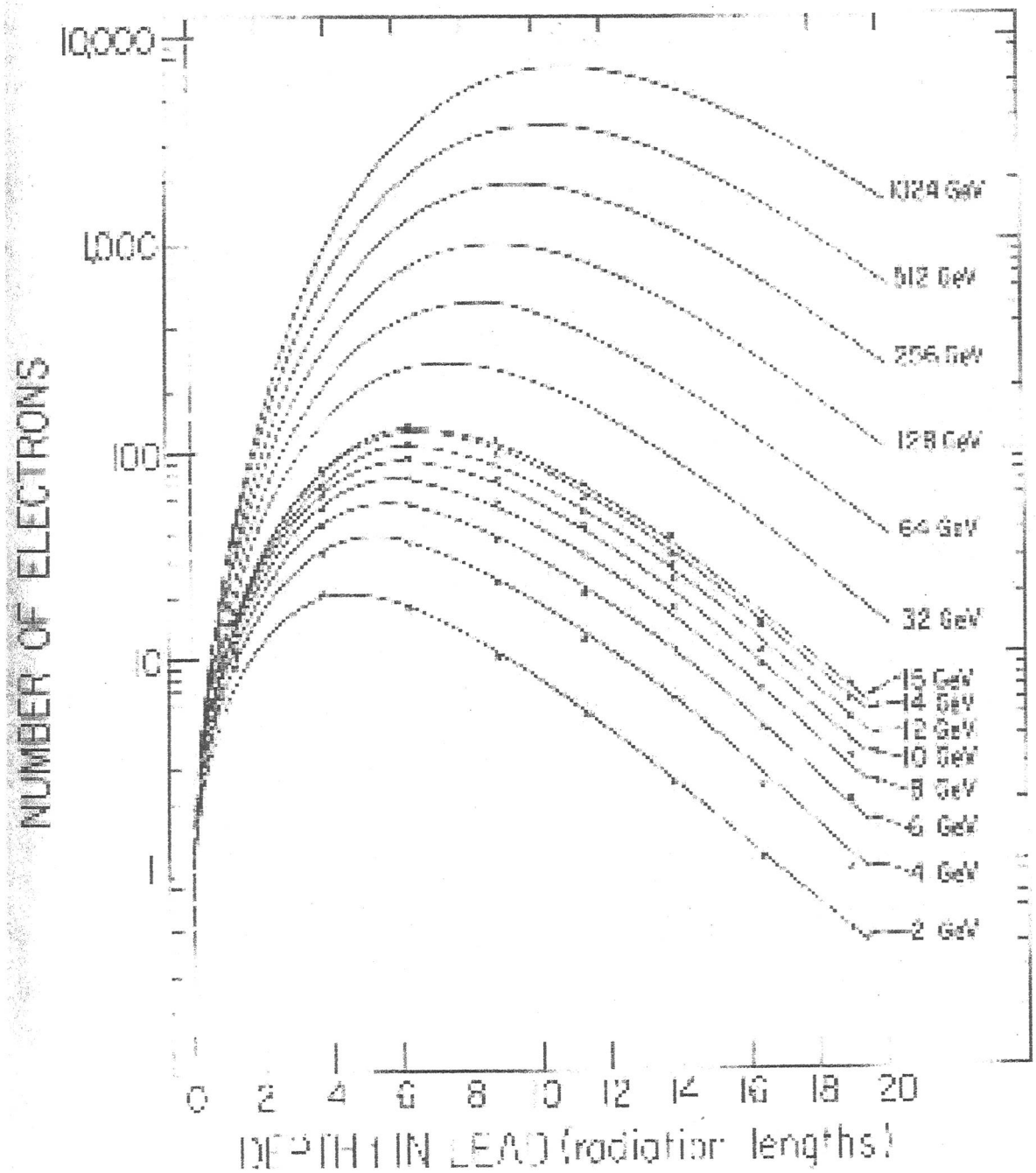
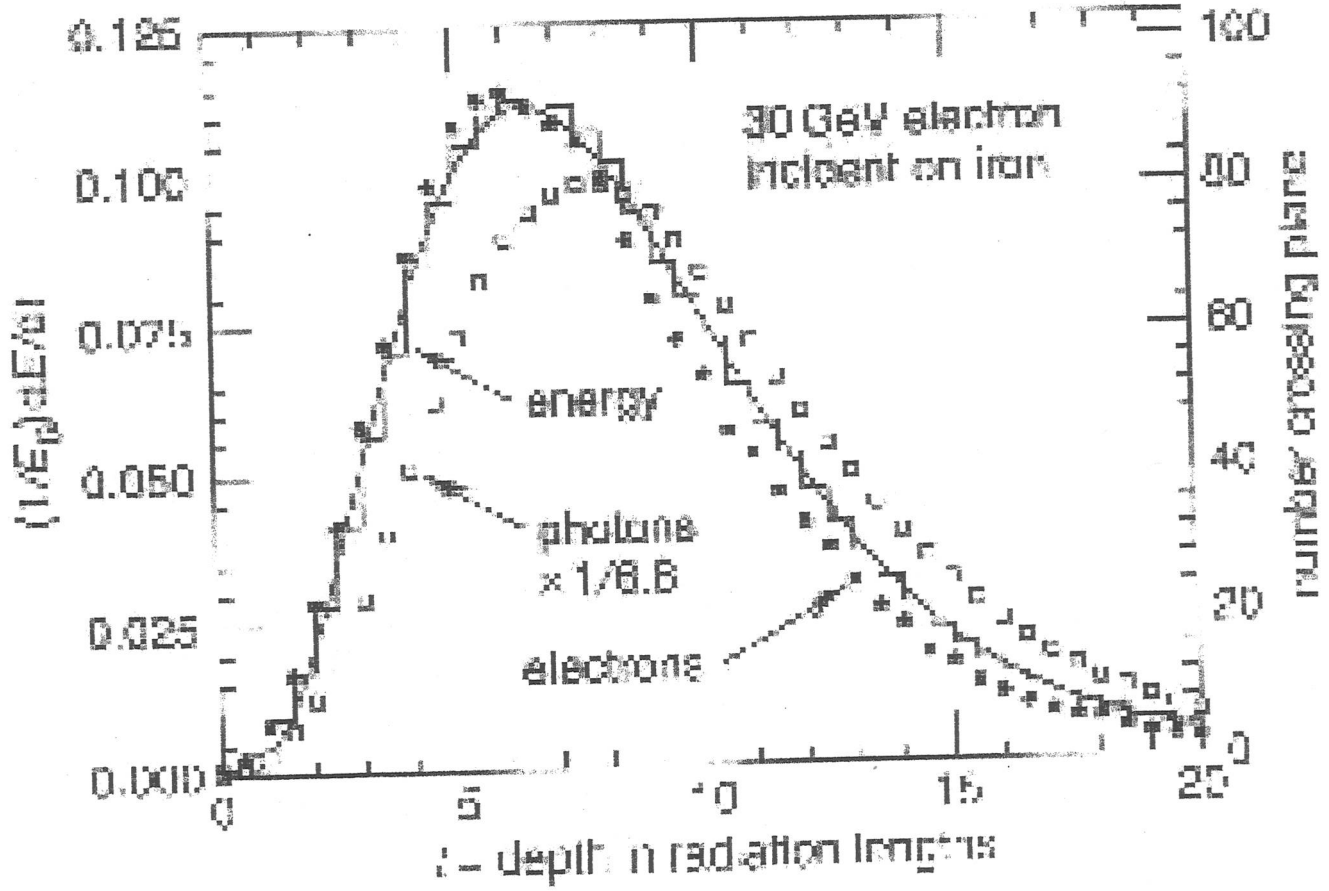
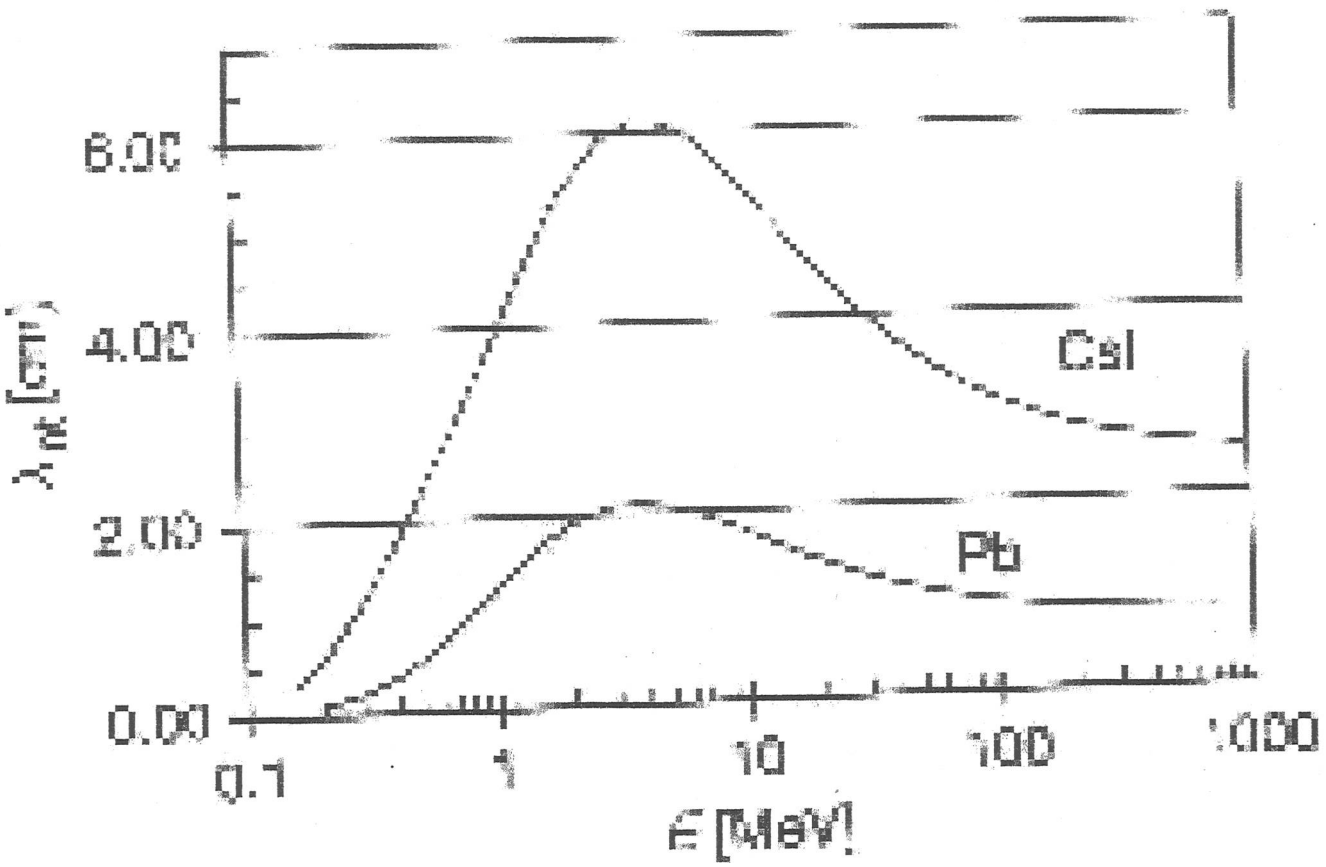
