Detector Geometry used for the current Geant 4 Beam Test Simulator

March 2, 2001

– update log of this document –
03/01/2001 Written by T. Mizuno based on a "Detector Geometry used for Geant 4 Balloon Test Simulator (27/Feb/2001)".

This document describes geometry implemented in the current Geant 4 Beam Test Simulator (03/Feb/2001 version). A schematic view of the whole detector is shown in Figure 1. Below we describe the detail of each component.

– Note –
The version Patric and Martin have used for the G4 validation is Jan. 5th version. This version differes in two points;
a) One of the ACD tile (ID=22) does not output the deposited energy, although it is placed in the world volume.
b) Position of Rubber sheets were incorrect. This might cause smaller energy deposition in Geant 4 simulater, and explain the diferrence between the actual experimental result and the simulation result (see Patric's plot about the Calorimeter).

1 Tracker (TKR)

A schematic view of a (standard) tray is shown in Figure 2, and materials used for each tray are summarized in Table 1 and 3. Although a core is composed of honeycome structure, we constructed it as a box of aluminum with a density of 0.17 g cm^{-3}, 0.6% of normal aluminum. Based on [2], distance between two top SSDs of consecuitive trays are assumed to be 32.0 mm. Z positions of each tray is shown in Table 2.

Aluminum walls and stand are also implemented in the simulator, as given in Table 2.

2 Carbon Wall

Material of wall is assumed to be Carbon (2.265 g cm^{-3}). Size of 4 side walls is 671 mm × 510 mm × 5 m and that of top wall is 510 mm × 510 mm × 5 mm, taken from [1].

3 Calorimeter (CAL)

A calorimeter consists of CsI crystals, polystyrene sheet (as refrector), and rubber sheets, as shown in Figure 3. Size and composition of materials are summarized in Table 5.

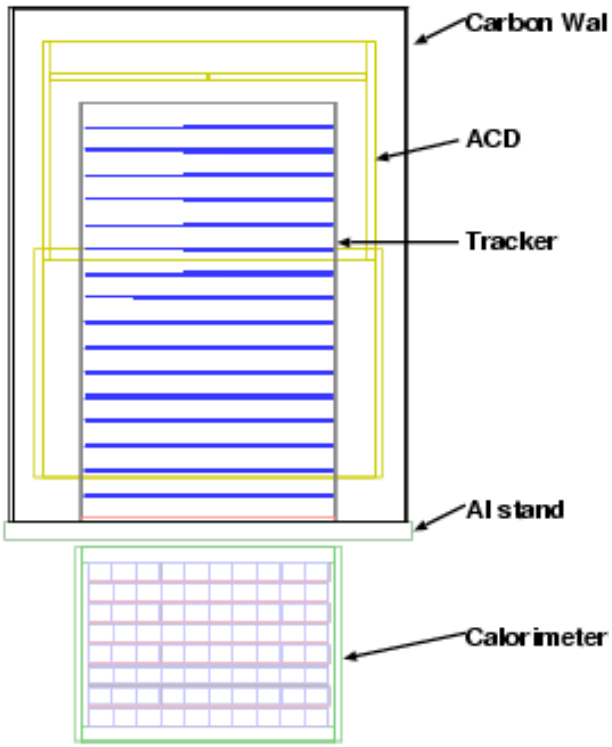

Figure 1: A geometry in the current Geant4 Beam Test simulator.

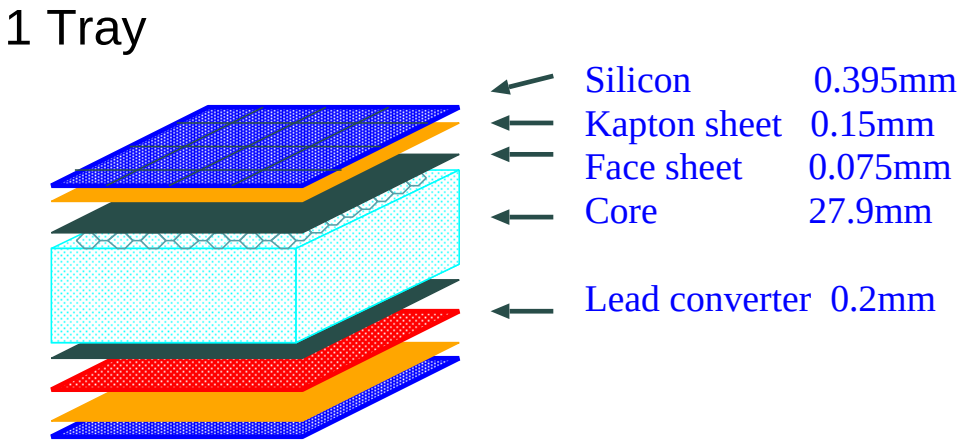

Figure 2: Schematic view of a standard tray

Table 1: Materials in each tray. Topmost tray is a Standard Tray without upper Kapton and top SSD, and the Bottommost tray is a no lead tray without lower kapton and bottom SSD. Thickness of trays is shown in bracket.

