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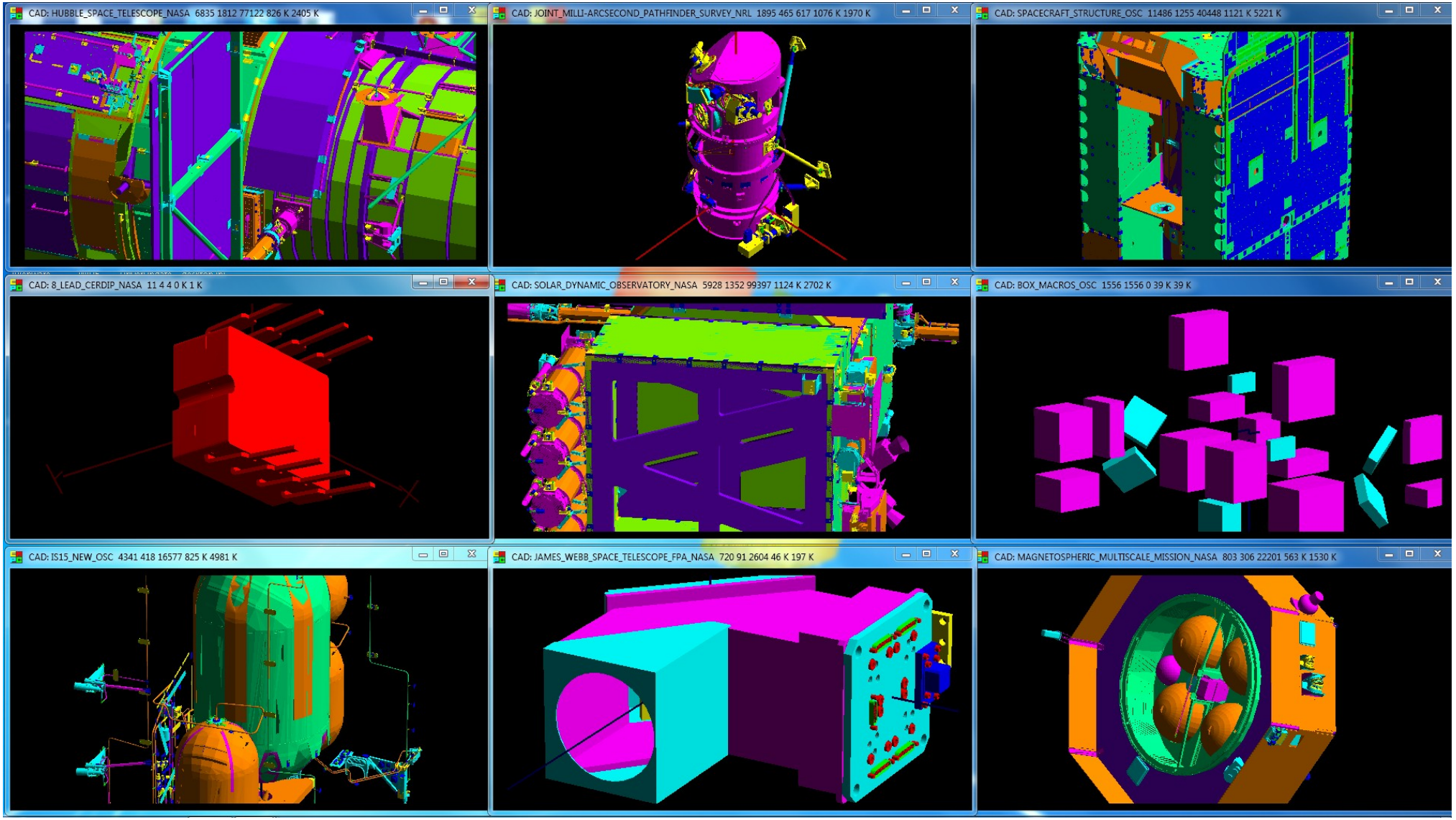
NSREC 2014 Juillet 14-18 Marriott Rive Gauche Paris, France



