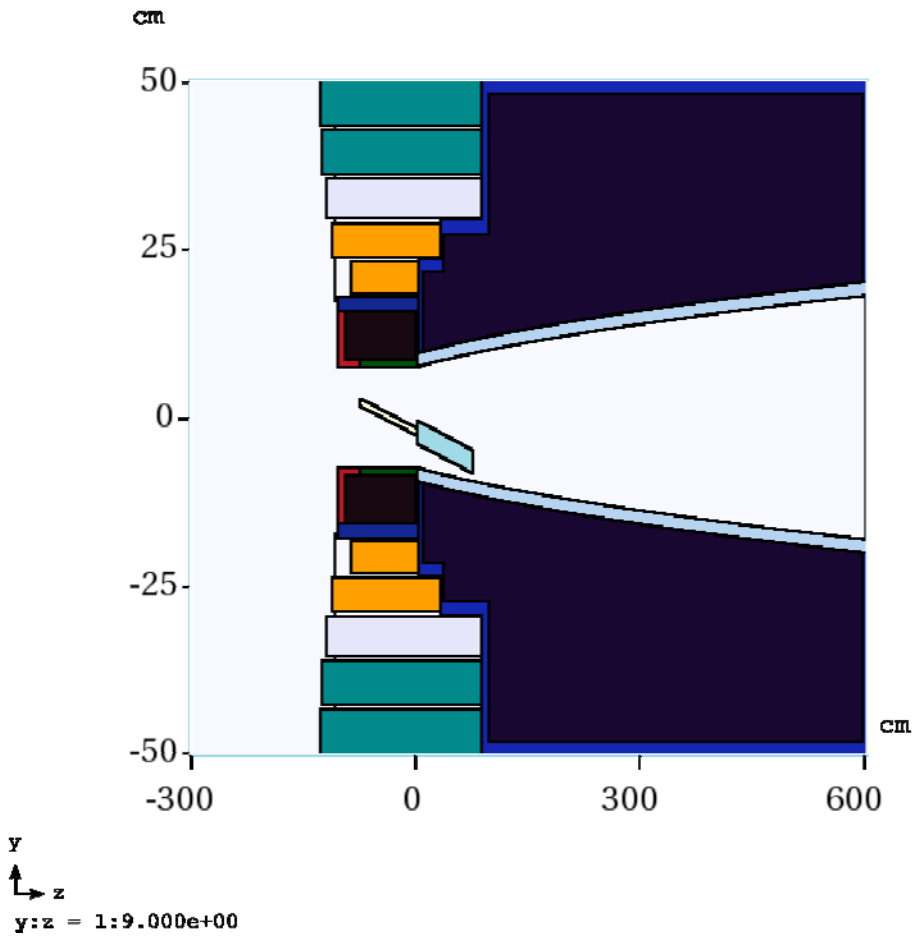




Dump Configuration

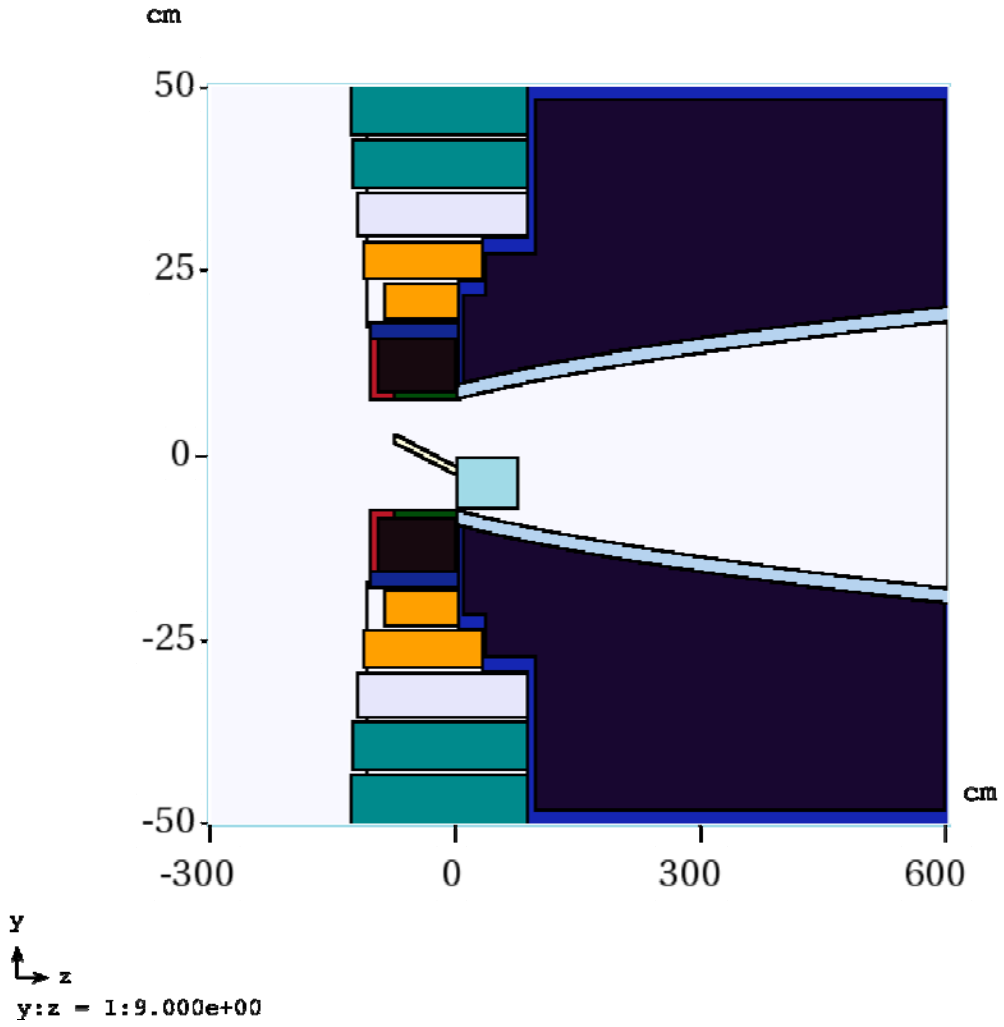
(Case3:left, Case 4: right)