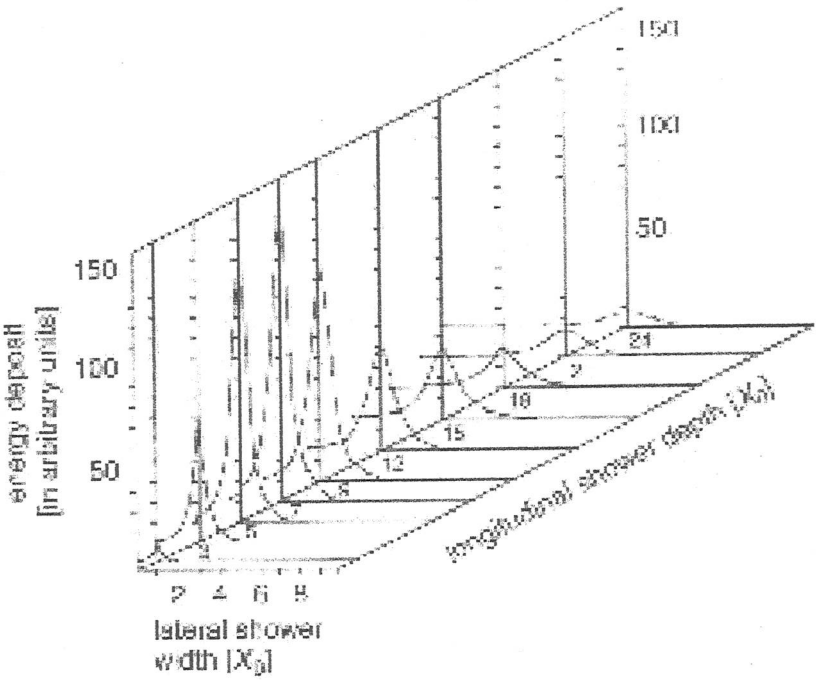
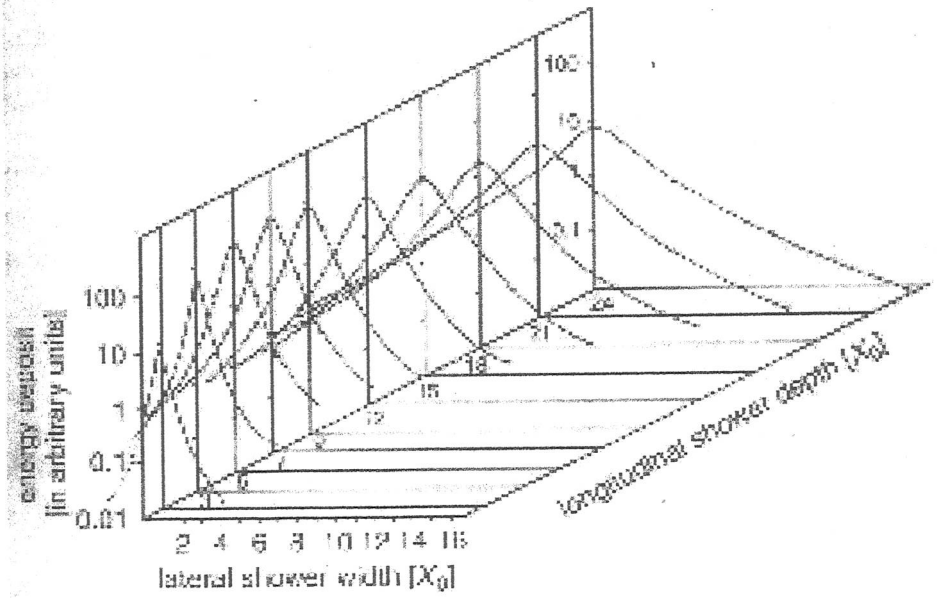
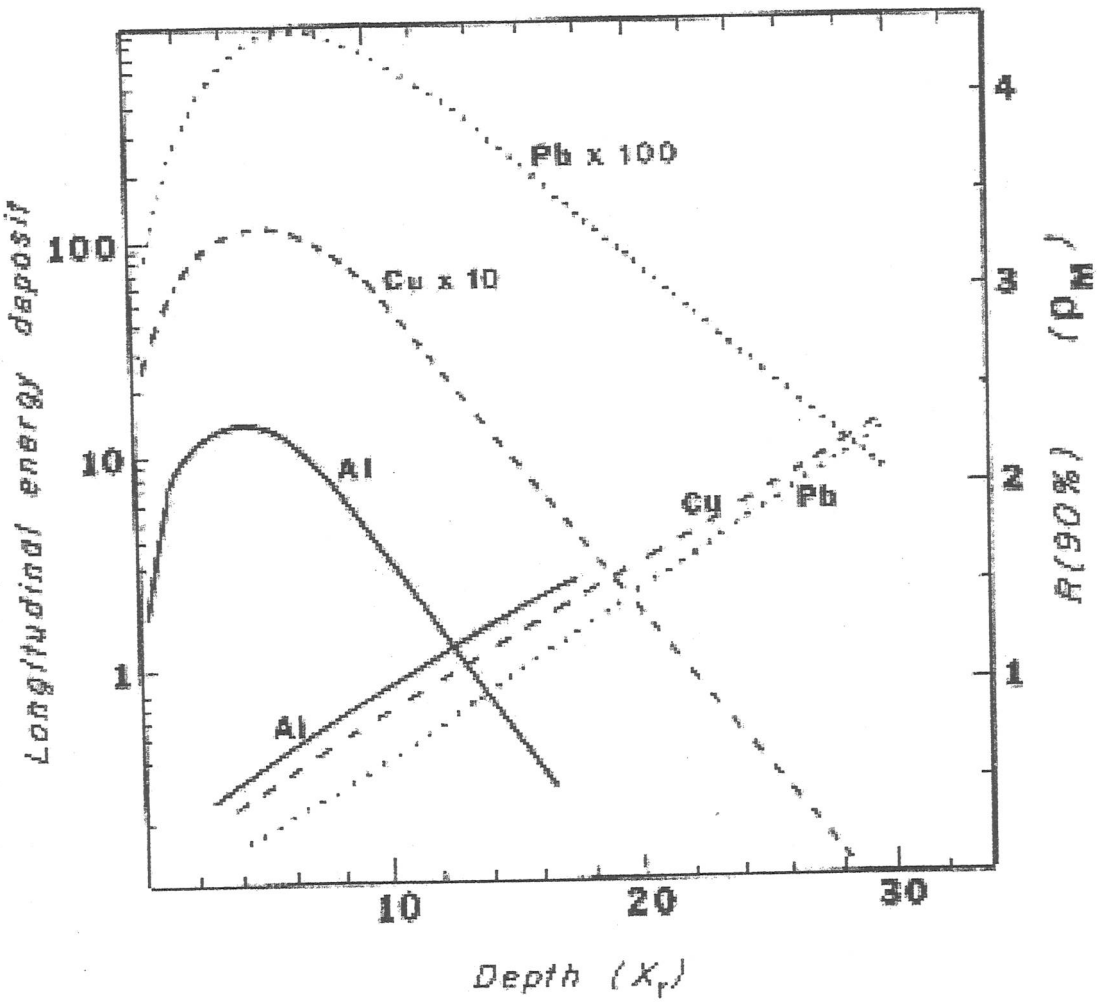

