First performance study on luminosity monitor and active mask by JIM simulation

T.Tauchi, JLC weekly meeting,12/10,1999

For this study;

(1) Luminosity monitor

geometrical acceptance:

163 < z < 178 cm   and $0.05 < \theta < 0.15$ rad.

made of tungsten with no sensitive detector

segmentation:

r	32 divisions	$\Delta r \sim 5$mm
ϕ	16 divisions	$\Delta\phi \sim 3.2 - 9.7$ cm
z	128 divisions	$\Delta z \sim 1.17$mm

(2) Active mask (front part of conical mask)

geometrical acceptance:

30 < z < 37.5 cm   and $0.15 < \theta < 0.20$ rad.

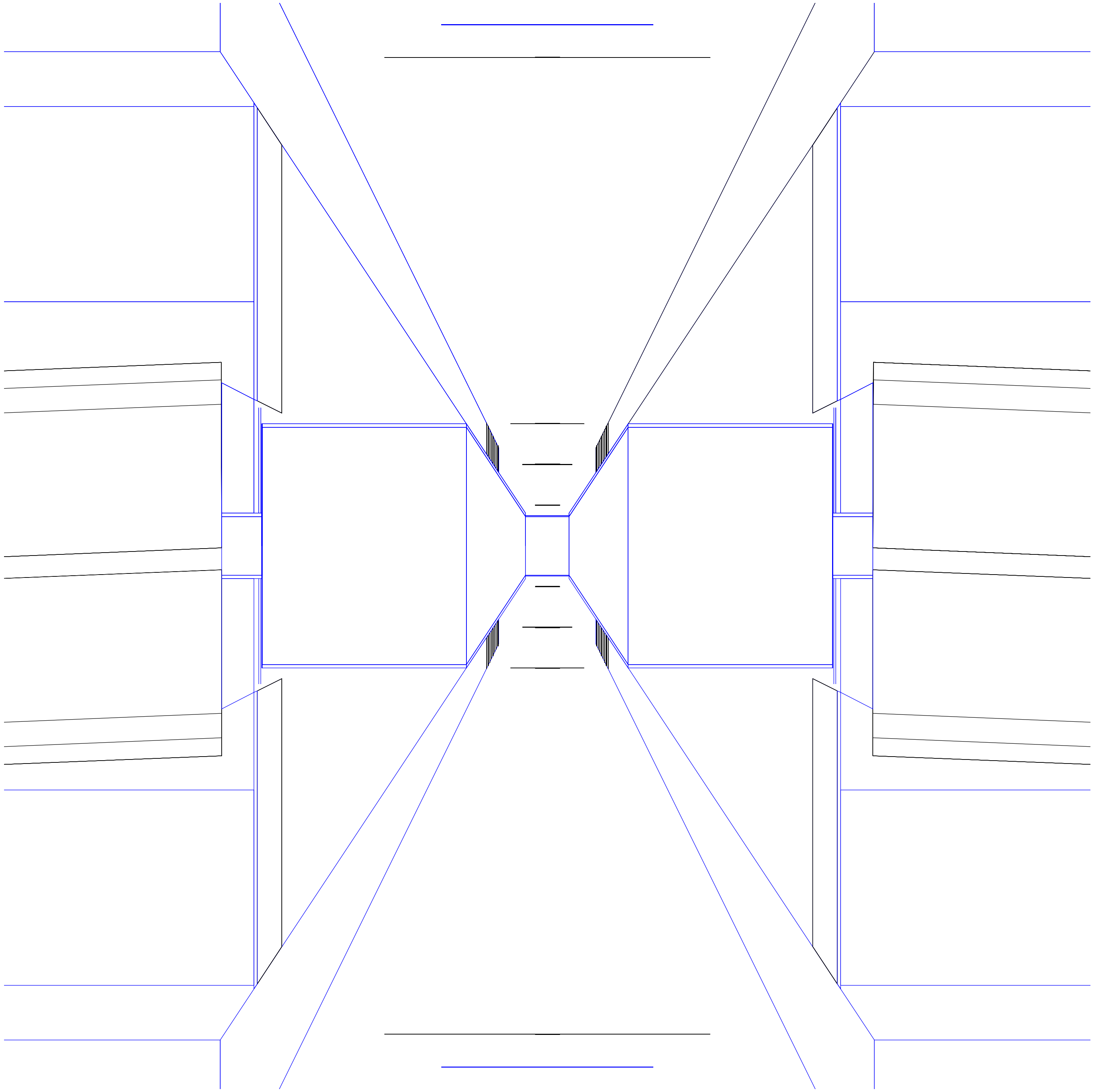
made of tungsten(W) and silicon pad(Si,200μm^t)

5mm^{t}W/Si/(1cm^{t}W/Si)^7 8 layers

segmentation:

r	8-10 divisions	Δr =2mm
ϕ	32 divisions	$\Delta\phi \sim 0.9 - 1.2$ cm

B = 2 Tesla and 3 Tesla



Generated events

(1) e^+e^- pairs by cain21d

parameter A at Ecm=500GeV

100 bunch crossings

correspond to 1 train crossing

(2) an electron/ muon into luminosity monitor and active mask

50 GeV and 250 GeV electrons

250 GeV muons

Simulation results

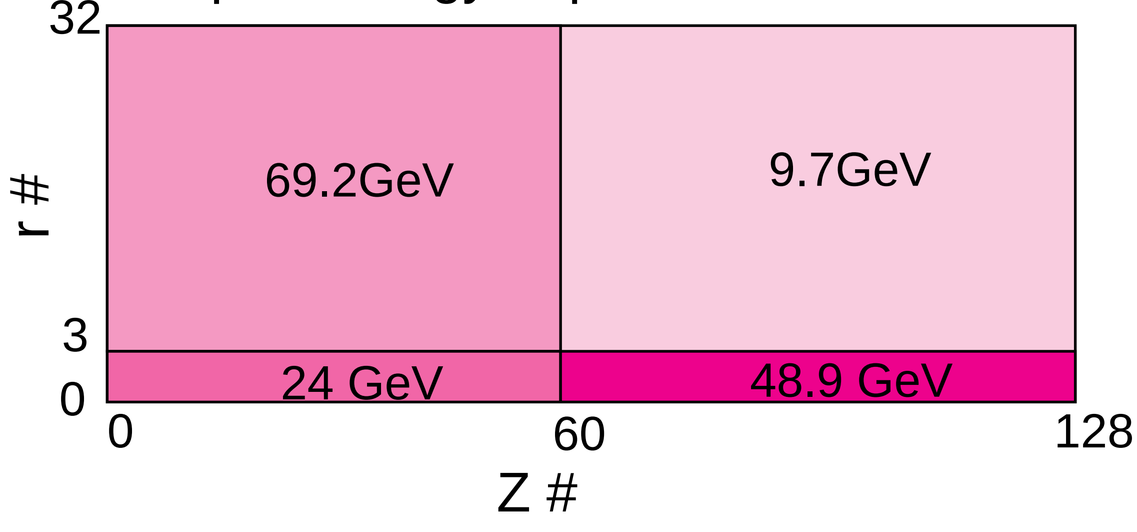
(1) Energy deposits in total volume

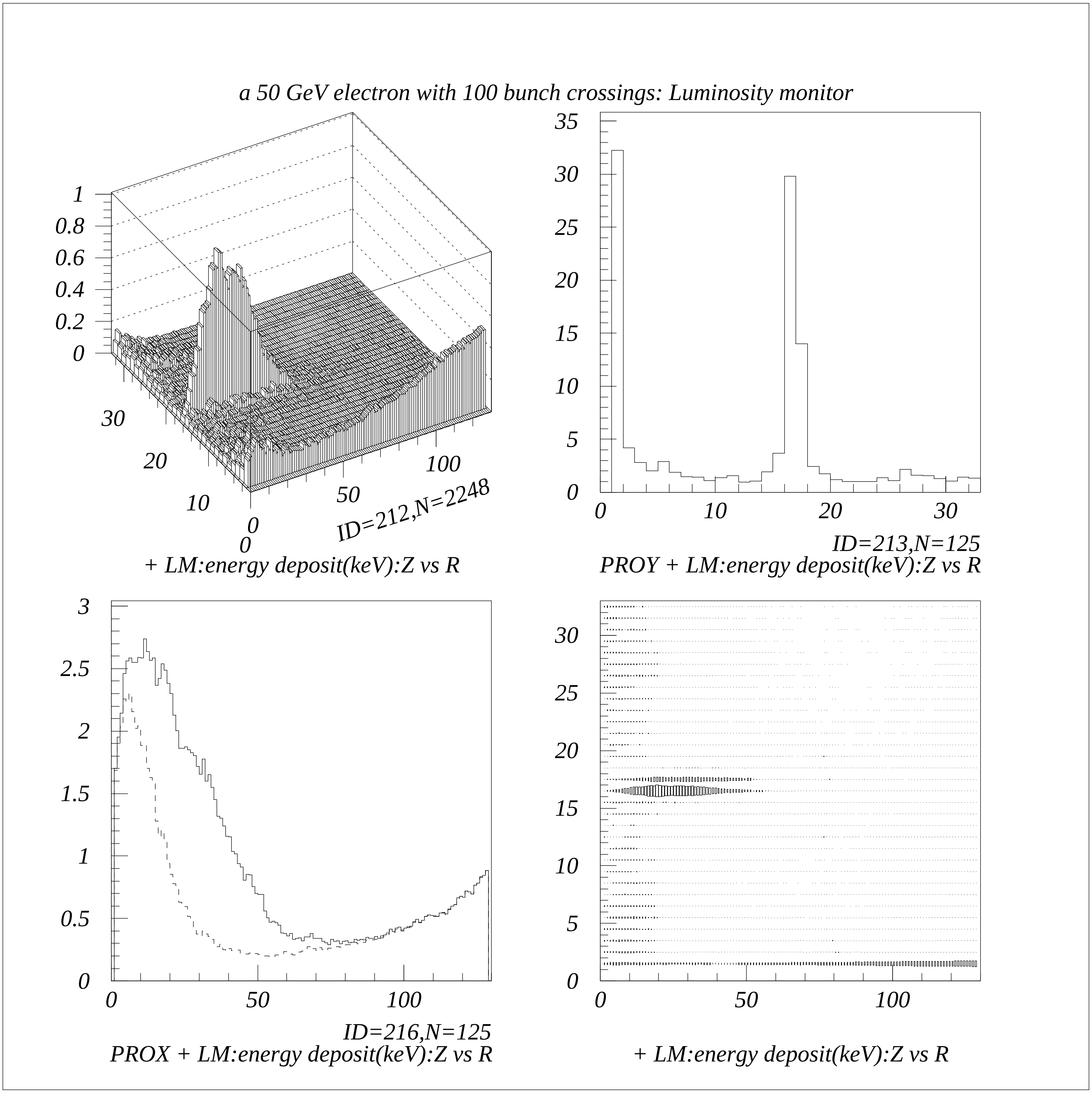
B=2T	e^+e^- pairs	50GeV e	250GeV e	250GeV μ
am	264MeV	120.4MeV	541.0MeV	0.48MeV
		121.7MeV	548.0MeV for 10 layers	
lm	152GeV	49.9GeV	249.5GeV	1.67GeV

