6 5 11

^{133}Ba B 1%

%%%%%%%%% 80μm

5.6%0 %%%0

1 B 8 5 B B 8

1

1 B– factory (KEK B–factory) B B E ”f B f CP B ” ” ” ” f ” C P o ” E r C a E r r B

1.1 KEK B–factory K

1964 K V.L.Fitch, J.W.Cronin i , Cf K Cf4V J CfK CP J , K F r [1] Cf K Cf4V ” P Cf4V K J 9 L C K_s K_L CP J 49K BP F 6 ” BV 4 ” ” K_s K_L CP BV 6 ” 4 ” Wo F ” ” K_L Ls 0.3%, P^{+} $^{-}$ CP J , K F 3 r (F

0Jh ” t B B 3 , 9 J o ” P^{0} ^{0} $_{s}$ $_{L}$ CP J K , 3 ” 0 CP J , K F , K E J 3 r C L F J ” Cf K Cf4V 0J30 CP J K 4 B, F J

3 ” KEK B–factory Wh ” Cf B Cf4V r B L K n ” Cf B Cf4V K 1 CP J] B , h , L CfK ”] r 9 a ”

1.2 CP . −1

KEK B-factory K B f CP B B Cf r K

1973 − 1 1 r 3 B — 3 9 9 E 9 r 9 3 × 3 9 −1 9 K r B t K 9 3 P 1 t 3 r E 7 3 t 3 7 CP B r 3 3 P a CP B r 9 7 o K

K −1 9 Wolfenstein 3 1 $\lambda = \sin\theta_c$ (θ_c ~ 0.22) r λ^3 3

$$\begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} = \begin{pmatrix} 1 & \lambda & A\lambda^3(\rho - i\eta) \\ -\lambda & 1 & A\lambda^2 \\ A\lambda^3(1-\rho-i\eta) & -A\lambda^2 & 1 \end{pmatrix} \tag{1.1}$$

3 −1Wi 9 s f K i

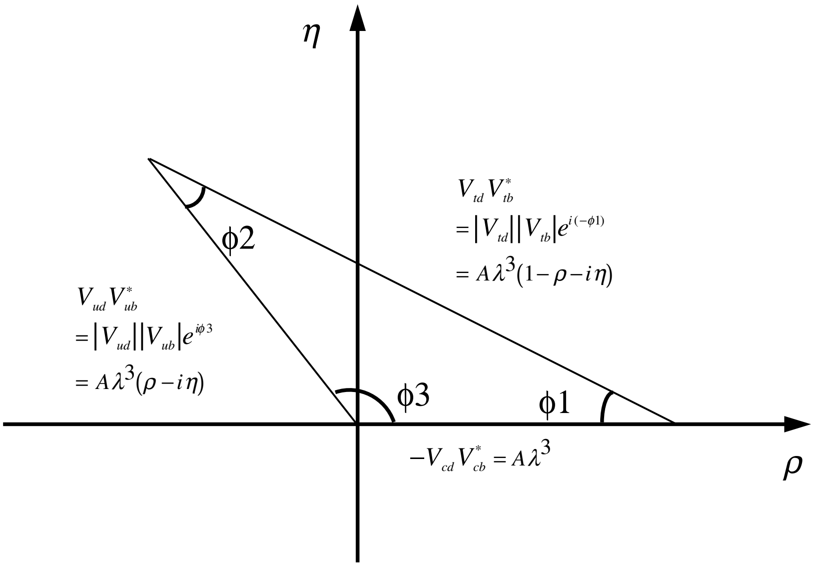
$$V_{ud}V_{ub}^* + V_{cd}V_{cb}^* + V_{td}V_{tb}^* = 0 \tag{1.2}$$

7 r K 7 1 1 P i 3 1 r 0 2=9 1.1 K = 1 3 0 3 7 0 9 0 3 r) K B 9 3 =) = 1.1K s 0 3 B Cf r B K E 3 r s 2

3 K B Cf 3 2 0 K) K B 9 3 =P 1 P

- −1Wi 9 s 3 W K 3
- B Cf 7 CP s B = E = + K + + 3

2 =



1.1: . −1 0

1.1 : .

: $\mathrm{B_d} \to \mathrm{J}/\psi \mathrm{K_s}$

$\lvert V_{td}/V_{tb}^{*}\rvert$	$\mathrm{B_d}$ or $\mathrm{B_s}$ mixing	$\sim 10\%$
$\lvert V_{ud}/V_{ub}^{*}\rvert$	$\mathrm{B} \to \rho l\nu, \pi l\nu$	$\sim 10\%$
$\sin 2\phi_1$	$\mathrm{B_d} \to \mathrm{J}/\psi \mathrm{K_s}$	$\ll 1\%$
$\sin 2\phi_2$	$\mathrm{B_d} \to \pi\pi$	$< 40\% \times \sin 2\phi_2$
$\sin 2\phi_3$	$\mathrm{B_s} \to \rho \mathrm{K_s}$	$< 40\% \times \sin 2\phi_3$

1.1: s J 0 B J K

1.3 CP

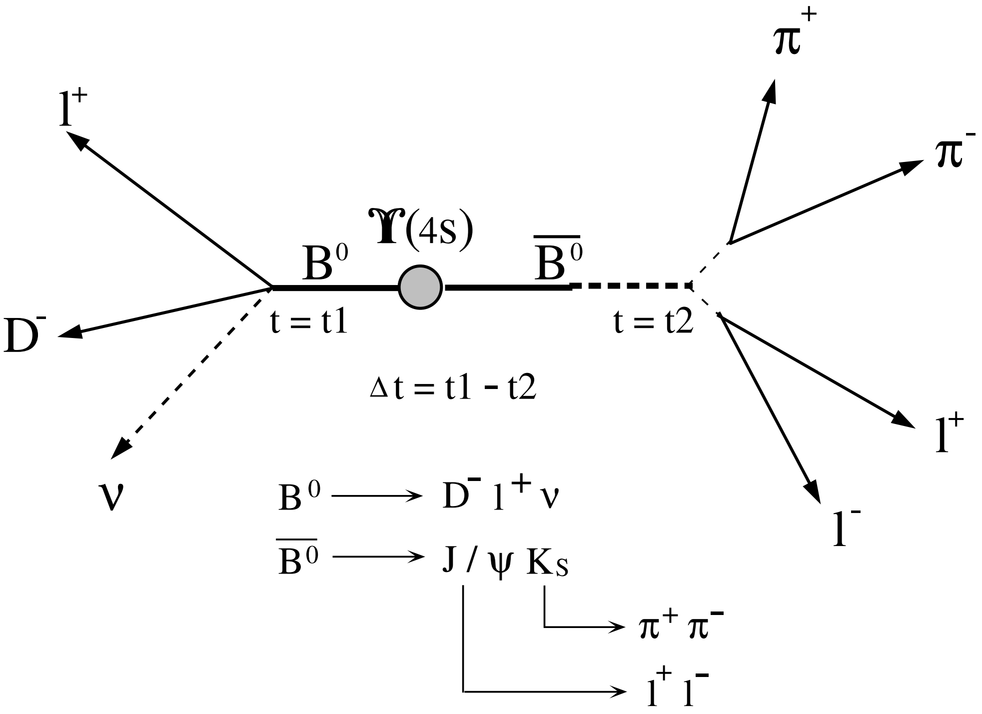
$B_d \to J/\psi K_s$ B J$\overline{B}$ K CP
B K J B
B C B C 10.58GeV G $\Upsilon(4S)$ 8 P b–$\overline{b}$
C 4V BV P 8 . 5 8 . CG 1.2nb G 8
. 5 B^0–$\overline{B^0}$ 0 s D C 4V K B J
CP 8G BVJCP= −1K G $J/\psi K_s$ s s
s B^0
$\overline{B^0}$
s B^0 $\overline{B^0}$ CP 8G BV
$J/\psi K_s$ J/ψ K_s
s $J/\psi K_s$

CP BP A_{CP} P P
CP 8G BVK J 2 0 4V (Δt) B D =P P

$$A_{CP} = \frac{\Gamma(B^0 \to J/\psi K_s) - \Gamma(\overline{B^0} \to J/\psi K_s)}{\Gamma(B^0 \to J/\psi K_s) + \Gamma(\overline{B^0} \to J/\psi K_s)} \tag{1.3}$$

$$= \sin 2\phi_1 \times \sin \Delta m \Delta t \tag{1.4}$$

=1 G 4V Δt t A_{CP} $\sin 2\phi_1$ ϕ_1 1.1G D 5 0 3
b 3 1 D K 3 +
4V Δt B^0–$\overline{B^0}$ B^0–$\overline{B^0}$
0 $\Upsilon(4S)$ BV P 3 8 . 5 $B^0\overline{B^0}$
s 0 1 0 B^0–$\overline{B^0}$ B^0–B^0
$\overline{B^0}$–$\overline{B^0}$ 0 B^0
$\overline{B^0}$ s
s B^0 $\overline{B^0}$
1 0 s
B^0 $\overline{B^0}$ B^0–$\overline{B^0}$ CP
8G BV$J/\psi K_s$ 0 1



1.2: B^0

CP B 1

2 CP B 2 C 1

2 B C

CP B P Δt

KEK B–factrory Δt

2 B^0 CP B

r

2 E 2r K BP : E a

K K B^0–$\overline{B^0}$ $\Upsilon(4S)$ P Cf4 r P .

$\Upsilon(4S)$ 10.58 GeV P B^0 5.28 GeV G a

$\Upsilon(4S)$ E K BP B^0 $_0$ 346 MeV/c G

B^0 1.3×10^{-12} B^0 $_2$

25 μm

3 3 B^0

KEK B–factory f EE 8GeV EE 3.5 GeV G 3 Υ(4S) 3 EE S 8 K 4.5 GeV/c 1 r G B 83 G 8 165 μm

Δt

$$\Delta t \simeq \frac{\Delta z}{\beta\gamma} = \frac{(z_1 - z_2)}{c\beta\gamma} \tag{1.5}$$

a 3 G 3 3 G $\beta = c/v$ $\gamma = (1-\beta^2)^{-1}$ 0 $\Delta z = (z_1 - z_2)$ 2 B^0 2 z 8 (S 8) 5 G G 8eK B 83 G 8 6 2 165 μm A_{CP} 3 G B a K 2 E 8 =4o 1 2rG= r 8 Δz / 80 μm [2] 3 CP] B88 K =E r 3 r 2 2 E 8 =BoK 2] E G 3 E r C . 3 2f 8 G

a G 3 5ar K 2 E 8 =Bo 3 C 8 =Bo K =

1.3: CP P – P P B–$\overline{\mathrm{B}}$C
CP B $\mathrm{J}/\psi\mathrm{K}_\mathrm{s}$ $_\mathrm{s}$
B C J (Δt) (τ_B) C J B^0 $_0$
$\mathrm{J}/\psi\mathrm{K}_\mathrm{s}$ B^0 CP J B $\Delta t/\tau_\mathrm{B}$ 0 C K
BP J K J CP J B J K BP CP K B
$\sin 2\phi_1 = 0.6$

1.4 4 4 . 4 4 4

100μm 0

1 1 5

[1]

KEK B–factory

K o r o (1.4)[2]

4–K 1991 K 9 B K 9 4o 9

K B 9 0 2r r B–factory m 9 o

1.5K (9 2 [3][4] $B^0 \to J/\psi K_s$ [1] Δz / /

$83 \pm 3\mu m$ Δz / /

/ KEK B–factory 1 0 1 GeV

0J2 3 G 8 9 (3 J 1 0 . 5 J 2 EB KB

J f G B E 5 G J J 3 G 2f 9 J 3 9 8 4o

1 8 J G 2 85 B 8 B 2 G J 3 9 8 4or 3 r

3 3 9 8 4oK 1992 G K G 9 9 J o

2 J J 3 G J 2 E 8 4o J K G 3 3 G 5

[4]

3 G J 3 B] K 3 9 8 4or J 2 E 8 4o 9

9 K 9 (3 9 8 4or K 9 3

o 1 G J 8 5 9 1.4 G 3 3 9

8 4oK 3 50 r 8 J 2 E r 5aa G 3 9

8 4o K t 1.2 G 166 K 3 9 8 4of K r

9 3 K J

5 K 8 4of K K t 4 K 9 r 9 3 r 9 (

E E J 40. J 8 3 5 K r 3) 9 3 6Ka E G 3 G K J8G

---

[1] 1.4 4 17°

[2]

	z $\times\phi$	
	4×8	32
2	4×11	44
3	6×15	90
		166

1.2: 3 3 9 8 4

3 9 8 4 3 9 4 2 3 5 9 3 5 3 9

1.4: 3 9 8 4 9

1.5: Δz

2

2.1

p n n

p 4 3 3 n 3 (hole) n 3 4 5 5 3 h n l 3 3 5 l 5 o 3 l l n^+ p^+

2.1.1

p-n p-n p 3 n 3 5 5 5 n 3 3 - n 3 3 5 p 3 3 - p 3 5 3 5 l p 3 5

n n p
9 ( ) p-n 9
n
9

p-n 9) (ρ) (E) 2.1(B) (C) (9
p-n 9 B EE 9 EE 9 p-n 9 9 EE
E 1V E 2.1(B) (C) ” ” 2
” EE2 9 B ” C EE 9 n
9 EE C 1 EE2 B
” EE 9 9 BV ” C ”
9 - C ” ” 2 EE EE 9 B n
” n EE 9 EE 9 B 9 C
” 9 EE C 1 ” C ”
9 B EE ” ” 1 EE2 9 ” EE2
C n (. B - ” 4 2
9 ” B EE 9 B n (. 3.6eV ” ” 2
9 3.0eV ”

2.1.2 2

p-n 9 EE0 1V ” 3 1 n EE 9 9 B.
EE6 9 3 ” 6 3 0 C n
(. . 4 E EE B - ” EE6 EE
2 EE0 . 9 499 EE2 4 C B - 3 B3
1 6 ” 3 6 B - ” 4 - 0-
0 e B p-n 9 30 ” 9 EE0 [1]
(2.1(D)) 3 ” 4 3 EE2 (EE
9) EE6 0 ” ” 9 EE0 (” 4

---

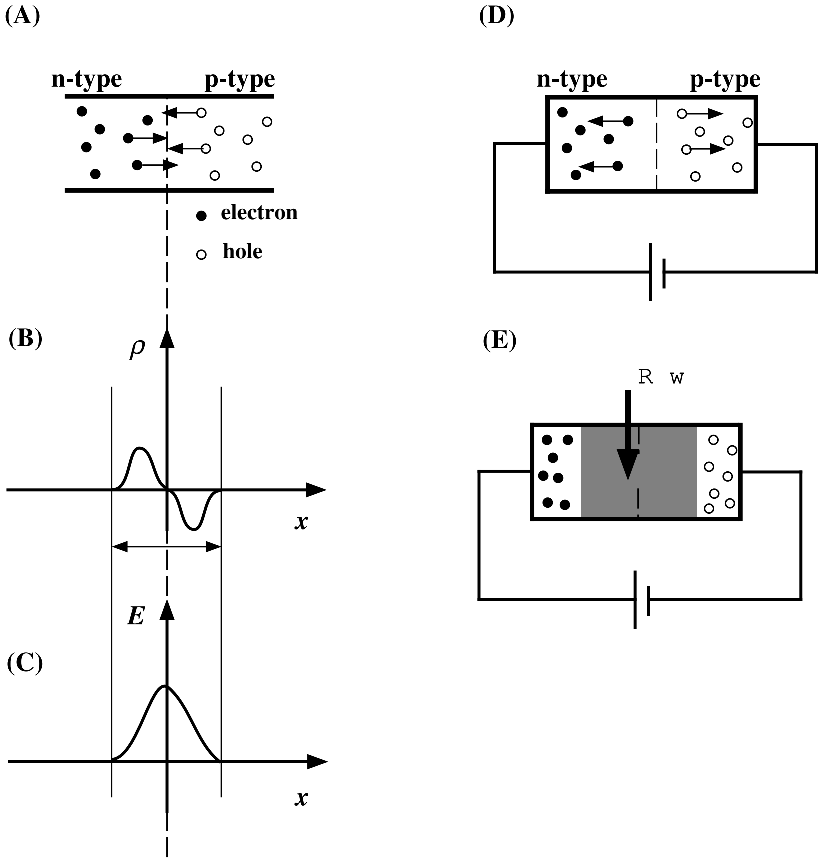
[1] p n

2 2 2.1(E) 2

1 0 EE EE 0 0 EE

2

2 E



2.1:

2.2

2.2 n p^+ n^+ p^+ n p-n 1 n - 2 2 2 n .[2] p^+ p^+ n^+ + p-n . 2 p^+ ^{2} ^{2} + ^{2} $25\mu m$

EPS File
silicon-detector.epsf.ps not
found

2.2:

---

[2] 3.7eV . .

