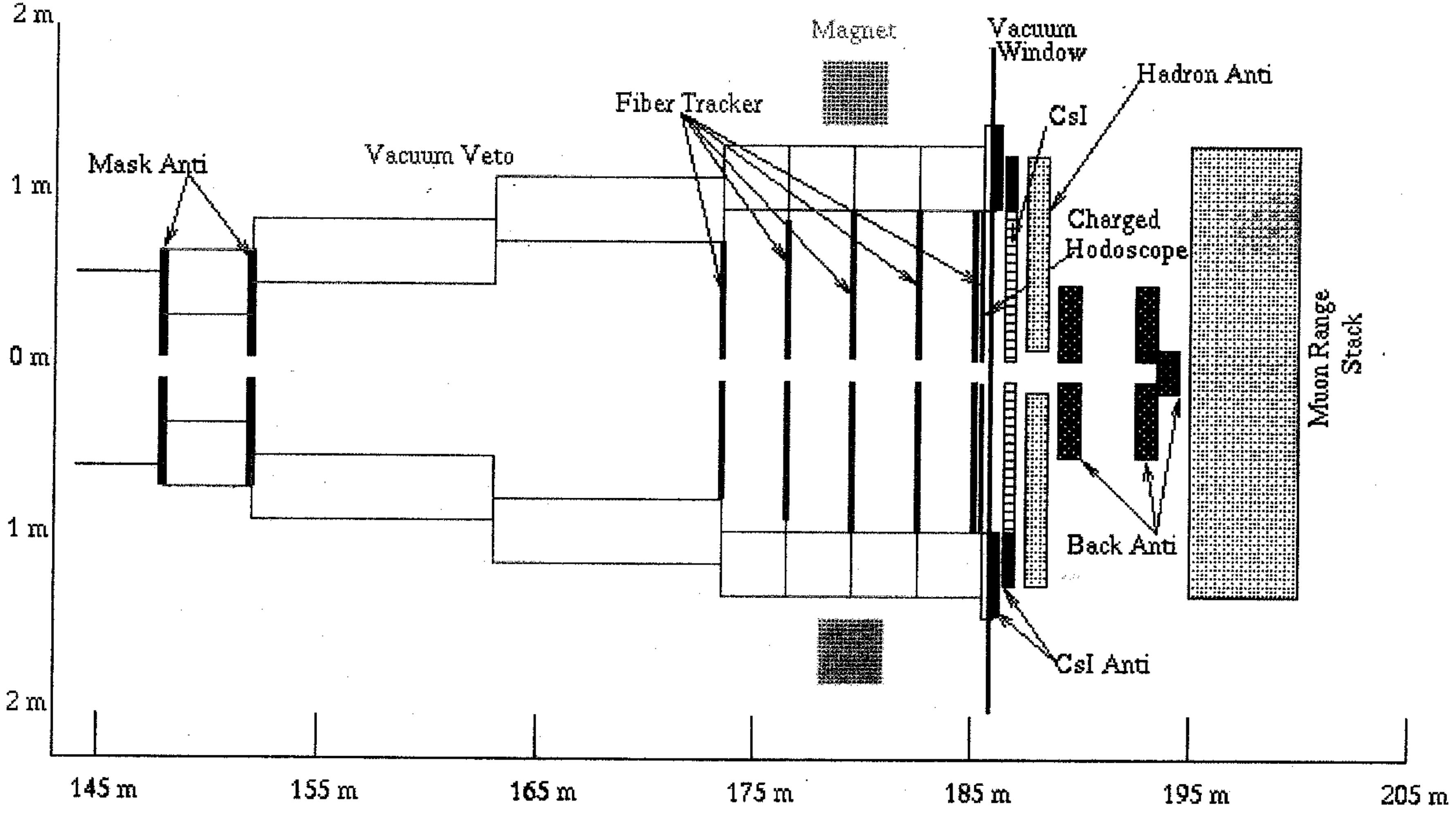
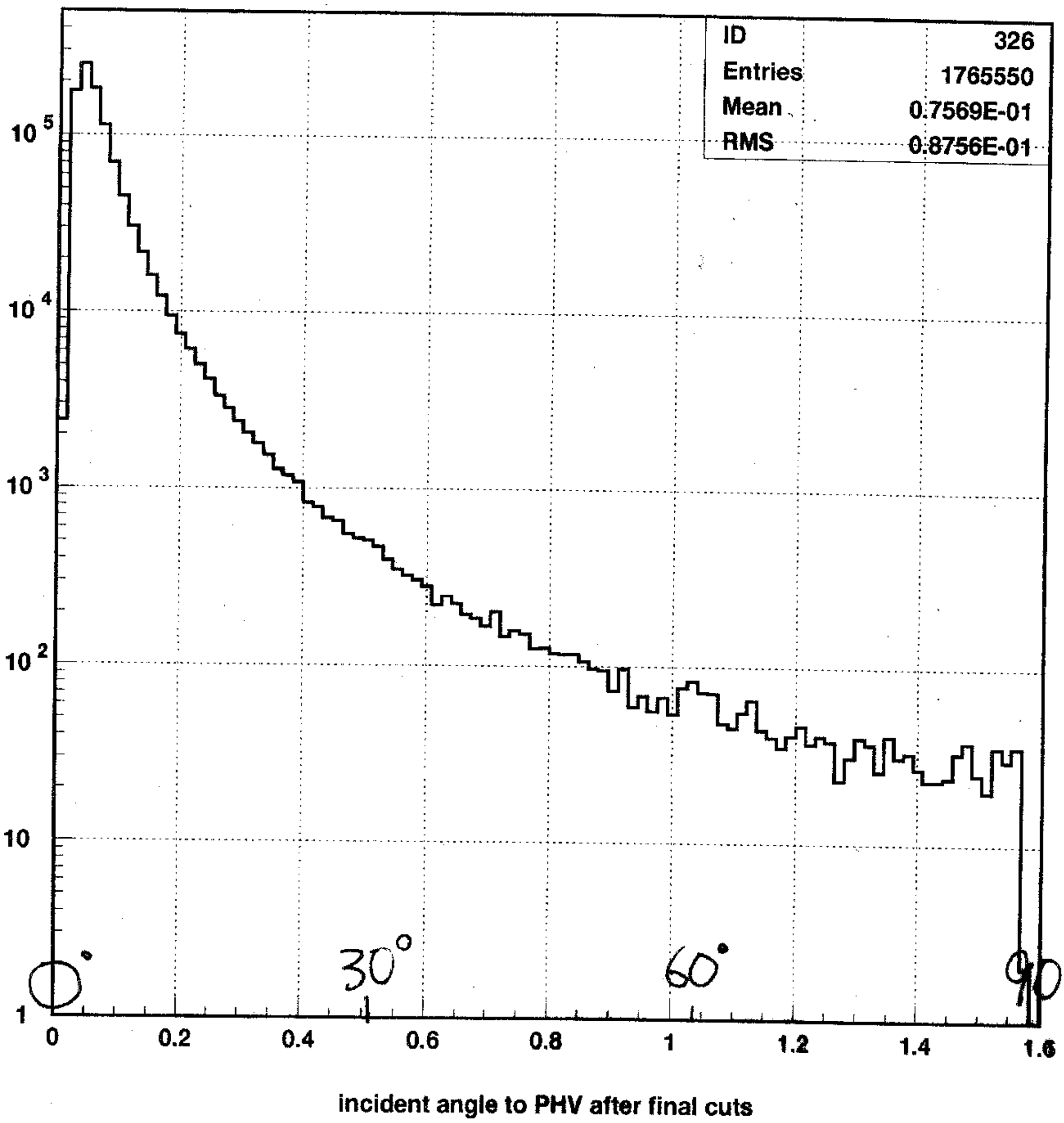
A study of the photon veto inefficiency dependence on incident angle

