SDC-91-134

SDC
SOLENOIDAL DETECTOR NOTES

GEOMETRIES, NUMBER OF HIT LAYERS AND MATERIAL THICKNESSES OF THE NEW SI DESIGNS

November 1, 1991

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Geometries, Number of hit layers, and Material thicknesses of the New Si Designs

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Two geometries for the SDC Silicon tracking system have been proposed which have been designed to cost after the LOI. One geometry has an characteristics of all Barrel layers/cylinders in the same length (All Square), and the other has the Barrel-Disk transition at 45 degrees (45° transition). In this note, number of hit layers of silicon strip detectors and the material thicknesses of the two designs were calculated. Both were only for silicon detectors and no overlap was assumed.

Table I. lists the coordinates and silicon areas of Design #1 and Design #2. Fig. 1(a) and 1(b) show the geometries overlaid with the pseudorapidity(η) lines of step of 0.05. In the figures, the top figure is for the overall view and the bottom is for the enlarged central part for clarity. Fig. 2(a) and 2(b) show the number of Si hit layers and the material thickness in the unit of radiation length(X_0.) of the Design #1 as a function of η. Fig. 3(a) and 3(b) show the ones of the Design #2. Average material thicknesses are listed in Table II. over the η ranges up to 1.5, 1.8, and 2.5 which correspond to the coverages of the Barrel EM calorimeter, the Central tracker, and the full tracker, respectively. Within $|\eta|<1.8$, the Design #1 has an average of 3.17% X_0 and the Design #2 has 2.96% X_0.

The number of hit layers for both design are almost equal though, there is a difference in the material thickness in η=1.3~1.5, in which the design #1 (All Square) has an excess caused by the two inner most long cylinders. If this excess were not tolerable, one might shorten the two cylinders and extend the first two disks inward. Further optimization may be necessary in future, including such materials as cooling rings and cables.

Table Captions

Table I. Coordinates and silicon areas.

Table II. Average material thicknesses in the unit of radiation length(X_0.).

Figure Captions

Fig. 1 Geometries overlaid with the pseudorapidity(η) lines of step of 0.05; (a) Design #1 and (b) Design #2. The top figure is for the overall view and the bottom is for the enlarged central part.

Fig. 2 (a) The number of Si hit layers and (b) the material thickness in the unit of radiation length(X_0.) of the Design #1 as a function of η.

Fig. 3 (a) The number of Si hit layers and (b) the material thickness in the unit of radiation length(X_0.) of the Design #2 as a function of η.

Table I.

Design 1

All Barrel Layers Same Length

Barrel	r	z	
(1)	9 cm	30 cm	
(2)	12 cm	30 cm	
(3)	18 cm	30 cm	6.78 m^2 for Barrel.
(4)	21 cm	30 cm	
(5)	24 cm	30 cm	
(6)	27 cm	30 cm	
(7)	33 cm	30 cm	
(8)	36 cm	30 cm	

Disks	r_{in}	r_{out}	z	
(1)	15 cm	39 cm	33 cm	
(2)	15 cm	39 cm	38 cm	
(3)	15 cm	39 cm	44 cm	10.63 m^2 for Disks
(4)	15 cm	39 cm	52 cm	(both sides)
(5)	15 cm	39 cm	61 cm	
(6)	15 cm	39 cm	72 cm	
(7)	15 cm	39 cm	85 cm	
(8)	15 cm	39 cm	102 cm	
(9)	15 cm	39 cm	122 cm	
(10)	22.5 cm	46.5 cm	146 cm	
(11)	22.5 cm	46.5 cm	178 cm	
(12)	34.5 cm	46.5 cm	218 cm	
(13)	34.5 cm	46.5 cm	258 cm	

Table I(cont'd). Design #2

Barrel – Disk Transition at 45°

Barrel	r	z	
(1)	9 cm	15 cm	
(2)	12 cm	15 cm	
(3)	18 cm	18 cm	5.99 m^2 for Barrel.
(4)	21 cm	21 cm	
(5)	24 cm	24 cm	
(6)	27 cm	27 cm	
(7)	33 cm	33 cm	
(8)	36 cm	36 cm	