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NOVICE	Numerical Optimizations, Visualizations, and Integrations on CAD(computer aided design)/ CSG(combinatorial solid geometry) Edifices.
DEVELOPMENT	Copyrights, Licensing, Maintenance, and Support (with associates) by: Thomas M. Jordan, Doing Business As: EXPERIMENTAL AND MATHEMATICAL PHYSICS CONSULTANTS
CODE INTERFACES	SCALE, ITS3/ACCEPT, CEPXS/1LD, MCNP, SPENVIS, GEANT4
MATERIAL LIBRARY	Handbook of Chemistry and Physics (63rd Edition), Atomic Data, Volume 27, #2/3, J.Janni, NIST NBSIR 82-2550-A, M.Berger/S.Seltzer.
CSG INTERFACES	*MAGIC (*ITS/ACCEPT, *MCNP, MORSE), *MEVDP, *SVC, *ESABAS, *SYSTEMA, *DESIGN, *SURFACE/*REGION/CELL.
CAD INTERFACES	CATIA/AlCapone, ProEngineer/CREO, *STEP, *IGES, VRML, STL, SAT, NX, CADLOOK, SOLIDWORKS, AUTOCAD
CAD PROCESSING	TREE Files (Multi-Instance Object Placements) GEOM Files (Unique Object Tessellations) NEW_VIEW openGL Viewing: Zoom, Rotate, Blend, Cuts NEW_REPAIR: CAD data summary and Fixes, volumes, weights, material assignment/change, ray-trace picture command files, point/surface/volume detector files, macro-box/board/detector CSG fix files. LARGE JOBS: >100,000 OBJECTS, >16 CADFILES/JOB
RAY-TRACING	Overlap Recognition and Resolution, by Design, in Combined CAD/CSG Models, Resolution, by Design, of Undefined Space as Void, Second Generation Algorithms with FACTOR-OF-10 Speed Improvement; First Generation Still Available.
SPACE ENVIRONMENT	AE8/AP8(*SOFIP), AE9/AP9, PSYCHIC Solar Particles, CREME 96/MC Galactic Cosmic Rays (*GCR), On-Board Nuclear RTG/RHU, Nuclear Propulsion Reactors, bremsstrahlung and secondary electrons, activation/decay, spallation/fragmentation, Mott-Rutherford electrons and recoil nuclei (*NIEL).
MAJOR PROCESSORS	*ADJOINT: 1D semi-analytic and 3D Adjoint Monte Carlo. *SIGMA: ray-trace solid angle sectoring, minimum path and slant path models, optional physics adjustments. *PULSE: multi-channel pulse height distributions, sensor noise, single particle upsets, latches, burnout, LET (linear energy transfer) spectra. *PICTURE: ray-traced perspective geometry views. *SOCODE: weight minimized box wall shields, STL files for weight minimized 3D printed shields. *HITS: on-orbit sensor noise, with local ephemeris and geomagnetic shielding, trapped electron, trapped protons, solar particles, and galactic cosmic rays. *BETA, *FASTER, *SHIELD, *SELTZER, *SOFIP, *XRAY, …

*KEYWORD indicates a NOVICE*processor/application

RHU SHIELDING

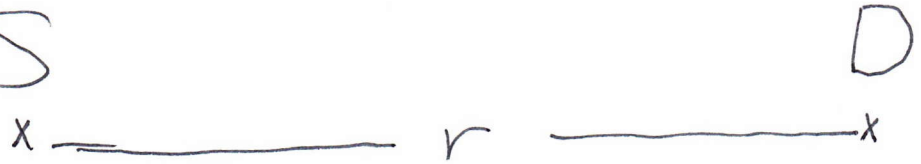
$$S = 2\,\text{watts} \times 3.1\,\frac{\text{fissions/s}}{\text{watt}} \times 2.5\,\frac{\text{neutrons}}{\text{fission}}$$

$$D = 3\cdot10^{5}\,\frac{\text{eV}\cdot\text{barns}}{\text{Si atom}} \times \frac{0.6023}{28} \times 10^{24}\,\frac{\text{atoms}}{\text{g}*\text{atom}} \times 10^{-24}\,\frac{\text{cm}^2}{\text{barn}}$$