Ken Sakashita
(Osaka University)

KAMI DETECTOR LAYOUT



$K_L \to \pi^0 \pi^0$


ID 326
Entries 1765550
Mean 0.7569E-01
RMS 0.8756E-01
10^5
10^4
10^3
10^2
10
1
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
0°
30°
60°
90°
incident angle to PHV after final cuts

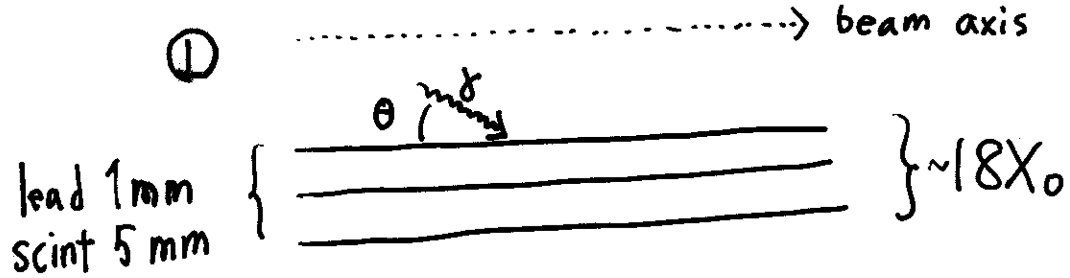
The photon veto inefficiency

⇨ photo nuclear interaction
EM interaction
↳ punch through
sampling effect

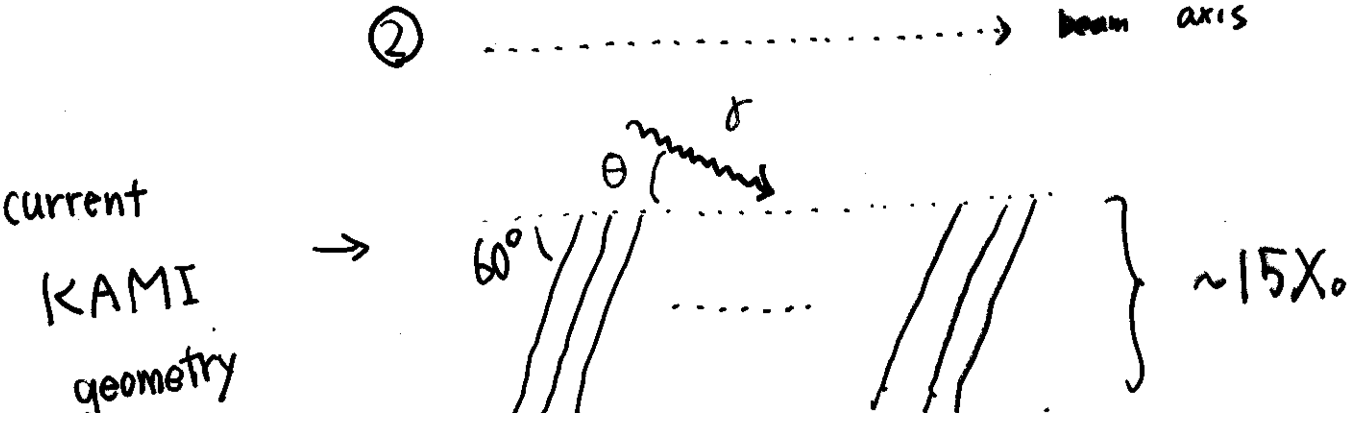
I studied the photo veto inefficiency cased by EM interaction. (using EGS4)

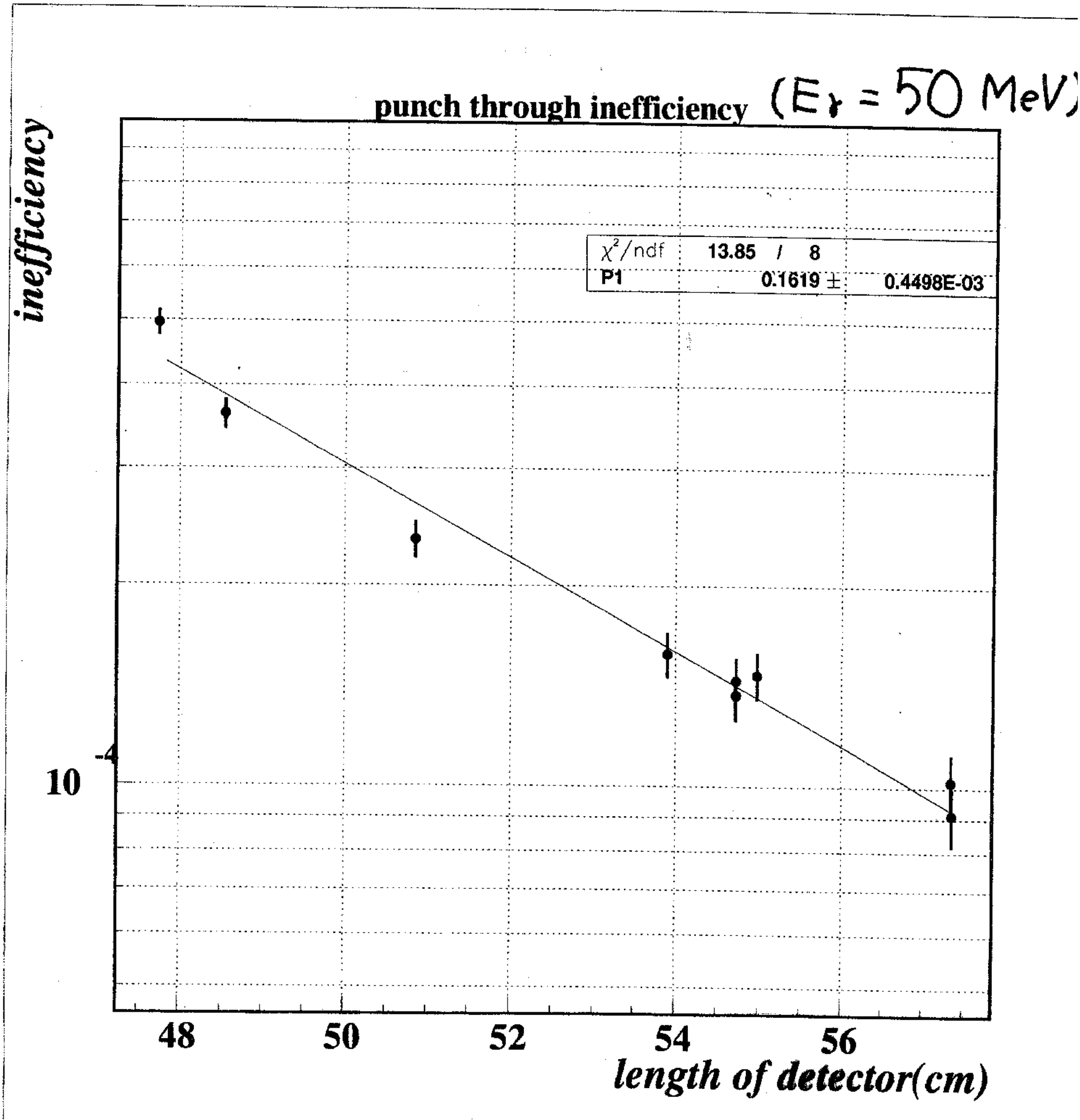
- $E_\gamma = 50$ MeV
- detector's geometry : 2 type