Disks	r_{in}	r_{out}	z	
(1)	9 cm	16.5 cm	16.5 cm	
(2)	9 cm	19.5 cm	19.5 cm	
(3)	9 cm	25.5cm	25.5 cm	Close Barrel 1.24 m^2
(4)	9 cm	31.5 cm	31.5 cm	
(5)	15 cm	39 cm	38 cm	
(6)	15 cm	39 cm	44 cm	
(7)	15 cm	39 cm	52 cm	
(8)	15 cm	39 cm	61 cm	Outer Disks 9.81 m^2
(9)	15 cm	39 cm	72 cm	
(10)	15 cm	39 cm	85 cm	
(11)	15 cm	39 cm	102 cm	
(12)	15 cm	39 cm	122 cm	
(13)	22.5 cm	46.5 cm	146 cm	
(14)	22.5 cm	46.5 cm	178 cm	
(15)	34.5 cm	46.5 cm	218 cm	
(16)	34.5 cm	46.5 cm	258 cm	

Total Area = 17.04 m^2

Table II. Average material thicknesses in the unit of radiation length(X_0.).

$\eta<\eta_0$	Design #1	Design #2
1.5	3.14%	3.02%
1.8	3.17%	2.96%
2.5	2.91%	2.73%

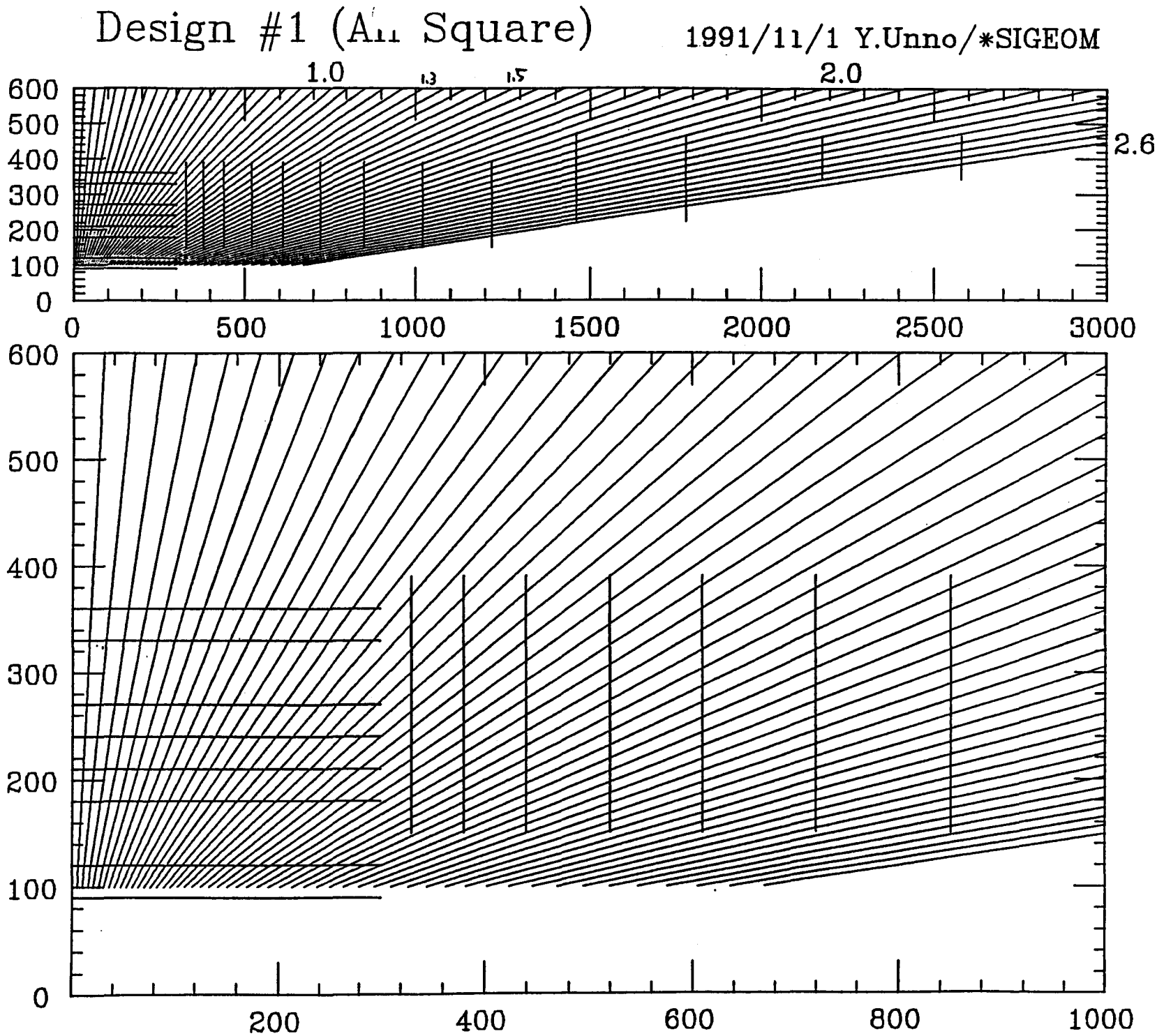

Design #1 (An Square)
1991/11/1 Y.Unno/*SIGEOM
1.0
1.3
1.5
2.0
2.6
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500
3000
600
500
400
300
200
100
0
200
400
600
800
1000

Fig. 1(a)