2.3 .

2.3.1 3

2 2 3

3 3

3 2 . 3 3

300μm

80keV 3 0 k k 3.6eV

22,000 8 , 8 k 3 , k 3 4fC 3 . f

C k 3 , 3 0 3 8 4

k

3 6 8 2 2.3 2 4 C 0 4 k

3 3 6 8 2 Q V

Q C_f

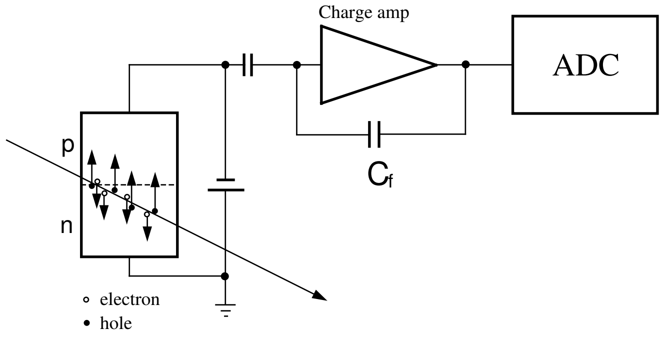
$$V = \frac{Q}{C_f} \tag{2.1}$$

= 2 4 0 4 . f 8 k 4 4 ADC A

8 k C 4 k 8 k C 4 . f 3 , 8e

2 1 k 0 e , 0 3 8 =4 = 6

3 C 8 =4 1 k



2.3: 8 =4 =

2.3.2 3

3

3 4fC

f 3 2 f

S/N f N N f 3 2 N3 2

N f 2 3 N C f 3S C 4

C N 3 C 2

N3 2 2 N f V_{before}

V_{after} a f V_{signal}

$$V_{signal} = V_{after} - V_{before} \tag{2.2}$$

3 N ”Double Correlated Sampling”

” 2 N3 D 2a N f r = a ” N3 D 2a N

f r ” 2C 4or S 3 ” S 4 3N

C a ” N3 D 2a e r 3 = ” C d

r 3 N i r ” 3 t = 4or C

/ 3 C 4 r CN ” = 3 ””Double Correlated Sampling” r

a N = r N l ”

1. e = N r 3 N ” V_{before} s s i V_{after} s s o f r ” ” / ”
2. 3 t = 4o ” 2 N3 D 2a N / 3 C 4 r CN
3. 2 CNC / 4 ” ” / ” b ” l ” = N ” = r 3

2 ”” ” / ” N 3 4 ” D N 4 4 ” 3 l 3 N = r r 1 i l d ” 3 N p ” 3S 3 / N b 3 4 r 1 g

b l ” 3 C = 4o N = 4o g / N ” g 1cm 200 C b N o g N N = r o 1 l i ”

ADC C 2 C 4
2 A 4 C 4 C 4 2
2 1 μsec s

e
s e

3

3 3 3

3.1 3

3 **3**

1 **3** X x_i

Q_i i

$$X = \frac{\displaystyle\sum_{i \in cluster} x_i Q_i}{\displaystyle\sum_{i \in cluster} Q_i} \tag{3.1}$$

3 . (

$$X = \frac{x_1 Q_1 + x_2 Q_2}{Q_1 + Q_2} \tag{3.2}$$

3.2 Q_1

$$\frac{\partial X}{\partial Q_1} = \frac{Q_2(x_1 - x_2)}{(Q_1 + Q_2)^2} \tag{3.3}$$

Q_2 1 Q_1 Q_2

$$(\partial X)^2 = \left(\frac{\partial X}{\partial Q_1}\right)^2 \partial {Q_1}^2 + \left(\frac{\partial X}{\partial Q_2}\right)^2 \partial {Q_2}^2 \tag{3.4}$$

3.3

$$(\Delta X)^2 = \frac{(x_1 - x_2)^2}{(Q_1 + Q_2)^4}[Q_2^2(\Delta Q_1)^2 + Q_1^2(\Delta Q_2])^2] \tag{3.5}$$

$$\Delta X = \frac{|x_1 - x_2|}{(Q_1 + Q_2)^2} Q_1 Q_2 \sqrt{\left(\frac{\Delta Q_1}{Q_1}\right)^2 + \left(\frac{\Delta Q_2}{Q_2}\right)^2} \tag{3.6}$$

3 3 $\Delta Q_1/Q_1$ $\Delta Q_2/Q_2$ 2

4 1

$$\frac{\Delta Q}{Q} \equiv \frac{\Delta Q_1}{Q_1} \sim \frac{\Delta Q_2}{Q_2} \tag{3.7}$$

3.6 2 =

$$\Delta X = \frac{|x_1 - x_2|}{(Q_1 + Q_2)^2} Q_1 Q_2 \sqrt{2} \left(\frac{\Delta Q}{Q}\right) \tag{3.8}$$

3 $\Delta Q/Q$ /

$$\frac{\Delta Q}{Q} = \frac{1}{\sqrt{2}} \frac{\Delta X}{|x_1 - x_2|} \frac{(Q_1 + Q_2)^2}{Q_1 Q_2} \tag{3.9}$$

3 3 2 = 1μm

/ / 50μm $|x_1 - x_2| = 50\mu m$,

0 3.9

$$\frac{\Delta Q}{Q} = \frac{1}{50\sqrt{2}} \frac{(Q_1 + Q_2)^2}{Q_1 Q_2} \tag{3.10}$$

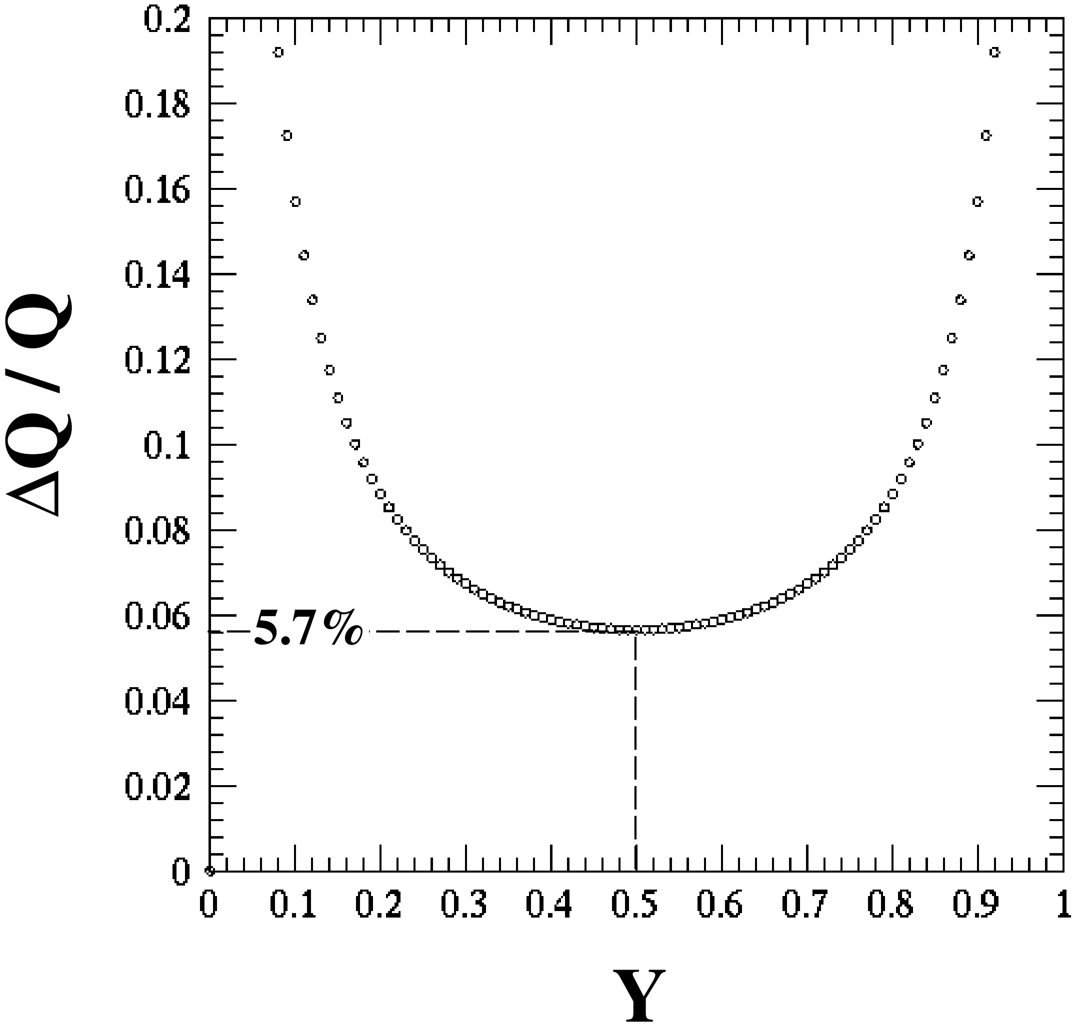
99

$$Y \equiv \frac{Q_1}{Q_1 + Q_2} \tag{3.11}$$

$$\frac{\Delta Q}{Q} = \frac{1}{50\sqrt{2}} \frac{1}{Y(1 - Y)} \tag{3.12}$$

= 0 3.12 3 7 2 3.1 (9

$Y = 0.5$. = 5 2 0 5.7%0 2


ΔQ / Q
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
5.7%
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Y

3.1: 2 2

3.2 3 3

3.2.1 2 . 3 3

3 . **3**

2 [7][9]

8 9 2 9

2 2 9

7 2 8

9] 2 9 8

3.2 9 [3]

3.2.2 ^{90}Sr r

S r

3.3 9 8 9 7 3 7 2cm

7 7 3 9 8 3 9

7 8 3 7 3 9 8 3

7 3 9 8 2 . 9 7 2

9 7 3 . 9 8 3 9 3 7 3

9 8 2 7 3 3 9 7 3 9 8 9 7

2 9 7 3 3 9 3

. [. 3[1]

1 9

9

9

1 0 3.4 8 3 81keV

7 8 9 18keV(23%) 9 k k 3 %2%%%%%(%7%

% 1% 2 7 9 k 3 %9%%%% 530 8] 8

---

[1] 3

3.2.3 3 3

3 . 3 3 3

3 [10][3] 3 0 3.5 9

3 3 30 9 $10\mu m$

$10\mu m$ $25 \sim 50\mu m$

2.3.2 0 9 3

3 3 9

3 3 9 $859nm$

$10\mu m$ $300\mu m$

$1.5 \sim 2.0\mu m$.

.

n^+ n^+

p−n 3 5 0 9 30

1

3 9 5[9 9 $100\mu m$ $1000nm$

. .

μm . .. n

3.2.4 ^{241}Am

A SLAC Linear Collider MARK

II 8 o K 3 9 C 8 o r 3 0 K C ^{241}Am 8 59.5keV

γ [2] [?] 3 3 1.35
cm 3 $300\mu m$
2.2% 3 250 mCi
1 %%%% % 2 i 3 $100\mu Ci$
i 2500 2.3.2
%%%%% %%%% C 5[1] C 5[5 5
0 20] C i 3 %%%%C %2%%3 5 C
512 3 %%%%C 30 $\sim$ 40] 15 4
3 4 C1 %%C%%C 3 3
250mCi 0

---

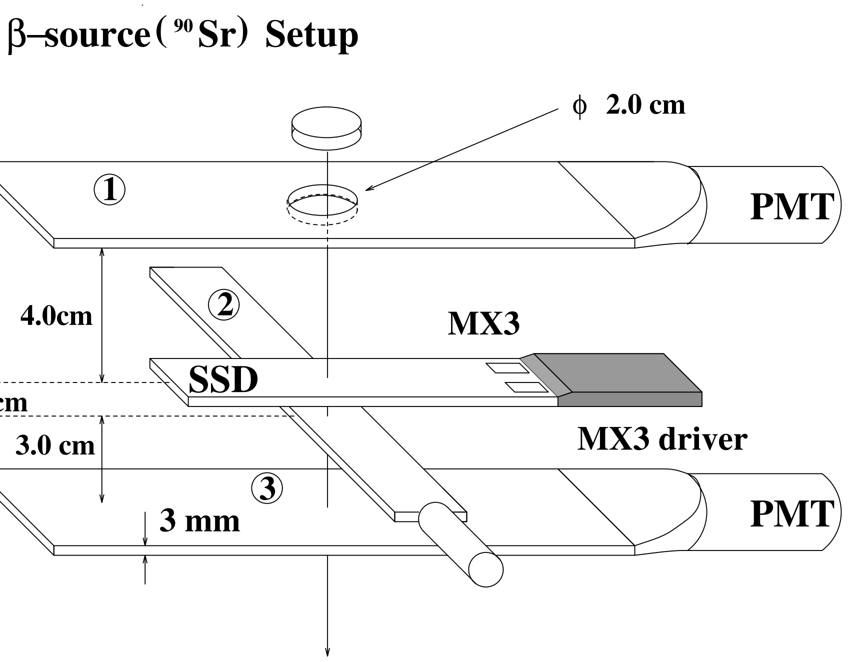
[2] 59.5keV k . . 9 $300\mu m$
70% k

3.2: 3

DSSD 3 2 –

. 2 . 2 SSD 3

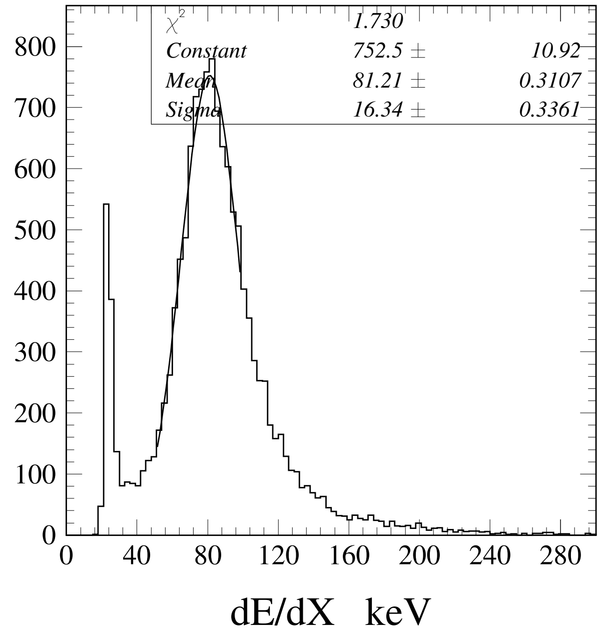
2 D



3.3: ^{90}Sr r 3

1 3 2 3 3

3 r



3.4: ^{90}Sr .