①



②

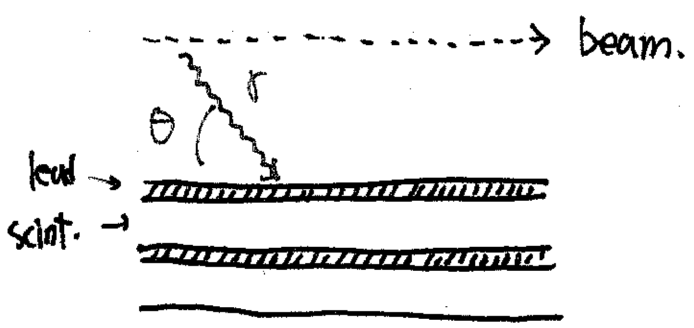


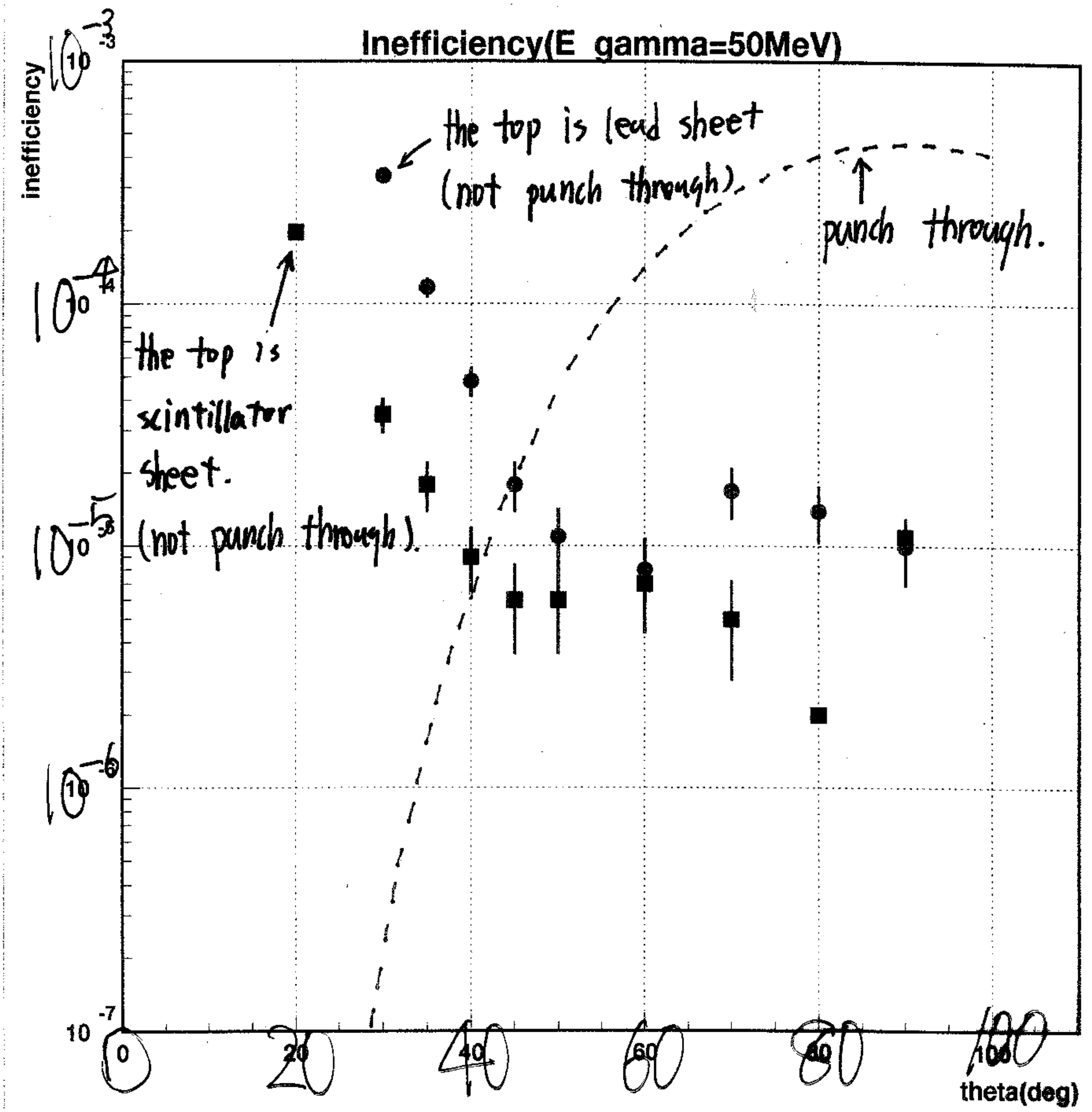


punch through

⇨ $(\text{inefficiency}) = e^{-0.169 \times x}$

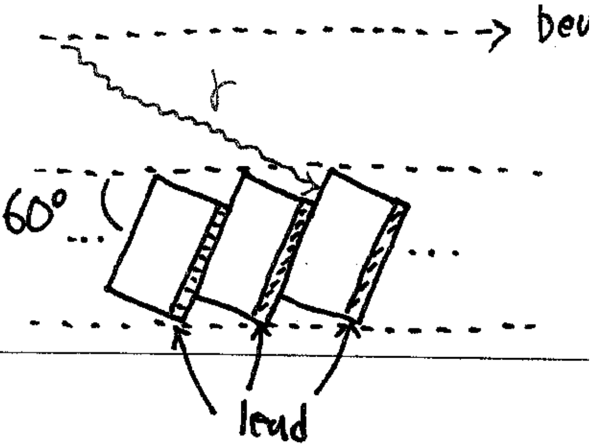
First, I studied one case.
