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Study of the distinction between 1γ and 2γ in CsI "

(KAMI)

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Motivation

$K_L \to \pi^0 \nu \bar{\nu} : 2\gamma$ ← background

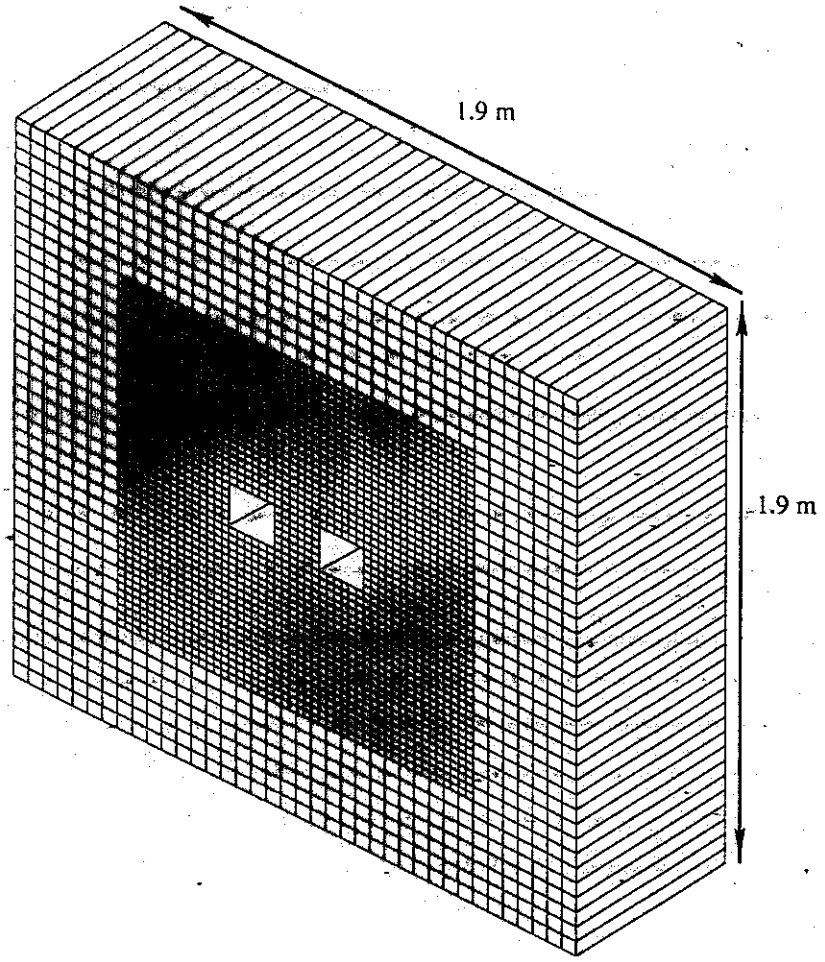
$K_L \to \pi^0 \pi^0 : 4\gamma \longrightarrow 2$

overlapped

cluster(s)