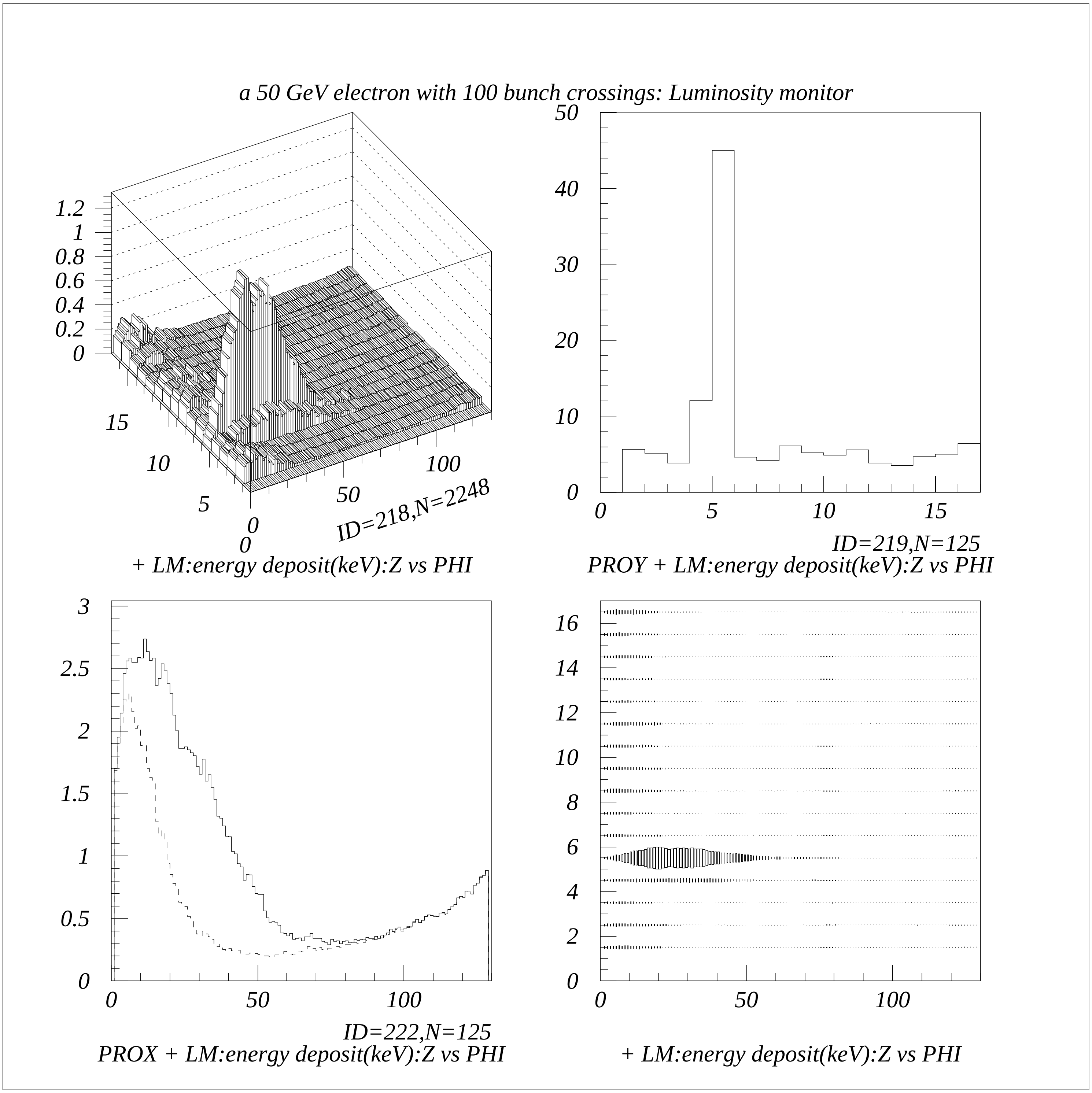
B=3T	e^+e^- pairs
am	29.3MeV
lm	46.7GeV

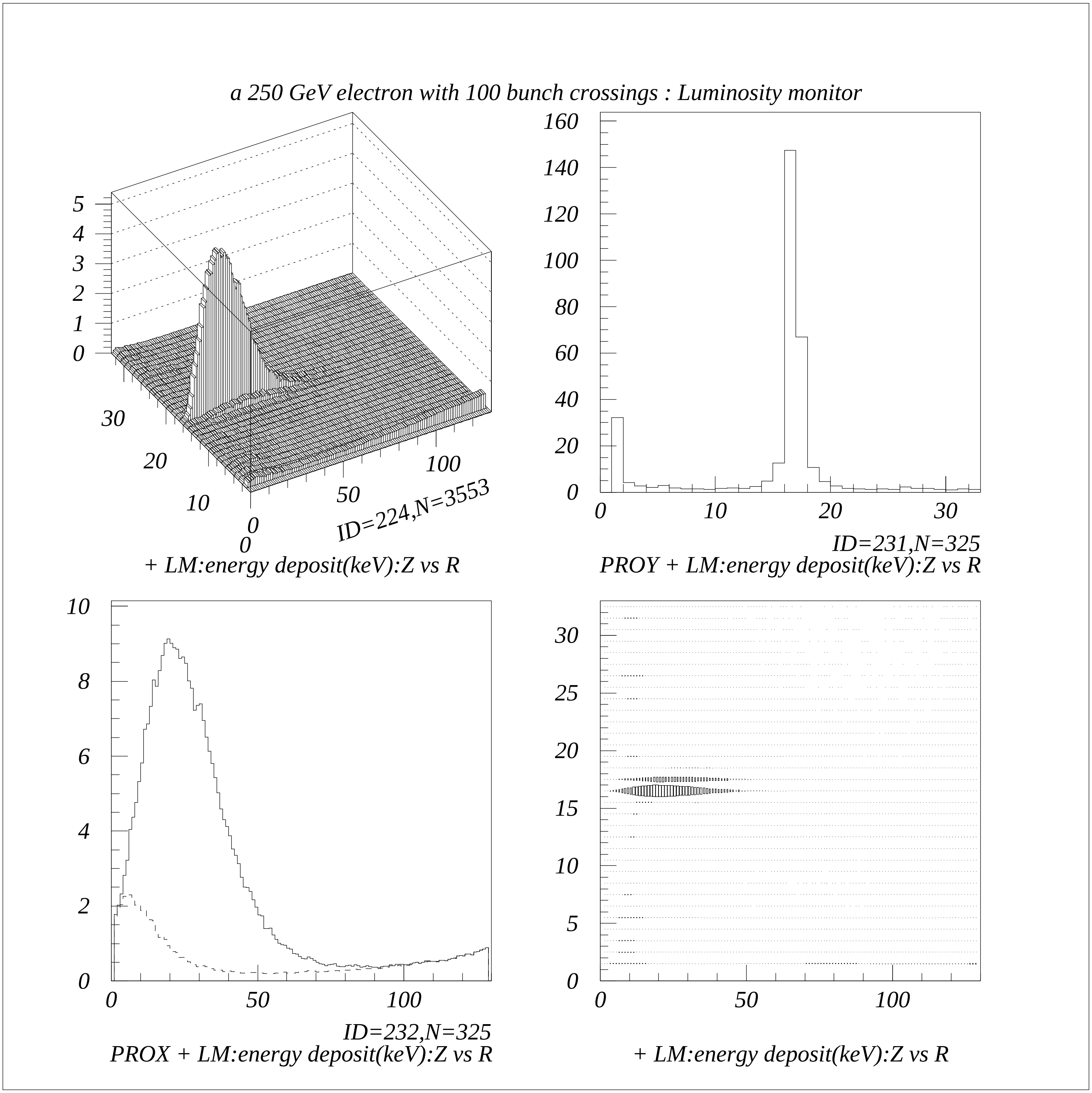
am=active mask, lm=luminosity monitor

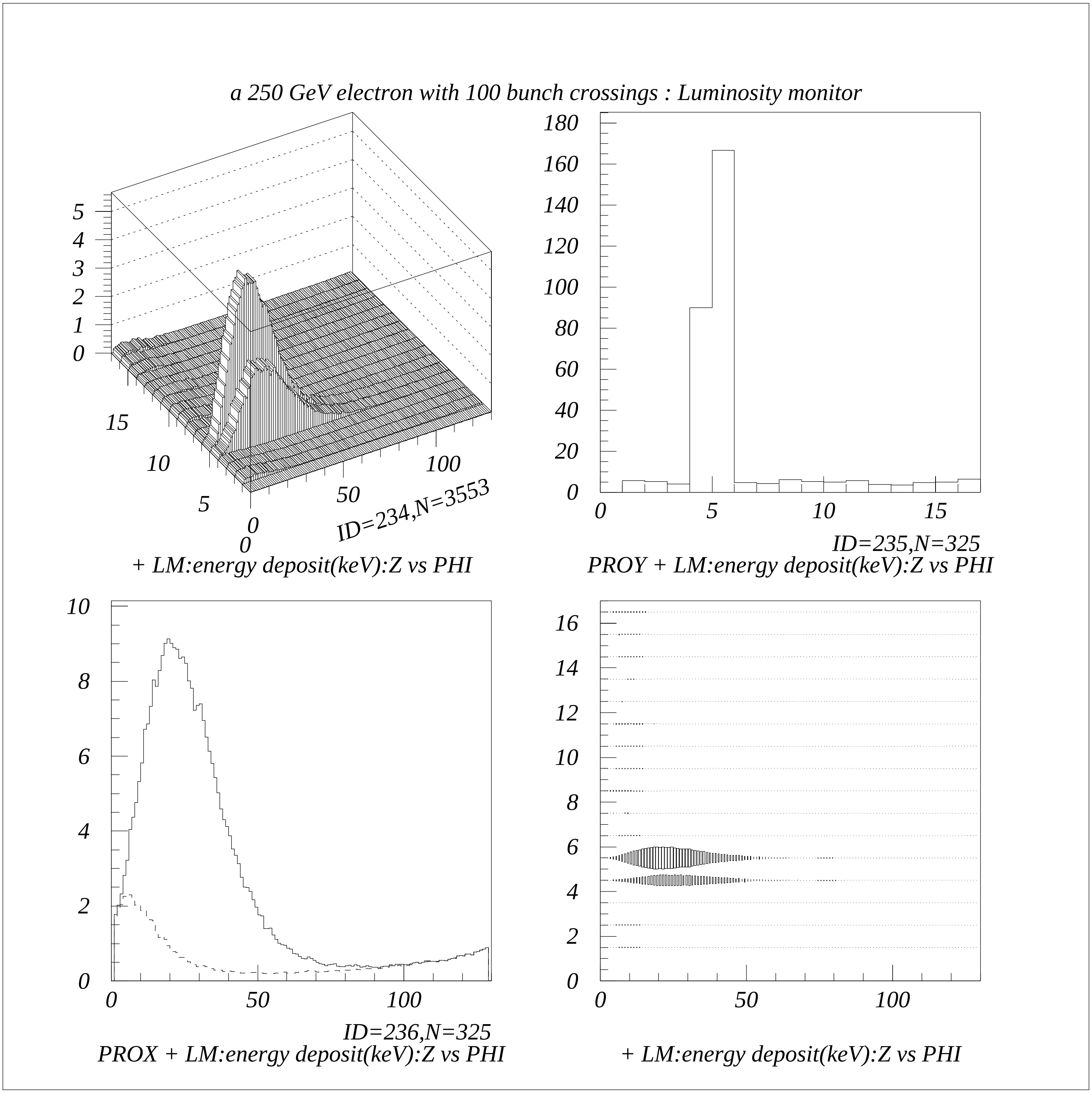
Map of energy deposit in lm at B=2 T

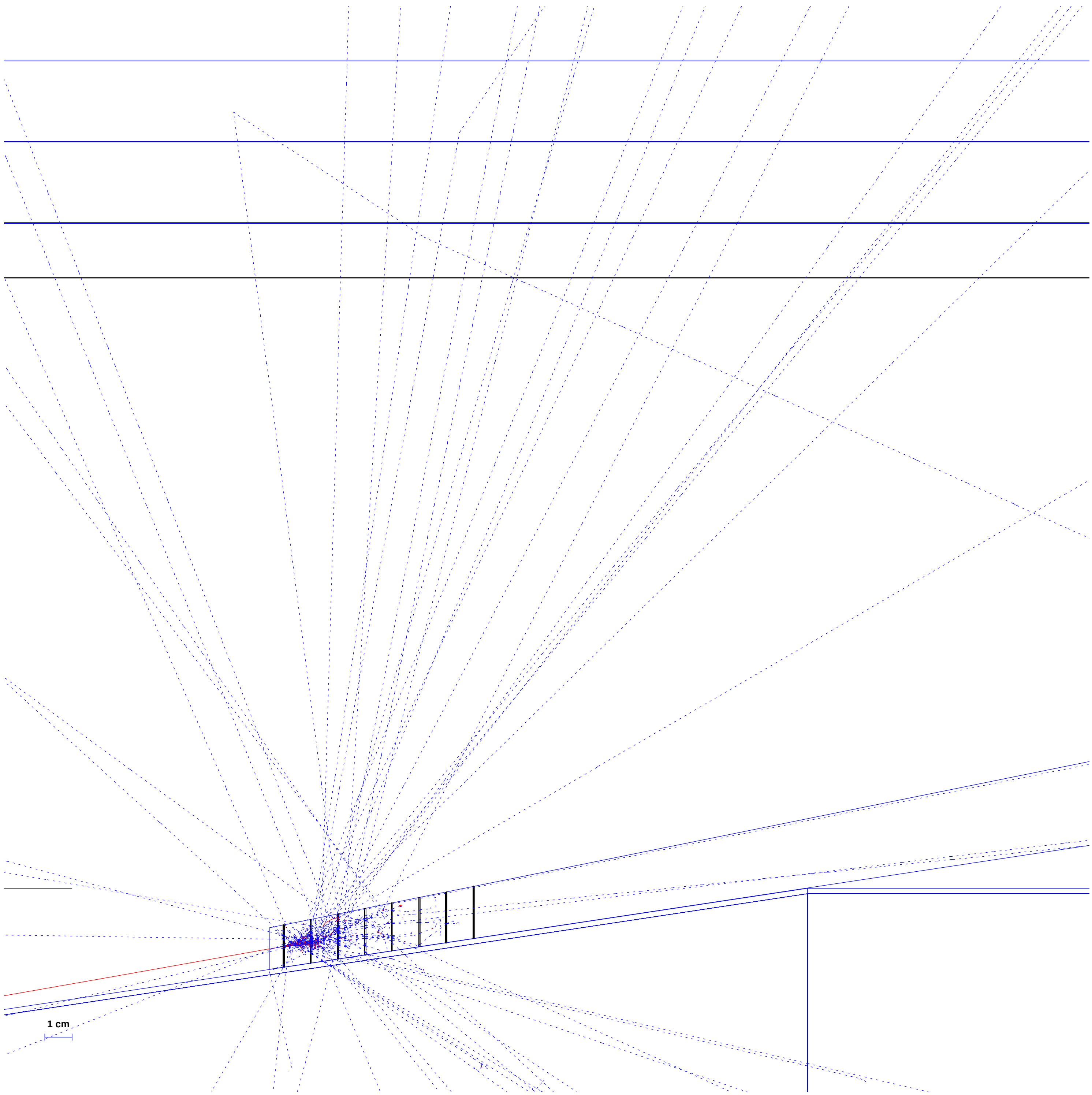