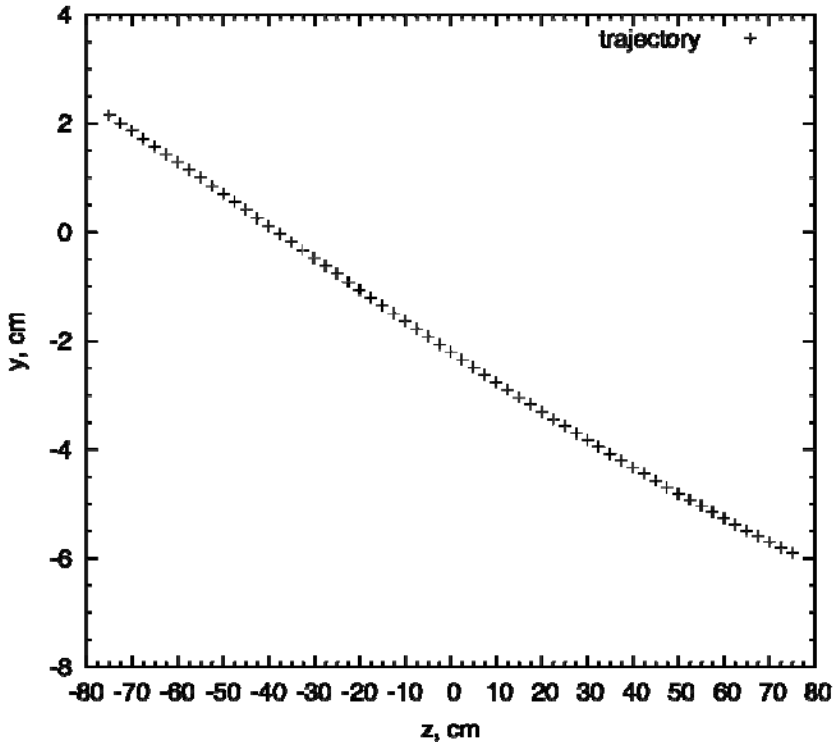
Dump Configuration

(Case7)

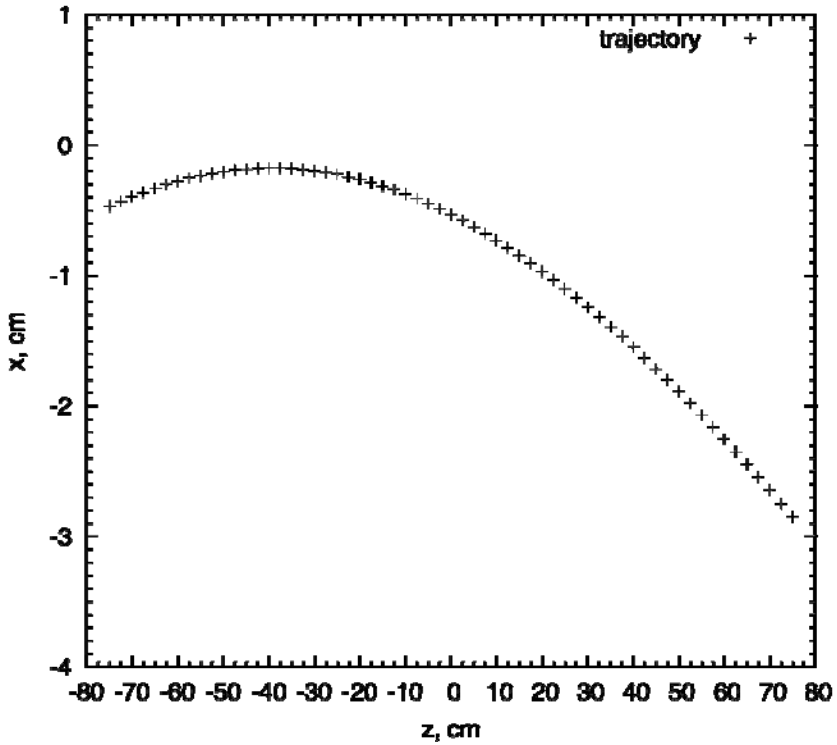


Single Proton Tracking

(KE=6.75 GeV)



Dump Range (z=0 to z=75cm)
Y=-(z+37.5)*tan(0.059)



Dump Range (z=0 to z=75cm)
x=-(z+37.5)*tan(0.059)*0.5238+0.6279

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 γ (Default:10^{-4} GeV);

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

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

Particle Production and Protons

(1000000 events, focal beam of 5 μm)

	Z (m)	Yield (pos)	Yield (neg)	Yield (sum)	Protons (all KE)	Protons (KE>=6 GeV)
Case1	0	78564	63541	142105	608753	187189
	5.5	74176	60825	135001	200685	10535
	50	72558	58935	131493	134542	1067
Case2	0	79441	63896	143337	609440	187136
	0.75	79333	63559	142892	407246	150936
	50	73024	58360	131384	129309	1113
Case3	0	81407	65399	146806	610537	186628
	0.75	77052	61589	138641	371875	108084
	50	71118	56982	128100	125467	1210
Case4	0	82084	66121	148205	611340	187322
	0.75	71951	57504	129455	340808	74087
	50	66987	53398	120385	119392	1096