The geometry of detector is parallel to the beam axis.

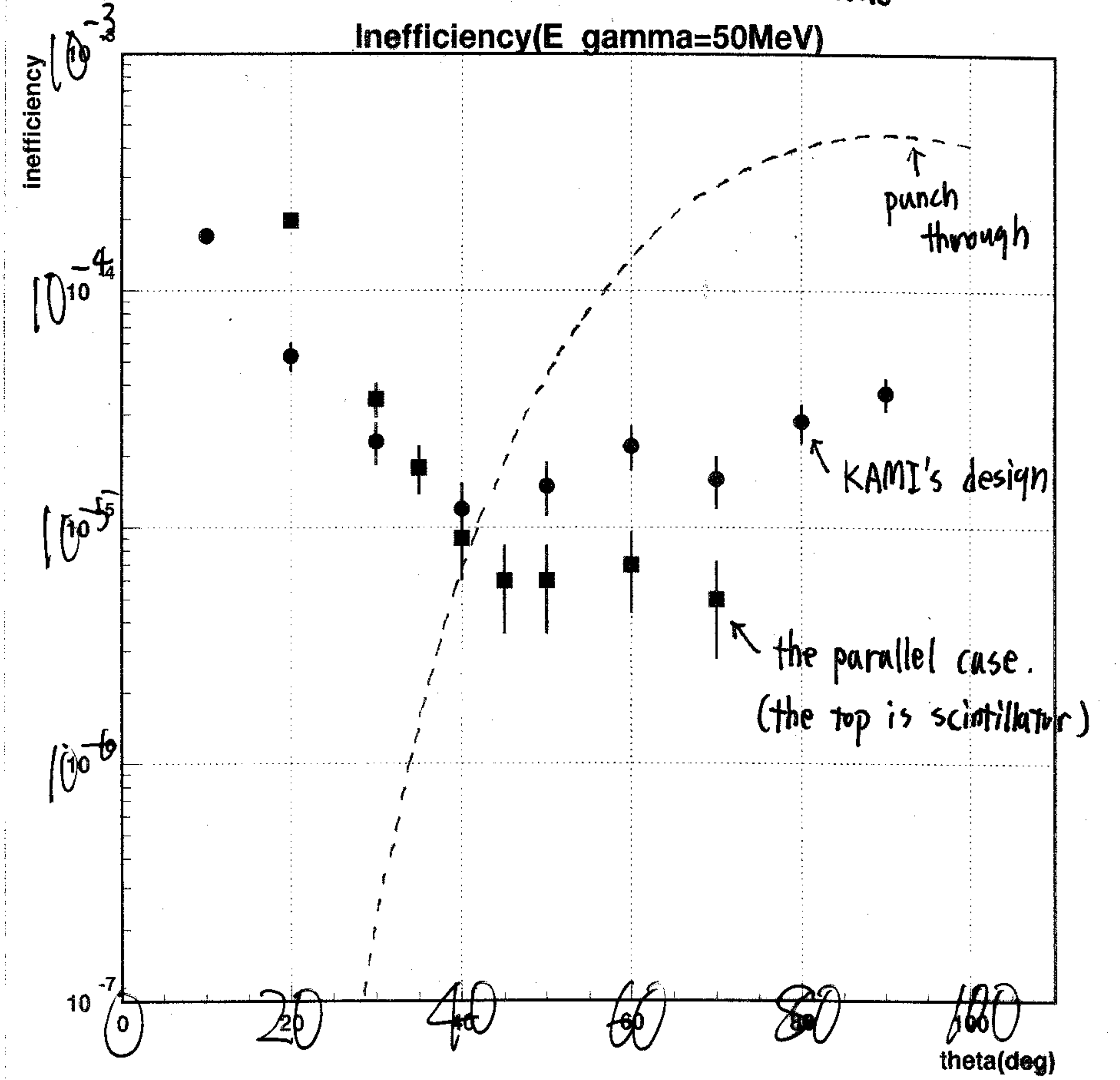




In the case that the top sheet is scintillator, the backsplash is detected by the top scintillator. So, the inefficiency is better than the case that the top sheet is lead.