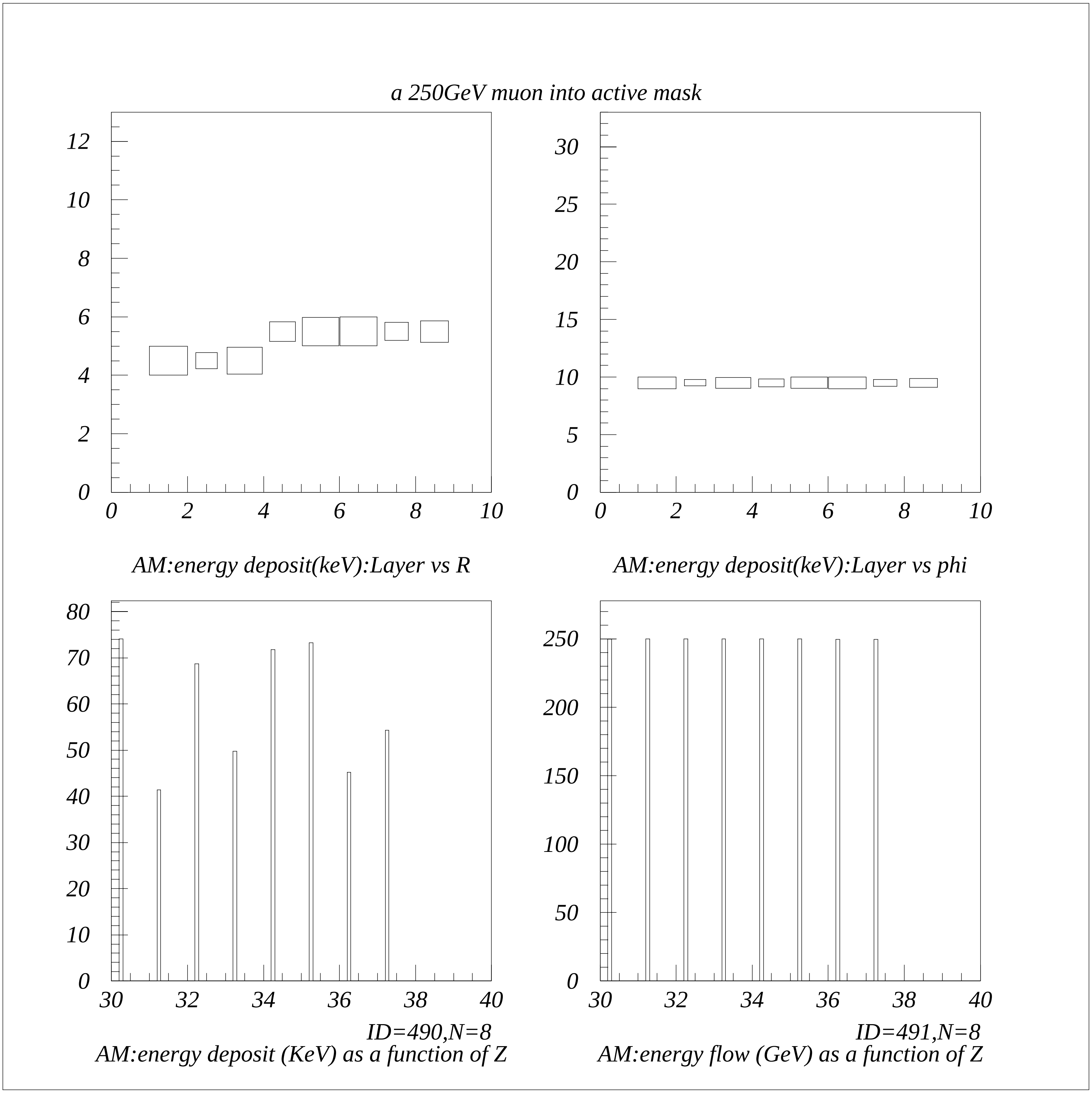

a 50 GeV electron with 100 bunch crossings: Luminosity monitor
ID=212,N=2248
+ LM:energy deposit(keV):Z vs R
ID=213,N=125
PROY + LM:energy deposit(keV):Z vs R
ID=216,N=125
PROX + LM:energy deposit(keV):Z vs R
+ LM:energy deposit(keV):Z vs R