10,000
1,000
100
10
1
NUMBER OF ELECTRONS
1024 GeV
512 GeV
256 GeV
128 GeV
64 GeV
32 GeV
16 GeV
14 GeV
12 GeV
10 GeV
8 GeV
6 GeV
4 GeV
2 GeV
0
2
4
6
8
10
12
14
16
18
20
DEPTH IN LEAD (radiation lengths)

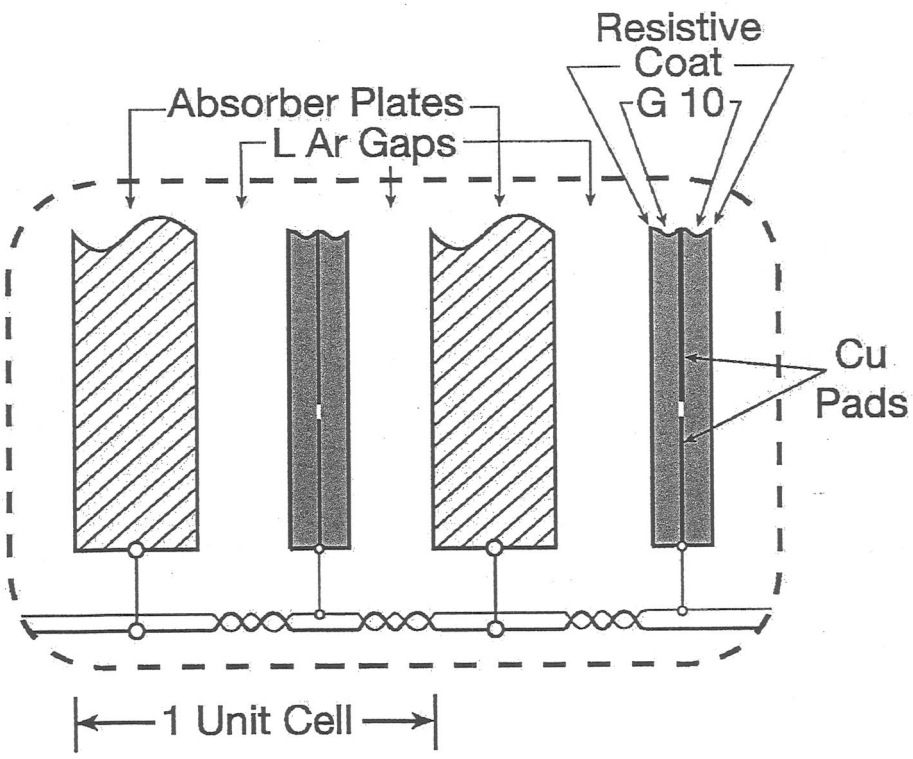

0.125
0.100
0.075
0.050
0.025
0.000
100
80
60
40
20
0
0
5
10
15
20
30 GeV electron
incident on iron
energy
photons
× 1/6.8
electrons
number crossing plane
t = depth in radiation lengths

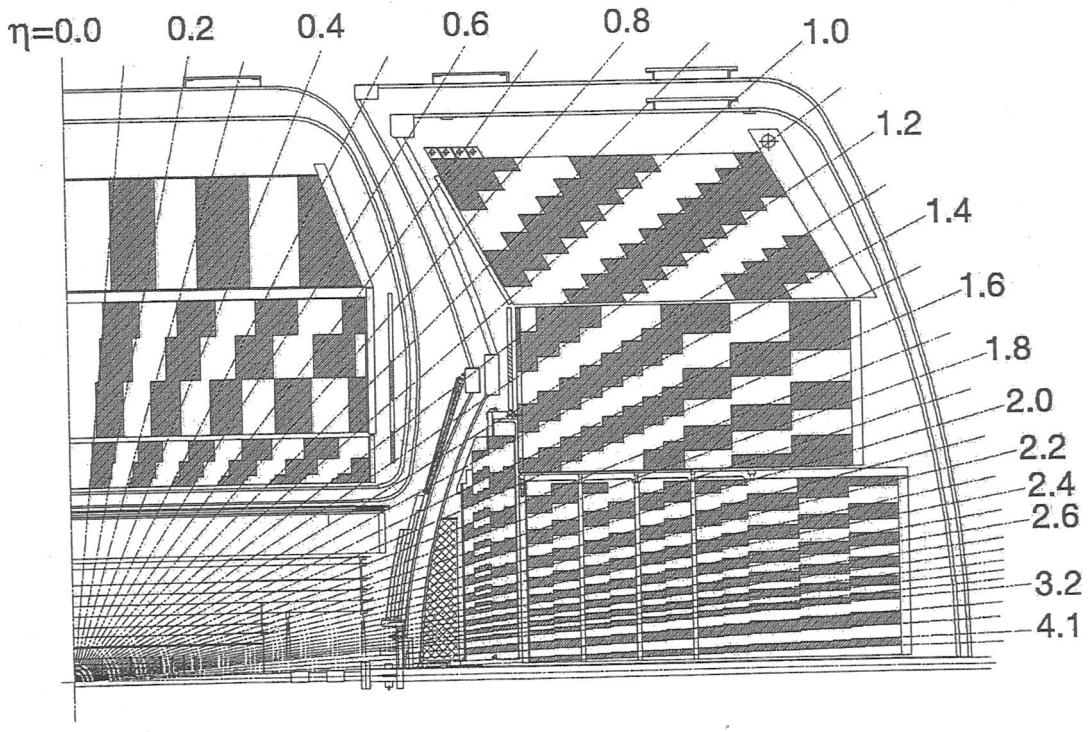

6.00
4.00
2.00
0.00
CsI
Pb
0.1
1
10
100
1000
E [MeV]