Next, I studied the case that the detector's geometry is current KAMI's design.



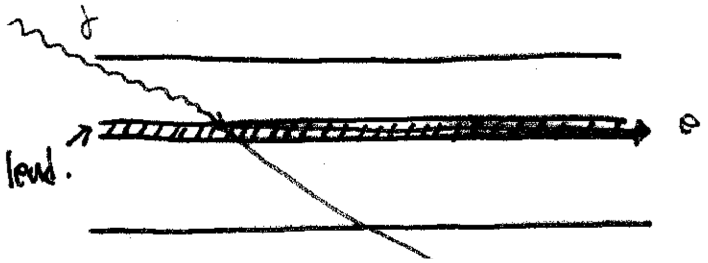


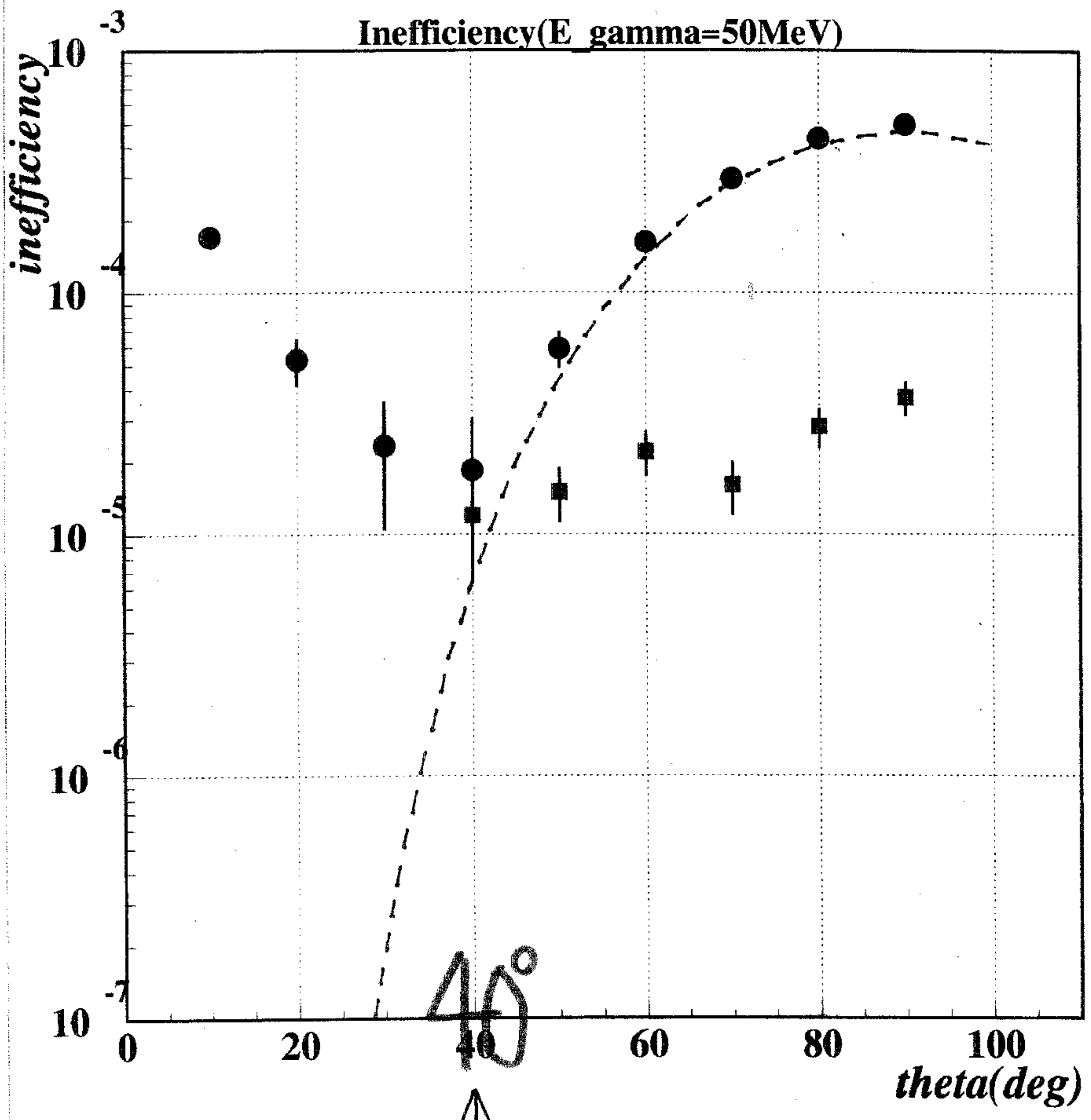
punch through

KAMI's design

the parallel case.
(the top is scintillator)

In the parallel case, when the photon's incident angle is small, the electron go to through length in the lead sheet.