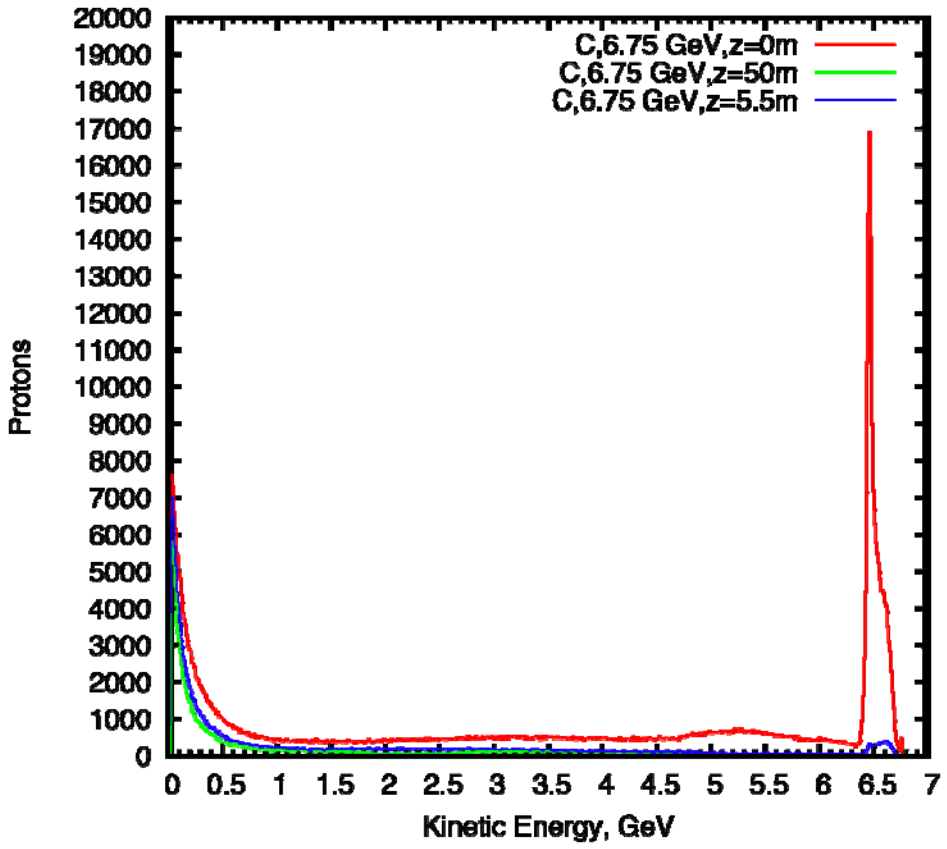
Particle Production and Protons

(1000000 events, focal beam of 5 μm)

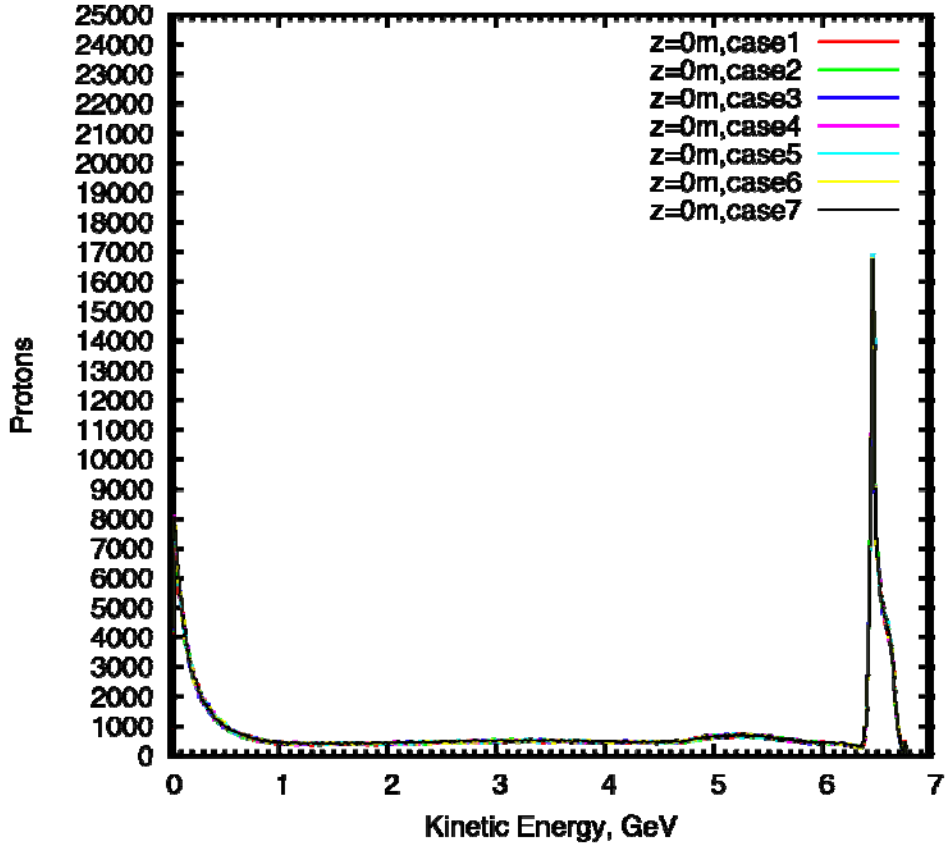
	Z (m)	Yield (pos)	Yield (neg)	Yield (sum)	Protons (all KE)	Protons (>= 6 GeV)
Case5	0	80108	64730	144838	610031	187652
	0.75	81939	66327	148266	395470	123986
	50	74845	60650	135495	133513	1107
Case6	0	81142	65881	147023	610618	186734
	0.75	79737	64745	144482	361150	78303
	50	73406	59453	132859	130006	1186
Case7	0	83116	66611	149727	610653	187051
	0.75	51614	40704	92318	281742	33458
	50	45440	36251	81964	89383	802