− : 3 81keV r : 8 : 18keV 23% %%%%.

3.5: 3 3

3 3 4 : 5

4

4

4

250mCi

2 2 5 5 i 0 i

C C 0 5

4.1

γ

$$\nu' = \frac{\nu}{1 + \frac{\nu}{m_e c^2}(1 - \cos\theta)} \tag{4.1}$$

ν $\cdots$

ν' $\cdots$

θ $\cdots$

$\ldots$ 3 . 3

3 3 6

3

1. 6 3 3 3
   . 3

2. 1 3

4.1 4.2

1 6 3 6 3

. . 6 3 2

. 2 3 3 1 6 3

6 3 1 6 3 4 4.3

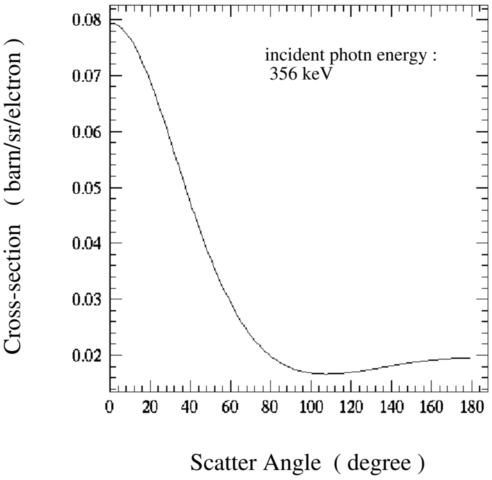
6 4 6

3 1 3 6 4 γ

4.13 3

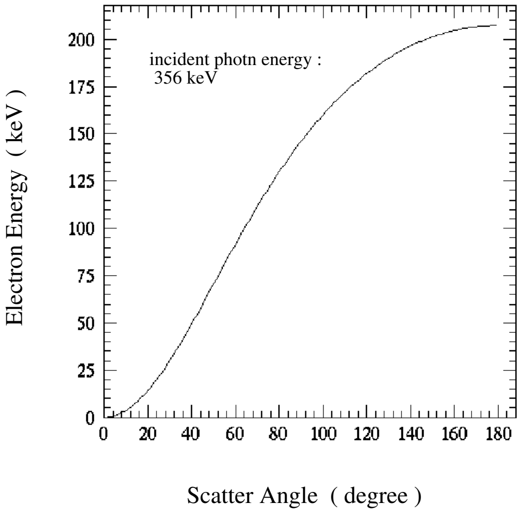
3 3 6 4 2 4

2 4 3



4.1: 3 3

3 7 7



4.2: 3 7 .

4.3: 180 8 **3** 83

4.2 ^{133}Ba

B B 80keV[1]

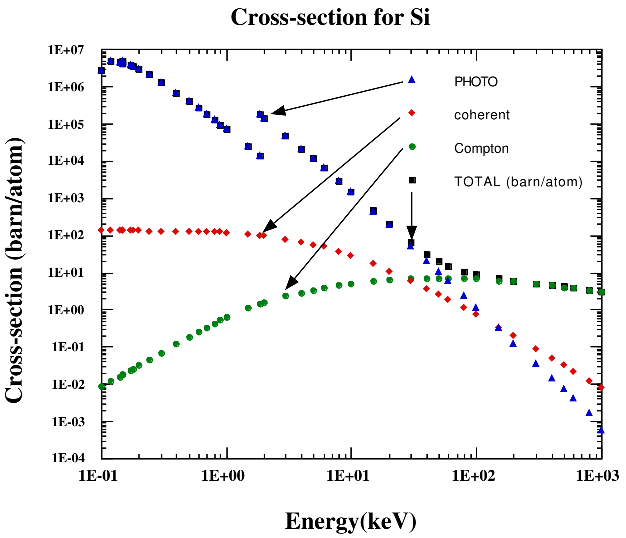
[8] 4.4 100keV 0 e 8 [1 8 k 3 k 100keV 8.56 barn/atom 600keV 3.76 barn/atom 3 k . 9b [4 . 5 . . . 0 8 5 8 k . 140 6 7 k . 4.1 5 7 3 9 k 4 4.4 8 9 4.5 r 9 3 b 9 7 ^{133}Ba r 3 7 a 6 8 8 4o 7 k 8 4or b 9 k ^{133}Ba 356keV B b r 7 356keV 6a k . 303keV, 276keV, 383keV 3 o k . 0 , k 4.6r 2 3 k . 0 r 6 9 k , , k 4.2 3 k . 0 0 k . , 1 4 0 6 7 8 k . r 7 0 k . 8 , 6 7 r 6 8 k . 5aa k k . , 2r , 9b 3 , 7 3 5ar 9 8 4o 7 2 9 2 k 8 4or

8	8 k . [keV]	k . [keV]
^{57}Co	122	36
^{133}Ba	**356**	**196**
^{22}Na	511	326
^{137}Cs	662	461

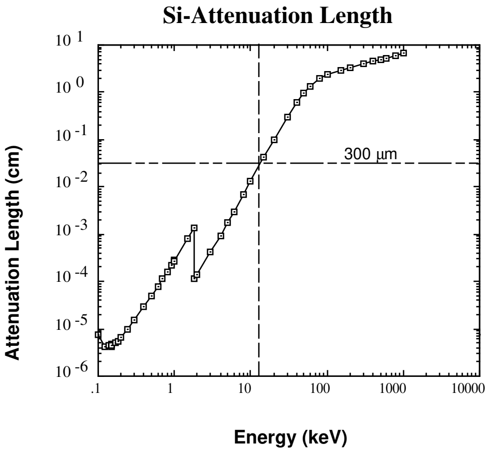
4.1: 8 5s, C 8 N k . 1 4 0 6 7 N N k .

---

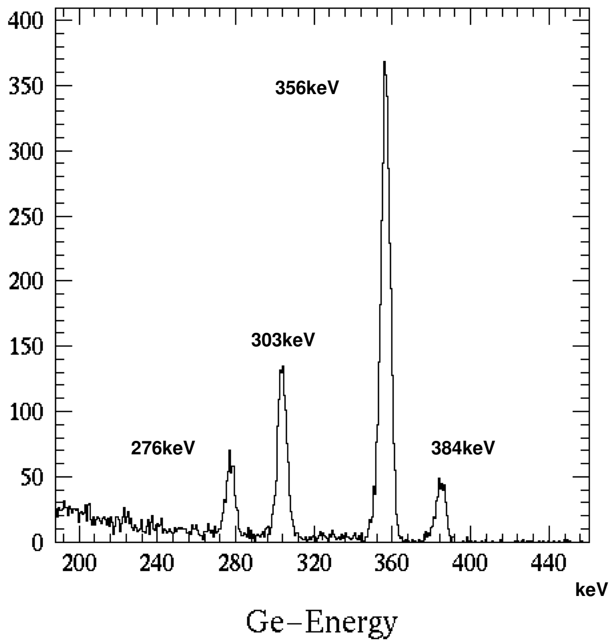
[1]


Cross-section for Si
Cross-section (barn/atom)
Energy(keV)
PHOTO
coherent
Compton
TOTAL (barn/atom)
1E+07
1E+06
1E+05
1E+04
1E+03
1E+02
1E+01
1E+00
1E-01
1E-02
1E-03
1E-04
1E-01
1E+00
1E+01
1E+02
1E+03

4.4: 4

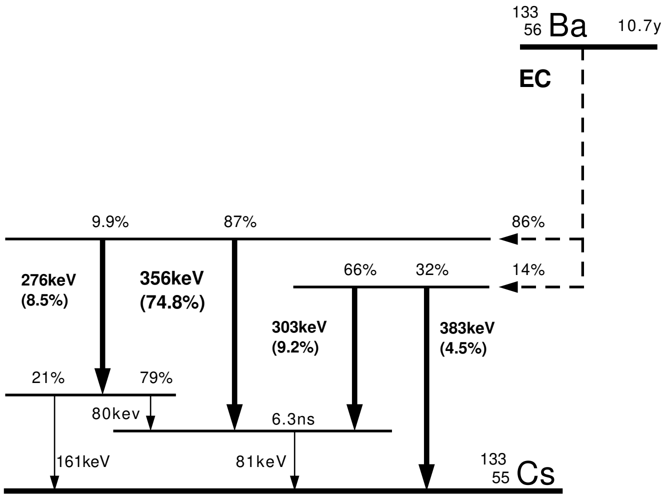

Si-Attenuation Length
Attenuation Length (cm)
Energy (keV)
300 μm
10 1
10 0
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
.1
1
10
100
1000
10000

4.5: :



4.6: 4 4 ^{133}Ba .

- ^{133}Ba 4 B



4.7: ^{133}Ba 7

	140	
[keV]	k [keV]	[%]
356	160	(100%)
303	148	47%
276	141	26%
384	165	14%

4.2: ^{133}Ba 4 %(% %k%. 0 B

4.3 3

3 **3**
4 **4** **3** **4**
4 **3**
3 **4** 4.13 4
1 3 . 4.8
8 4 8
500nsec 0 1 8 8
4 0 1 0 0 s 3
1 4 3 0 4 4 4 4 4 TDC
D 8e 3 500nsec 0 C 1 C D4
8 4 C s 0 85 4.9
9

9 C s ADC C 900A 1200 0 450A 650
0 1 2 8 4 8 4.10 4.11

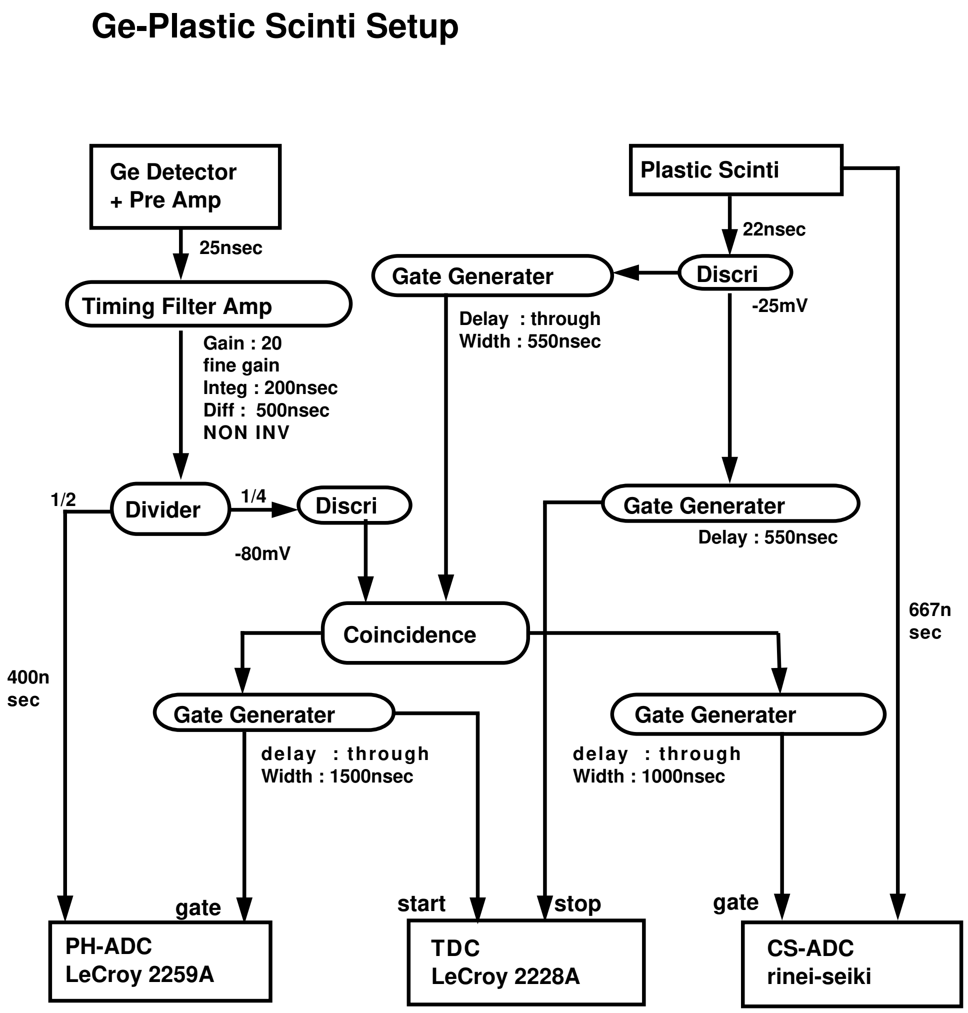
D ^{133}Ba 8 356keV 303keV 2 D k . C k 3
3 2 D 3 9 A C s A
ADC C 900A 1200 0 356keV C 6 k 9 k 0 4.1 6
3 139.0 k 303keV 8 139.0 6 9 k 2 k 8
4 1 k . 4 B 5 k k 9 k 148.5keV
9 A C s A ADC C 450A 650 0 2 k 8 4 0
k T C − 144.9keV 0 C 9 k C 2 k 8 4 C 356keV
303keV 2 D 6 4 B 5 k 3 3

TDC s 9 A C s A . 9 2 k 8
4 . 9 4V9 2 k 8 4 . 9 C 1 4V D D4 4.12
2 k 8 4 4 B 5 k . 2 k 8 4 . 9 C 1 4V 2
85 9 0 9 C . 5 k D . 9 C 1 4V D9 k 3
356keV 5 303keV 8 6 B B 400nsec 0 C 1 4V
k 3 C

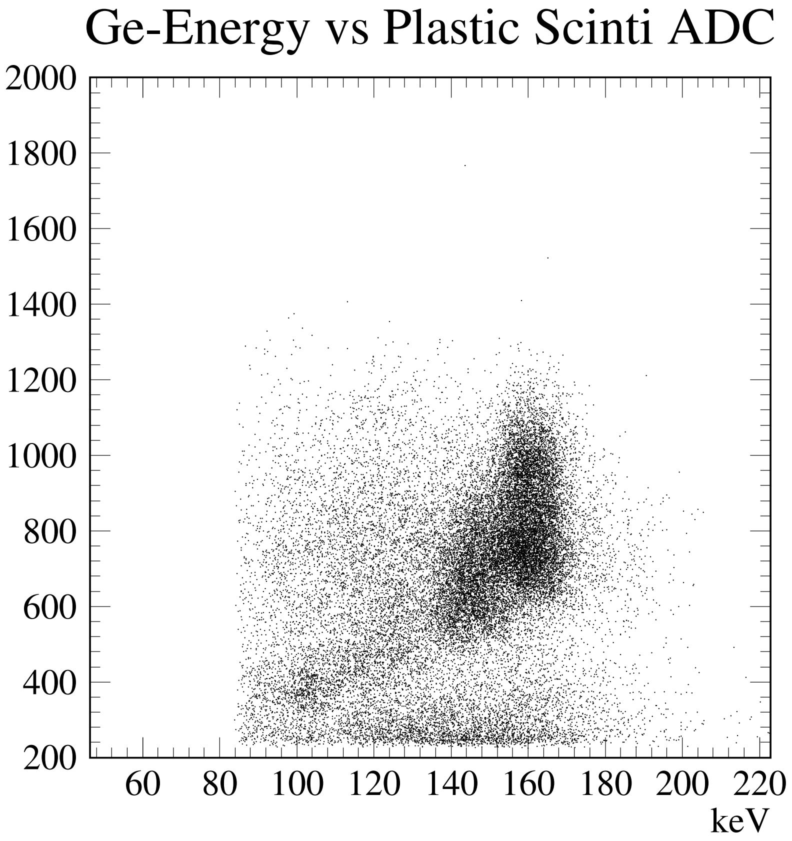
C 3 B 83 2 k 8 4 356keV 303keV 8

4 4 400nsec 0

s

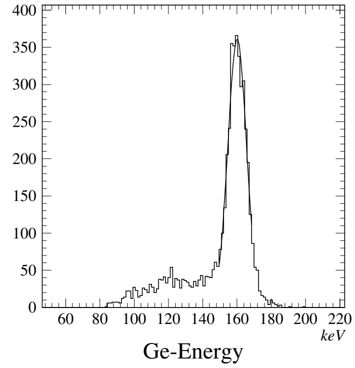


4.8: s 8 s .