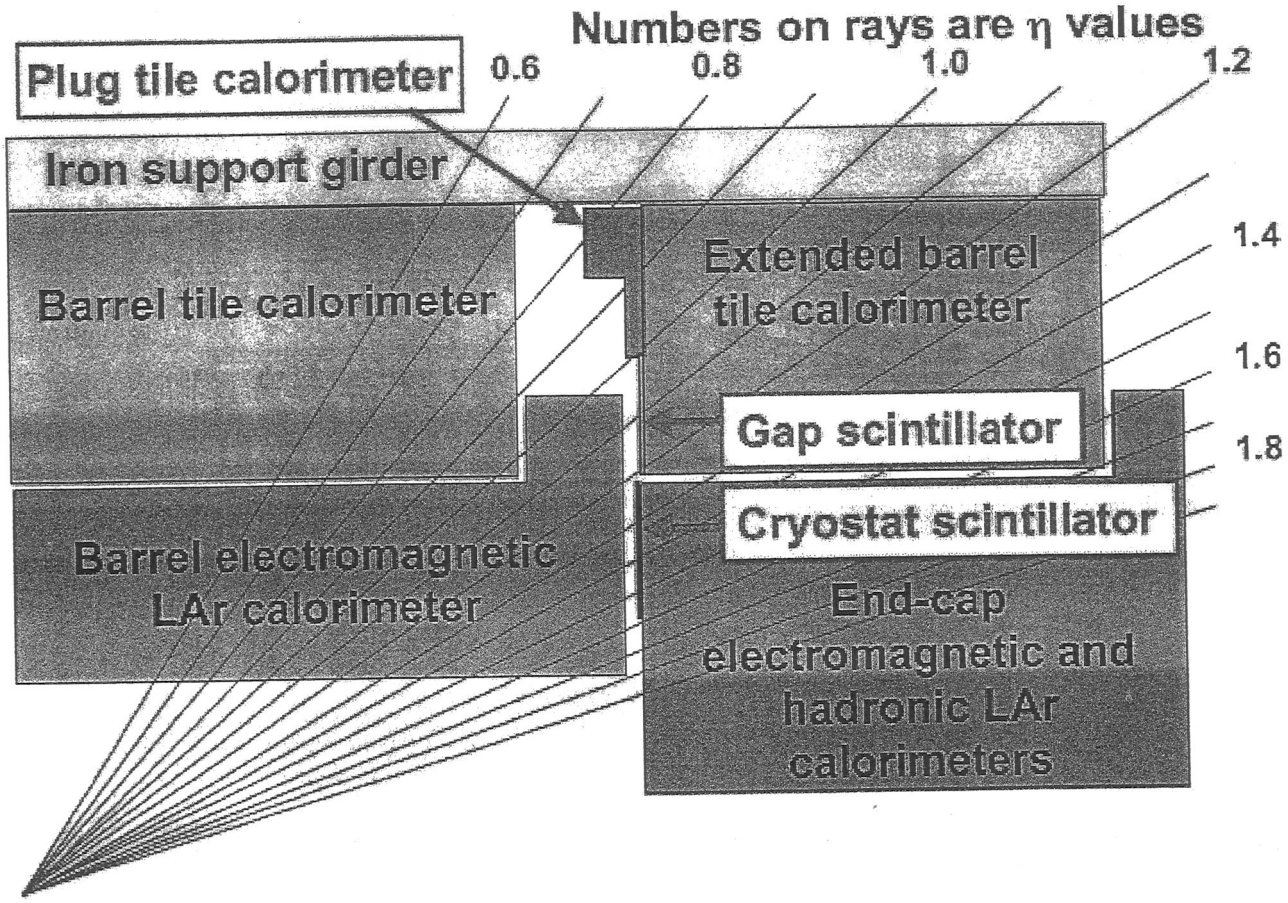

150
100
50
energy deposit
[in arbitrary units]
21
18
15
12
longitudinal shower depth [$X_0$]
2 4 6 8
lateral shower
width [$X_0$]

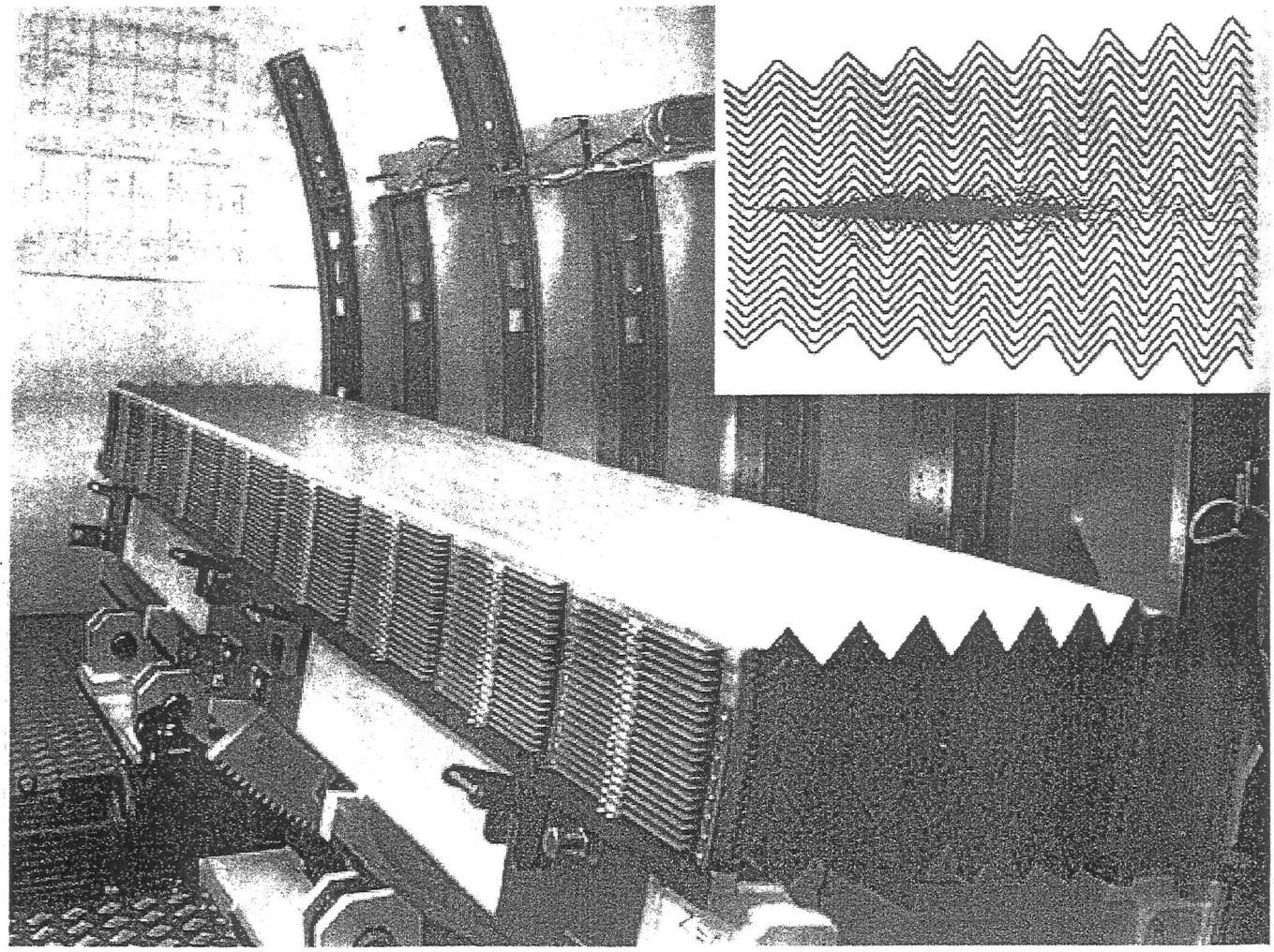

100
10
1
0.1
0.01
energy deposit
[in arbitrary units]
21
18
15
longitudinal shower depth [$X_0$]
2 4 6 8 10 12 14 16
lateral shower width [$X_0$]