Energy Spectra of Protons

(1000000 events, focal beam of 5 μm)



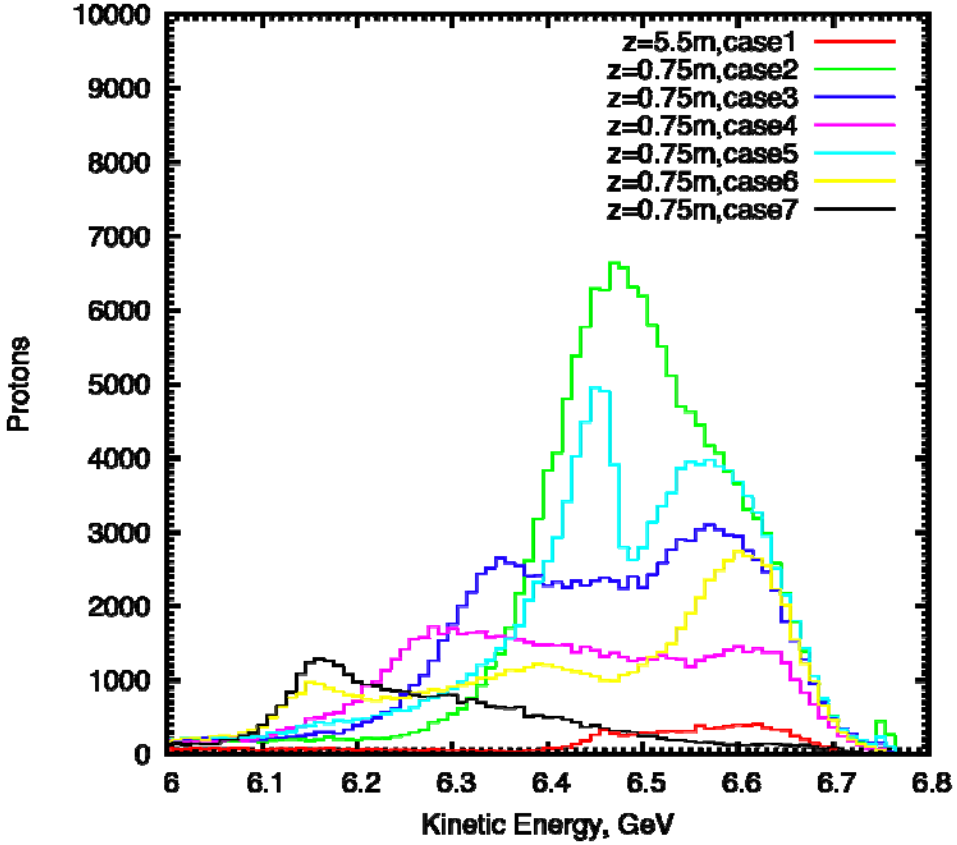
Case1 at z=0, 5.5, 50m



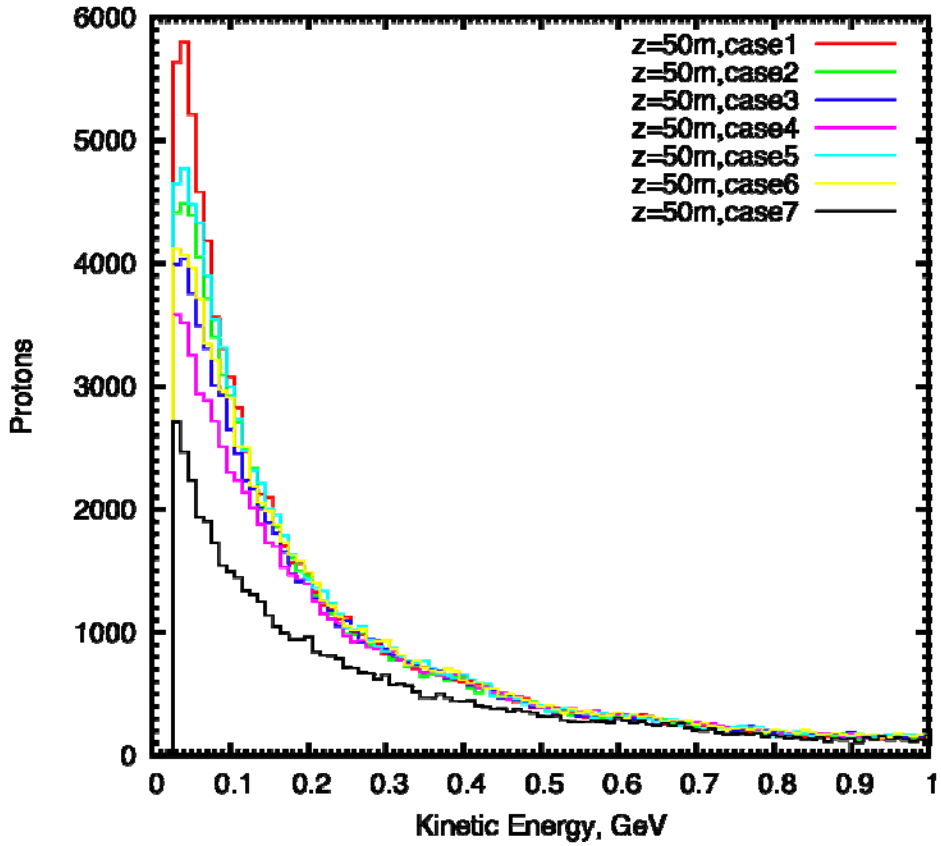
Case1-7 at z=0m

Energy Spectra of Protons (Cont'd)