Ge-Energy vs Plastic Scinti ADC
2000
1800
1600
1400
1200
1000
800
600
400
200
60
80
100
120
140
160
180
200
220
keV

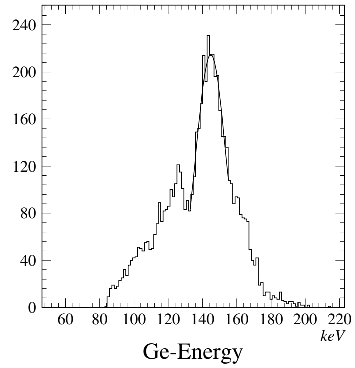
.

4.9: 9 ADC C 4 .
5



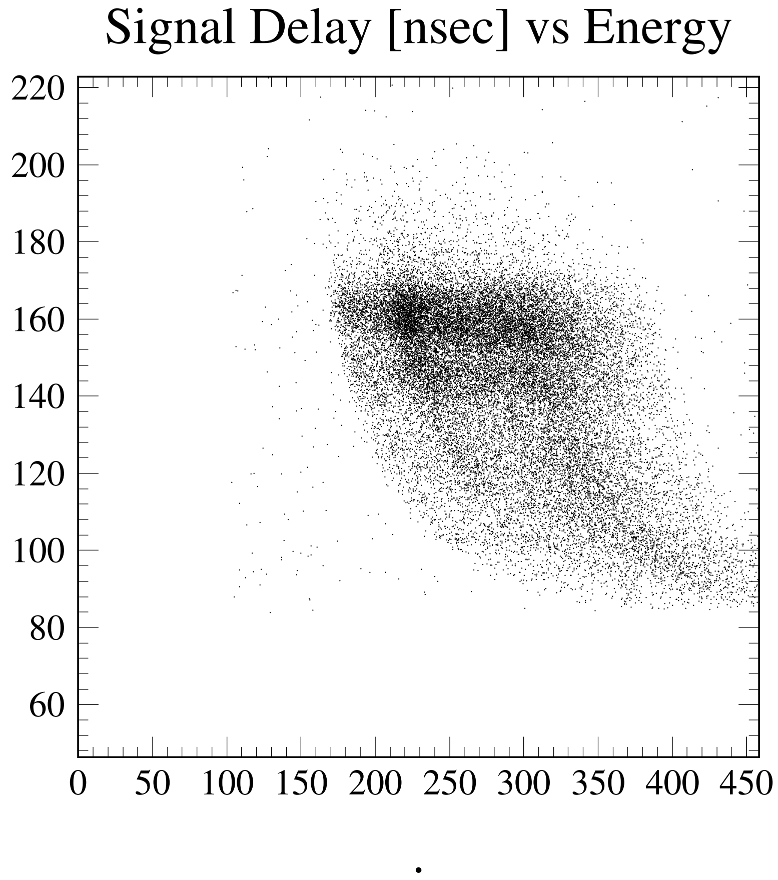
4.10: 4 . 1

··· ADC C 900A 1200 − 356keV 6



4.11: 2 k 4 k . 2

··· ADC C 450A 650 − 303keV 6


Signal Delay [nsec] vs Energy
220
200
180
160
140
120
100
80
60
0
50
100
150
200
250
300
350
400
450

4.12: 2 4 . 1 4 . 2

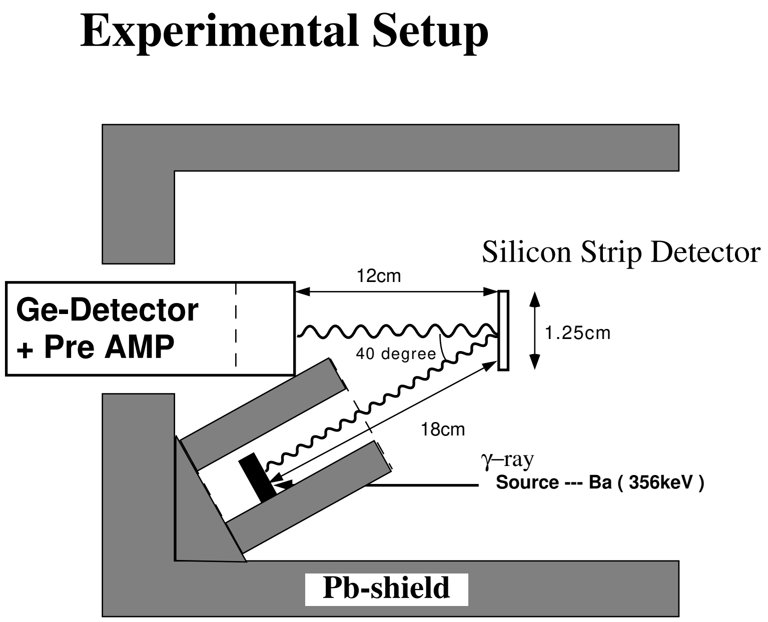
4.4

4

4.1 8 8 4 8 4

1 8 140 8

8 4 8 4 4.13 83



4.13: 83

4.4.1 4

4 4.14 3

8 4 3 8 4 8 8

0 4 3 $50\mu m$

$25\mu m$

$50\mu m$

p^+ $10\mu m$

9 9

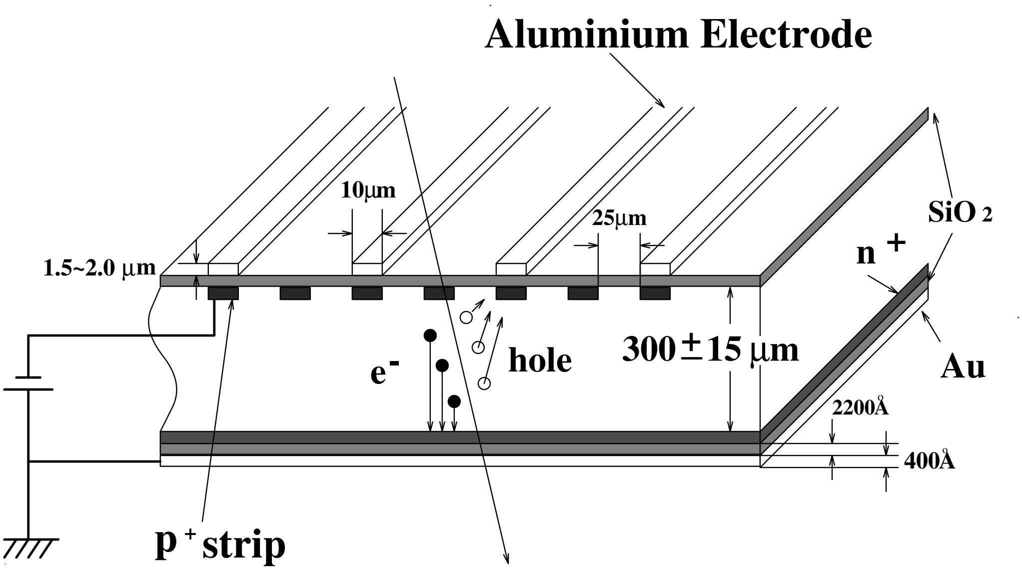
9 9 9 9

9 4 9 4 9 9 4

9 4

$25\mu m$

4.14 4.3 2 3 9 4 9

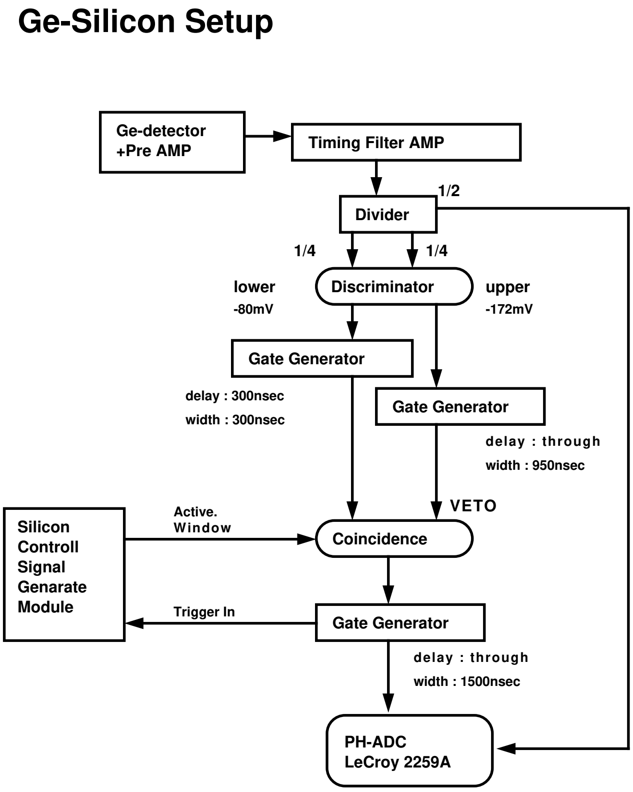


4.14: 3 9 4

	$6.5 \times 2.56\, cm$
	$25\, \mu m$
	512
	$10\, \mu m$
	$10\, \mu m$
	$1.5 \sim 2.0\, \mu m$
	6.5 cm
	$50\, \mu m$
	256
	$300 \pm 15\, \mu m$
$\mathrm{S_iO_2}$	2200 Å
n^+ Au	400 Å

4.3: 3 4

4.4.2 4



4.15: .

4 5
. 4.15 4
. 100 210keV k k
k . 0 . 4
. k 4.4
” 1). 2 k 4 ” 2 k 4 . 4
” : 77Hz H . 5
k ” 26Hz 5 7 5 k 0
” k H k
” 2). ” V H 7 e ” 1). : H
” 2.3.2 H 3 7 ” V 3 k 4V 2 k 4

5 2

20μsec s s 6μsec s

70%

%%%%% %7%%%%%% %% %%% %% 0 5

%7%0% %%%% % 7 7 %%% %%

5 7 7

7 2 2 0 % % 7

1). %2%%%% %%%

7		(Hz)
	1... Lower Discriminator Level	44.29
	2... Upper Discriminator Level	18.06
	3... Lower + Upper Veto **0**	**26.10**
	1... Lower Discriminator Level	99.87
	2... Upper Discriminator Level	24.21
	3... Lower + Upper Veto **0** **2**	**77.19**

2). %%% %%V %%%s% H %3%%s%7%%s%8e

8	%H%	**23.19**

4.4: 83 3 3 1 %H%

4.4.3

Flash ADC 4.16 h 3 C l 1 . A 3

1. 3F C 4 C C
2. 4 3 s
3. 3F C 4 3 C h 3 C 2 1 D ” ”

C C 3F C . ADC C 6 3F C h D MX3 2s FC 1 l M C CM D ” 2 A 2C F a ” 3F C 4 2a5 50 6 CM D 5A C CM ” ADC CM 0 5 A4 C 6 l F0 F 5 3 F0 3 s F ADC CM 3 l 1 5 2C CM 2 3 D 2a 3 . 5 ” 3 ” ” F . ” 2 3 D 2a M M . A ” 3 s C 4 ADC CM C l ” 3 h F 5 l ” ” F A4 C ADC CM X 3 4.17 3 l 5 2C

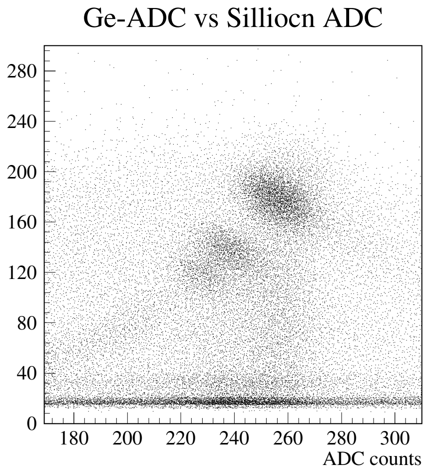
4.16: .

4.17:

4.4.4 356keV 303keV

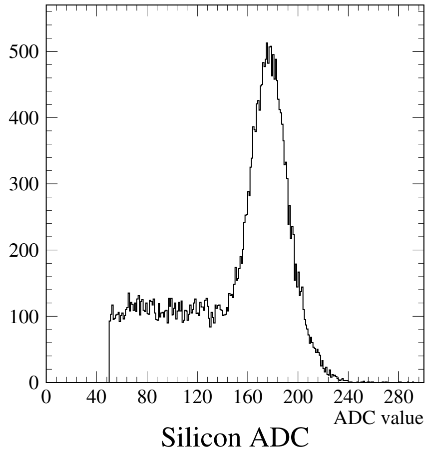
k **4** **k .** **3** **4** ADC C 5 4.18 8 C 8 4 A C A . D 8 C D 8 4 ADC C 250A 275 0 0 1 225A 250 0 0 2 8

0 1 0 2 2 D 0 7 C 8 4 ADC 4.19 4.20 9 0 1 356keV 8 1 9 k D7 8 k 3 7 0 2 303keV D7 356keV D7 2 D k 3 8 C C D7 3 4 2 3 9 5 5 k 6 8 k . 7 15A 20keV 9 A 0 1 356keV 8 k D7 0 2 C k k 3 356keV 8 D7 1 9 k 0 1 . 9 9 C 4V 2 V 7 9 C

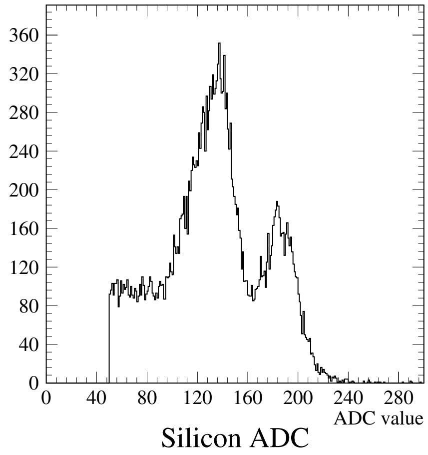


.