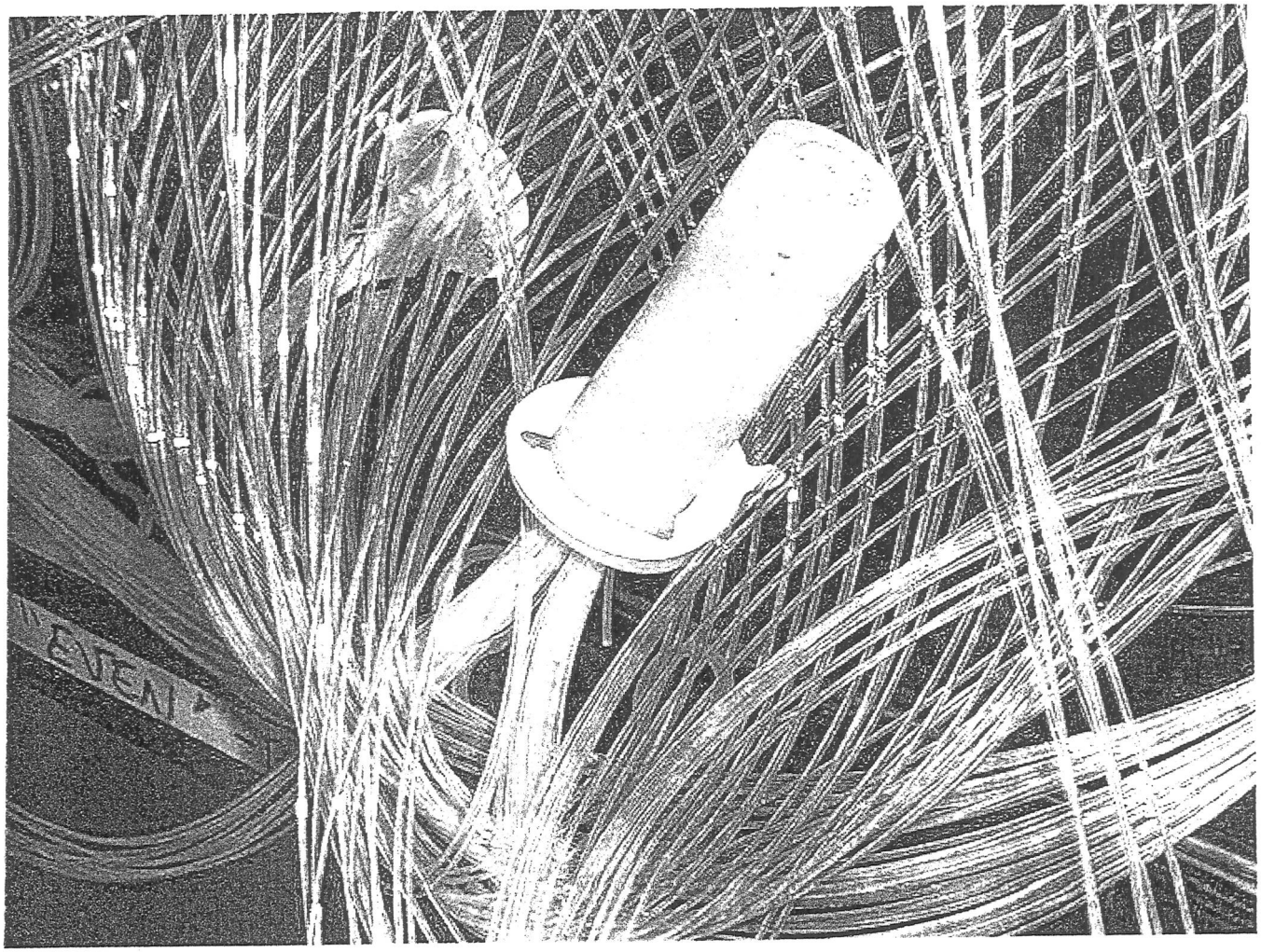

Pb x 100
Cu x 10
Al
Cu
Pb
Al
100
10
1
4
3
2
1
10
20
30
Longitudinal energy deposit
R(90%) (ρm)
Depth (Xρ)