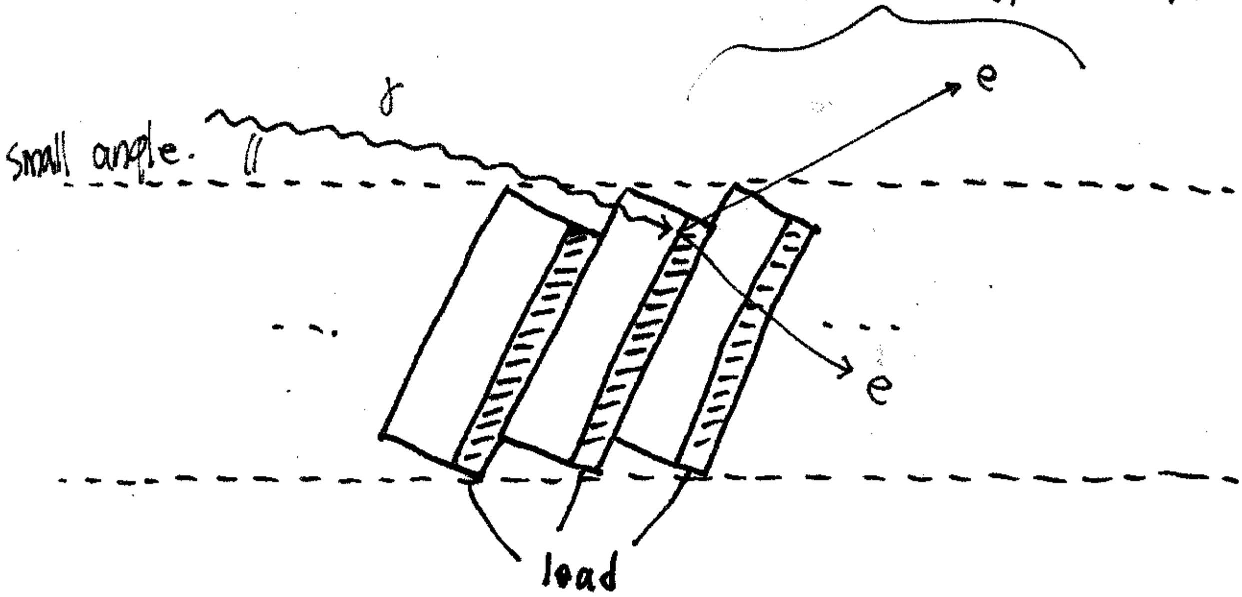
"not punch through" is dominate.

"punch through" is dominate.

The inefficiency increases under 40°.