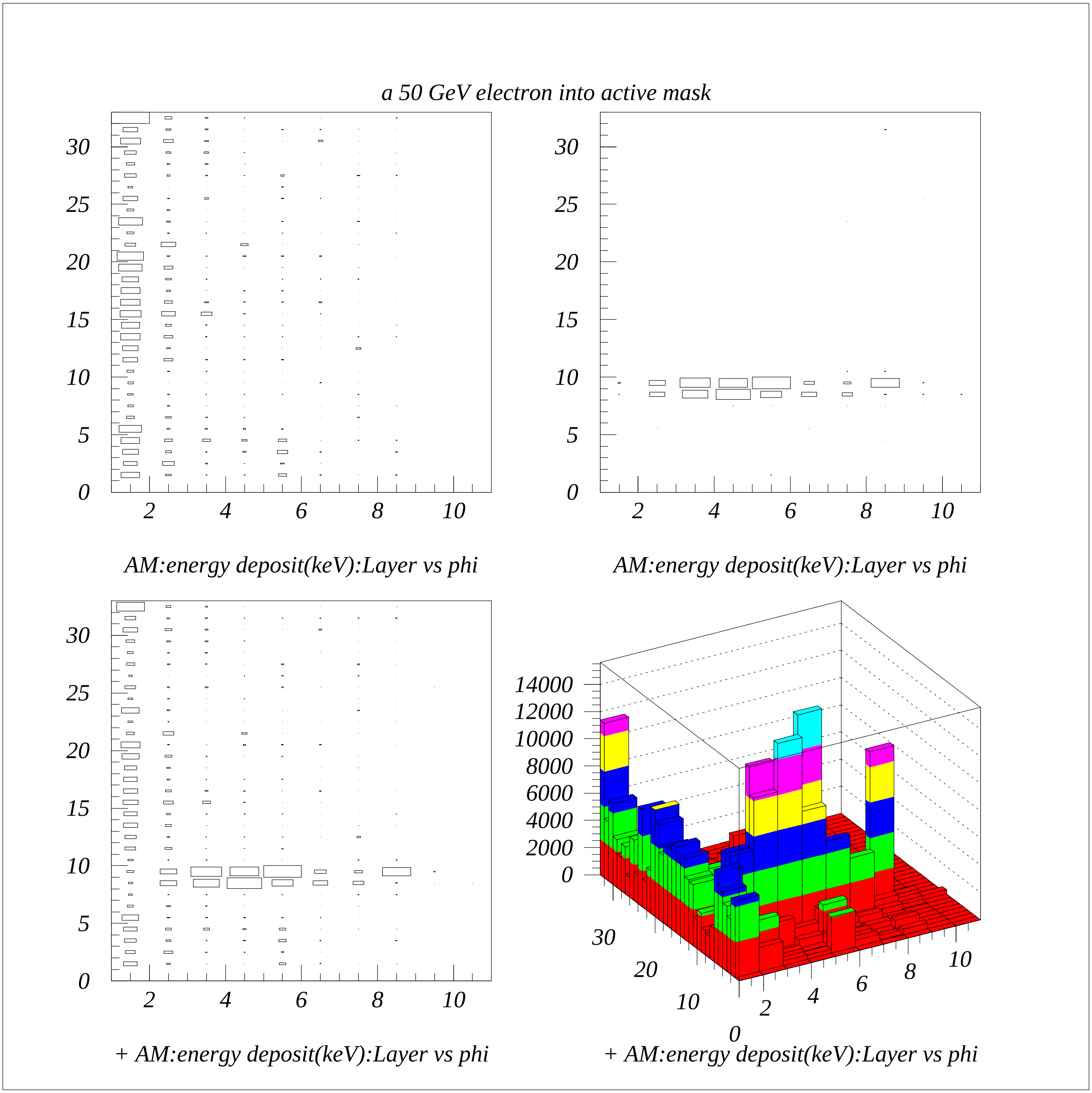

a 50 GeV electron with 100 bunch crossings: Luminosity monitor
ID=218,N=2248
+ LM:energy deposit(keV):Z vs PHI
ID=219,N=125
PROY + LM:energy deposit(keV):Z vs PHI
ID=222,N=125
PROX + LM:energy deposit(keV):Z vs PHI
+ LM:energy deposit(keV):Z vs PHI