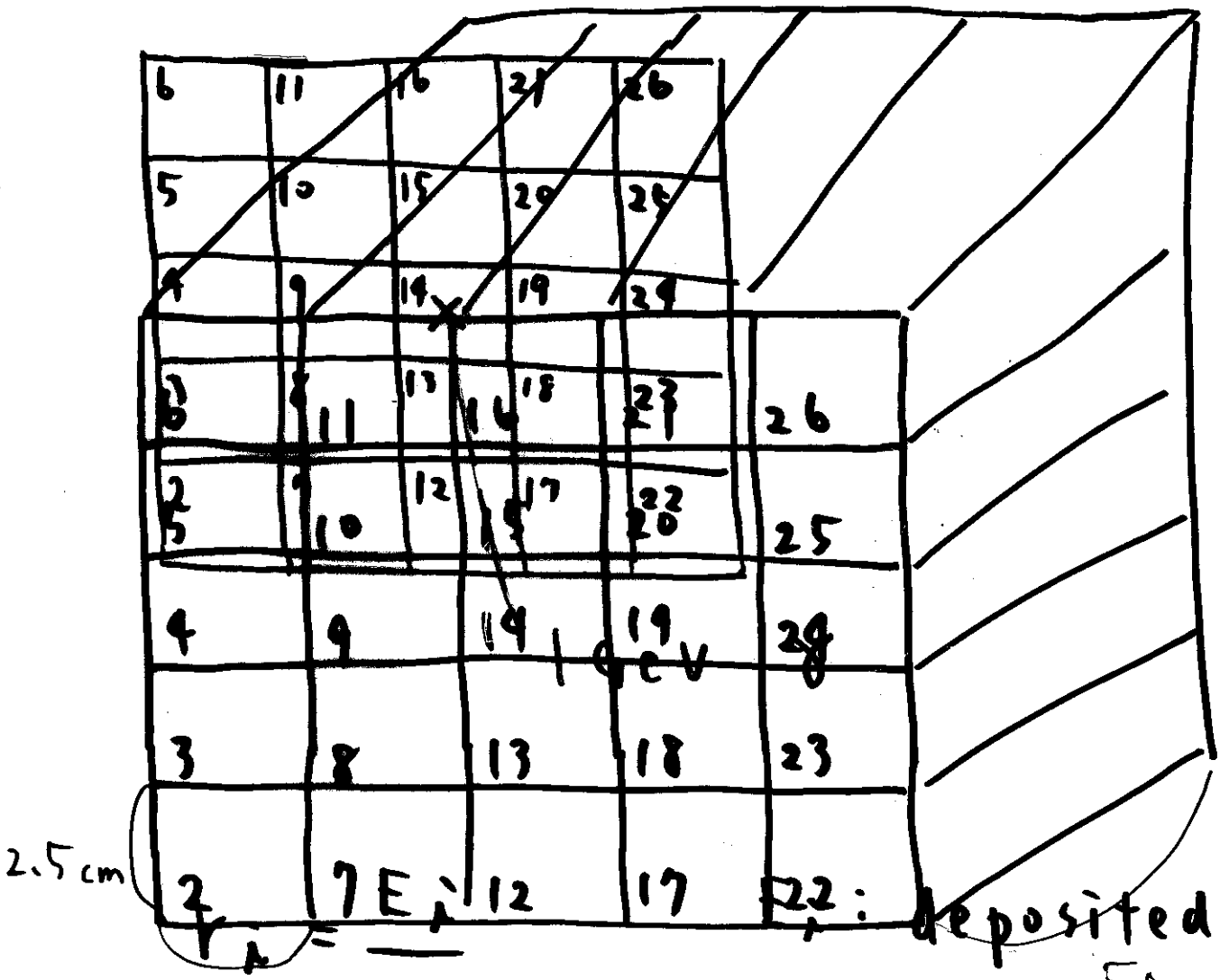
1 γ ?

2 γ ?



Cesium iodide calorimeter array of 3100 crystals.