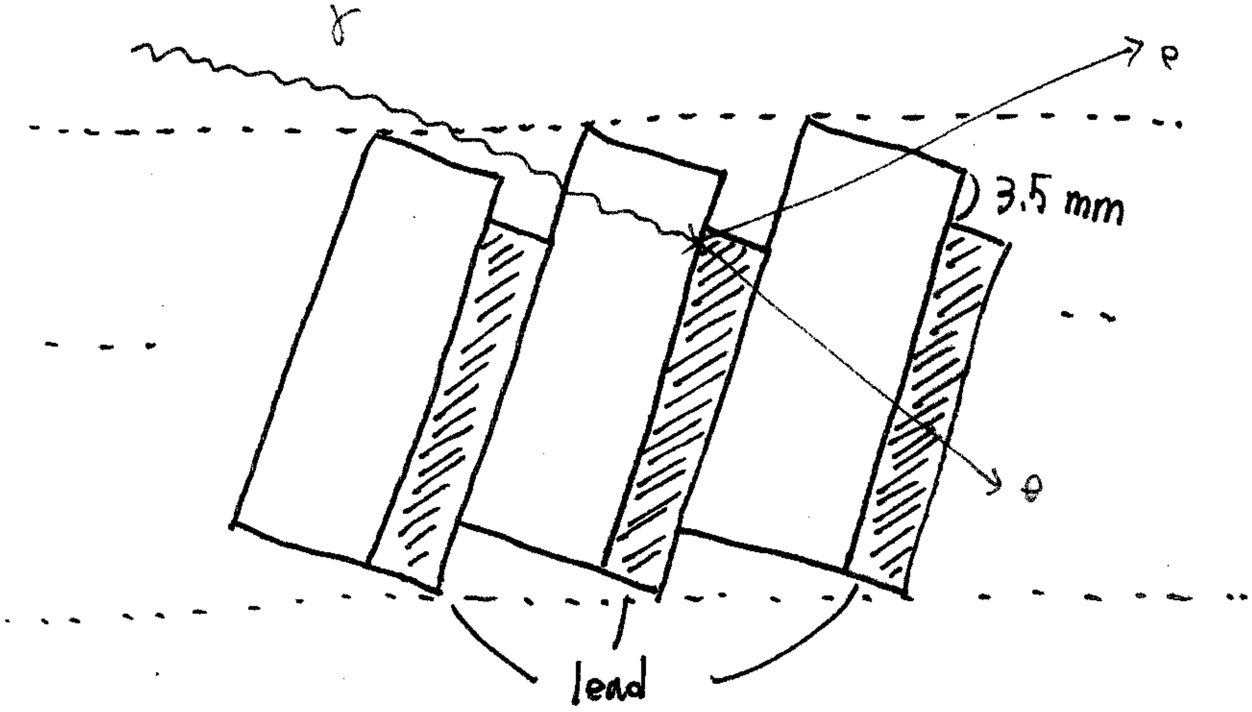
I considered its cause is

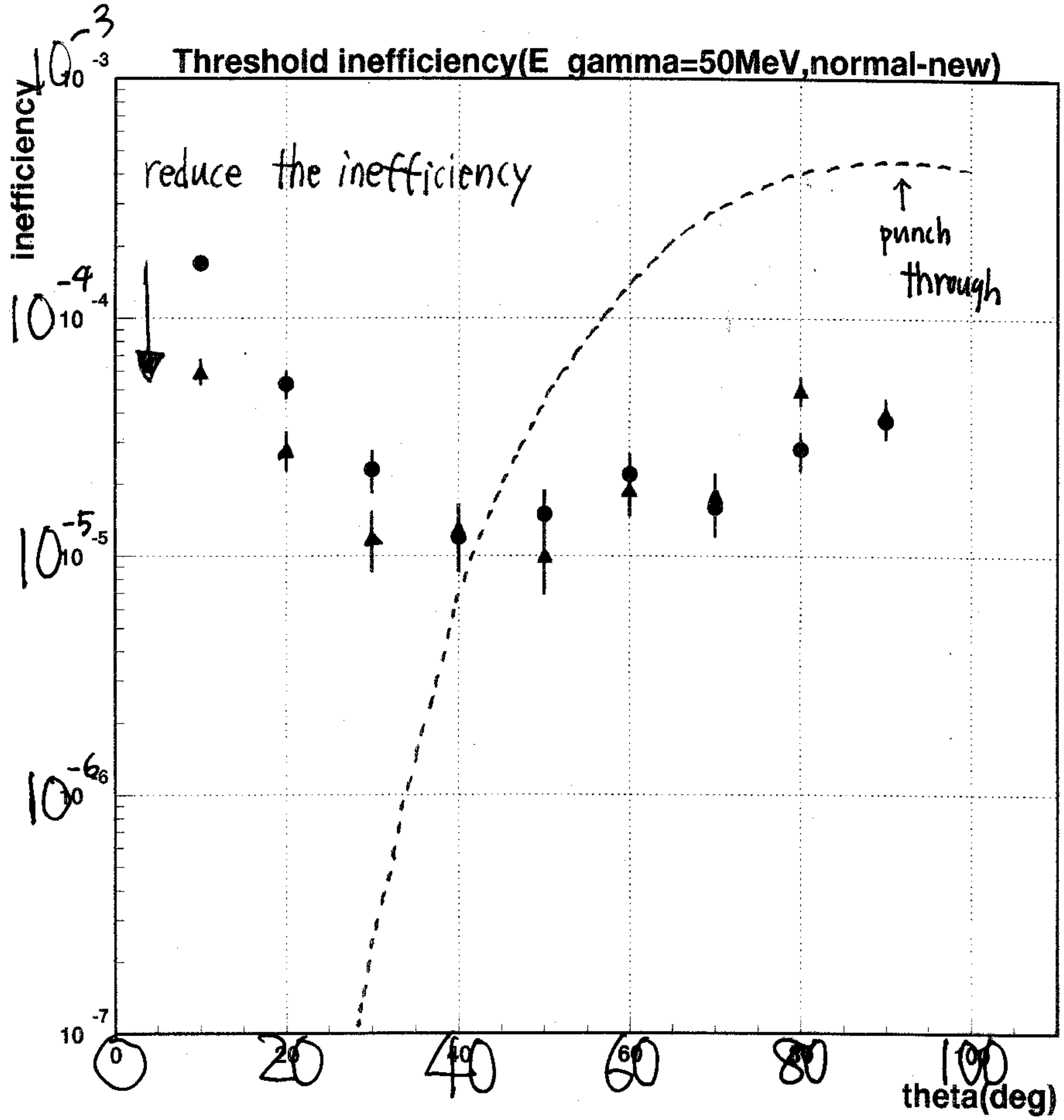
this electron (positron) can not deposit energy enough.



So, I change the geometry to reduce this event.

in this case, this electron(posit
can deposit energy enough.





Threshold inefficiency(E gamma=50MeV,normal-new)

reduce the inefficiency

punch through

Conclusion

① The number of photons ($K_L \to \pi^0\pi^0$)

the small incident angle

↓

the large incident angle

② The cause of the inefficiency

punch through : $\theta > 40^\circ$

sampling effect : $\theta < 40^\circ$

③ The reduction of the inefficiency (at $\theta < 40^\circ$

(i) the backsplash event

place a scintillator sheet
in the front of the lead sheet.

(ii) the event that the electron goes through
the lead long length.

cross the detector (sheets) and the beam ax

(iii) to get more effect