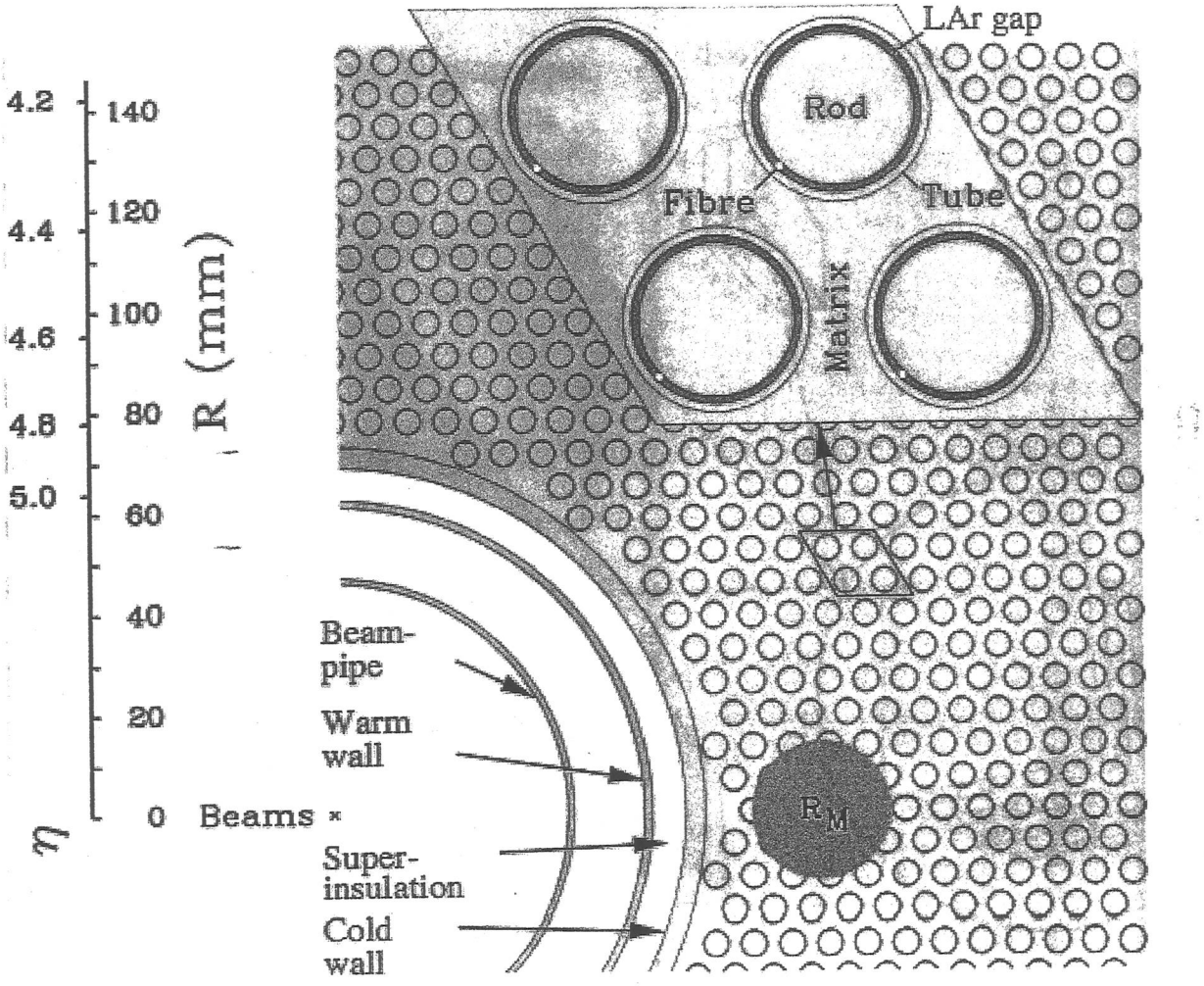

Resistive
Coat
G 10
Absorber Plates
L Ar Gaps
Cu
Pads
1 Unit Cell

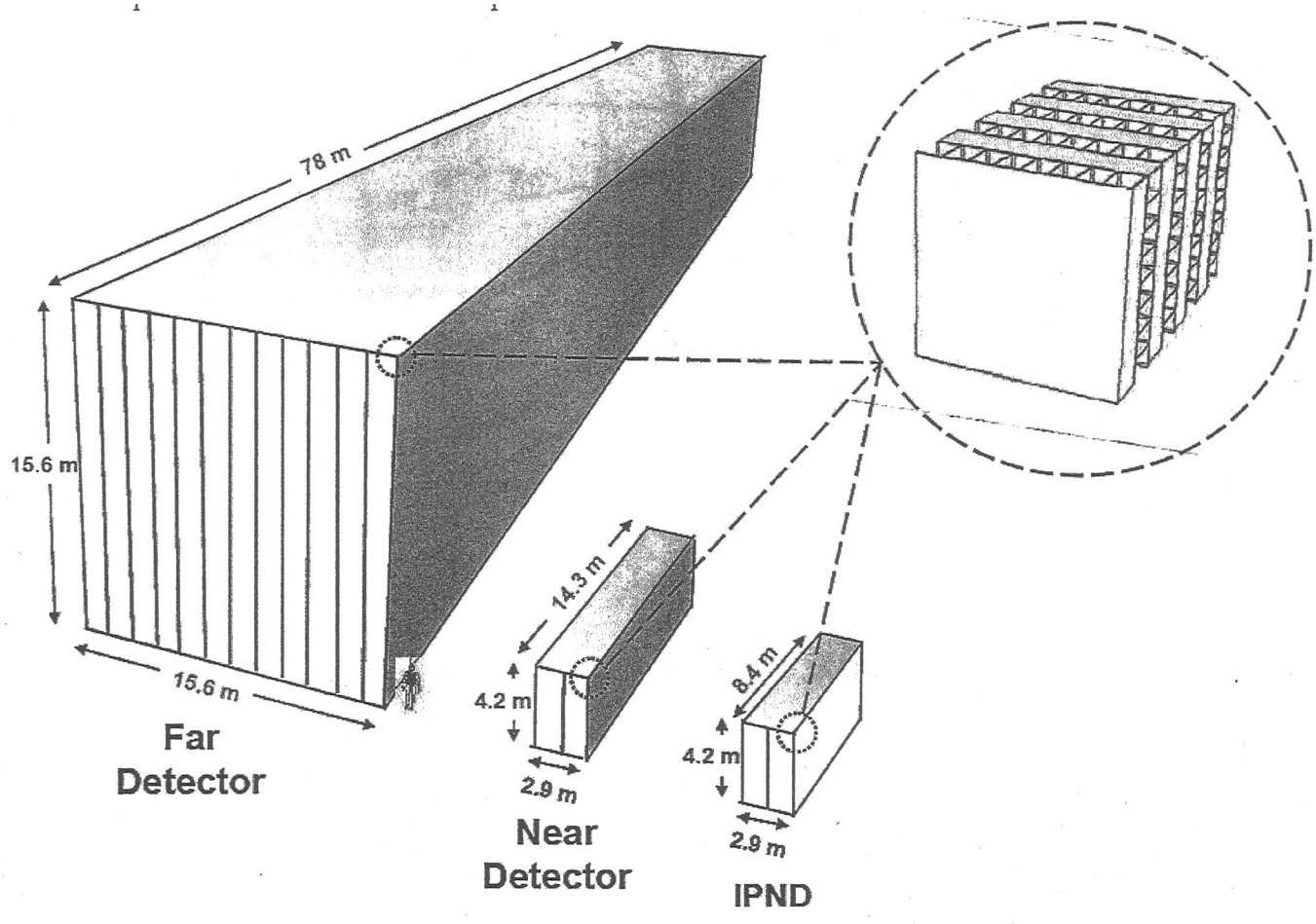

η=0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
3.2
4.1

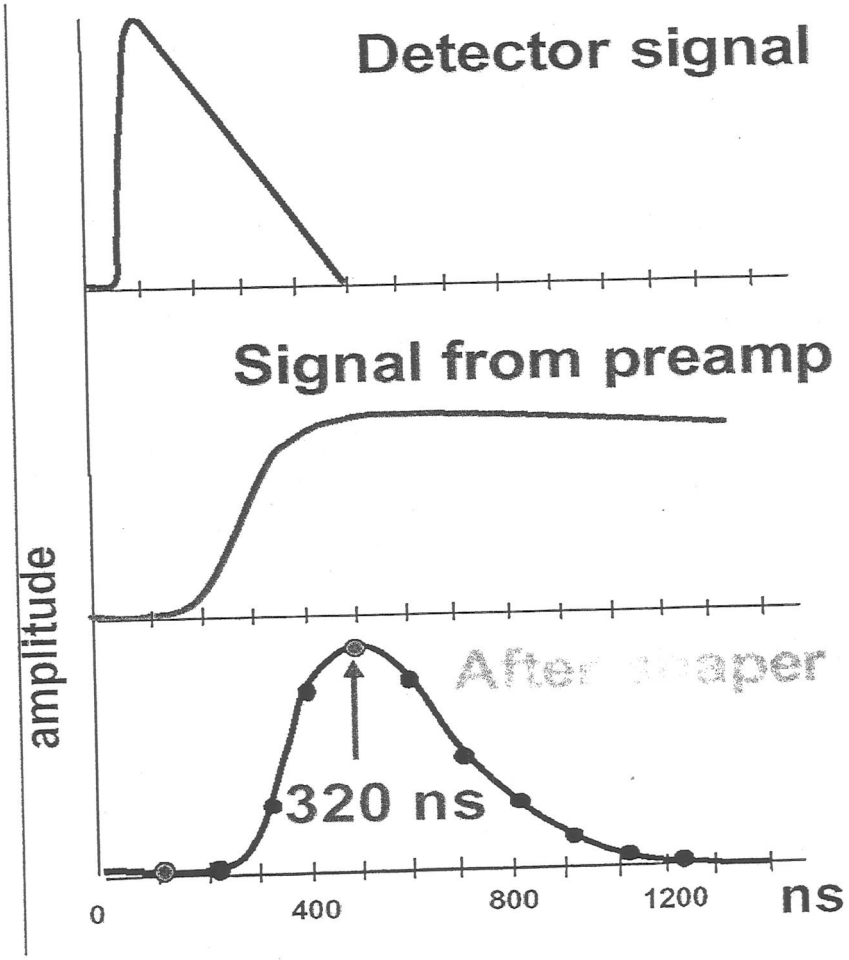

Numbers on rays are η values
Plug tile calorimeter
0.6
0.8
1.0
1.2
Iron support girder
Barrel tile calorimeter
Extended barrel tile calorimeter
1.4
1.6
Gap scintillator
1.8
Cryostat scintillator
Barrel electromagnetic LAr calorimeter
End-cap electromagnetic and hadronic LAr calorimeters