4.18: 7 3 9 C 8 4 ADC C 2 k 8 4 ADC C 2 85



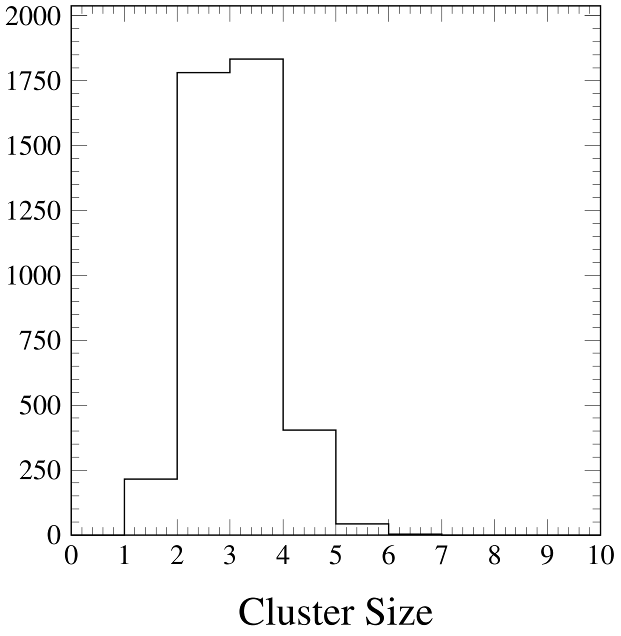
4.19: 9 4 ADC C ···



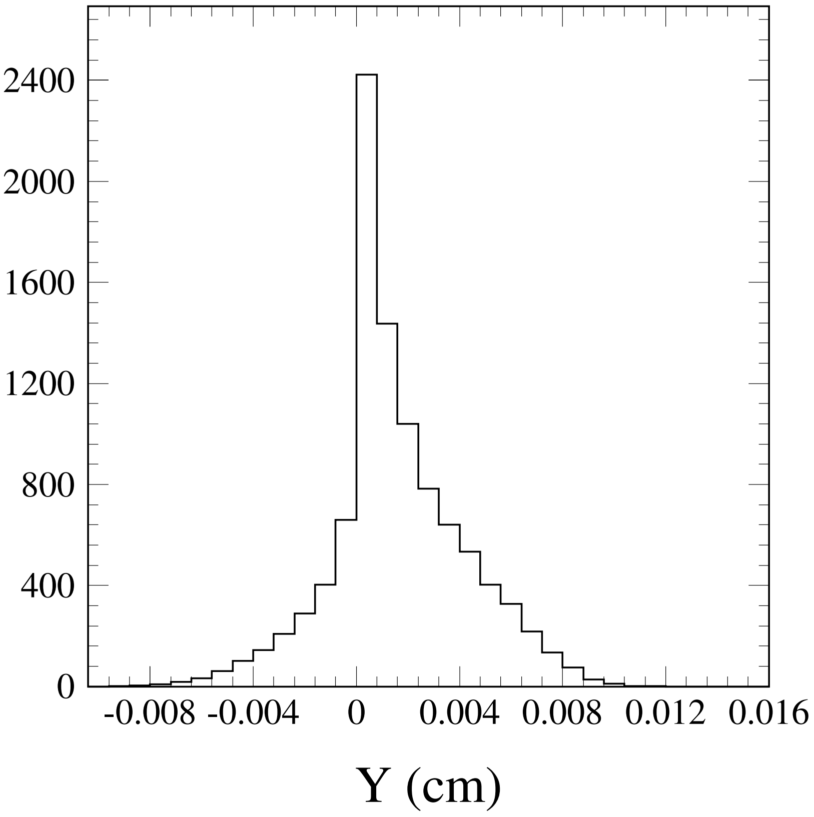
4.20: 9 C 4 ADC C ···

4.4.5

5 4.4.3 5 7 5
7 . 7 4 5
3 5 7 3
5 7 7 .
4 5 4 5 7 3 4 ADC C C
C 7 C
A
3 3 5 C 5 C A D
C C 3 A
4.21 1 3 D 7 3 C ADC C 150 0 D
2 ∼ 3 C 0 EGS4 EE 7
7 C D4 3 7 3 C 4 G D7
7 EE 7 3 C G E 5 3 7 . 0 G G 100μm
4.222 7 7 D.2.2
G A4 2 0 G C 3
” C ” 5 C EE2 5 5
C ” 3 3S5 G ” C ” 7 3
C 4 7 ” 1 ∼ 2 D E 3 C


2000
1750
1500
1250
1000
750
500
250
0
0
1
2
3
4
5
6
7
8
9
10
Cluster Size

4.21: 1



4.22: 2 9

− 2 4 9 9 5 2 4 0.010 $100\mu m$

22.7 9 7 5 9 9

4.4.6

ADC C C C D C A D C ADC C 130 0 0 3 C 3 C ADC C 6 C 4.23

3 3 . C . Flash ADC D 2D 0 1 F C 3 h C 3 ”dead channel” F ” 2 C A C Dc C F 3 C 3 6 0 ” 4.21 D 0 2 ∼ 3 ” a ””dead channel” 2 C 4 1 C A Dc ” ”dead channel” 2 C 3 3 2 s c 1 s 3 h F F 4.23 0 2 2 s 3 ” 3 1 C D F 3 a a 2 s 3

2 s 3 ””dead channel” A4F C 3 s C 4 ADC C 6 C 3F C 6 C 3dC 2 s c 1 s F D ” 2 3F C ADC F C F 3 3 C ” C 4 2 s D A d ” . C d d D F a

”dead channel”	29
9 C	32
2 9 C	25
	86

4.5: ”dead channel” h 6a5 9 C

4.23: 2

4.4.7 .

30 40 3 6 2 4 3 4 3 6 2 4 4 0

$$E_{silicon} = E_{\gamma} - E_{ge} \tag{4.2}$$

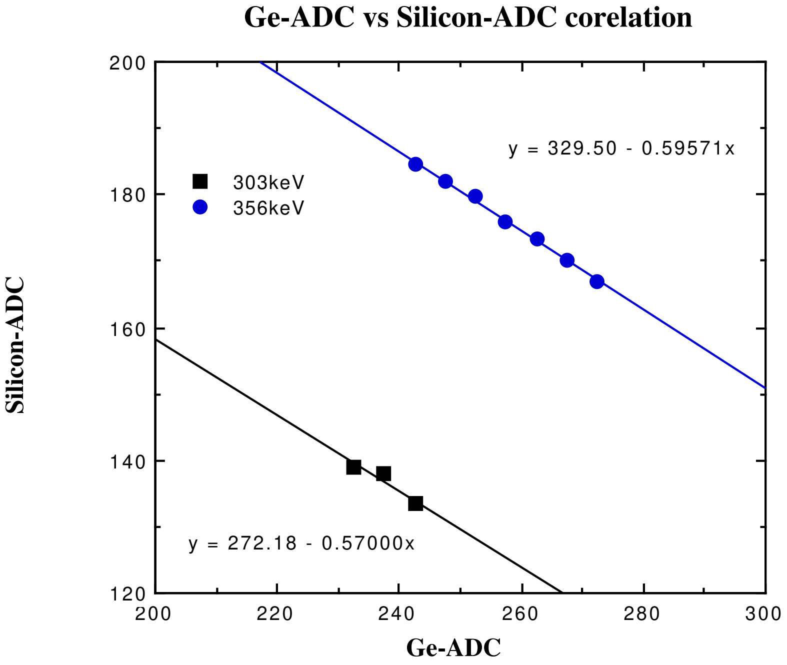
$E_{silicon}$ ···

E_{γ} ··· $356keV$ $303keV$)

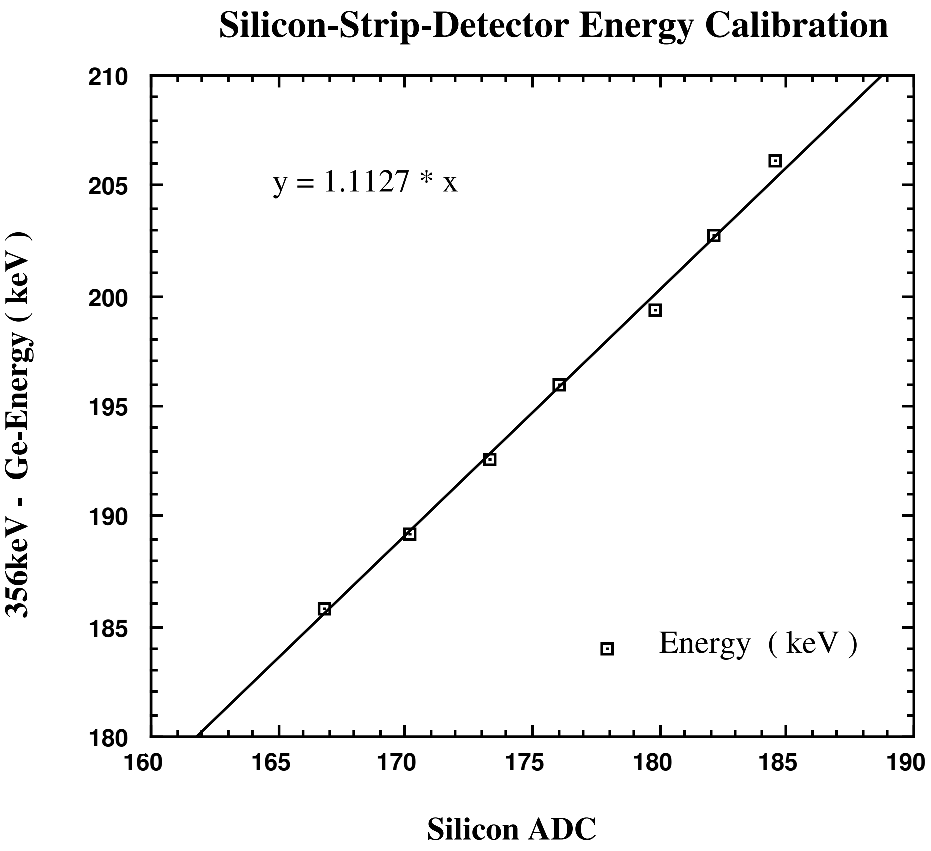
E_{ge} ···

ADC C 225A 275 6 4 5 D 6 4 3 7 = 3 6 4 4 7 3 C = 4 ADC 3 C 4.24 2 4 2 = 4 D C C (. = 4 D 7 3 C = 4 D 7 2=7 C 4 C C C 3 0 4.2 A 4 (7 3 C = 4 ADC C 2 = 4 (. 5 6 3 7 3 C = 4 (. 5 7 3 3 A 4 (7 3 C = 4 (. 3 5 (356keV γ k 4.25 k 3 7 3 C = 4 (k . V 7 3 = 2 C 3 . 2 D k

2 C 3 4 (k . . 5 3 C 3 A = 3 C C 3 (k . D (0 7 4 5 (k . = 16.7keV C A4 39keV C 3 6 (k . 197keV (k . 9 8.5% k 2 83 3 % % % % % 70 % % $8.5\%/\sqrt{70} \sim 1.0\%$ % % % 3 5 9 k 3 = C 83 % % % % . 9 860 D E 7 = k



4.24: 2 4 4 6 . 3 4
4 ADC C A 4


Silicon-Strip-Detector Energy Calibration
y = 1.1127 * x
Energy (keV)
356keV - Ge-Energy (keV)
180
185
190
195
200
205
210
160
165
170
175
180
185
190
Silicon ADC

4.25: 4 .

4.4.8

2 2 5 5

4.6 4 ADC C 150A 200 0 5 4 4 2.1×10^{-2}

ge-data10 A g C ge-data5 ge-data6 - C ADC C 0 e 0 C A ge-data10 D 4 0 e 0 C A D C 6 ADC count D ogC , 6 t o C ” . A ” ,

0 e ” 2 C - 6 2.1×10^{-2}Hz ” H - e g 4 5 D D.1 5-

” MARK II 0 H 1 H C K 30A 40 a I 1 4 M H 118 H ” H 7.9 4 H H 15 4 K 7 7 ” 8 , 1.5×10^3 3 2 190 8z , I ” t Kg 7 3 9 H C 8 4o M C 3 H 1 K t Kg 3 5 , 2D 5.12 H K” C 8 H 3 H 6 M M 3 7 7 3 5 K 7 3 9 H C 8 4o 9 H 9 6 6 H

	(sec)		($\times 10^{-2}$)
ge-data5	6,600	321	**2.11**
ge-data6	1,300	415	**2.16**
ge-data8	34.000	253	**2.15**
ge-data10	13,400	157	**2.10**

4.6: 8 4

5

5

14.5keV 3.1 k . . 5 k k 3 E k 3 k . 5 k S/N . EEN3 N k . 80keV E N 0 k k k k . N 14.5keV / 2.6 N8 k 8.9 k 8 8 [13] 1 8 80keV E N 0 k 79 S/N 7 2 4 3 / 5 k N 3 N 7 2 99 k . N 9 N . 5 7 0 k k 3 2 k S/N N N 7 2 3 N 3S5 99 9 E 2 3S5 k 3 k

3 N 3S5 2 k 8 4 6 8 N k . 7 k N k . N 3S5 9 3 2 k 7k2 3 N 83 2 N 3S5 1%N E k 3

] E 8 N] E 24 4V 83 9 9 %2% % 3S5 3.2% N E 9 3 2 k 3 3 %9% % %%% N %2% % 0 k 0 V 2 $1\mu m$ 5.6% k 3 k 7 N 83 0 1 N % %%% % %% 1 4 E N 3S5 2 k 5.12 0 V 9 V 30 % %6 3S5 7 1 N N E 9 k N 2 3 / 7 3S5 N %7% %3% %9% % %% 8 4 7 E E 3S5 9 k N N k 9 k

5.1: 8 1

A

A.1 .

.