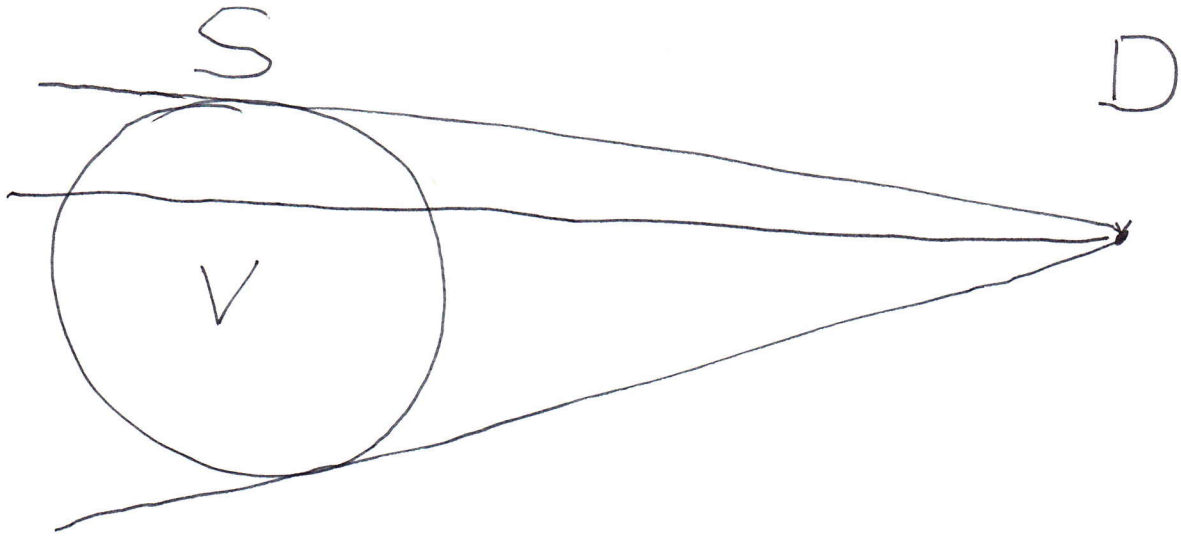
$$\times\, 10^{-6}\,\frac{\text{MeV}}{\text{eV}} \times 1.602\times10^{-8}\,\frac{\text{rad}}{\text{MeV/g}}$$

$$R = S\,M\,D$$

$$= S\,\frac{1}{4\pi r^2}\,D$$



VOLUME SHIELDING



$$S_V = S/V$$

$$R = \int_V S_V \frac{e^{-kr}}{4\pi r^2} D \, dV$$

$$= \int_{\Delta\Omega} \int_0^\infty S_V \frac{e^{-kr}}{4\pi r^2} D \, r^2 dr \, d\Omega$$

$$= \frac{\Delta\Omega}{4\pi} \frac{S_V}{k}\left(1 - e^{-kh}\right) \simeq \frac{\Delta\Omega}{4\pi} S_A \left(= \frac{S_V}{k}\right)$$

$$= S_A \quad \text{IF INSIDE THE VOLUME}$$
$$\& \; D \equiv 1 \; (\text{PARTICLE COUNTING})$$