Bottommost Tray	NoLead Tray	SuperGLAST Tray	Standard Tray	Topmost Tray
top SSD	top SSD	top SSD	top SSD	Face sheet
Kapton	Kapton	Kapton	Kapton	Core
Face sheet	Face sheet	Face sheet	Face sheet	Face sheet
Core	Core	Core	Core	Lead
Face sheet	Face sheet	Face sheet	Face sheet	Kapton
Bottom	Kapton	SuperGlast Lead	Lead	bottom SSD
	bottom SSD	Kapton	Kapton	
		bottom SSD	bottom SSD	

Table 2: Tray configuration. Ladders are loaded with five small SSDs (4 inch) or three large SSDc (6 inch). The number of ladders of each tray is listed for each layer. ID numbers of SSD are also listed, with the coordinate that can be measured in brackets.

Tray	Top ladders				Bottom ladders				Lead
	No 4 in	No 6 in	Si ID	z (mm)	No 4 in	No 6 in	Si ID	z (mm)	(%Xrad)
17					3		31(y)	485.995	3.6
16	3		30(x)	479.94	3		29(x)	453.995	3.6
15	2	1	28(y)	447.94	3		27(y)	421.995	3.6
14		3	26(x)	415.94	3		25(x)	386.995	3.6
13	2	1	24(y)	383.94	3		23(y)	354.995	3.6
12	3		22(x)	351.94	3		21(x)	322.995	3.6
11	3		20(y)	319.94	3		19(y)	290.995	3.6
10	3		18(x)	287.94	4		17(x)	258.995	3.6
9		4	16(y)	255.94	5		15(y)	226.995	3.6
8		5	14(x)	223.94		5	13(x)	194.995	3.6
7		5	12(y)	191.94		5	11(y)	162.995	3.6
6		5	10(x)	159.94		5	9(x)	131.195	28
5		5	8(y)	127.94		5	7(y)	99.195	28
4		5	6(x)	95.94		5	5(x)	67.195	28
3		5	4(y)	63.94		5	3(y)	35.195	0
2		5	2(x)	31.94		5	1(x)	3.195	0
1		5	0(y)	0					0

Table 3: Material table of TKR

Material	elemental composition	density [g cm^{-3}]	size	comment
4-inch Silicon	Si	2.330	$64.0 \times 64.0 \times 0.395$ mm^3	(a)
6-inch Silicon	Si	2.330	$64.0 \times 106.8 \times 0.395$ mm^3	(a)
4-inch Lead	Pb	11.35	$62.4 \times 62.4 \times 0.20$ mm^3	(b)
6-inch Lead	Pb	11.35	$62.4 \times 105.2 \times 0.20$ mm^3	(b)
Lead for super GLAST	Pb	11.35	$62.4 \times 105.2 \times 1.6$ mm^3	(b)
Core	Al	0.017	$330.2 \times 330.2 \times 27.9$ mm^3	(c)
Core for super GLAST	Al	0.017	$330.2 \times 330.2 \times 26.3$ mm^3	(d)
Kapton sheet	$C_{10}H_2O_4Cu$	1.420	$330.2 \times 330.2 \times 0.15$ mm^3	(e)
Facesheet	C	1.20	$330.2 \times 330.2 \times 0.075$ mm^3	(f)
Bottom	Al	2.70	$330.2 \times 330.2 \times 5.305$ mm^3	(g)

(a) XY size of Si is based on [2]. and the thickness is taken from ***.
(b) XY size and thickness of Pb are taken from [2]
(c) XY size and thickness are taken from [2]. (d) XY size is taken from [2]. Thickness (26.3 mm) = Tray thickness (27.9 mm) - lead thickness (1.6 mm).
(e) Material composition is based on ***. XY size and thickness are taken from [2].
(f) XY size and thickness are taken from [2]. Weight of one facesheet is measured as 12.0 g (private communication with Takanobu Handa). Therefore the density is 1.47 g cm^{-3}. The value of the current source code (1.20 g cm^{-3}) may be a mistake .
(g) XY size is assumed to be the same as that of Tray. 5.55025 mm (thickness) = 33.9 mm - 0.5*0.395 mm (half of SSD thickness) - 27.9 mm (Tray thickness) - 2*0.075 mm (two face sheets) - 0.15 mm (kapton).

Table 4: Material table of Aluminum walls and stand

Material	elemental composition	density [g cm^{-3}]	size	z coordinate of the center[mm]	comment
side wall	Al	2.70	$330.2 \times 546.1 \times 1.5$ mm^3	238.8525	(a)
stand	Al	0.017	$528.3 \times 528.3 \times 22.6$ mm^3	-45.0025	(b)

(a) 330.2 mm is the same as Tray XY size, 546.1 mm = Tkr Height = 33.9 + 16*32.0 + 0.5*0.395 mm, and 1.5 mm = (33.32-33.02)/2. (see [2])
(b) XY size (528.3 mm) is assumed to be 1.6 times Tray XY size (330.2 mm), and height (22.6 mm) = 86.1 mm (top SSD to top of CsI log, see [1]) - 33.9 mm (bottommost tray height, [2]) - 9.6 mm (gap size, see [1]) - 20.0 mm (Cal frame thickness). Material is assumed to be the same as that of Core.