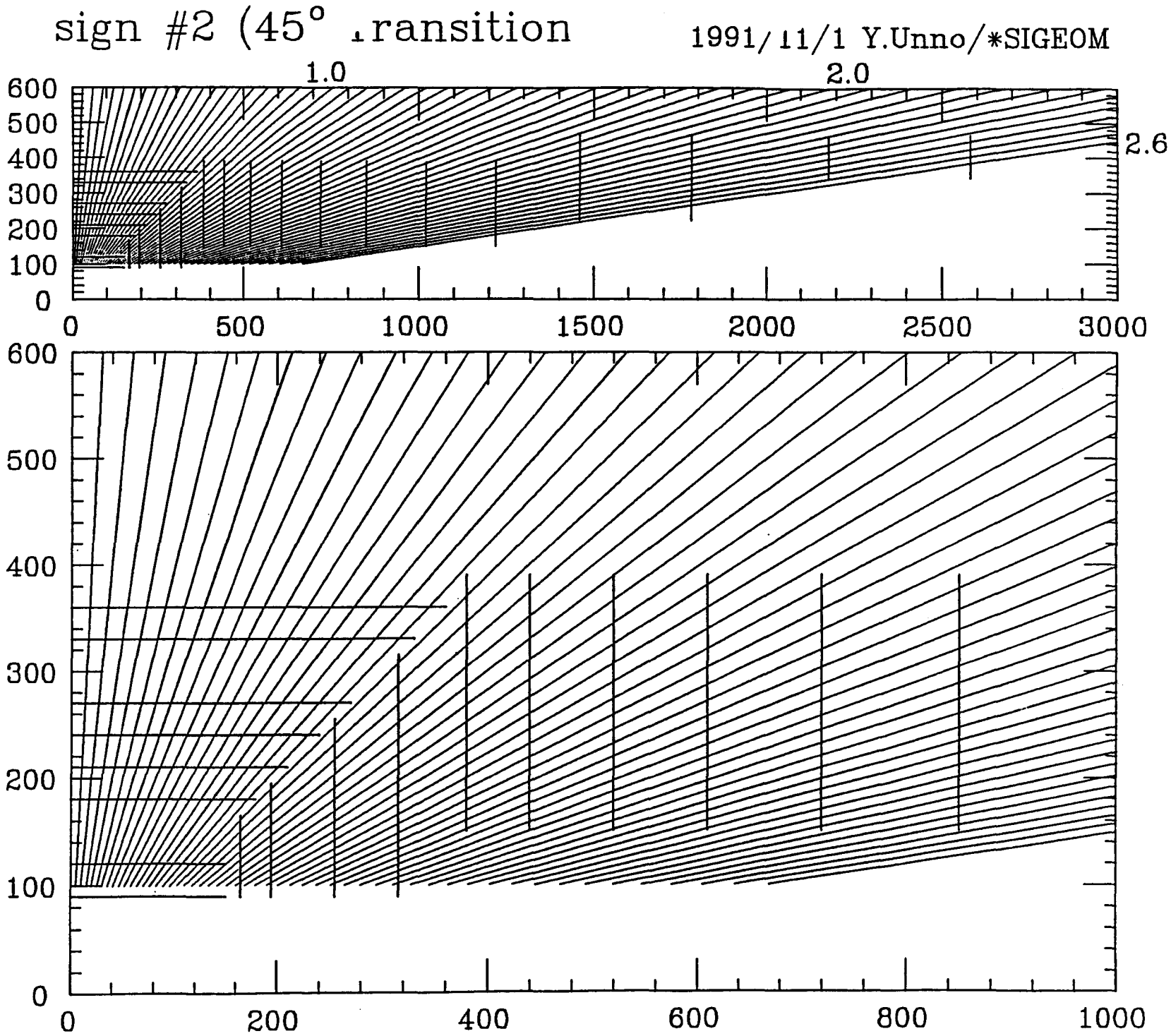
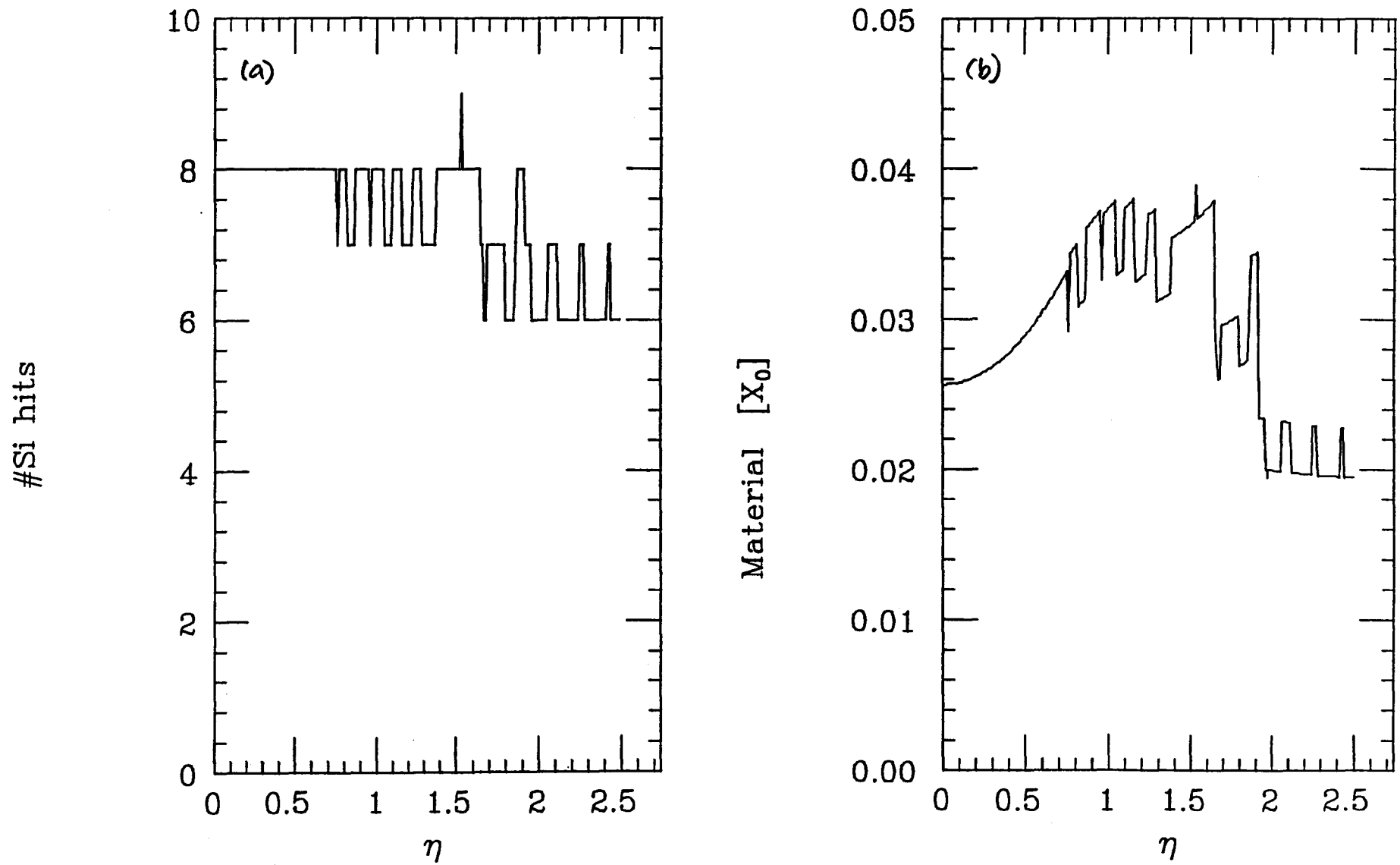

sign #2 (45° transition
1991/11/1 Y.Unno/*SIGEOM
1.0
2.0
2.6
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500
3000
600
500
400
300
200
100
0
0
200
400
600
800
1000