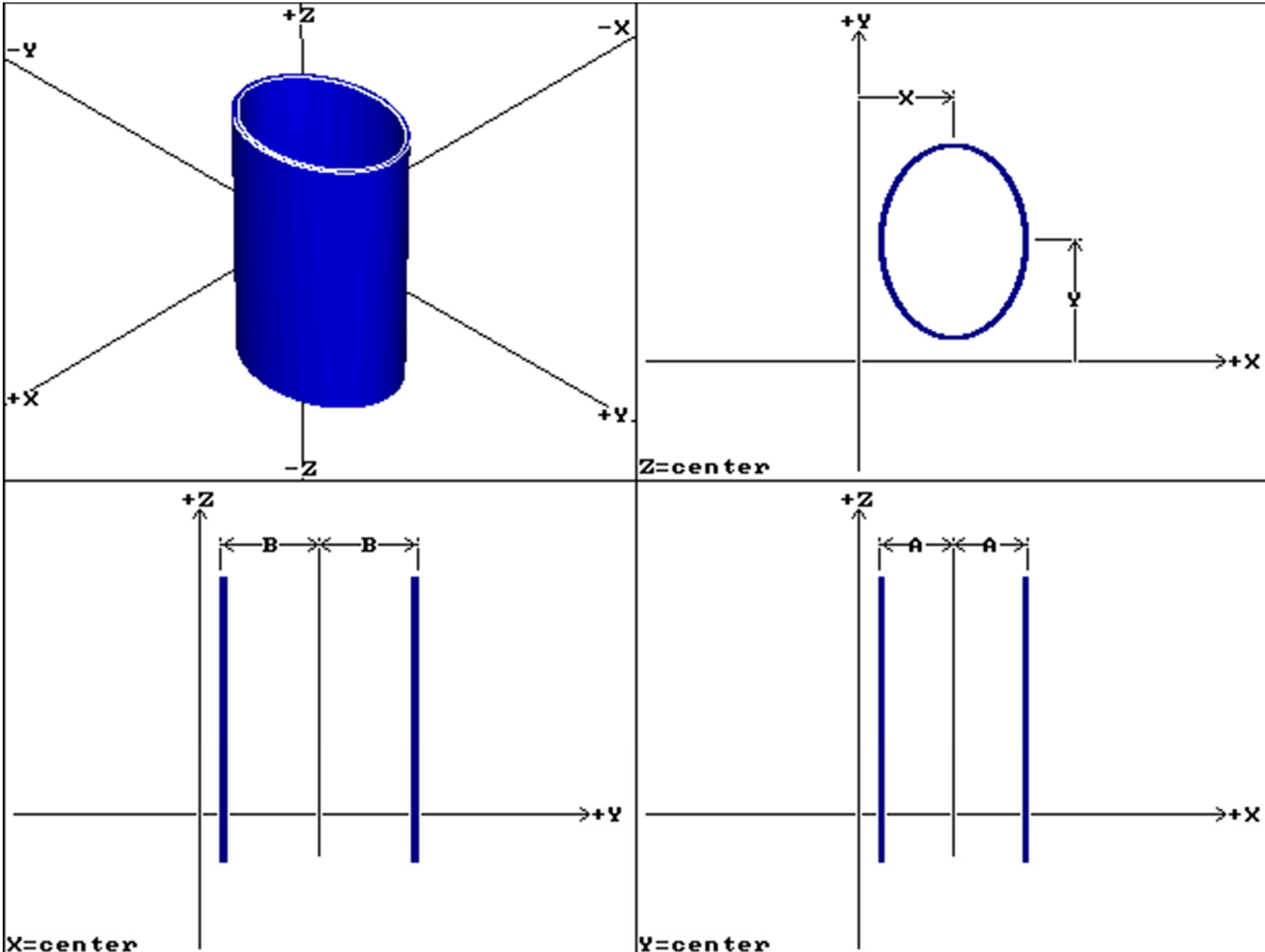
```
c*****si            , eV*barn/atom

rad_si              neutron  tab scale 1.602e-8/
,  1.73E+01,  1.42E+01,  1.22E+01,  1.00E+01,  8.61E+00,  7.41E+00
,  6.07E+00,  4.97E+00,  3.68E+00,  3.01E+00,  2.73E+00,  2.47E+00
,  2.37E+00,  2.35E+00,  2.23E+00,  1.92E+00,  1.65E+00,  1.35E+00
,  1.00E+00,  8.21E-01,  7.43E-01,  6.08E-01,  4.98E-01,  3.69E-01
,  2.97E-01,  1.83E-01,  1.11E-01,  6.74E-02,  4.09E-02,  3.18E-02
,  2.61E-02,  2.42E-02,  2.19E-02,  1.50E-02,  7.10E-03,  3.35E-03
,  1.58E-03,  4.54E-04,  2.14E-04,  1.01E-04,  3.73E-05,  1.07E-05
,  5.04E-06,  1.86E-06,  8.76E-07,  4.14E-07,  1.00E-07,  1.00E-11
/
,  3.57E+06,  3.61E+06,  3.36E+06,  2.70E+06,  2.50E+06,  1.30E+06
,  6.71E+05,  4.55E+05,  4.22E+05,  2.86E+05,  2.95E+05,  2.35E+05
,  2.50E+05,  2.30E+05,  2.43E+05,  2.30E+05,  2.37E+05,  1.48E+05
,  1.73E+05,  1.86E+05,  9.92E+04,  1.31E+05,  8.81E+04,  8.00E+04
,  1.10E+05,  2.07E+04,  8.38E+03,  1.09E+04,  4.15E+03,  3.37E+03
,  3.00E+03,  2.81E+03,  2.33E+03,  1.40E+03,  6.98E+02,  3.19E+02
,  1.27E+02,  4.58E+01,  2.28E+01,  1.14E+01,  7.35E+00,  8.17E+00
,  1.16E+01,  1.73E+01,  2.50E+01,  4.25E+01,  9.77E+01/

rad_si              gammaray tab scale 1.602e-8/
,  1.40E+01,  1.00E+01,  8.00E+00,  7.00E+00,  6.00E+00,  5.00E+00
,  4.00E+00,  3.00E+00,  2.00E+00,  1.50E+00,  1.00E+00,  8.00E-01
,  7.00E-01,  6.00E-01,  4.00E-01,  2.00E-01,  1.00E-01,  6.00E-02
,  3.00E-02,  2.00E-02,  1.00E-02/
,  9.59E+00,  7.82E+00,  6.63E+00,  5.60E+00,  4.93E+00,  4.15E+00
,  3.39E+00,  2.55E+00,  2.01E+00,  1.54E+00,  1.19E+00,  1.02E+00
,  8.95E-01,  6.85E-01,  3.89E-01,  2.21E-01,  2.64E-01,  5.52E-01
,  2.37E+00,  6.61E+00/
```