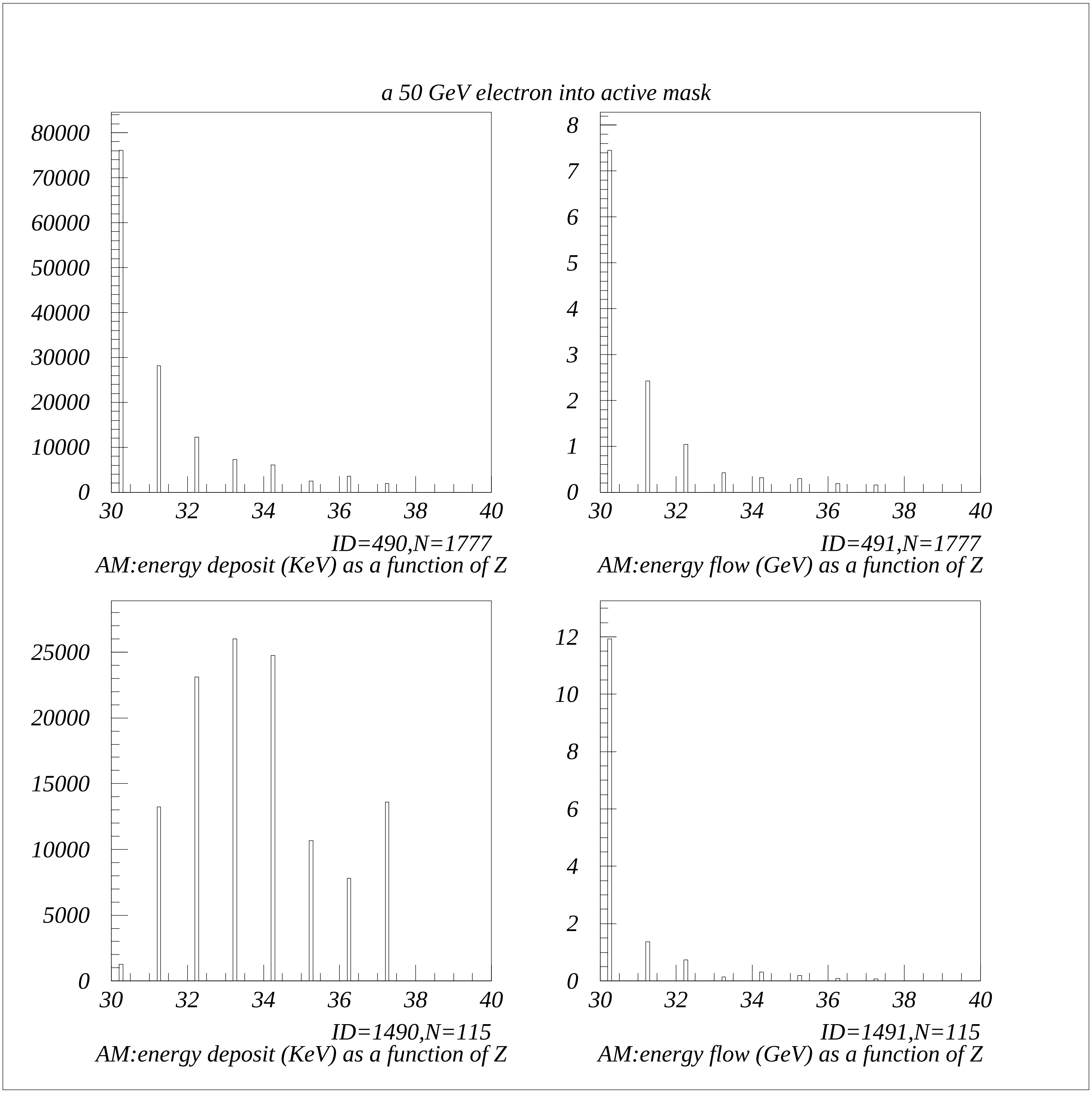

a 250 GeV electron with 100 bunch crossings : Luminosity monitor
ID=224,N=3553
+ LM:energy deposit(keV):Z vs R
ID=231,N=325
PROY + LM:energy deposit(keV):Z vs R
ID=232,N=325
PROX + LM:energy deposit(keV):Z vs R
+ LM:energy deposit(keV):Z vs R

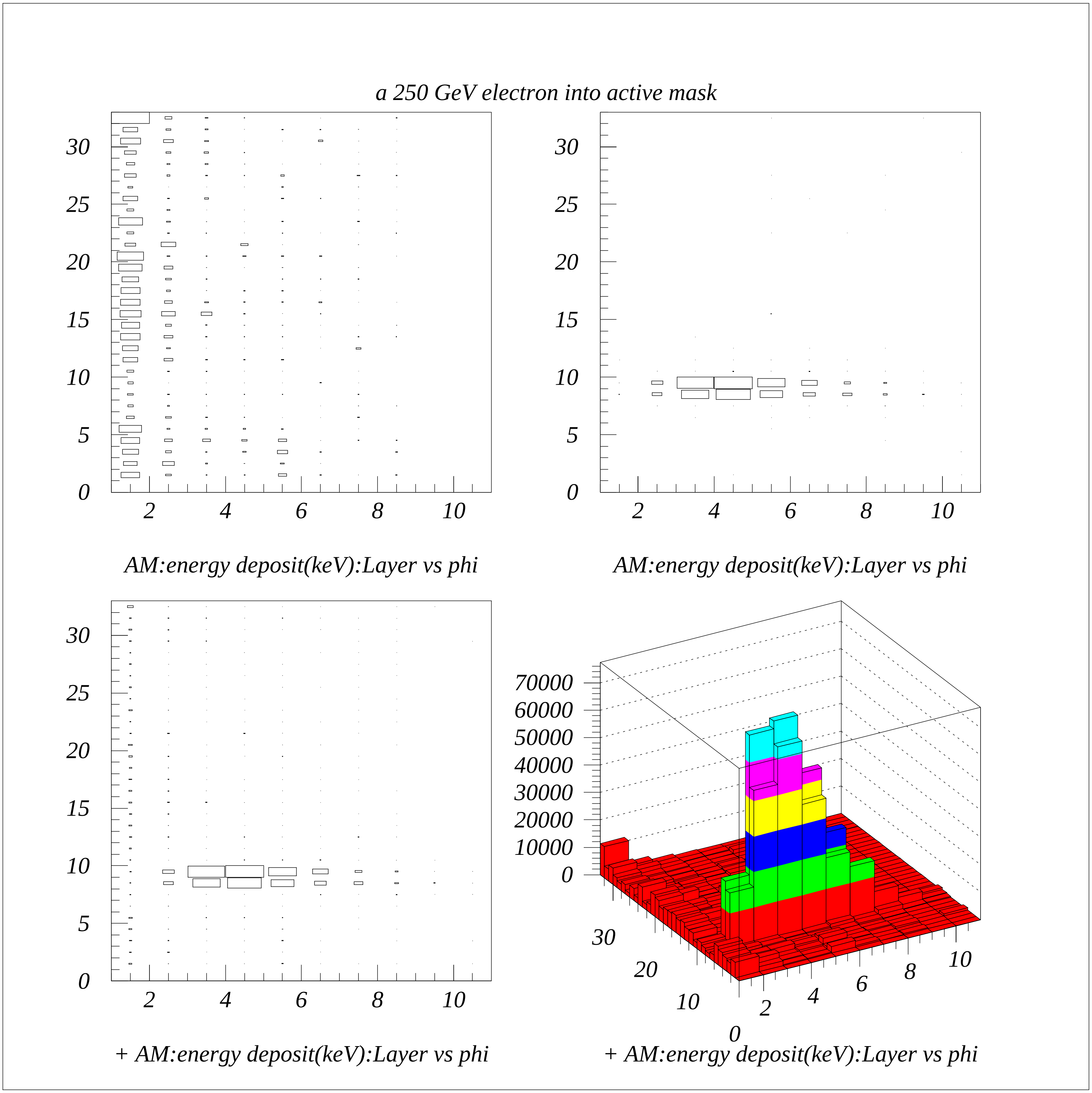

a 250 GeV electron with 100 bunch crossings : Luminosity monitor
ID=234,N=3553
+ LM:energy deposit(keV):Z vs PHI
ID=235,N=325
PROY + LM:energy deposit(keV):Z vs PHI
ID=236,N=325
PROX + LM:energy deposit(keV):Z vs PHI
+ LM:energy deposit(keV):Z vs PHI

