Olsson

Jade Computer Note No. 35

H. Takeda

Y. Watanabe

4.3.1980

LGCDIR

LGECOR < bar

Energy Corrections for showers in the lead glass counters

Shower energies observed by the lead glass counters have to be corrected for the following effects:

1) A loss of shower energy due to the presence of material (~1/2 rad. length of Al coil). When a shower starts in the material, part of the Cerenkov light is absorbed in the material. ENGLOS

2) Dependence on the incident angle. ANGBAR

3) Dependence on the hit position at each counter. This is due to the fact that a phototube only covers the small fraction of the area of the back face of corresponding lead glass block. This is particularly true for end cap counters where the fraction is smaller and longer light pipes are used. POSEND

+ΔE

L

Note that these corrections are only for electrons and photons. The corrections for nonshowering particles are entirely different. For them, the observed energies are just due to the Cerenkov light emission of a single track, so the correction no. 1 does not apply. The corrections of no. 2 and no. 3 may be similar, but are not known yet. Typical response expected for nonshowering particles is shown in Fig. 1, where the light yield is plotted as a function of particle momentum. It is normalized to the asymptotic pulse height, which is about 200 MeV.

Note also that the corrections no. 1, 2 and 3 are applied to all the observed shower energies because it is impossible in the program to separate showering and nonshowering particles in a bias free way. The difference must be included in Monte Carlo simulation in an appropriate way.

The corrections for photons and electrons are assumed to be the same. Only difference between them is the shower depth from which the direction cosines are calculated. The formula used in the program is

$$\text{depth} = 22.39 \exp(E/E_o) \ (\text{mm}) \qquad \begin{array}{l} E_o = 4.979 \text{ for } e^{\pm} \\ E_o = 1.725 \text{ for } \gamma \ (E \text{ in MeV}) \end{array}$$

At present, clusters are thought to be electrons if they are associated with charged particles detected by the inner detector.
The energy corrections are done at the stage of LGCDIR. The correction no. 3 for the barrel part is not applied, because the position resolution is generally poor to obtain the hit position within each individual counter. It is applied for the end cap part to reduce the resolution of Bhabha peaks, even though the position resolution is poor for less energetic showers.
The corrections are determined by combining:

1) Beam calibration data up to 5 GeV (taken with e^+ beam).

2) Bhabha events at beam energies of 6 - 15.8 GeV.

3) Monte Carlo simulation of showers. (Some aspects of corrections are not well reproduced yet.)

Correction factors E_{obs}/E_{in} are given in a data statement at representative values of energies and angles (or positions). The actual corrections for given energy and angle (or position) are obtained by linearly interpolating between two closest points. Then the actual value of E_{in} for given E_{obs} and angle (or position) is obtained after a few itterations. (Because E_{obs} instead of desired E_{in} has to be used for the lookup table). Correction factors used in the program are plotted in Figs. 2,3 and 4.

Figure Captions

1) Response of lead glass counters to nonshowering particles.
   The asymptetic value is about 200 MeV. (This is obtained by using the subroutine described in Jade note no. 20. The effect of energy loss through lead glass counter is also included).

2) The loss of shower energy due to the 1/2 rad. length coil, plotted as a function of incident angle at various incident energies. (Barrel part)

3) The factor E_{obs}/E_{in} as a function of incident angle at E_{in} = 1 and $\geq$ 5 GeV. (Barrel part)