Quadric Surface Data

Type	Constant list	
0 EXP	$a_0\ a_1\ a_2\ a_3\ a_4 \ldots\ldots a_j$ /	expanded quadric
1 XPLane	a /	x=a plane
2 YPLane	a /	y=a plane
3 ZPLane	a /	z=a plane
4 YZPlane	$y_0\ z_0\ y_1\ z_1$ /	plane parallel x axis
5 ZXPlane	$z_0\ x_0\ z_1\ x_1$ /	plane parallel y axis
6 XYPlane	$x_0\ y_0\ x_1\ y_1$ /	plane parallel z axis
7 XCOne	$y_0\ z_0\ r_1\ x_1\ r_2\ x_2$ /	X cone
8 YCOne	$z_0\ x_0\ r_1\ y_1\ r_2\ y_2$ /	Y cone
9 ZCOne	$x_0\ y_0\ r_1\ z_1\ r_2\ z_2$ /	Z cone
10 XCYlinder	y_0 a z_0 b /	X cylinder
11 YCYlinder	z_0 a x_0 b /	Y cylinder
12 ZCYlinder	x_0 a y_0 b /	Z cylinder
13 SPH	x_0 a y_0 b z_0 c /	ellipsoid
19 XXP	a b /	x-a= +- b
20 YYP	a b /	y-a= +- b
21 ZZP	a b /	z-a= +- b
22 XYZ	x1 y1 z1 x2 y2 z2 x3 y3 z3	3 point plane