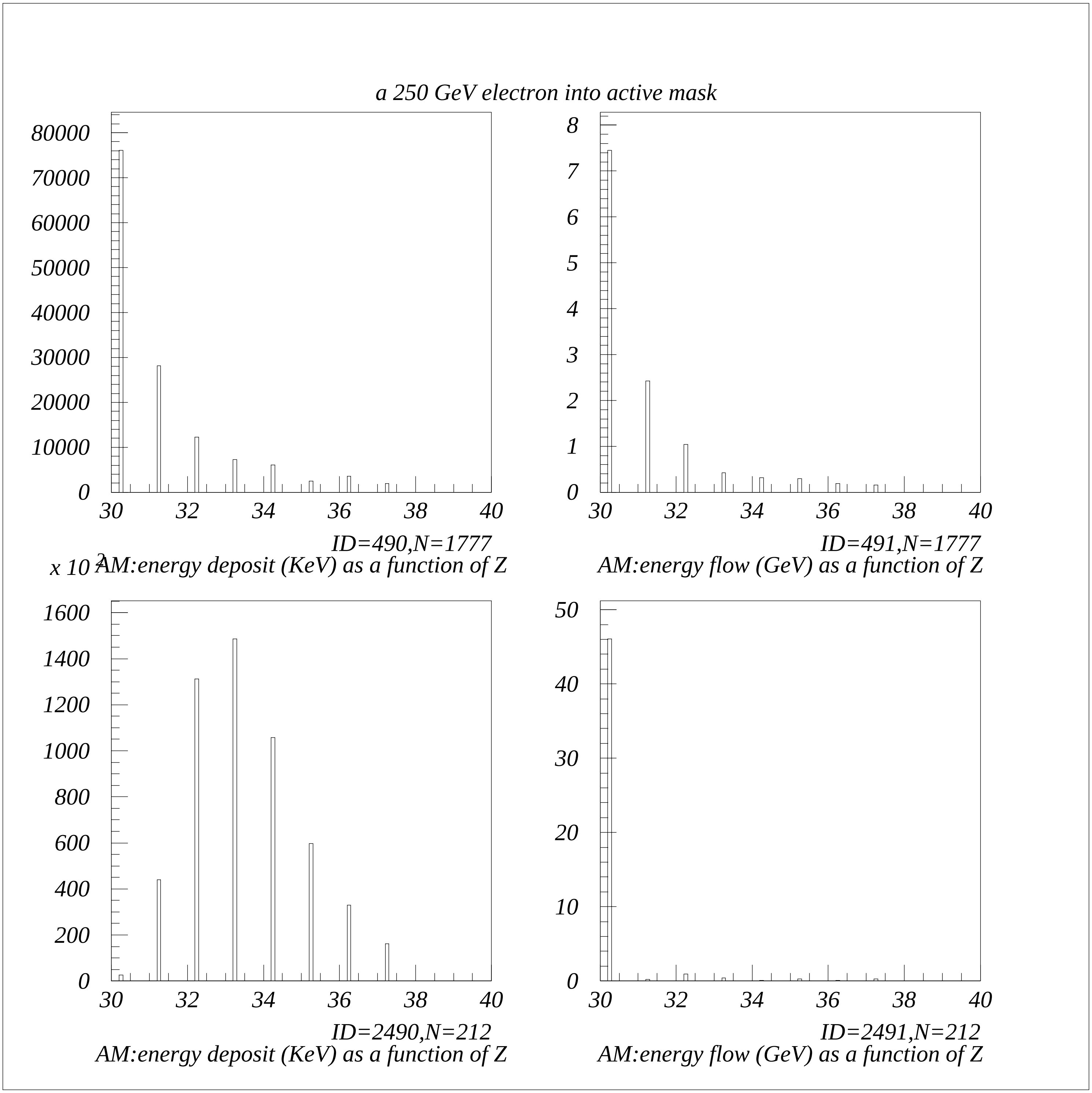

1 cm

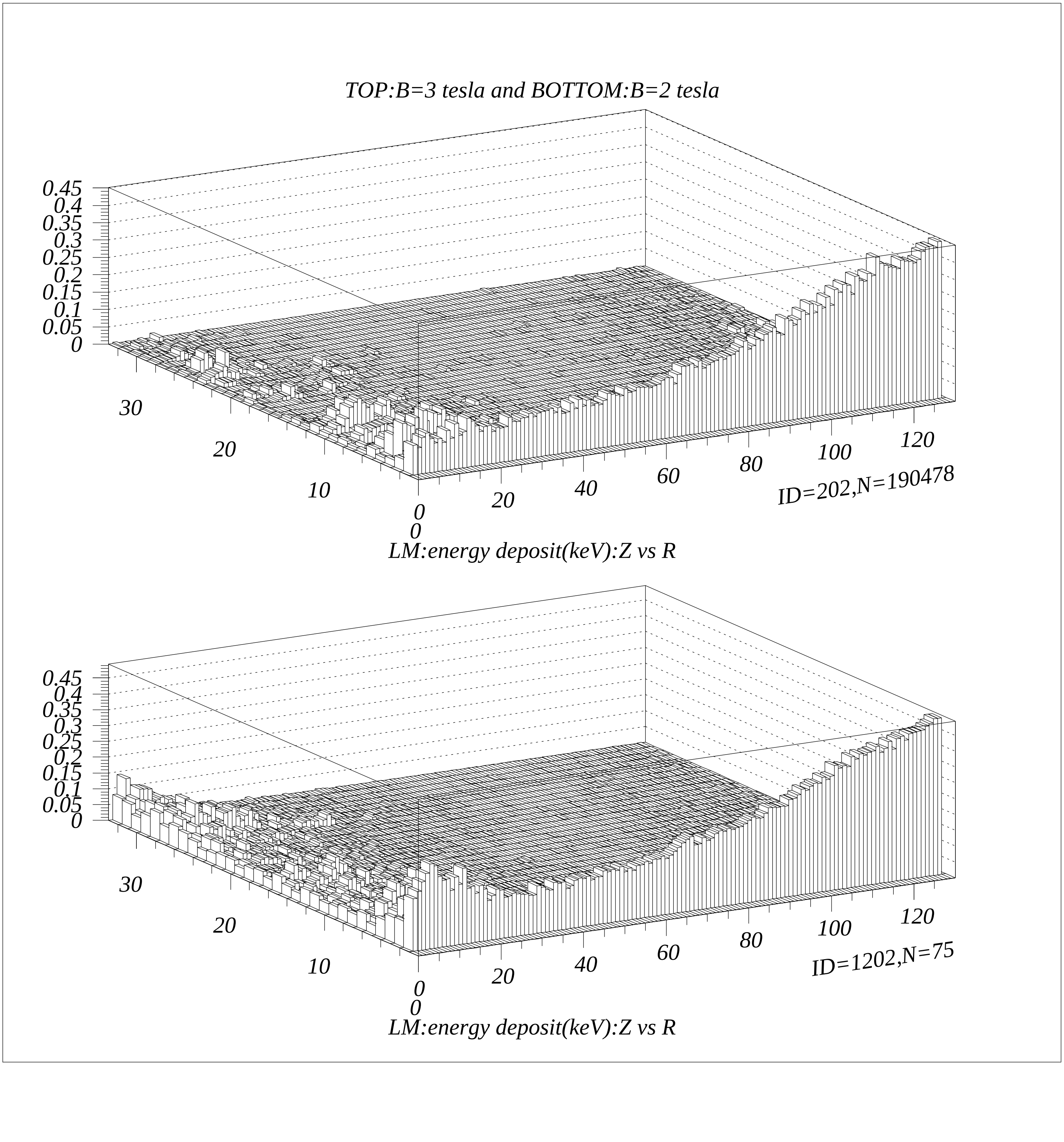

a 250GeV muon into active mask
AM:energy deposit(keV):Layer vs R
AM:energy deposit(keV):Layer vs phi
ID=490,N=8
AM:energy deposit (KeV) as a function of Z
ID=491,N=8
AM:energy flow (GeV) as a function of Z