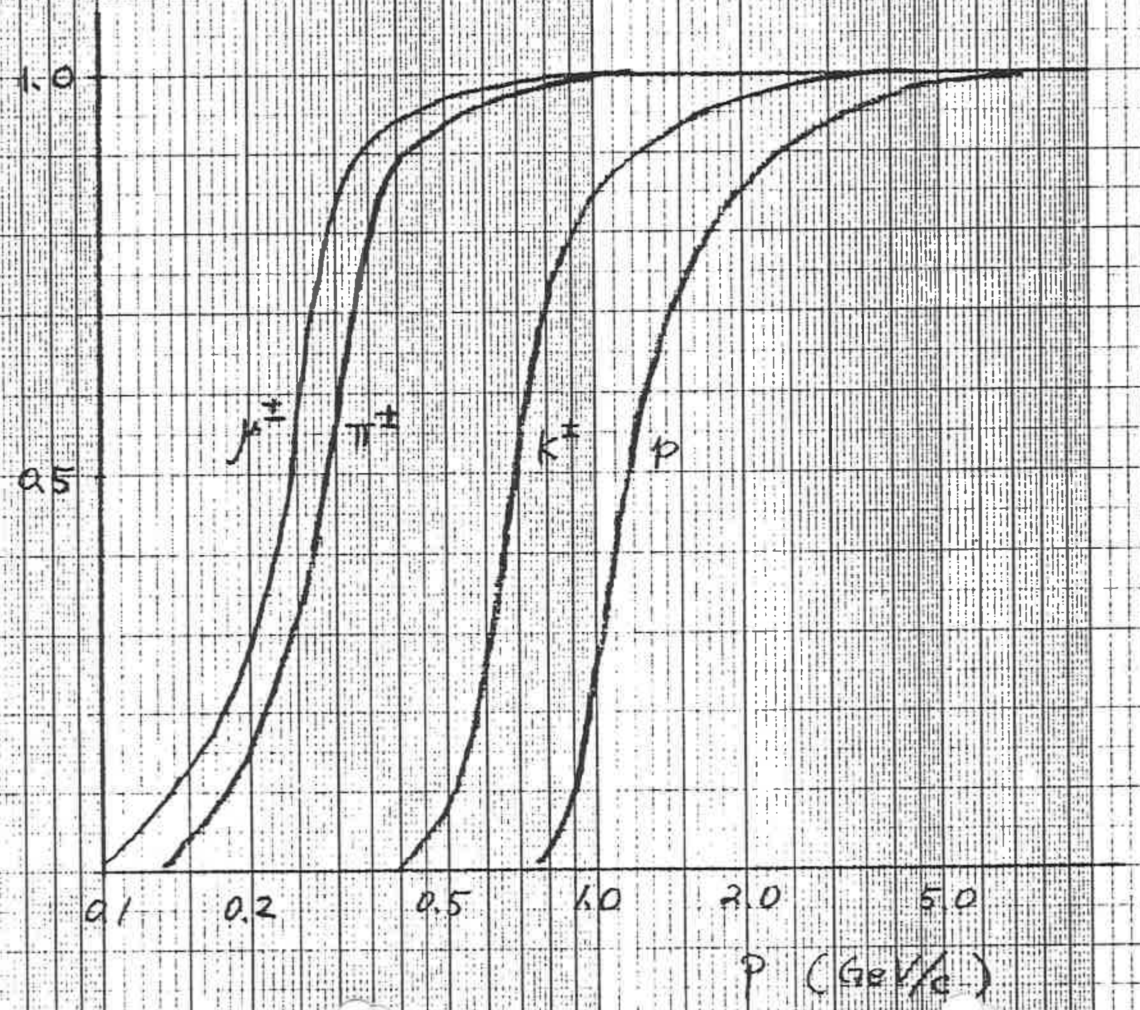
4a) The factor E_{obs}/E_{in} for an end cap counter at the back face of the counter depends not only on r, the distance of the hit point to the center of the counter, but also on the incident angle. The latter effect is put in by giving two values at each r (define $-r$ to be closer to the beam axis), and by interpolating linearly between the two according to $R - R_c$ (see the figure for the definition : $r = |\vec{R} - \vec{R}_c|$).

4b) The factor E_{obs}/E_{in} for end cap as a function of r, the distance between the hit point and the center of the counter. See the definition of $-r$ in the caption for Fig. 4a.

Fig. 1

L.G. pulse height vs incident momentum

(NORMAL INCIDENCE)