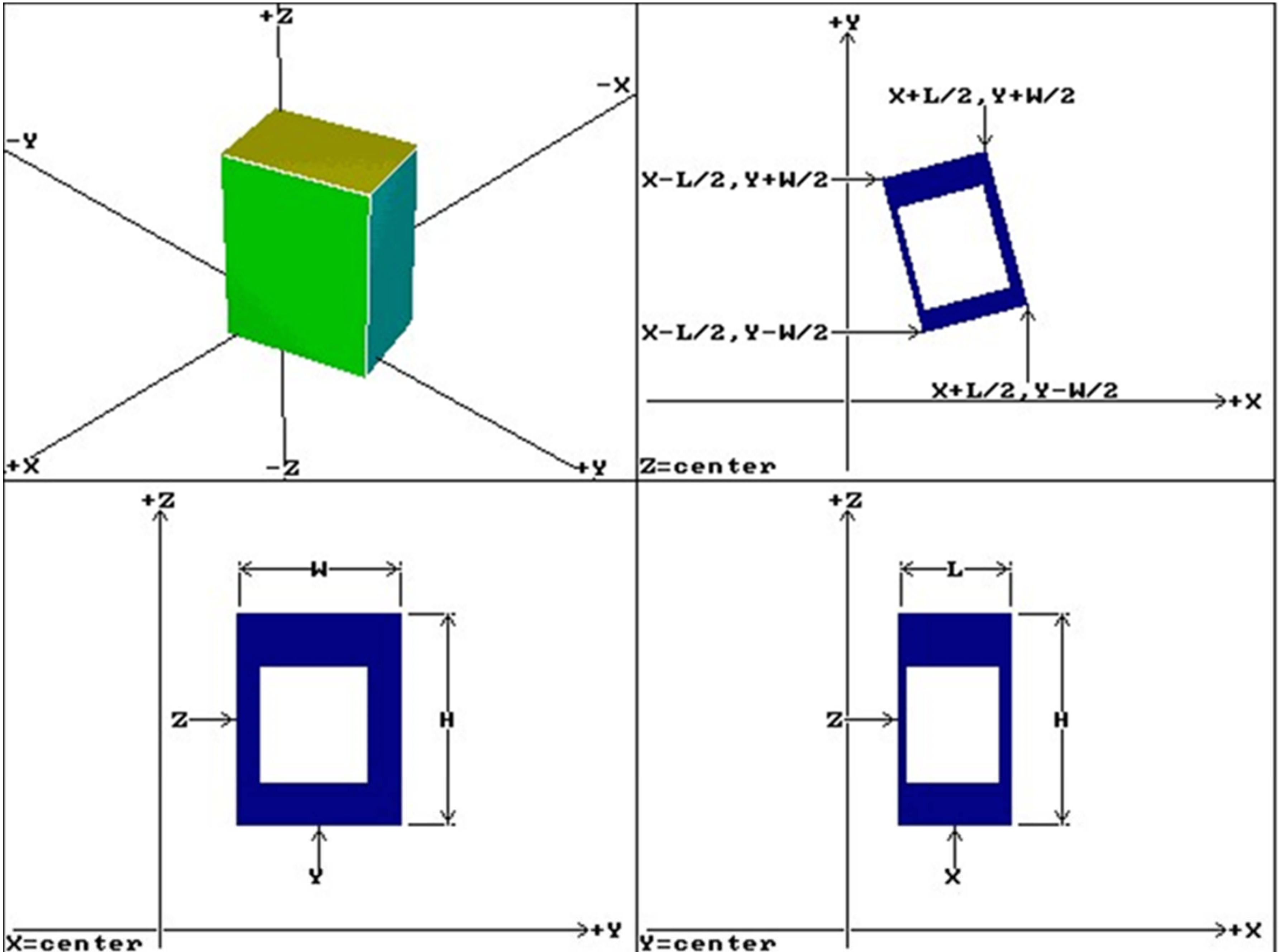
ID#,'ZCY',X,A,Y,B/ (X,Y)=center; A=x-radius; B=y-radius