Model simulation



$$E_{tot} = \sum_{i=2}^{26} E_i$$

$$\chi^2 = \sum_{i=2}^{26} \left(\frac{r_i - \mu_i}{\sigma_i} \right)^2$$

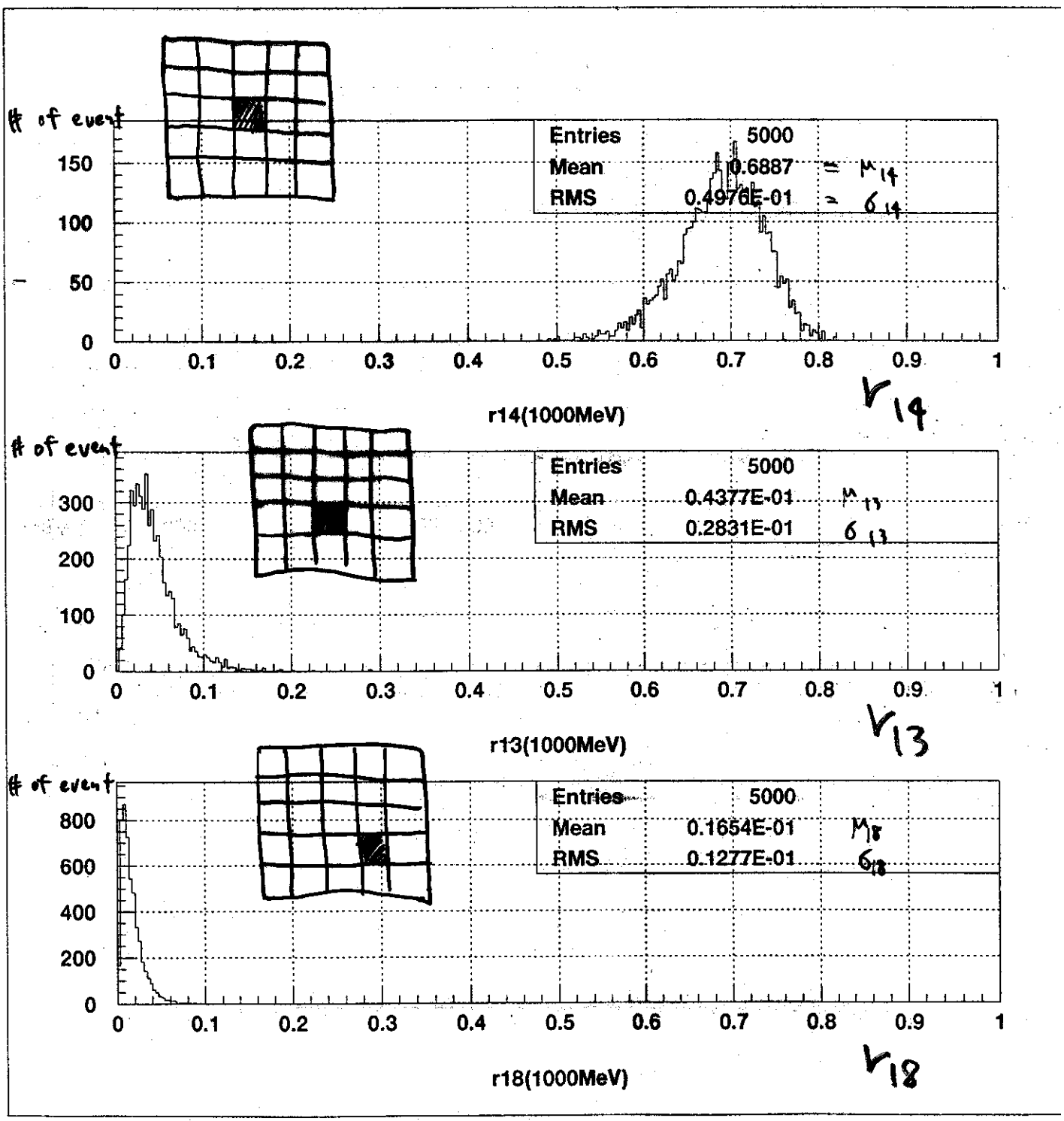
50 cm 27 radiation length

μ_i: mean of r_i

σ_i: RMS of r_i histgram

1 γ = 1 GeV

r_i

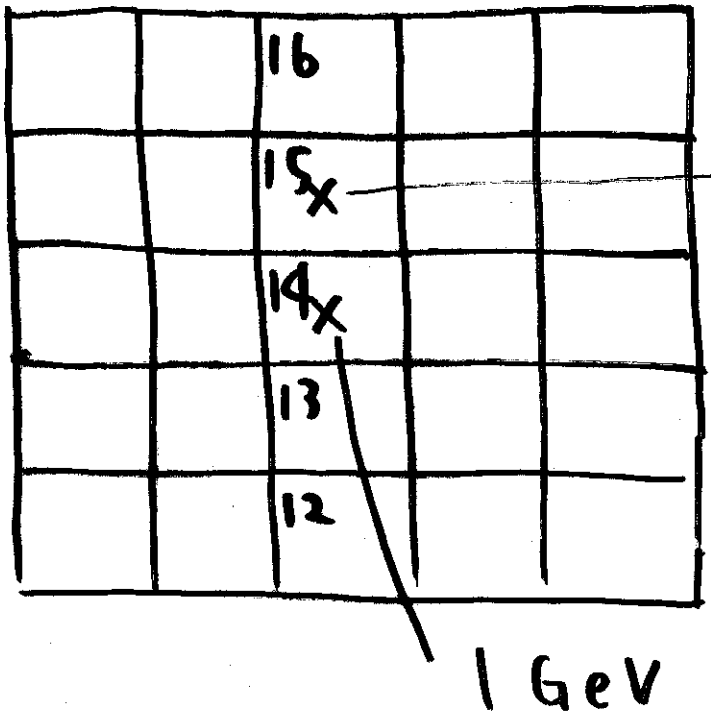

# of event
Entries 5000
Mean 0.6887 = μ_{14}
RMS 0.4976E-01 = σ_{14}
r14(1000MeV)
r_{14}
# of event
Entries 5000
Mean 0.4377E-01 μ_{13}