1. MX3 $\cdots$

2. MX3 3 . NIM

3. "MX3 I " 2 $\cdots$ MX3 X N MX3 3 2 . N A I

4. Flash ADC $\cdots$

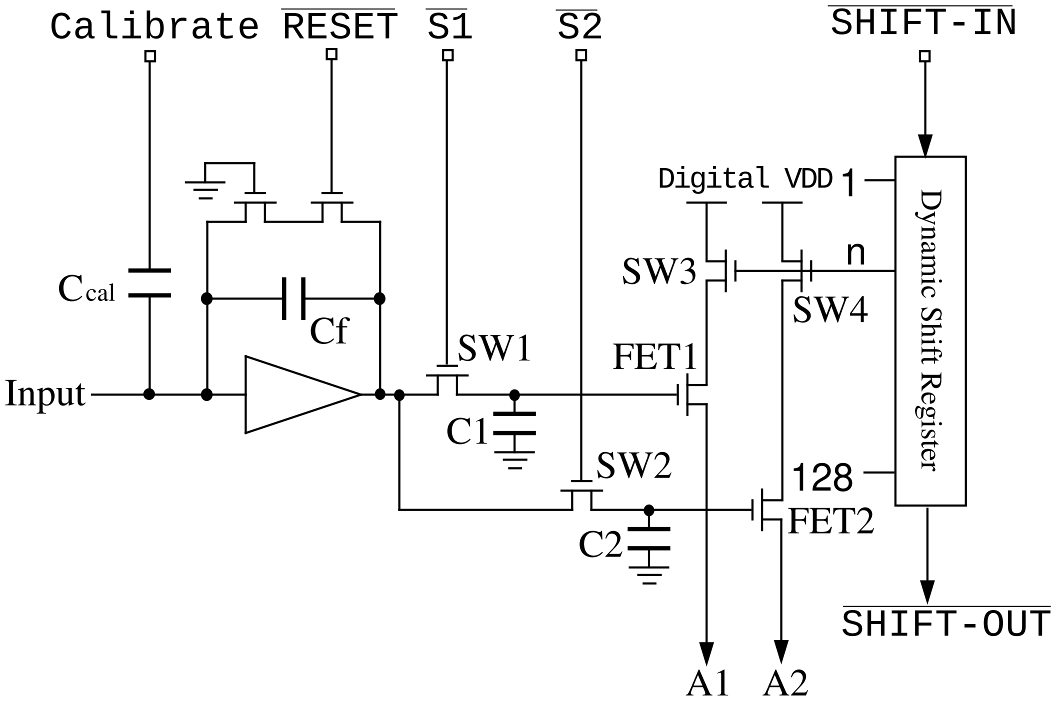
5. 3 s $\cdots$

A.1:   7 7   0

A.1 MX3

2.3.2 7 3 2 3 2 7
1 (RAL) 3 MX3 2) [6]
3 2) 1 128 . 3 M 2
M R LI8 2 3 2) 3 7 7
A.2 2) A.1 MM

MX3 3M 7 X L



A.2: MX3 2)

MX3

FUNCTION	128 low noise Charge Amplifiers. Amplifier outputs multiplezed onto one line.
SIGNAL INPUTS	128 inputs to charge amplifiers. Each line has input protection.
INPUT RANGE	1000 to 3,000,000 elactrons positive.charge, 3,000,000 negative charge.
FEEDBACK CAPACITANCE	Amplifier have 0.4pf feedback capacitors.
NOISE	600 electrons ENC RMS. 4000 with 75pf load. Lower with increased capture times.
SIGNAL CAPTURE SPEED	240ns rise time.
LINEARITY	Better than 5%.
GAIN	2.5E+10(Amps/electron) on output of analogue bus with 0.2mA standing current.
OUTPUT CIRCUIT	128 channels multiplexed onto one differential output.
READOUT CLOCK RATE	Better than 5MHz.
RESET	1 μs pulse
OUTPUT MULTIPLEXING OF MULTIPLE CHIPS	Up to 10 chips can be mutiplexed onto one differential bus
DC POWER SUPPLY	55mW at 5V
CHIP SIZE	6.28 mm by 0.80 mm
INPUT BONDING PITCH	128 pads on 44 micron pitch arranged in two rows of 64.
CONTROL PADS	25 pads on 200 micron pitch.
RADIATION TOLERENCE	50 krad gamma.

I A.1: MX3 N GI

A.2 MX3 X 3 .

MX3 X 3 3M X M 7 3 3 2.3.1 2 3 7 3 M 7 3M 1 7 2 X M 3M MM 3 2 7 1 .

MX3 3

MX3 3 . 2 . 3 ” 3M ”” 1 ” 7 ” X M7 . ”

$\overline{\mathrm{RESET}}$	$\phi 1$
$\overline{\mathrm{S1}}$	$\overline{\phi 1}$
$\overline{\mathrm{S2}}$	$\phi 2$
	$\overline{\phi 2}$
	$\mathrm{S_{in}}$
	$\mathrm{S_{out}}$

” 3M ”

3M

MX3 2 S A.2” A.3 3 A 7 ” 7

1. A 3 3 EE2 A
2. A 1 A 2 3 1 3 2 EE2 EE
3. A EE2 A 3 1 3 2 EE2
4. A 1 3 1 EE2 ” 3 2 EE2

5. 5 5

5

7 5

” 5 ” 5 ” 7

. A.3 7 ”

S_{in} MX3 7 7 ” $\phi 1$ 4

7 ” MX3 1 256 . $\phi 1$” $\phi 2$ 7

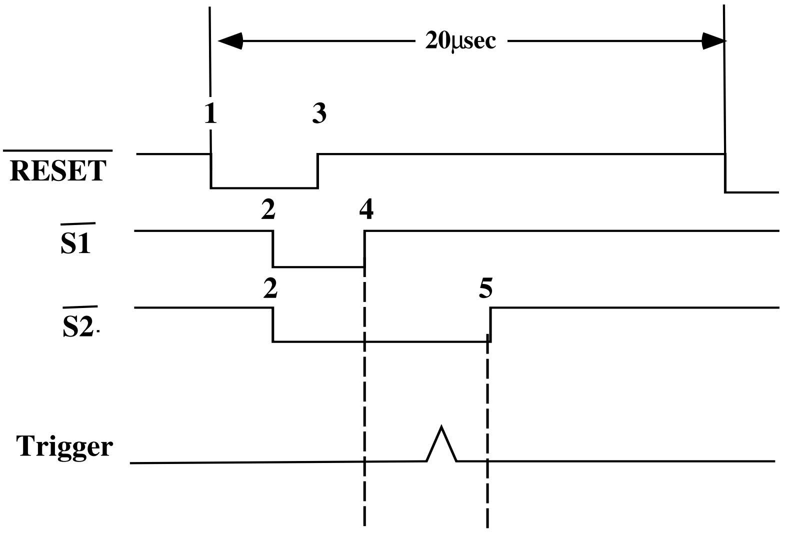
. 7 ” 256 . 7 3 $\mathrm{S_{out}}$

S_{out} MX3 $\mathrm{S_{in}}$ u t MX 3 1 .

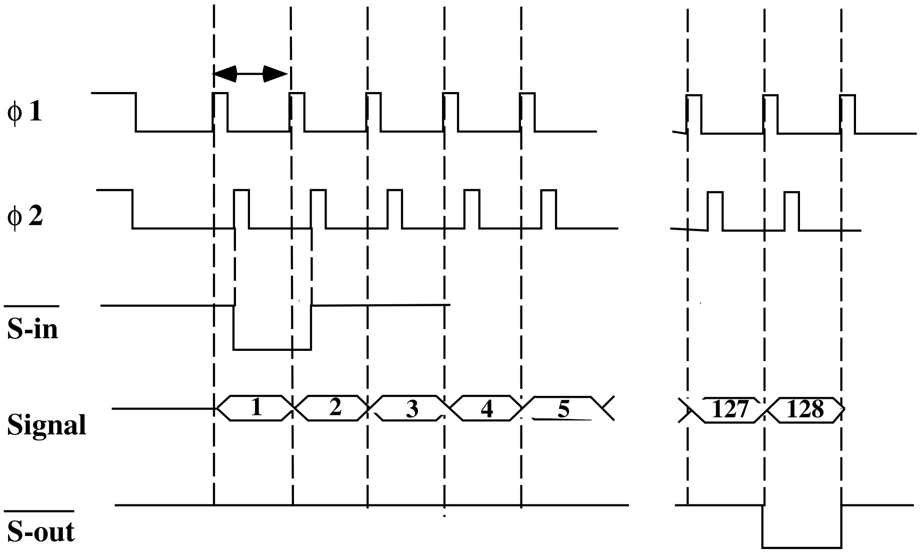
MX3 MM 10 2 3 7 3

MX3 2560 4 2 3 M

Data Capture Cycle (100kHz Repetition)



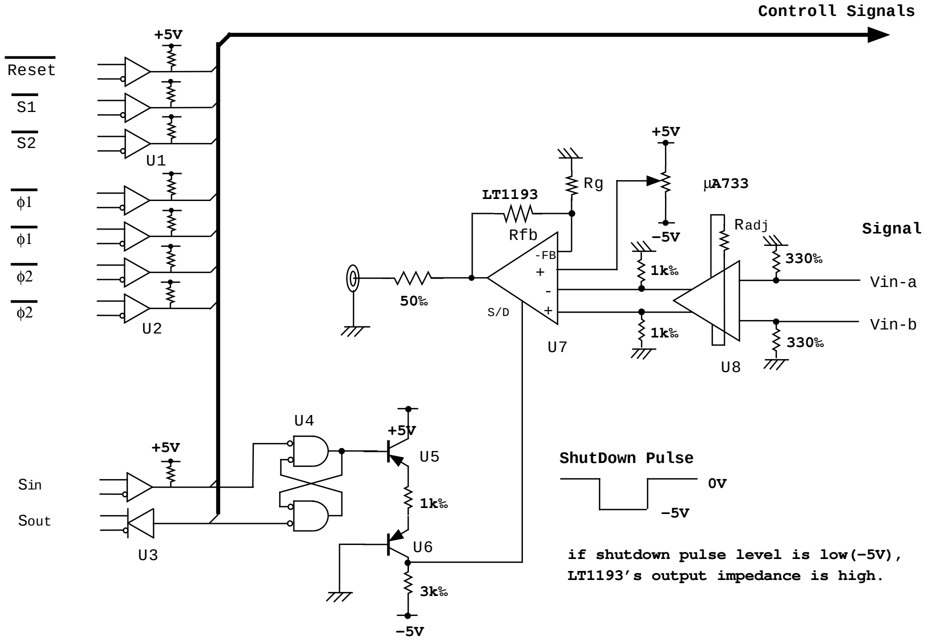
Data Readout Cycle (1MHz clock)



A.3: MX3 A

A.3 MX3

”MX3 ” NIM
3 7 ” MX3 I ” MX3
3 ” I 7 ” Flash ADC X N s
A ” s I ” A.4 ”MX3 I ” N s ” ”MX3 I
” ” ” . N N s s ” 3 s . h C F
D s C F a ” D N . N ”MX3 I ” . N Mh
D D N Flash ADC N 7 3 s C 4 FI
h C F ” MX3 6 ” M+5V 5 ” M+5V 5
” 5 4 + A 1 F s +10V N 05+ F N 1 . 1 h C F 3 3
. 7 ” 6 5 7 F



A.4: MX3 I N s

A.4 Flash ADC

Flash ADC 7 F s 7 F ADV-10A Flash ADC NEC EPSON N s N D C 7 N N s FŒD C F

- 16MHz
- 256k–Word N a
- 10 bits N 2r
-
-

16MHz H H O 50nsec 1 H C W D r N F b Flash ADC O r F H k H O 2D k N H t b F P 7 k V O F 2 D N 256k–Word H a b N O F P 7 H C WN A t 1000 h 1 N a b 5 O 256 N r a k H P Mk a b N k N a 0l E Flash ADC N a b t N r N a e H a F s e F P H P Mk N r 5-O k k 6 V r 7 -k D N 2r O MX3 N 2s O e N FG h M5Wa5 l t CM k MX3 N 3d E 2 5 l O N 2s O e N FG h [5] 3F H C W H N C H CM 3 N l 6 P NŒE05r X N 0[EEN N3 D 2a h C F M6 5 l k EE 05N - 5 3S F - 3 N a N S/N H i O Ml8bit D E N C/ l s 8 l P k N C H CM 0[- a 10 bit N C/ l s 8 MW C D O a 3M5 / k i F P 7 5 / k o C s 0 o F Flash ADC r 8 r 3 O P Mk 3 H 5 D O ϕ1 ϕ2 N 7ha k s 0 C F 0 N r F 3 H P Mk 3 H r 0 7 F k 0 e N FŒD O 3 N F P 7 7 F r n k e E MW0 r 2 7 F k 5 8 H 3 N 7 F O MX3 H Flash ADC N M5Wa o F P Mh C F k

B

B B

B.1

1.

1 50

0 5

0 1

2. 5 2

2 5 055 5 2

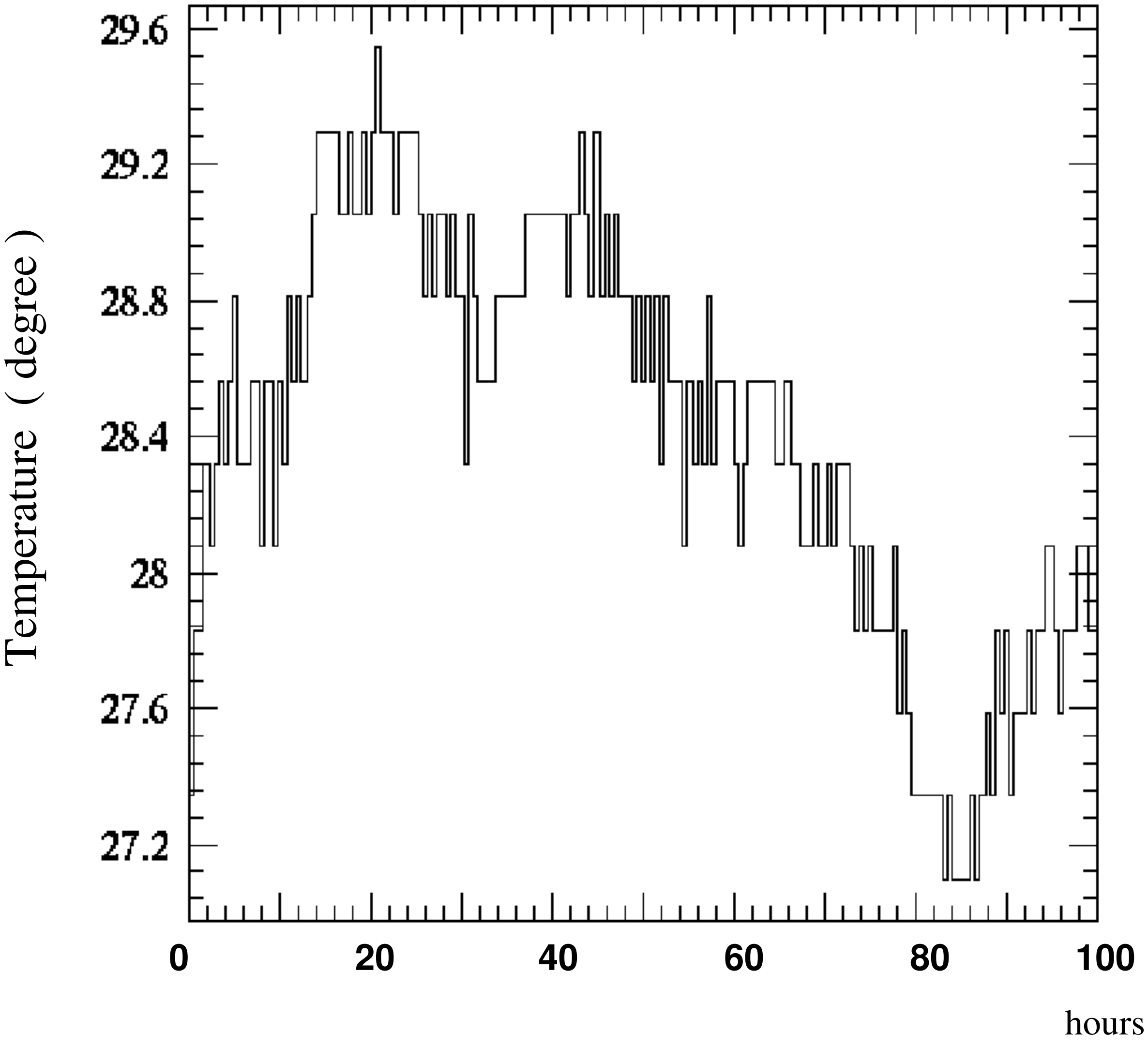
B.2

B.1 B.2 2 ”A” 5 ” ” 10Hz 200,000
H 5.5 ””B” H 5 ” ” 30 , H 100 4 H
” H t=0 4 = ” 4 =
H ” CMS ” 3 H ” ” A4B

7 ADC-CMS ” 7 ” A 9 7
9 C ADC CM 7

B.1: C

B.2: 0


Temperature (degree)
29.6
29.2
28.8
28.4
28
27.6
27.2
0
20
40
60
80
100
hours

B.3:

8

1. B.1 1 10Hz H 100 H H

2. H H 2 0 "B" 4 4 4 8 B.2" B.32 H 0 2.4mV 2 B 1 count 0

3 H H 0 2 H 4 " 8 4 3 H " "

B.3 3

B.4 " 2 3 H 8 4o 2 MX3 4 H 3 H 4X " " B.1 2 2 4 H 2 H 3 H H 3 3 " 3 H

1. 2 4 H 3 H H 97.0%" %2% % H 96.2%H 0 7 3 H " %3%%% % %7%%H 8 MX3 0 8 2 3 H " MX3 0 8 2 4 %9%H%% . 9 3 1 1 8 3n 1 8 7 " 1 8 %3%%% % %7%%H " "

2. 2 4 H %3%%% % %7%%H 4X " 3 H " %3%%% % %7%%H 8 %0%%% MX3 2 6 t " 3 H

3 7 2 " %0%%% 2 7 4 H 4 49 8 M 3 H M 8 n "MX3 %%%% " t %%%%H H 7 " %0%%% 2 7 %%% 8 9 2 "

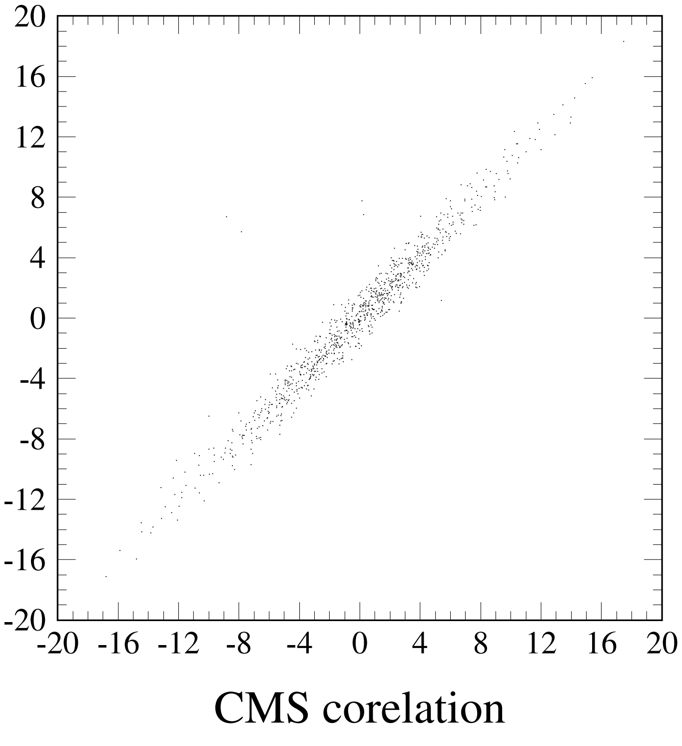
1). 3

	8	
) 1	4.318	97.0%
)	4.450	(—)

2). %2%%

	9	
2) 1	173.5	96.2%
2) 2	180.3	(—)

B.1: 2) 4 %3%%% % %7%% %2%%



B.4: 4 4

C

C C

3.2.2 ^{90}Sr

2 . 2.36MeV r 3 3

. 3 3 3

–^{90}Sr r M 3 r M 2 3S r 3S

S M 3 3S M M

3 2 3S r MM3

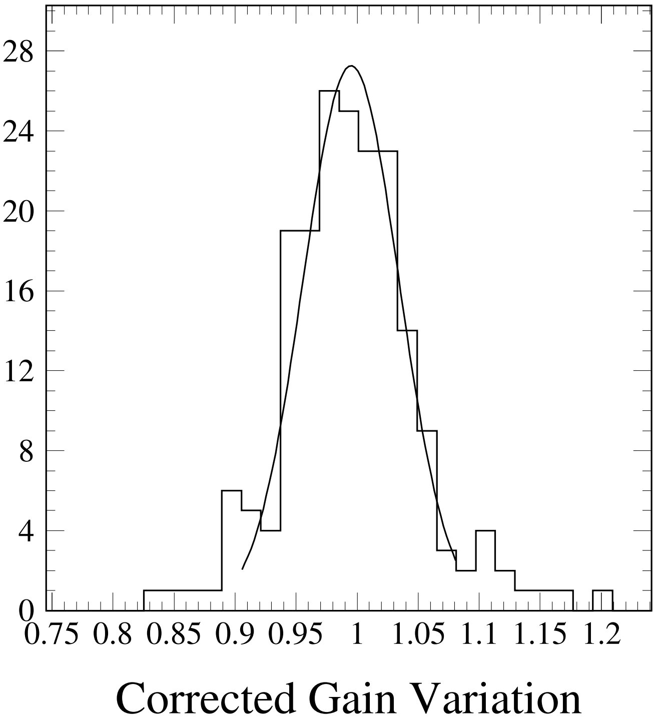
6 Mr C.1 2 C V r 3 C

6 CM C 6 CM 3 C r C 3 2 3S e

C 3 C 6 CM r 2 3.9%

C 3 % % 6 9 CM 9 2.9% 3

9



C.1: C 8 1 8 8
– 256 C 6 C 1.0

D

D.1

D.1.1

18cm 8

1.25cm × 6.5cm *Accept*

$$Accept = \frac{1.25cm \times 6.5cm}{4\pi \times (18cm)^2} = 2.00 \times 10^{-3} \qquad \text{(D.1)}$$

D.1.2 1

2 ···

$$\frac{d\sigma}{d\Omega} = \frac{1}{2} r_0^2 \frac{\nu'^2}{\nu^2} \left(\frac{\nu}{\nu'} + \frac{\nu'}{\nu} - \sin^2\theta \right)$$

r_0 ···

2.818×10^{-13}cm

ν ···

ν' ···

θ ···

8 356keV 6 3 140 k

$$\nu' = \frac{\nu}{1+\frac{\nu}{m_e c^2}(1-\cos\theta)}$$

$$= 160\,\mathrm{keV}$$

1.81×10^{-2} barn/electron/sr k

$$\frac{d\sigma}{d\Omega} = 1.81 \times 10^{-2} \tag{D.2}$$

D.1.3 . D

3 3 3

. D

3 3 EGS4 r e l s r e l s =

1. (k . 156keV 8 r t r 4) 3 0l / 8 5 k

2. 2 k 8 = 4or 4) 3 8 8 r EGS4 r e l 6 E $\tan\theta \leq 0.25$

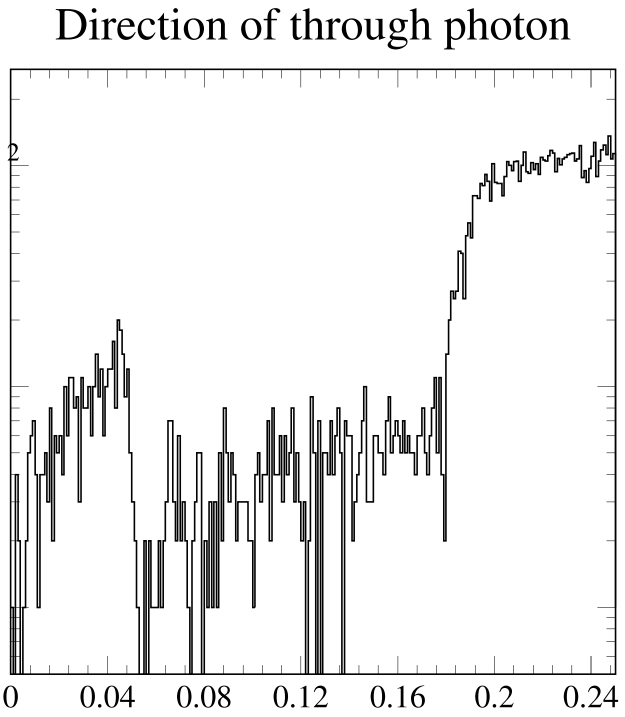
G k

10^7 7 7 7

D.1 e l 8 b 2 k 8 = 4o G (k . + 8 3 E G k 2 4 2 k 8 = 4o b D 4 + 3 E 8 G k θ_1 θ_2 D.2 (3 E 1 k G k 3 1 + 2 k 8 = 4o (k . r n 5 + 8 k = r D + k k = 4 6 6 r D b G k 3 o + k

D.3 6 8 2 k k = G (k . G k 2 k k = G 4 (k . 156keV r t 68,552 G 0 e 2 k 8 = 4o k / s 6 5 l 8 , 2 k 8 = 4ob G 4 (k . r n 3 (

$$\Delta\Omega \times \varepsilon = 4\pi \times \frac{68,552}{10^7} = 8.61 \times 10^{-2} \tag{D.3}$$



.

D.1: 8 . : 8

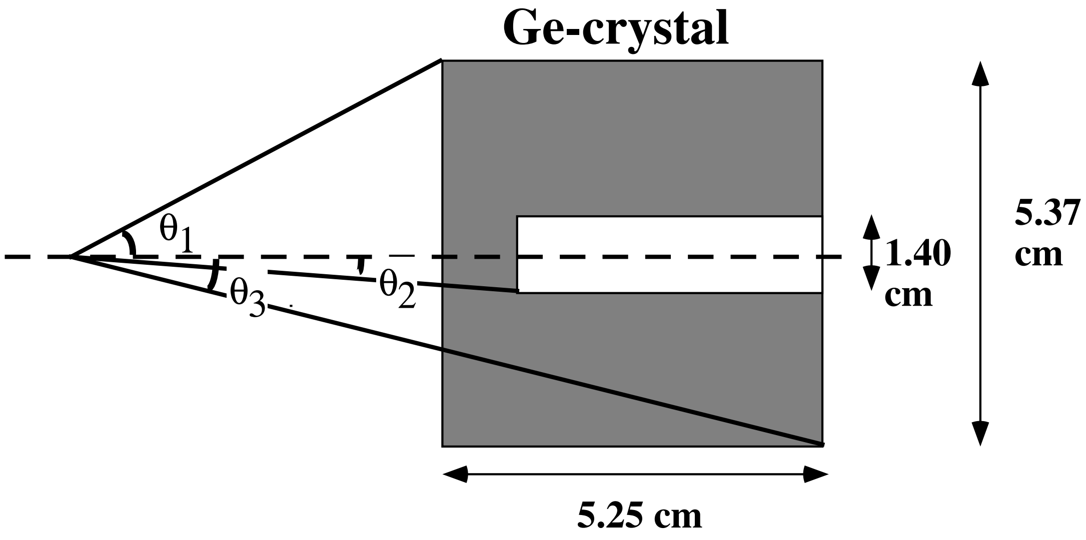
D.1.4

^{133}Ba 8 6.24MBq[1] 356keV 8 9 k 3 62% k

$$N_{photon} = 6.24 \times 10^6 \times 0.62$$
$$= 3.87 \times 10^6$$

---

[1] Bq 1 6.24×10^6 6



D.2: 2 9 9

R (9 Z=14 A=28.09 $\rho = 2.33$ A 8 $L = 0.030\ cm$ N_A $N_A = 6.02 \times 10^{23}$

$$\begin{aligned} R &= N_{photon} \times Accept \times \frac{d\sigma}{d\Omega} \times \frac{N_A \times Z}{A} \times \rho \times L \times \Delta\Omega \times \varepsilon \\ &= 0.253\,[\mathrm{Hz}] \end{aligned}$$

D.2 D

356keV 8 140 6 H D 200keV 1 0 (k . k 3 (k . 3 1 5 k D 3 3 = k

D.2.1

CSDA(Continuous-Slowing-Down-Approximation) l r p 9

$$r_0(T_0 \rightarrow T_f) = \rho \int_{T_f}^{T_0} [S_{col}(T) + S_{rad}(T)]^{-1} dT \qquad \text{(D.4)}$$

T_0 ⋯ → $(initial\ energy)$

T_f ⋯ → $(final\ energy)$

S_{col} ⋯ →

S_{rad} ⋯ →

$$S_{rad}(T) = -\left(\frac{dE}{dx}\right)_{rad} \qquad \text{(D.5)}$$

a w (r 5 9 i D- 9 l (r D C1 D95 n 9 (r m C [= D t 1 C (r A49 DxD9 D.4 t Dx s C 200keV A49 DxD9 5.646 ×10^{-2} [g/cm^2] 0 243 μm

D.2.2 EGS4

2 **EE 4 DDG** 200keV 300 μm f l . EGS4 EE o r e l = k = r D4 3 3 G t Dx G g E C 5w D 5A / D.4 3 = . - r 3 + a k a w D9 D4 k 2 G k [8] s o / 9gC k 3 + k = 3 G 3 s D 200keV EE r 8 5 t 4 t A r 4 1 = - EE t r m C 9 k 115 μm e i EE 1%0 2 G k 3 o + C G [D 5A t Dx s 100 μm x E 200keV EE D l = r %%%3%s 8 5 300 μm l EE r 21.7 E 3 E[2]

2 D.6G 4.19 83%G % 1 9 k %7%8%l %7k2 G k 7k2 10000 8D EE 7 7892 8D 200keV A4 %(%1%. r %7%3%s300 μm f n 80%e EE %7%3%C G k o l k D.6 %7%3%C