(1000000 events, focal beam of 5 μm)



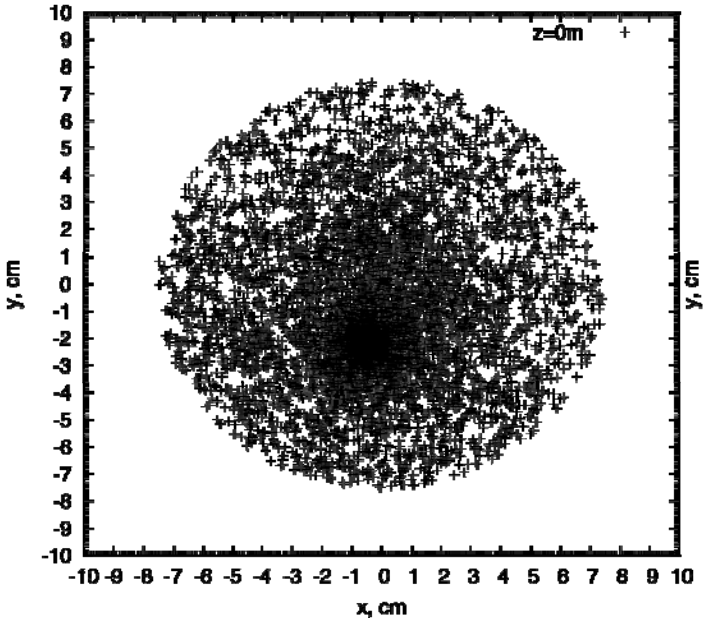
Case1-7 at end of dump



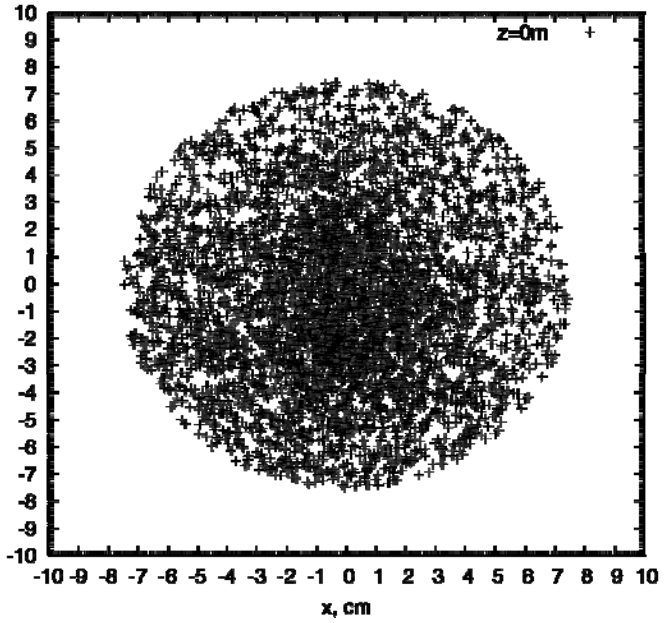
Case1-7 at z=50m

Proton Distribution (z=0m)

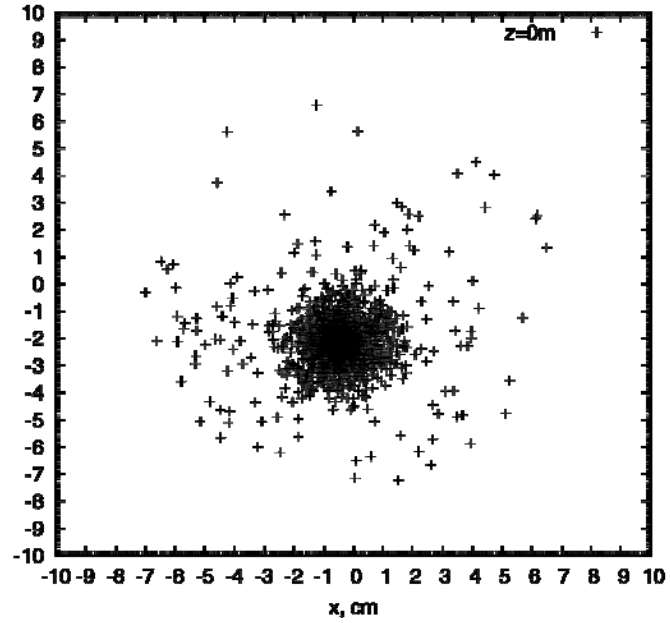
(Case1-case8, 10000 events, focal beam of 5 µm)