*SURFACE Z-CYLINDER INPUT
*PIC,Q=3,Z=3,G=97,T=1,J,L='SURZCY'

Design Shapes and Dimensions

#	Name	Dimension Data	(...)==> optional data
0	BOX	X1 X2 Y1 Y2 Z1 Z2 /	
	or	Xmid Xdel Ymid Ydel Zmid Zdel /	if E option
1	XCYlinder	Y0 Ry Z0 Rz X1 X2 (Y1 Y2 Z1 Z2) /	
2	YCYlinder	Z0 Rz X0 Rx Y1 Y2 (Z1 Z2 X1 X2) /	
3	ZCYlinder	X0 Rx Y0 Ry Z1 Z2 (X1 X2 Y1 Y2) /	
4	SPHere		
4	ELLipsoid	X0 Rx Y0 Ry Z0 Rz (X1 X2 Y1 Y2 Z1 Z2) /	
7	XANulus	Y0 R1 Z0 R2 X1 X2 (Y1 Y2 Z1 Z2) /	
8	YANulus	Z0 R1 X0 R2 Y1 Y2 (Z1 Z2 X1 X2) /	
9	ZANulus	X0 R1 Y0 R2 Z1 Z2 (X1 X2 Y1 Y2) /	
10	XCOne	Y0 Z0 R1 X1 R2 X2 (Y1 Y2 Z1 Z2) /	
11	YCOne	Z0 X0 R1 Y1 R2 Y2 (Z1 Z2 X1 X2) /	
12	ZCOne	X0 Y0 R1 Z1 R2 Z2 (X1 X2 Y1 Y2) /	
13	THEtabox	X Y Z A L W H/	A in degrees
14	PIE	R S A B H Z/	A and B in degrees
15	MIDpointbox	X Y Z L W H/	
16	ROTatedbox	Z A R L W H/	A in degrees
17	CAKe	R1 R2 Z1 Z2 A B/	A and B in degrees
18	HOLlowbox	X Y Z A L W H T1 (T2 T3 ... T6) /	
	T1 is thickness of all walls unless U option. A in degrees		
19	XBOX	X1 X2 Y1 Y2 Z1 Z2 TX1 TX2 ... TZ2 W NB MTL RHO/ If W is 0, void interior. If W > 0, wall weight is subtracted. Then if NB=0, smeared interior.	
20	YBOX		
21	ZBOX		
	If NB > 0, weight put on NB boards perpendicular to X,Y, or Z axis. Interior mtl/den=MTL/RHO if input, else wall values.		
22	NSIdebox	#SIDES X_ Y_ Z_CENTER X_ Y_ Z_SIDE X_ Y_ Z_TOP/	
23,24,25	XYBoard,YZB,ZXB ==> (XI,XJ,XK)=(X,Y,Z),(Y,Z,X),(Z,X,Y) mtl,rho,name,XImin,XImax,XJmin,XJmax,XKmin,XKmax ,XIdel,#XI,XJdel,#XJ,XKdel,#XK(or BACK,FRONT,BOTH) (,mtl,rho,GROund,XIin,XIout,XJin,XJout,XKin,XKout) (,mtl,rho,PACkage,WIin,WIout,WJin,WJout,HKin,HKout)/		