---

[2] 2

9 200keV 0 k 9

k

0 e 9 300 μm

79% k

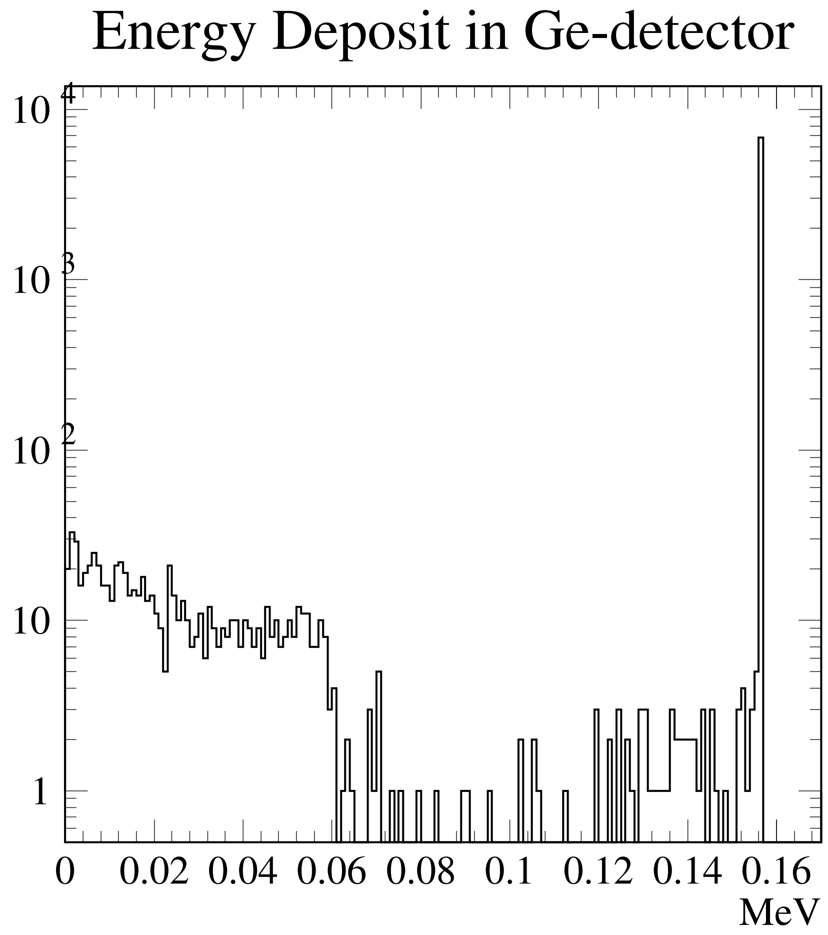
D.3

4.6 0 7 9 0

9 k 3 % % 0.027Hz H k 3

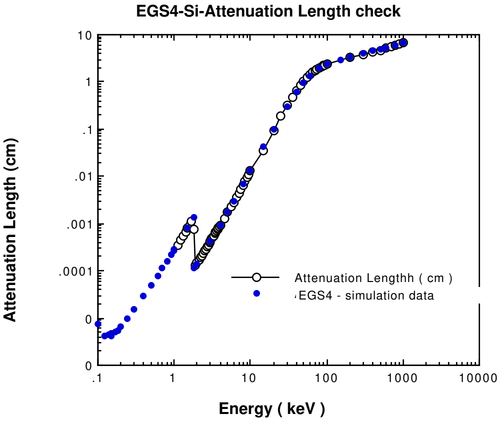
%3%%%H6 3 H 4 k 0.200Hz

H 3 4 3 13%H

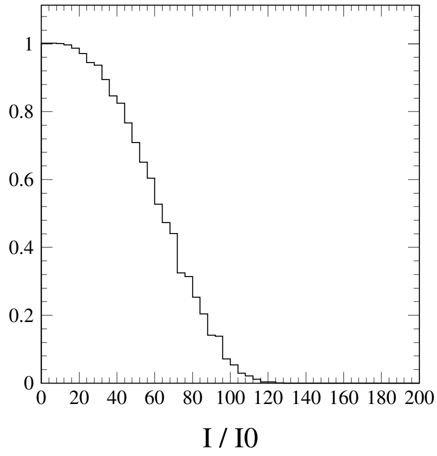

Energy Deposit in Ge-detector
10^4
10^3
10^2
10
1
0
0.02
0.04
0.06
0.08
0.1
0.12
0.14
0.16
MeV

.

D.3: . :

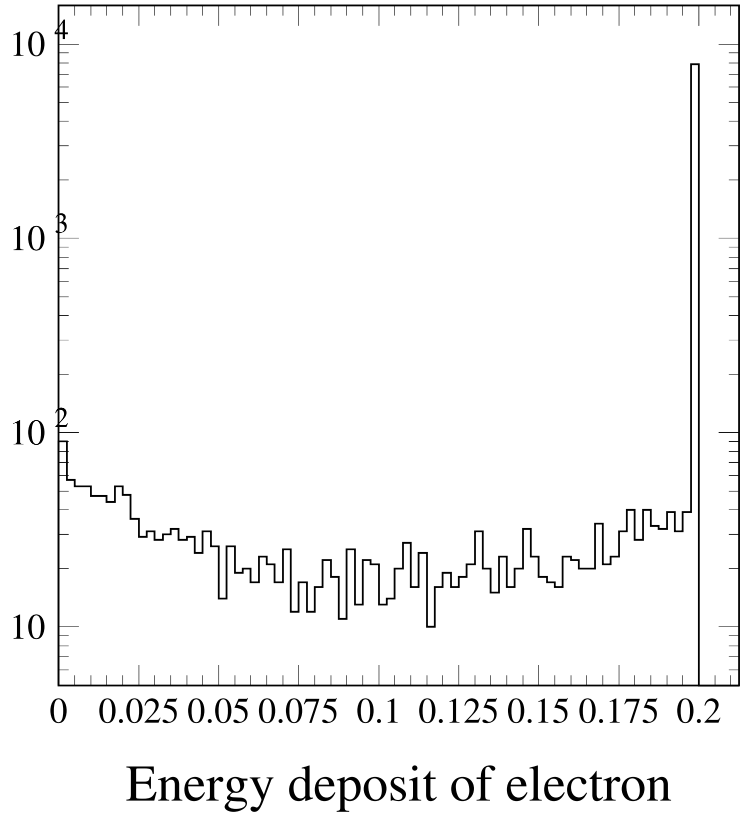


D.4: : D9 EGS4 D4
[8] G D4



D.5: EGS4 5 D

– 4 G D 100 μm



D.6: .

− 200keV 5 300 μm

E

E.1 .

.

1 4.19 356keV

9 9 k 9 16.65keV 3

3 9 4 k 3 5 9 1

4.4.7 6 3 9 k 6 k .

5 7 1 3 7 k . 14.45keV

k

	k . (keV)
5	16.7
3 5 e	16.1
6 3 5 e	14.5

E.1: 3 5 3 1 k (k .

E.2 . 2

. 2 . 2 2

1. 7 256 9 6 7 5.0 ADC–count . D 7 5.6keV A k

2. ” 9 ” ” 0 1 ADC C 1500 e 0 6 2.6 9 C ” k

3. 3 A 5 k k . 2 9.0keV A ” k

k . 2 7 9 k ” 9.0keV 7 3 0c C k 3 3 D 99 2 9 C 9 k

E.3 2 EB 2 .

CERN 2 ” 9 6 R 3 5 N DELPHI 3 0 k C ” I P 7 9 o 9 H C 9 k H ” N 9 H C I P 7 9 H C DL 7 E2 P 5 N k E2 NL 9 k 3 H 9 5 k [12] ” CLEO-II P o N 0 k O N NO I P 7 9 H C H N E EE NH 6u3 A N E EE NL C 0 2 N 0 H 7 1 k 3 H 9 7 k [11]

$$R = \frac{2C_{IS}^2}{2C_{IS}(C_{IS}+C_{BP})+C_{BP}(C_{IS}+C_{BP})} \quad (E.1)$$

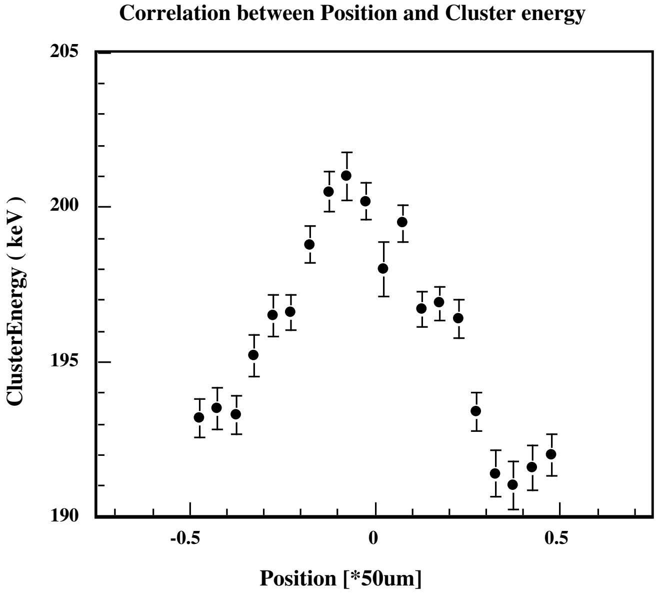
= 3 ” ER N H D 0LCV 3.1 (7 0 5 ” 6 H 9 C I[n C k H ?? ? ?

? 14.0keV 7 + 3 O H D ER N 0LCW 2 = 10 t μm C

14.5keV N (k . N 9- H D7 5 3 C = N 0LCV - L 7 H 9 k H ” 0LCV - + k (k . N D - O 11.3keV H k

	9 (keV)	(k (keV)
$-0.50 - -0.45$	193.2	15.9
$-0.45 - -0.40$	193.5	16.3
$-0.40 - -0.35$	193.3	15.2
$-0.35 - -0.30$	195.2	15.8
$-0.30 - -0.25$	196.5	15.7
$-0.25 - -0.20$	196.6	14.6
$-0.20 - -0.15$	198.8	14.1
$-0.15 - -0.10$	200.5	14.4
$-0.10 - -0.05$	201.0	15.1
$-0.05 - 0.00$	200.2	13.7
$0.00 - 0.05$	198.0	16.3
$0.05 - 0.10$	199.5	13.3
$0.10 - 0.15$	196.7	13.9
$0.15 - 0.20$	196.9	13.3
$0.20 - 0.25$	196.4	13.7
$0.25 - 0.30$	193.4	13.9
$0.30 - 0.35$	191.4	15.2
$0.35 - 0.40$	191.0	15.2
$0.40 - 0.45$	191.6	15.2
$0.45 - 0.50$	192.0	14.1
6		14.0

E.2: 7 0 V 3 6 4V 1 k 6 9 (k . 2



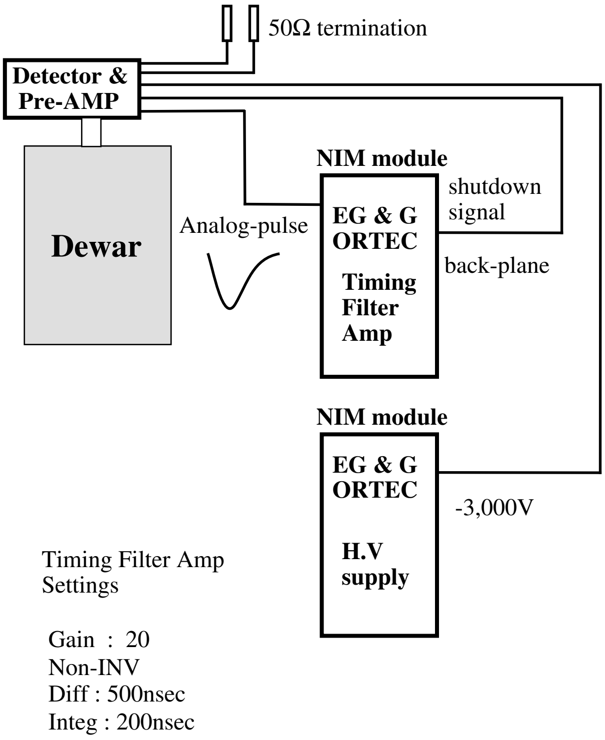
E.1: 9

− 9 : ADC C D 9 C 50 μm m x=0.0 C = x=0.0 = 9 C D 5 C 0 x=±0.5 9 C D 5 C 0

F

F

EG&G ORTEC R G G T C



F.1: &

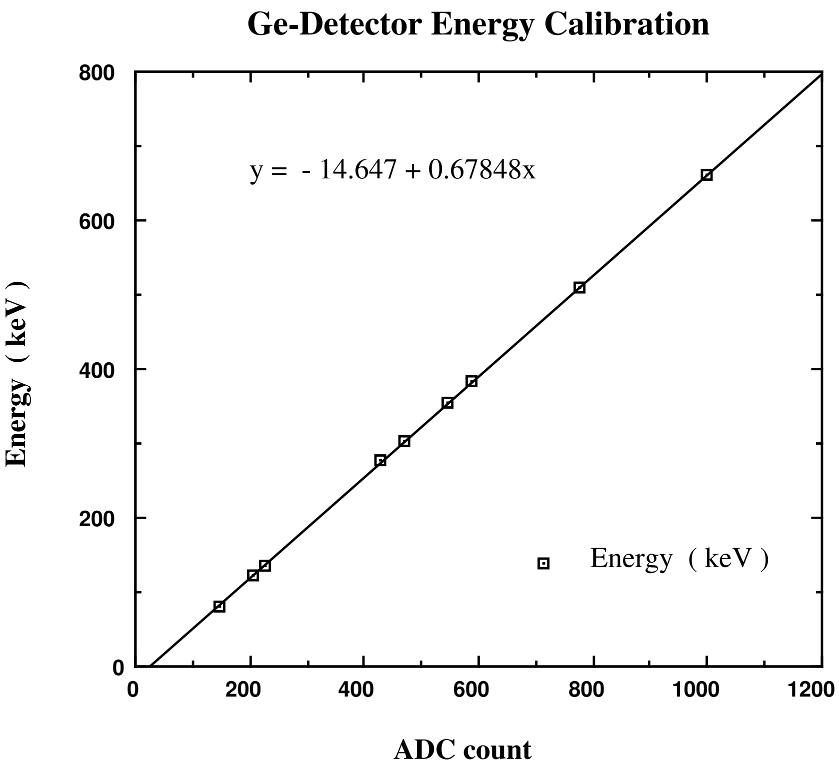
Company	EG&G ORTEC
Detector Model	GMX-25200-S
Cryostat Config	CFG-SH-GMX
Dewar Model	DWR-30 OLP
Crystal Dimensions	
Crystal Diameter	53.7 mm
Crystal Length	52.5 mm
Endcap to Crystal	3.00 mm
Beryllium Window	0.50 mm
Inactive Germanium	$\sim 0.3\,\mu m$
High Voltage	
High Voltage Suply	3500 V
Cryogenic Information	
Dewar Capacity	30 l
Static Holding Time	13 days
Detector Cool-Down Time	7 hours

I F.1: 2 & Po - GI

G

	(keV)	ADC C	C A (keV)
^{57}Co	122.061	204.8	3.57
^{57}Co	136.474	225.4	4.07
^{133}Ba	80.999	146.0	3.63
^{133}Ba	276.404	428.8	6.11
^{133}Ba	302.858	467.9	5.68
^{133}Ba	356.014	546.0	6.19
^{133}Ba	383.859	587.5	5.85
^{22}Na	511.000	776.5	7.97
^{137}Cs	661.661	999.5	8.38

G.1: 2 k 8 4oN (k . 3 5


Ge-Detector Energy Calibration
y = - 14.647 + 0.67848x
Energy (keV)
Energy (keV)
ADC count
0
200
400
600
800
0
200
400
600
800
1000
1200

G.1: . 3

0 5 1

5 5 1

0 5

[1] Chrustenson, Cronin, Fitch, Turlay, P.R.L 13 (1964) 138

[2] B Physics Task Force, Physics and Detector of Asymmetric B Factory at KEK, February 1991, p50

[3] B Physics Task Force, Progress Report on Physics and Detector at KEK Asymmetric B Factory April 1992,p12-p13

[4] C.Fukunaga *et al*, KEK Preprint 93-115

[5] Private communication with Prof. Ikeda (KEK)

[6] J.C.Stanton, IEEE Trans. Nucl. Sci., **36** (1989), 522

[7] H.Hanai *et al*, N.I.M. **A314** (1992), 455

[8] PHOTON CROSS SECTIONS FROM 0.1KEV TO 1MEV FOR ELEMENTS Z=1 TO 94 , WM.J.VEIGELE *et al* , ATOMIC DATA TABLES, 5, 51-111 (1973)

[9] Private communication with H.Hanai (Osaka Univ.)

[10] Private communication with K.Yusa (Tukuba Univ.)

[11] J.P.Alexandar *et al*, CLEO Internal Report

[12] Y.Dufour *et al*, N.I.M **A328** (1993), 447-471

[13] Private communication with P.Weilhammer (CERN)