All KE



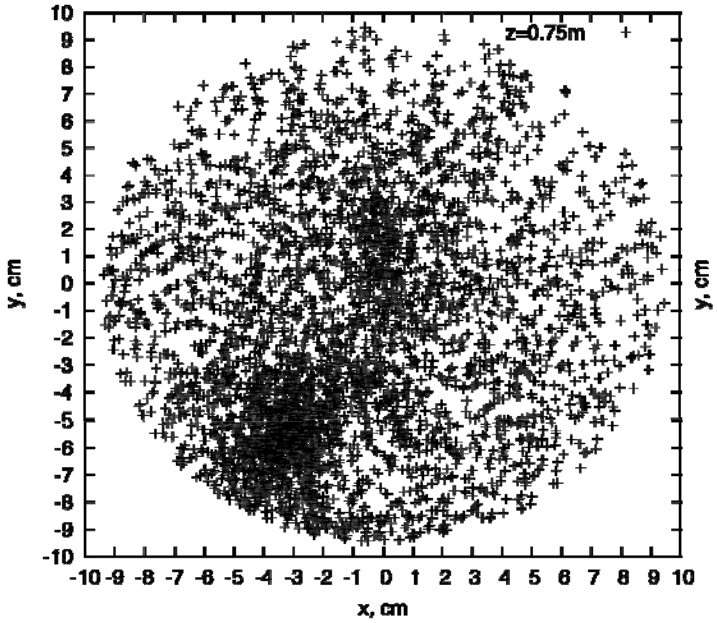
KE< =6 GeV



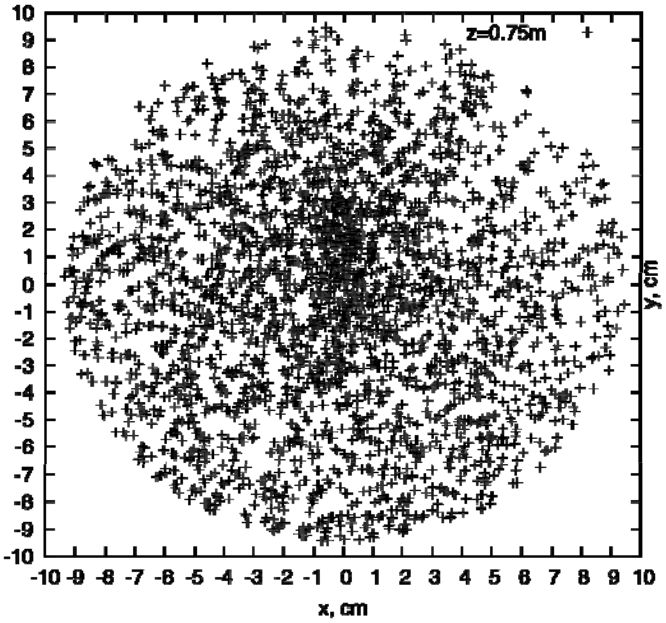
KE>= 6 GeV

Proton Distribution (z=0.75m)

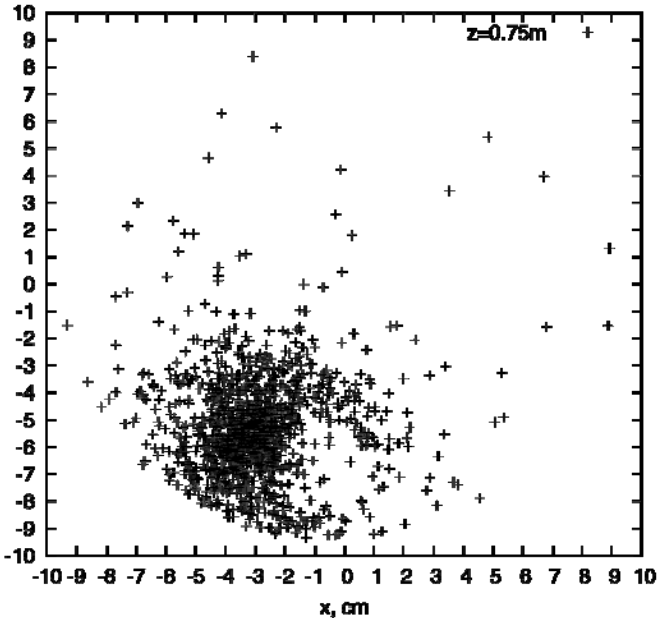
(Case3, 10000 events, focal beam of 5 μm)



All KE



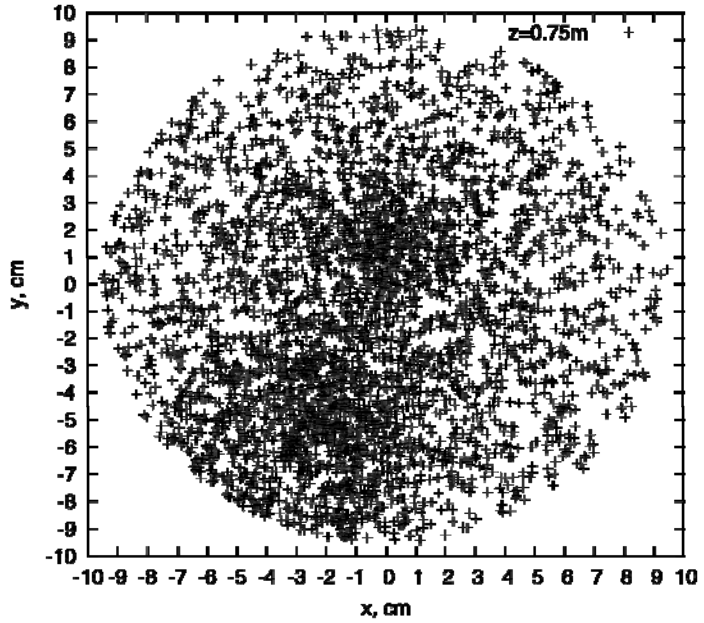
KE< =6 GeV



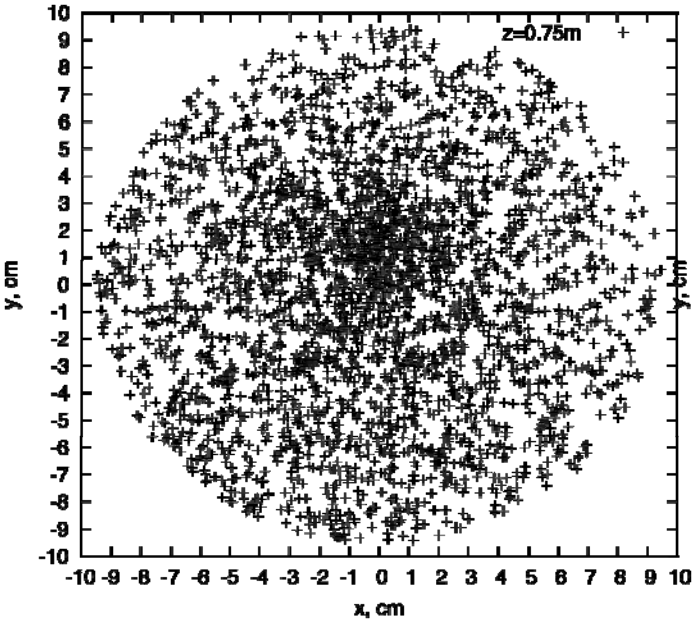
KE>= 6 GeV

Proton Distribution (z=0.75m)