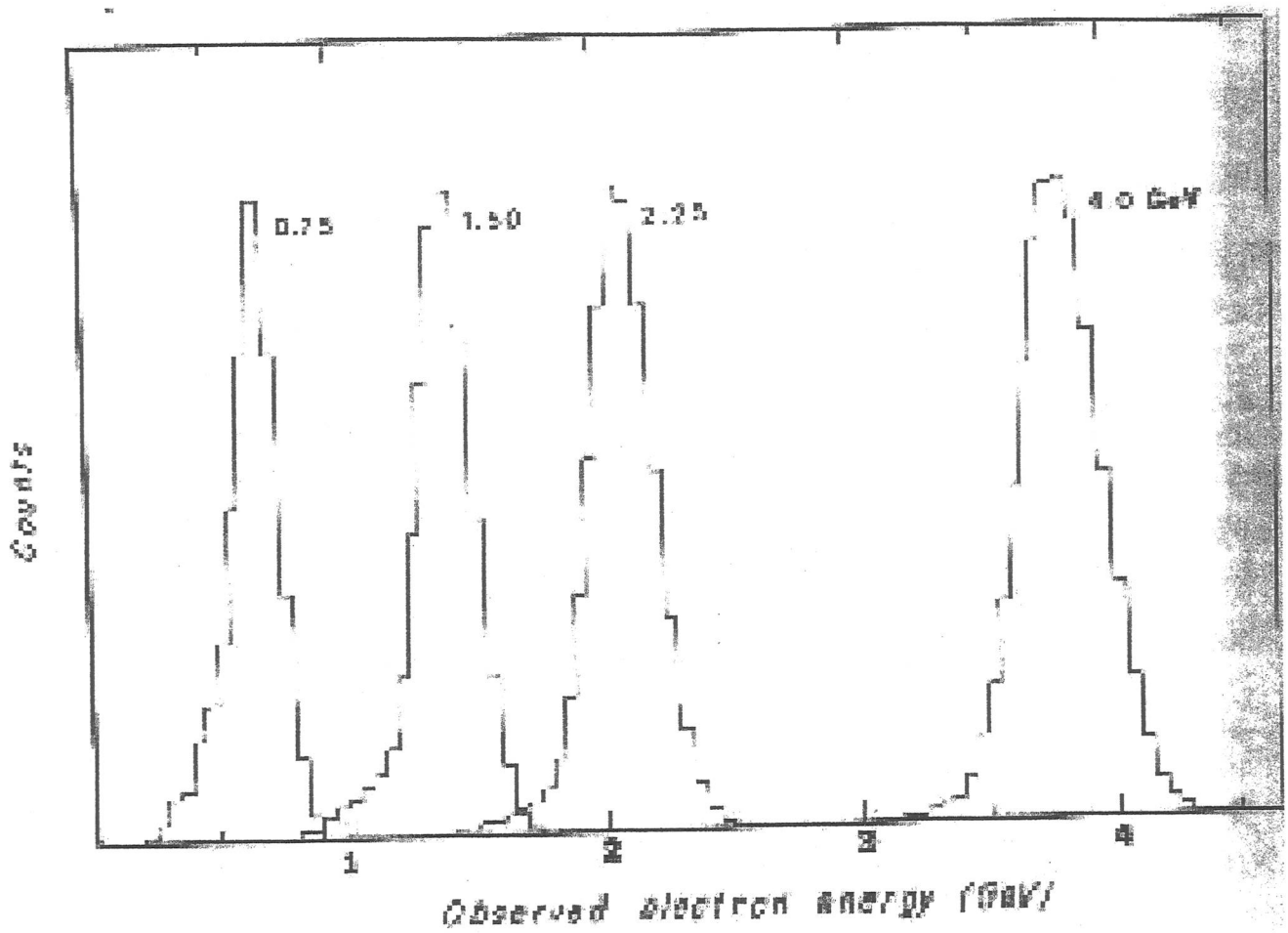


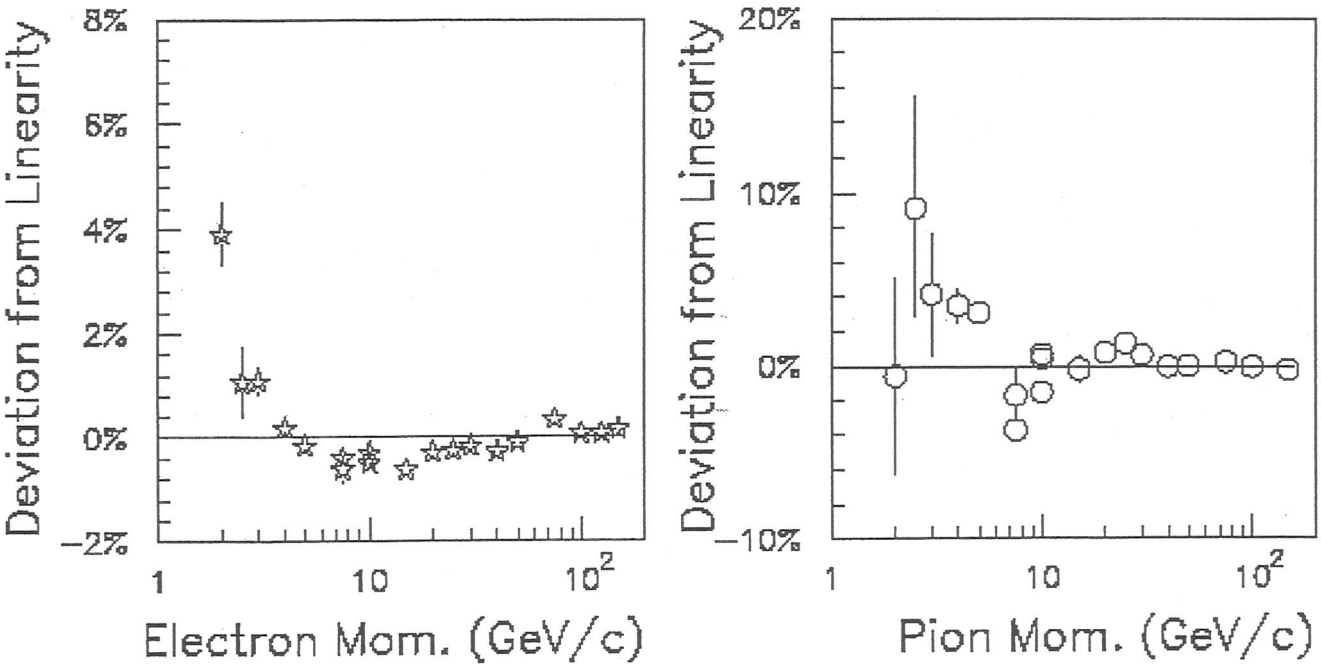


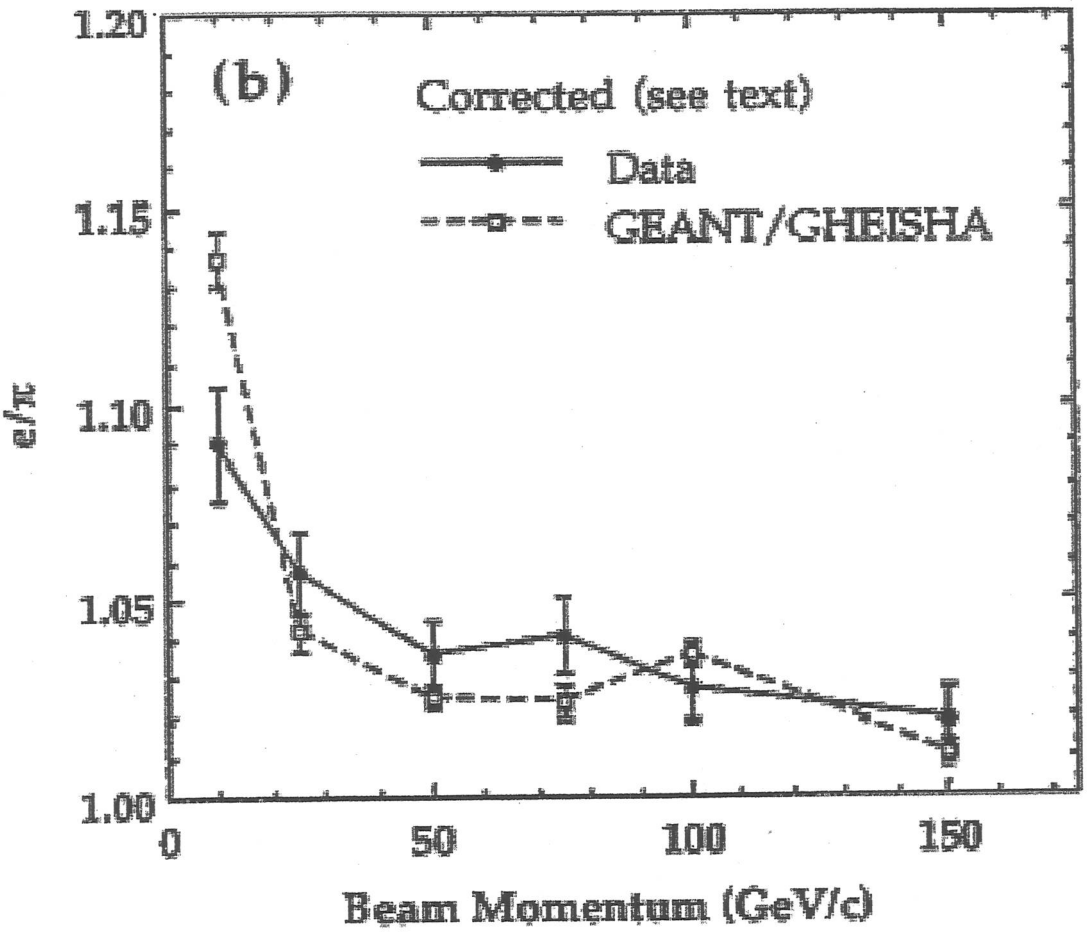

LAr gap
Rod
Fibre
Tube
Matrix
$R_M$
Beam-pipe
Warm wall
Super-insulation
Cold wall
Beams
R (mm)
$\eta$
4.2
4.4
4.6
4.8
5.0
140
120
100
80
60
40
20
0

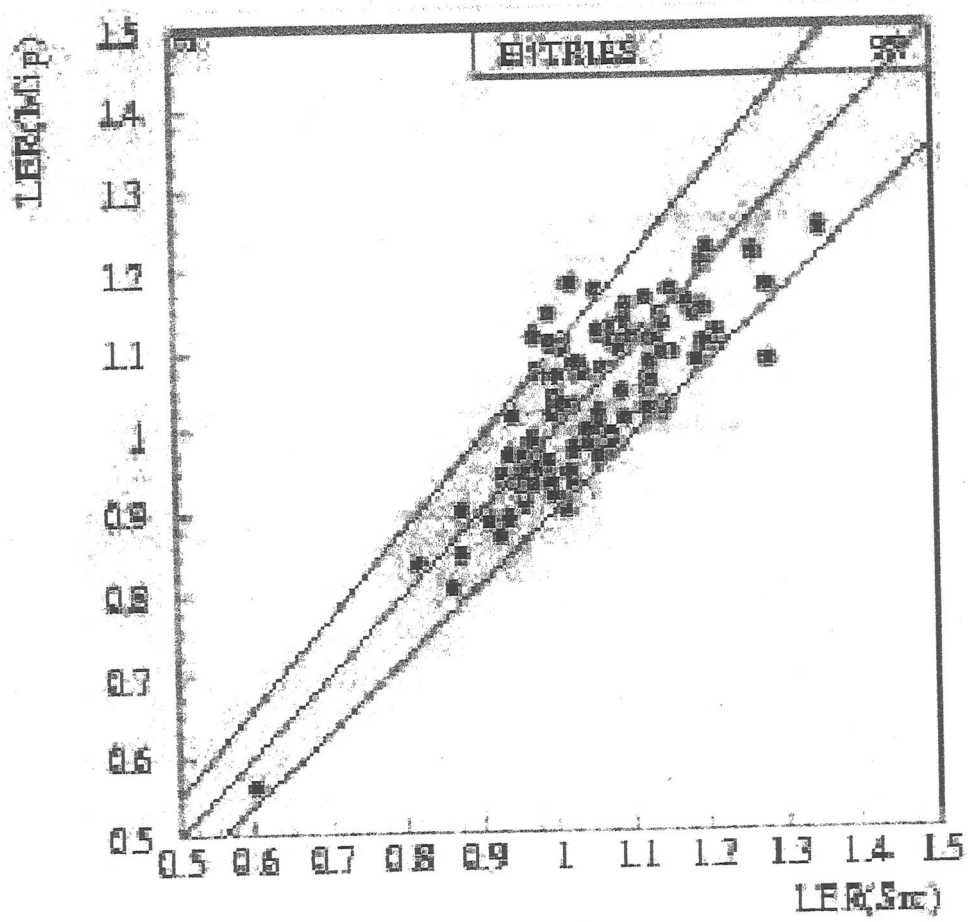

78 m
15.6 m
15.6 m
Far
Detector
14.3 m
4.2 m
2.9 m
Near
Detector
8.4 m
4.2 m
2.9 m
IPND