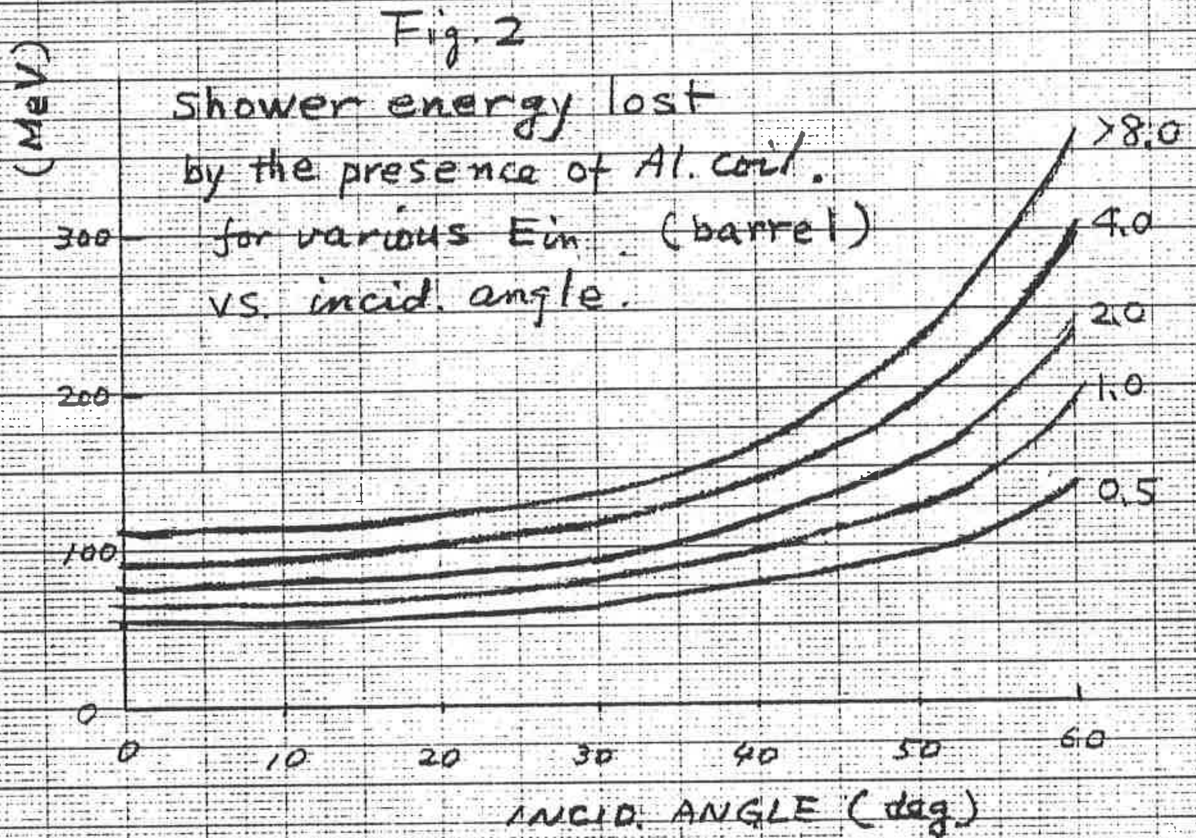


Fig. 2
Shower energy lost
by the presence of Al. coil.
for various Ein. (barrel)
vs. incid. angle.
(MeV)
300
200
100
0
0
10
20
30
40
50
60
INCID. ANGLE (deg.)
>8.0
4.0
2.0
1.0
0.5