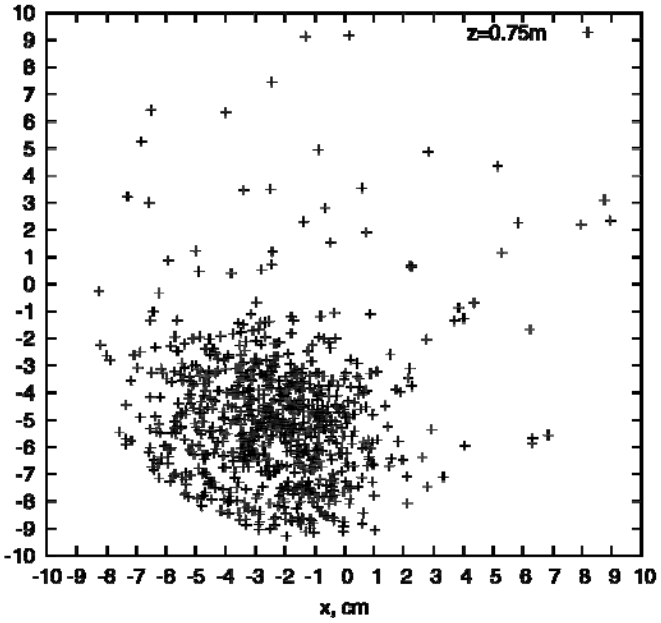
(Case6, 10000 events, focal beam of 5 μm)



All KE



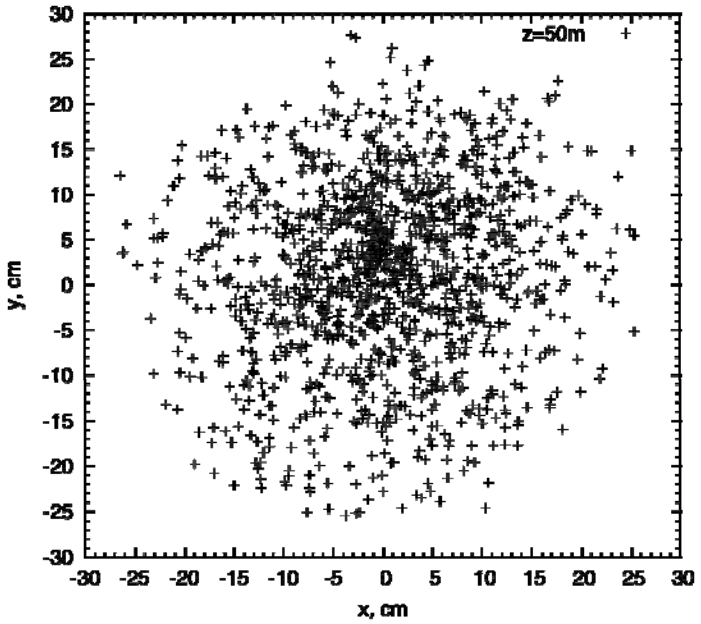
KE< =6 GeV



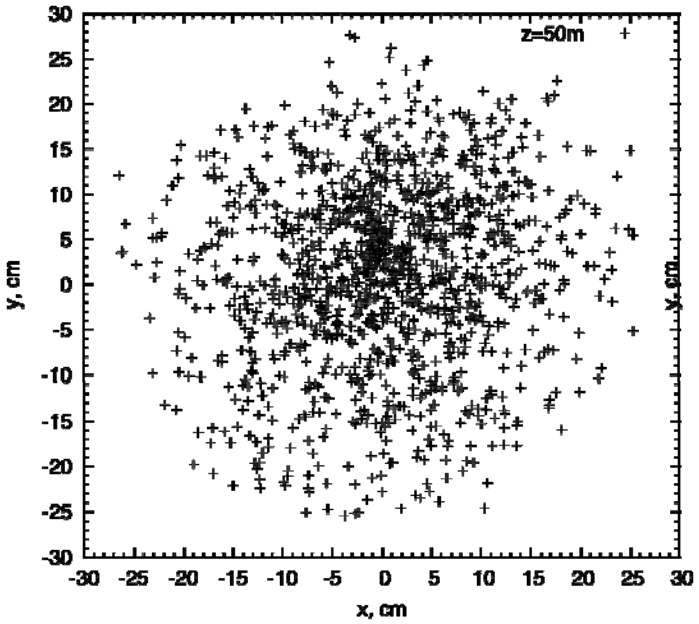
KE>= 6 GeV

Proton Distribution (z=50m)