RMS 0.2831E-01 σ_{13}
r13(1000MeV)
r_{13}
# of event
Entries 5000
Mean 0.1654E-01 μ_{18}
RMS 0.1277E-01 σ_{18}
r18(1000MeV)
r_{18}

Entries 5000
Mean 22.14
RMS 16.77
0 10 20 30 40 50 60 70 80 90 100
0 100 200 300
χ2(500MeV)

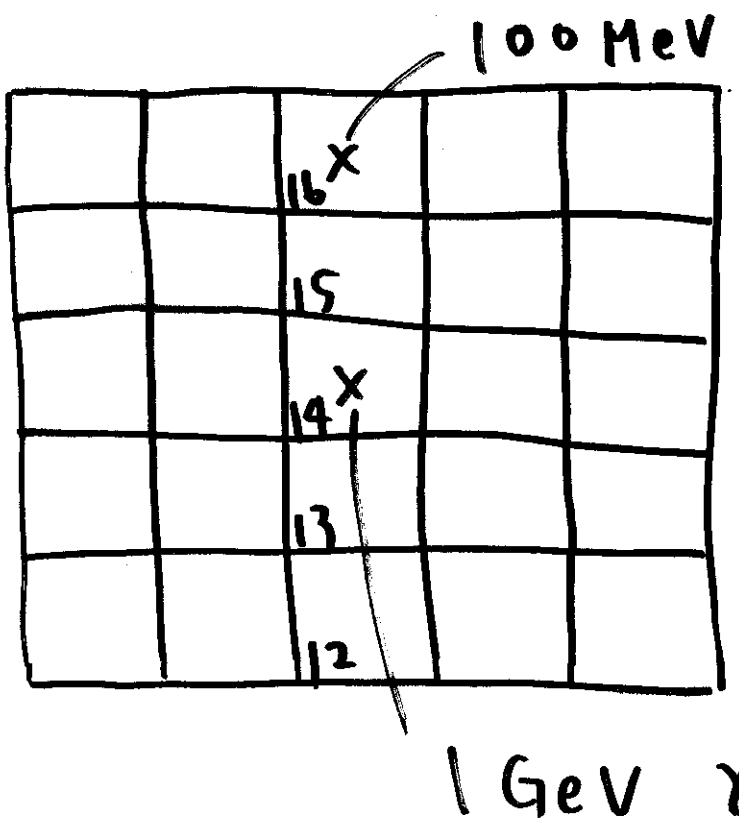
Entries 5000
Mean 23.87
RMS 15.96
0 10 20 30 40 50 60 70 80 90 100
0 100 200
χ2(1GeV)

Entries 1000
Mean 24.74
RMS 11.38
0 10 20 30 40 50 60 70 80 90 100
0 20 40 60
χ2(5GeV)