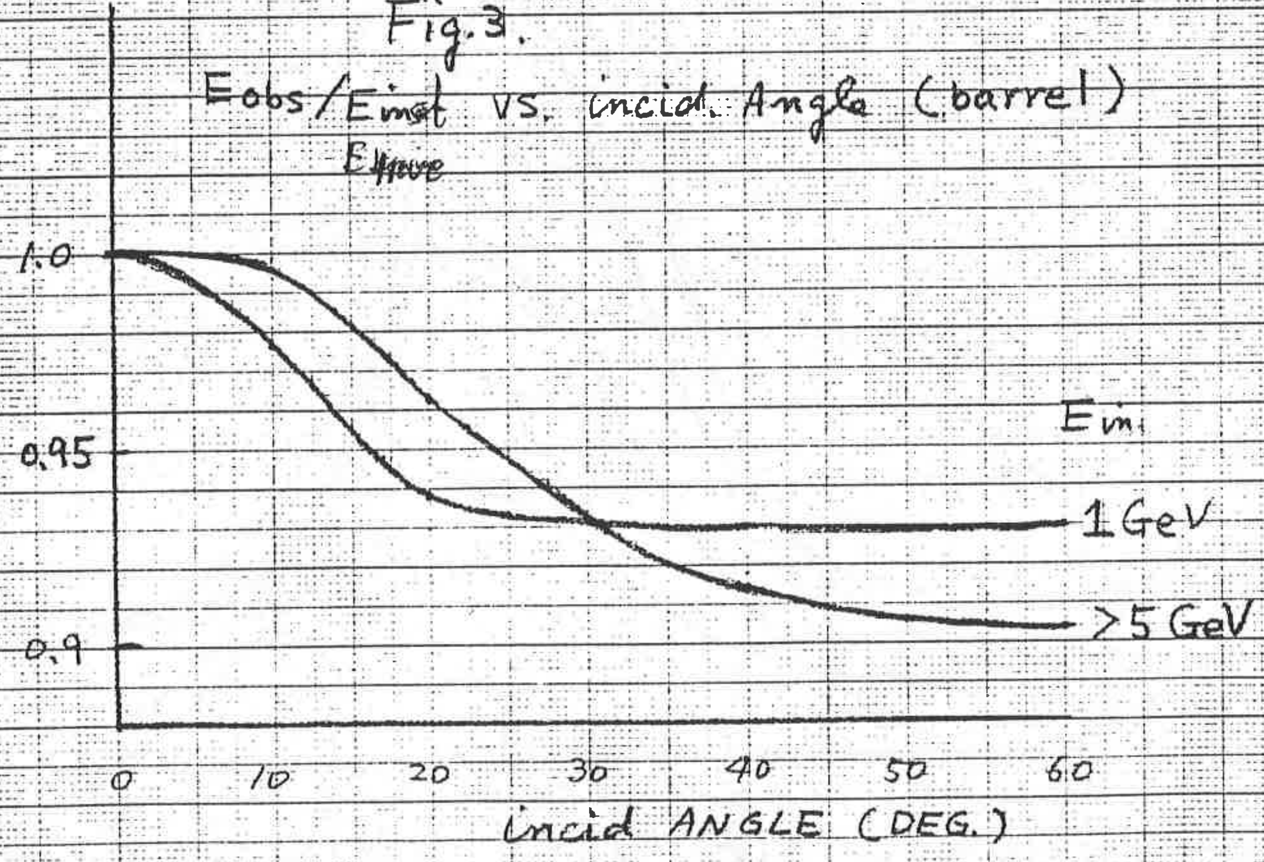


Fig. 3.
Eobs/Eimat vs. incid. Angle (barrel)
Ehave
1.0
0.95
0.9
0
10
20
30
40
50
60
incid ANGLE (DEG.)
Ein.
1 GeV
>5 GeV

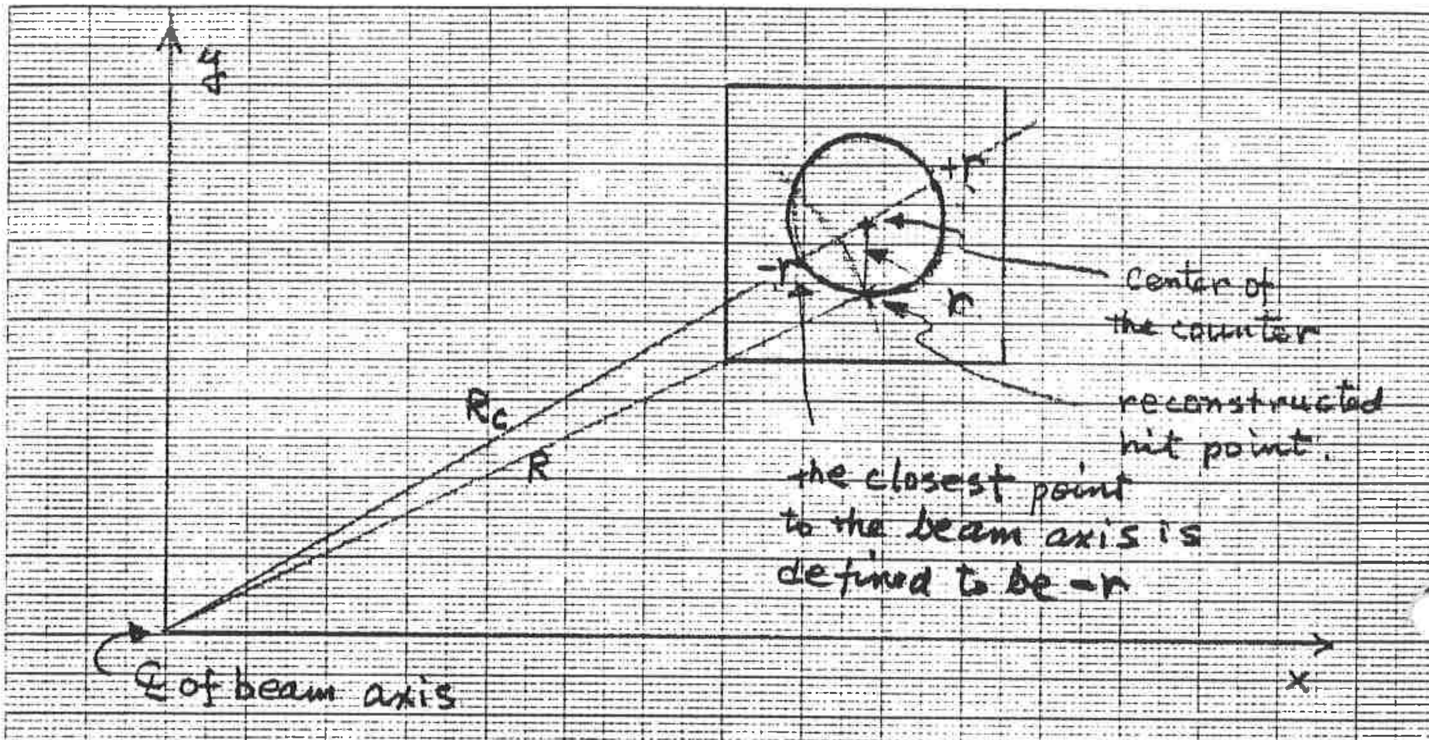

y
+r
-r
r
Center of the counter
reconstructed hit point.
R_c
R
the closest point to the beam axis is defined to be -r
℄ of beam axis
x