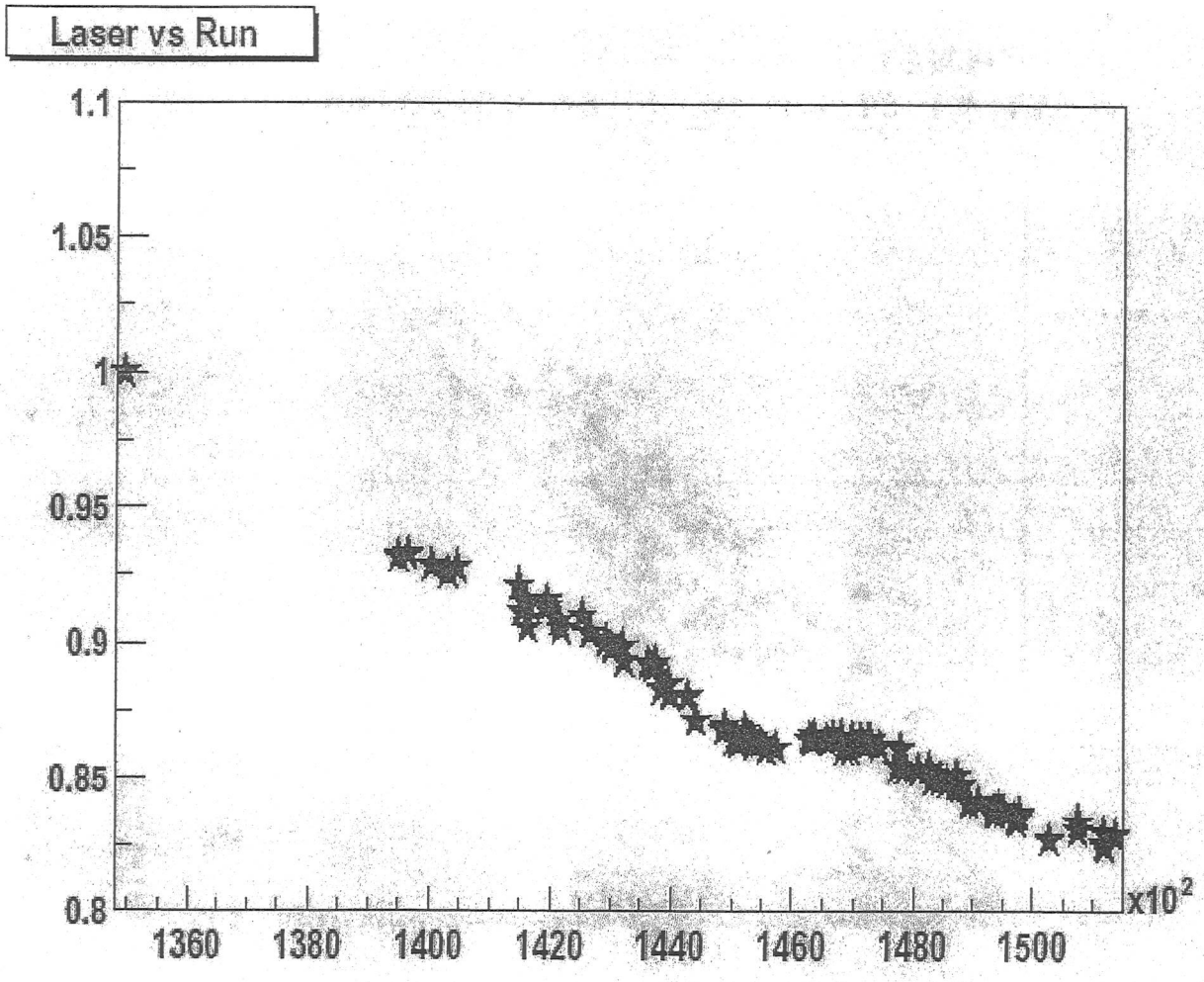

Detector signal
Signal from preamp
amplitude
320 ns
0
400
800
1200
ns

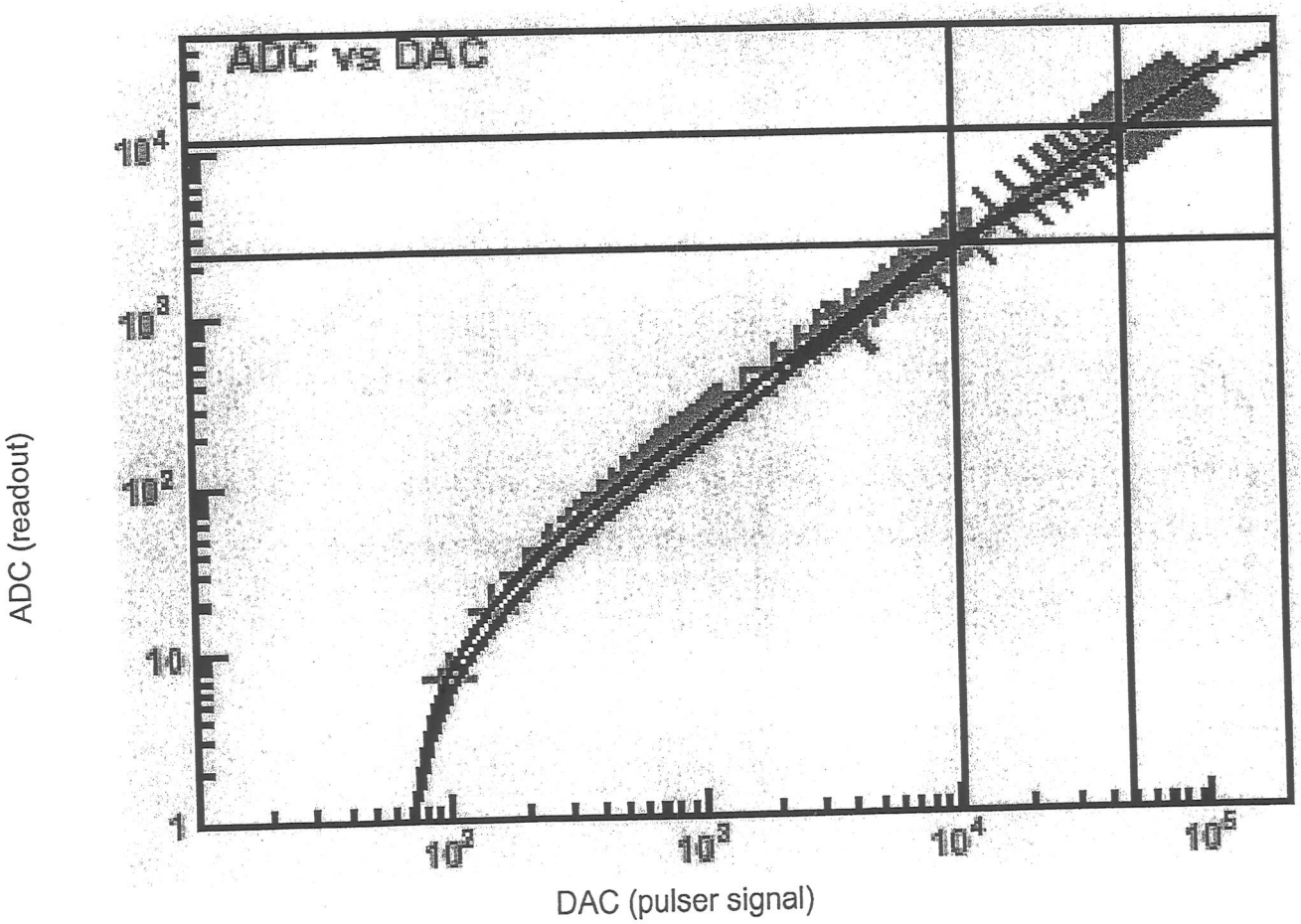

0.75
1.50
2.25
4.0 GeV
Counts
1
2
3
4
Observed electron energy (GeV)


Deviation from Linearity
8%
6%
4%
2%
0%
−2%
1
10
$10^2$
Electron Mom. (GeV/c)
Deviation from Linearity
20%
10%
0%
−10%
1
10
$10^2$
Pion Mom. (GeV/c)


(b)
Corrected (see text)
Data
GEANT/GHEISHA
e/π
1.20
1.15
1.10
1.05
1.00
0
50
100
150
Beam Momentum (GeV/c)


LER(TMip)
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5
LER(Smc)


Laser vs Run
1.1
1.05
1
0.95
0.9
0.85
0.8
1360
1380
1400
1420
1440
1460
1480
1500
x10²


ADC vs DAC
$10^4$
$10^3$
$10^2$
10
1
$10^2$
$10^3$
$10^4$
$10^5$
ADC (readout)
DAC (pulser signal)