Fig. 1(b)

Design #1 (All Square)

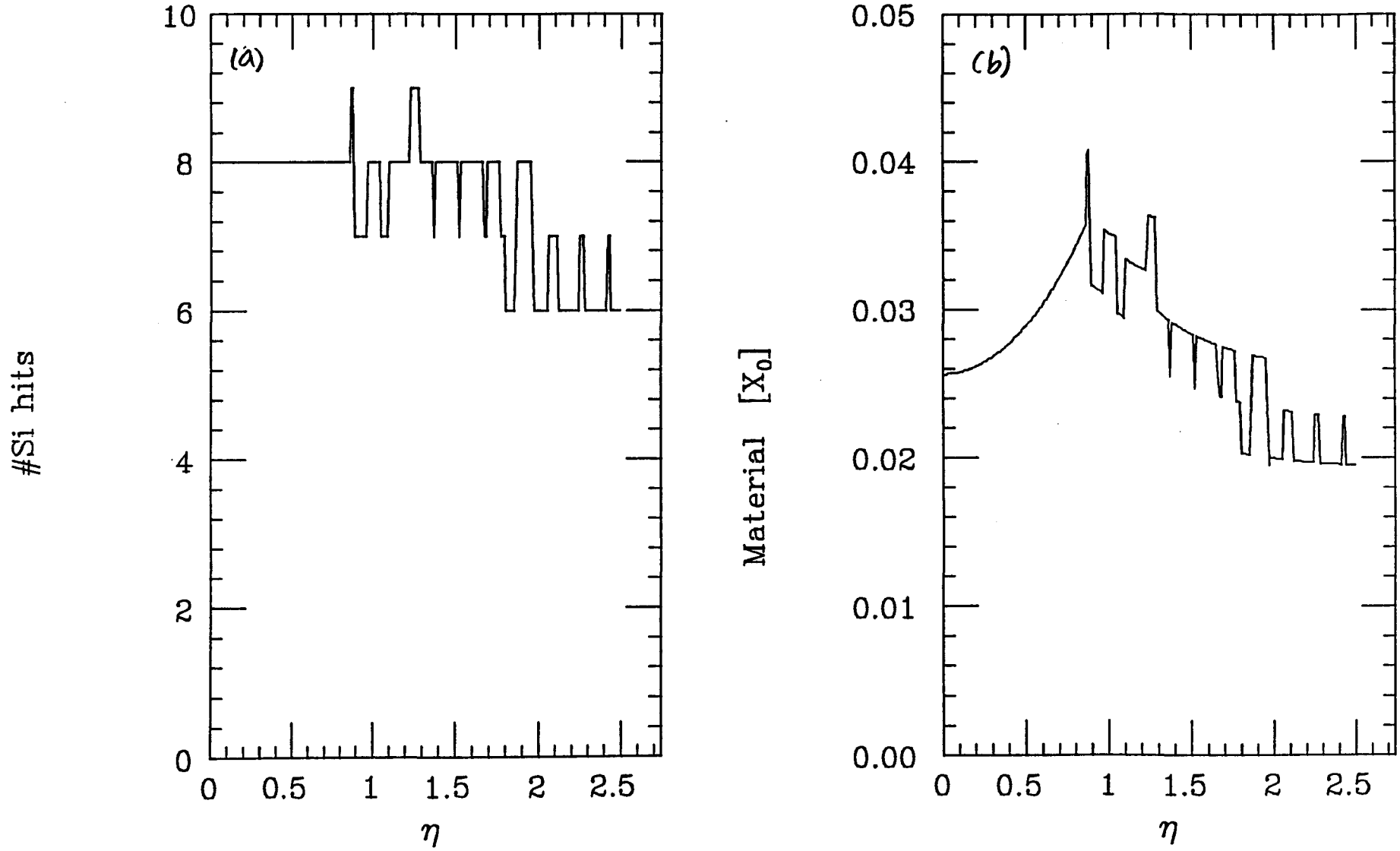
Y.Unno 1991/11/1



*SI_NEW

Design #2 (45° transition)

Y.Unno 1991/11/



*SI_NEW