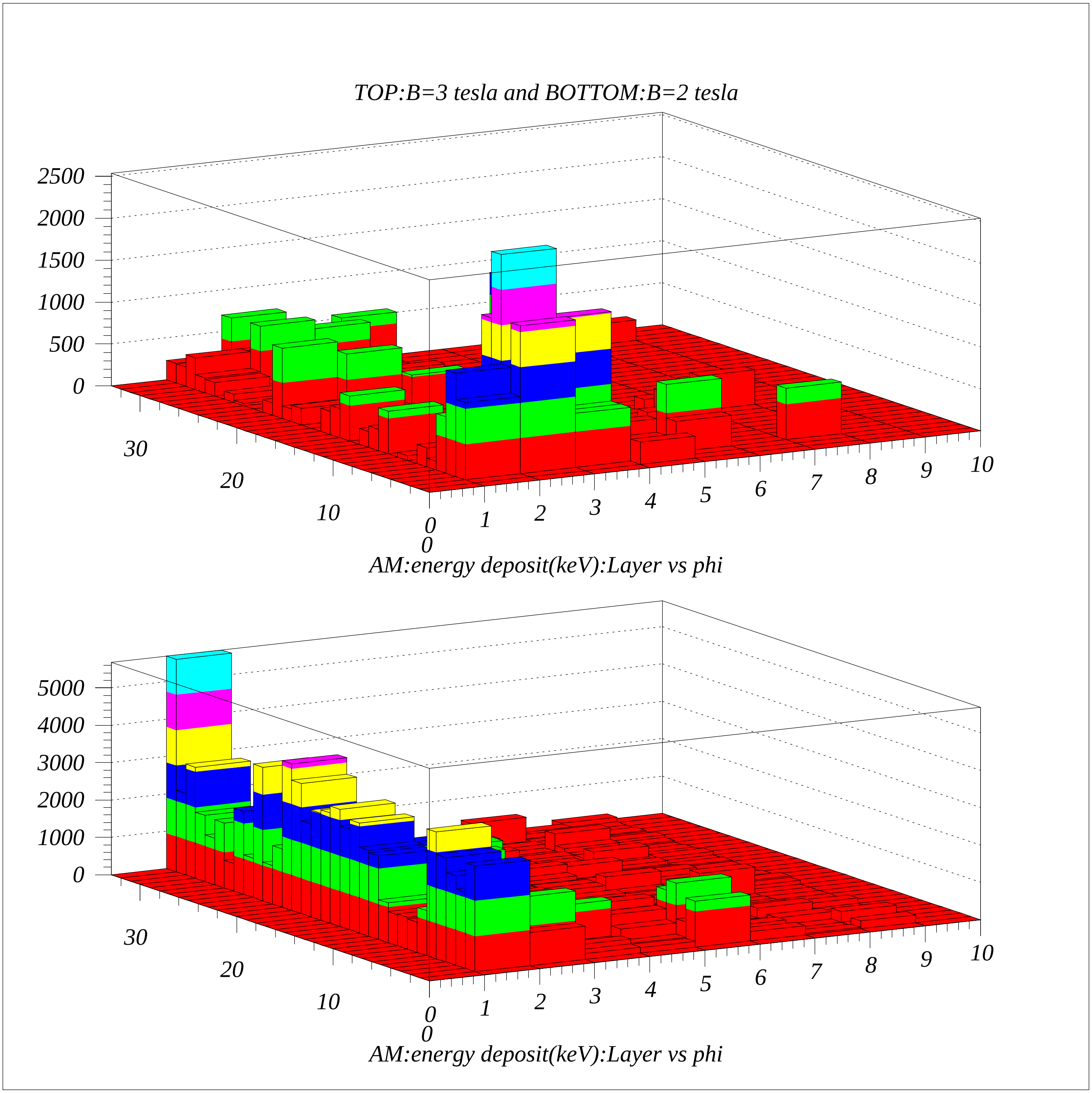

a 50 GeV electron into active mask
AM:energy deposit(keV):Layer vs phi
AM:energy deposit(keV):Layer vs phi
+ AM:energy deposit(keV):Layer vs phi
+ AM:energy deposit(keV):Layer vs phi
0
5
10
15
20
25
30
2
4
6
8
10
14000
12000
10000
8000
6000
4000
2000


a 50 GeV electron into active mask
80000
70000
60000
50000
40000
30000
20000
10000
0
30
32
34
36
38
40
ID=490,N=1777
AM:energy deposit (KeV) as a function of Z
8
7
6
5
4
3
2
1
0
30
32
34
36
38
40
ID=491,N=1777
AM:energy flow (GeV) as a function of Z
25000
20000
15000
10000
5000
0
30
32
34
36
38
40
ID=1490,N=115
AM:energy deposit (KeV) as a function of Z
12
10
8
6
4
2
0
30
32
34
36
38
40
ID=1491,N=115
AM:energy flow (GeV) as a function of Z


a 250 GeV electron into active mask
AM:energy deposit(keV):Layer vs phi
AM:energy deposit(keV):Layer vs phi
+ AM:energy deposit(keV):Layer vs phi
+ AM:energy deposit(keV):Layer vs phi


a 250 GeV electron into active mask
ID=490,N=1777
AM:energy deposit (KeV) as a function of Z
ID=491,N=1777
AM:energy flow (GeV) as a function of Z
x 10 2
ID=2490,N=212
AM:energy deposit (KeV) as a function of Z
ID=2491,N=212
AM:energy flow (GeV) as a function of Z


TOP:B=3 tesla and BOTTOM:B=2 tesla
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
30
20
10
0
0
20
40
60
80
100
120
ID=202,N=190478
LM:energy deposit(keV):Z vs R
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
30
20
10
0
0
20
40
60
80
100
120
ID=1202,N=75
LM:energy deposit(keV):Z vs R


TOP:B=3 tesla and BOTTOM:B=2 tesla
2500
2000
1500
1000
500
0
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
AM:energy deposit(keV):Layer vs phi
5000
4000
3000
2000
1000
0
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
AM:energy deposit(keV):Layer vs phi

Conclusions

(1) Lumonisity monitor

Among the total energy deposit of 152 (46.7) GeV/train due to e^+e^- pairs, only 54*(14*)GeV comes from the front at B=2(3)T, while most comes from the inner-back.
(* sum of incomming energies)

ϕ segmentation (16 div.) is very important,
r segmentation is desired to dertermine θ with $\delta\theta$~a few m radian.

So, a fine-segmented W/Silicon calorimeter seems to be ideal. Thickness of tungsten must be optimized in terms of energy-resolution.

(2) Active Mask

First layer ($5mm^t$ W) has ~ 50% energy deposit for e^+e^- pairs.

ϕ segmentation (32 div.) is very important.

8 layers of W/Si-pad calorimeter works very well for vetoing high energy electrons.