Fig 4a

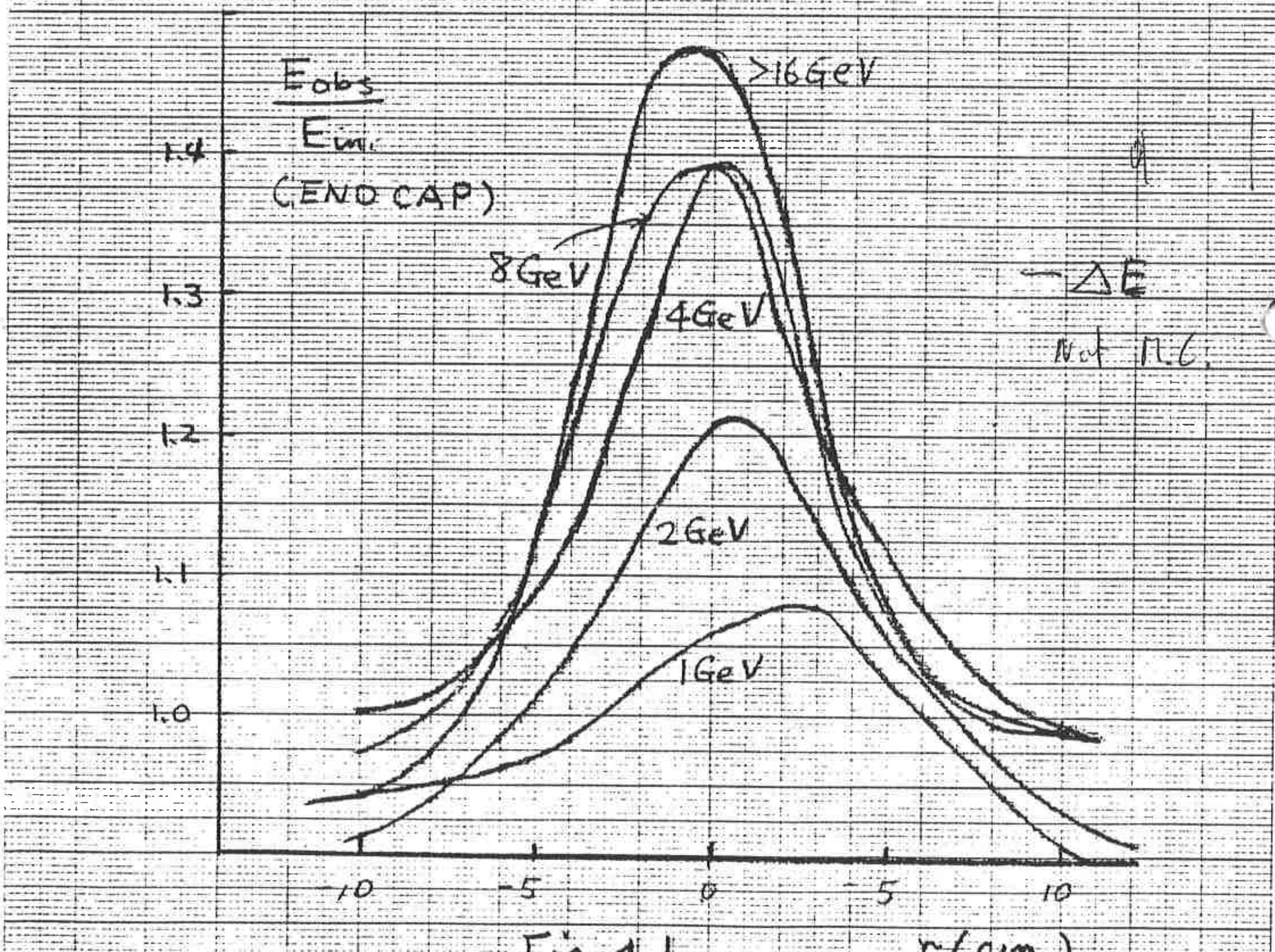

$\frac{E_{obs}}{E_{in}}$
(END CAP)
1.4
1.3
1.2
1.1
1.0
>16GeV
8GeV
4GeV
2GeV
1GeV
−ΔE
Not M.C.
-10
-5
0
5
10
r (cm)

Fig 4 b