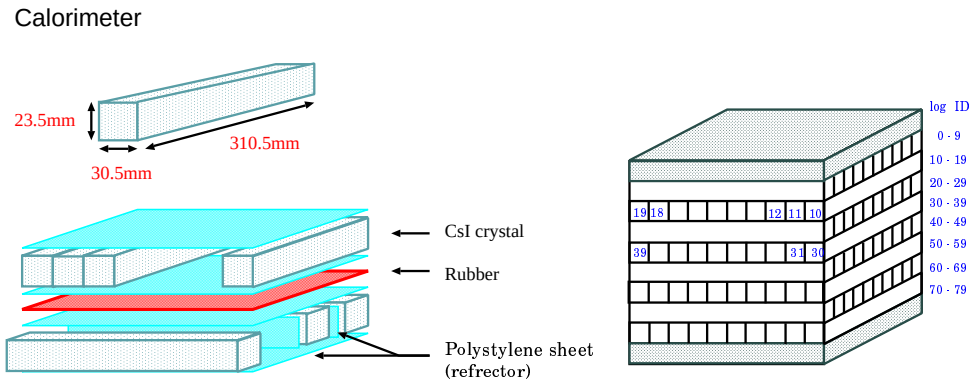

Figure 3: Schematic view of CAL

Table 5: Materials used in CAL.

Material Material	elemental composition	density [g cm^{-3}]	size (z coordinate value of the center)	comment
CsI crystal	CsI	4.53	$30.5 \times 310.5 \times 23.5$ mm^3	(a)
Polystyrene	C_8H_8	1.032	$30.92 \times 310.5 \times 23.92$ mm^3 thickness 0.42 mm	(b)
rubber	C_4H_6	1.0	$310.5 \times 310.5 \times 2.62$ mm	(c)
CAL support frame (top/bottom)	Al	0.017	$330.2 \times 330.2 \times 20.00$ mm (-76.10/-309.06 mm)	(d)
CAL support frame (side)			$8 \times 330.2 \times 146.48$ mm (-192.58 mm)	(e)

(a) XYZ size of CsI log is taken from [1].
(b) Thickness of polystyrene (0.42 mm) is taken from [3]
(c) Thickness of rubber sheet (2.62 mm) is taken from [3]. XY size is assumed to be the same as the length of CsI log.
(d) XY size is assumed to be the same as that of a Tray, and the thickness (20 mm) is taken from [3].
(e) Thickness (8 mm) is taken from [3], width (330.2 mm) is assumed to be the same as XY size of a Tray, and height (146.48 mm) = 8*2*0.042(polystyrene thickness) + 8*23.5(CsI thickness) + 7*2.62(rubber thickness)+2*20(top and bottom frame thickness).

3.1 Anti Coincidence Detector (ACD)

Elemental composition of the scintillator is assumed to be the same as polystyrene, i.e., C_8H_8 of 1.032 g cm^{-3}. Although the top tiles are bent in the (x,y) plane of the real anticoincidence detector, the flat tiles are implemented in the simulator.

Dimension of side ACD panels are taken from [1], and the z position of lower ACD panel is also taken from the same reference. Z position of the upper ACD panel is calculated as 172.9 + (297.0)/2 - 15.0 + 284.0/2.

Table 6: Dimensions and positions of ACD scintillator tiles.

Dimension(mm^2)	position of scintillator center			ID Number of tile
	x(mm)	y(mm)	z(mm)	
$\Delta z \times \Delta y$ 297 × 432	221	0	172.9	4
284 × 432	211	0	448.4	10
$\Delta z \times \Delta x$ 297 × 432	0	221	172.9	3
284 × 432	0	211	448.4	9
$\Delta z \times \Delta y$ 297 × 432	-221	0	172.9	1
284 × 432	-211	0	448.4	7
$\Delta z \times \Delta x$ 297 × 432	0	-221	172.9	6
284 × 432	0	-211	448.4	12
$\Delta x \times \Delta y$ 204 × 204	103	103	545	16
	-103	103	545	19
	-103	-103	545	13
	103	-103	545	22

References

[1] "GLAST Testbeam Users guide" of Ver 1.5
http://www.slac.stanford.edu/~hansl/glast/bt99/bt99.bk.pdf

[2] "Geometry for the TRACKER to update .XML"
http://www-glast.slac.stanford.edu/testbeam/geometrytkr.ppt

[3] ".XML file used for GLASTSIM input"
http://www-glast.slac.stanford.edu/testbeam/tbinstrument.xml