2 γ simulation



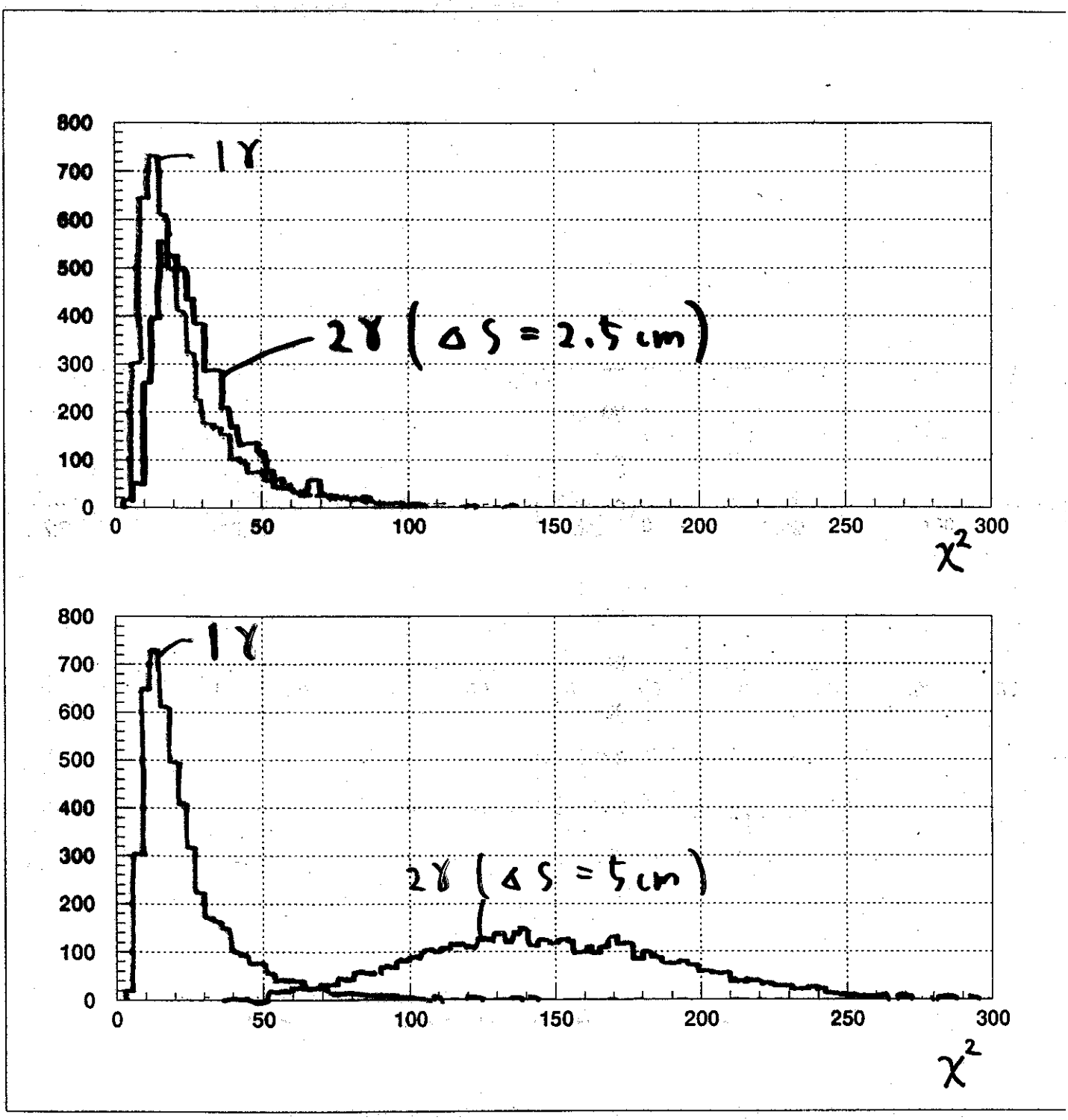
$\Delta S = 2.5$ cm



$\Delta S = 5$ cm

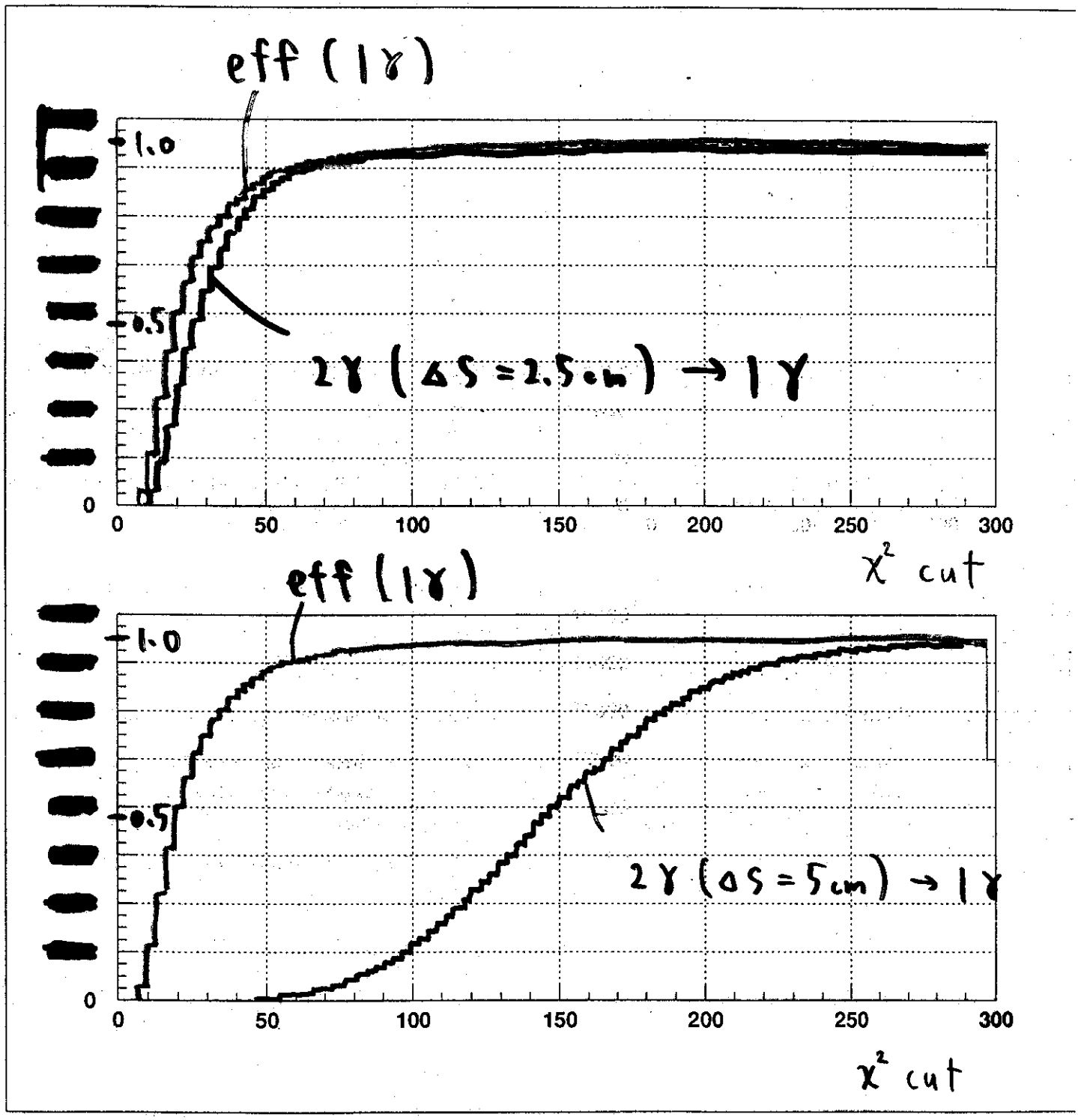
1 γ = 1 GeV

2 γ = 1 GeV + 100 MeV



1 γ = 1 GeV

2 γ = 1 GeV + 100 MeV



Conclusion

when χ^2 cut = 50,

eff (1γ) = 90%

prob (2γ (ΔS = 2.5cm) → 1γ) = 86%

prob (2γ (ΔS = 5cm) → 1γ) = 0%

1γ = 1 GeV

2γ = 1 GeV + 100 MeV

Future Plan

- the simulation that γ incident position is anywhere (containing edge)
- to make $\chi^2(1\gamma)$ and $\chi^2(2\gamma$