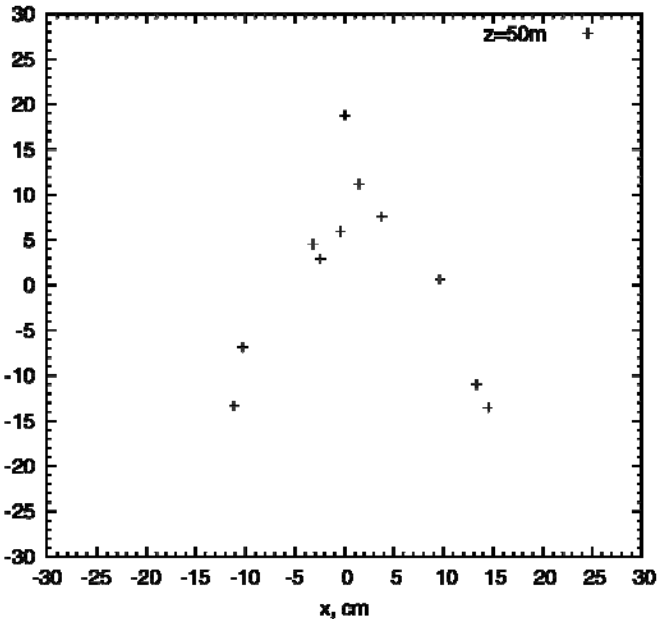
(Case3, 10000 events, focal beam of 5 µm)



All KE



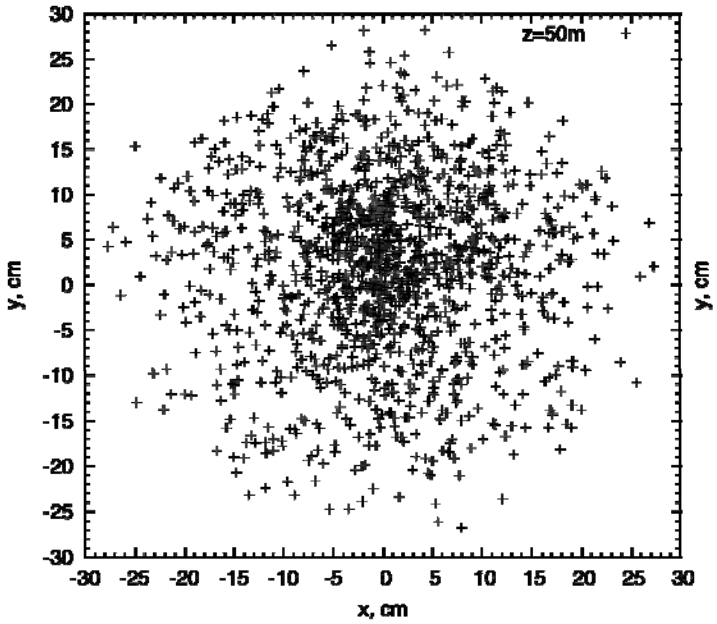
KE< =6 GeV



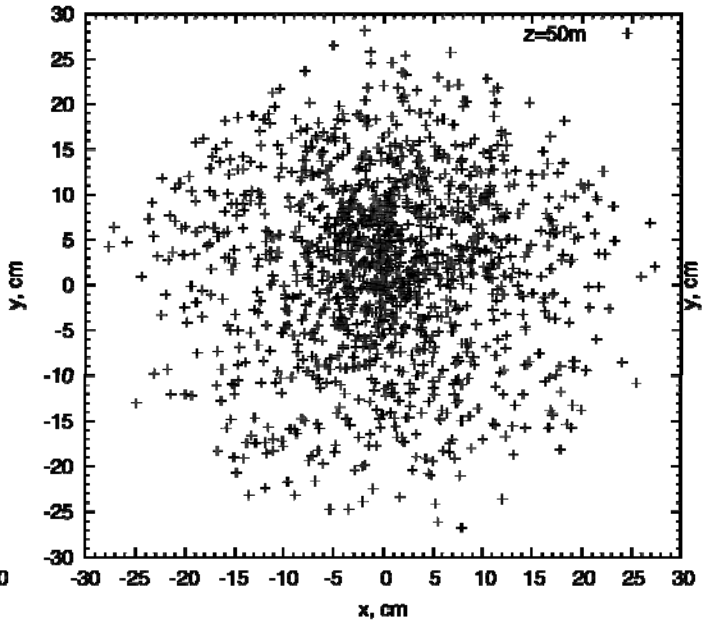
KE>= 6 GeV

Proton Distribution (z=50m)

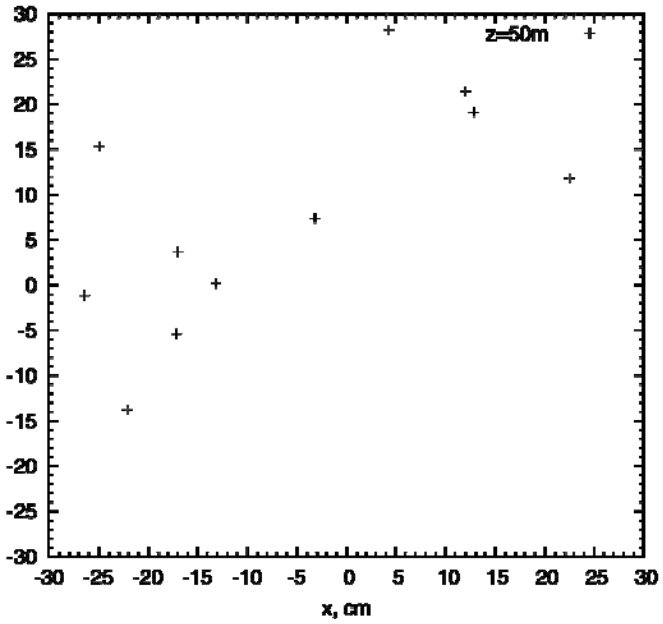
(Case6, 10000 events, focal beam of 5 μm)



All KE



KE< =6 GeV



KE>= 6 GeV