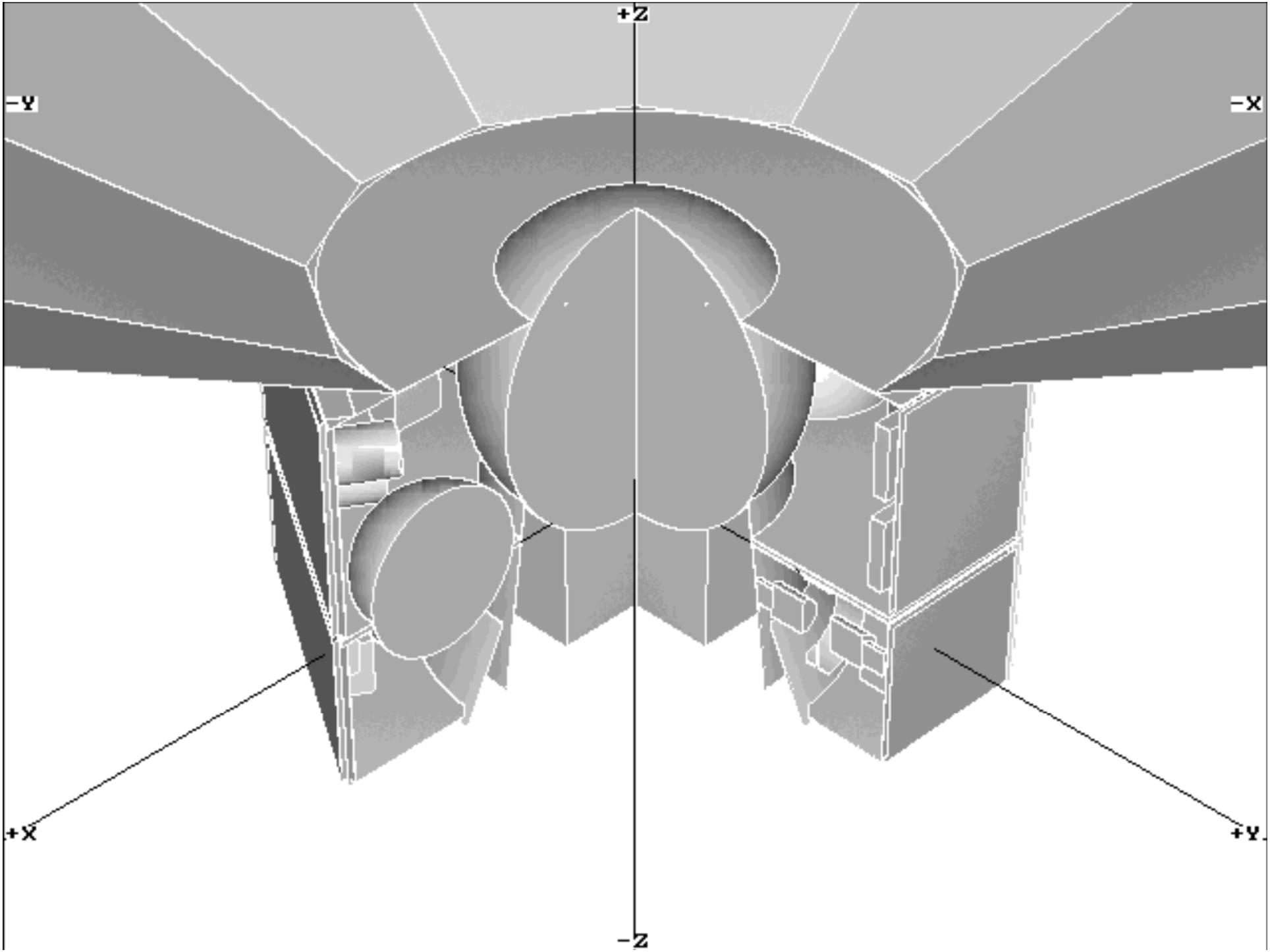
TYPICAL *DESIGN HOLLOW BOX INPUT
*PIC,Q=3,Z=3,G=97,T=3,J,L=' DESHOL'



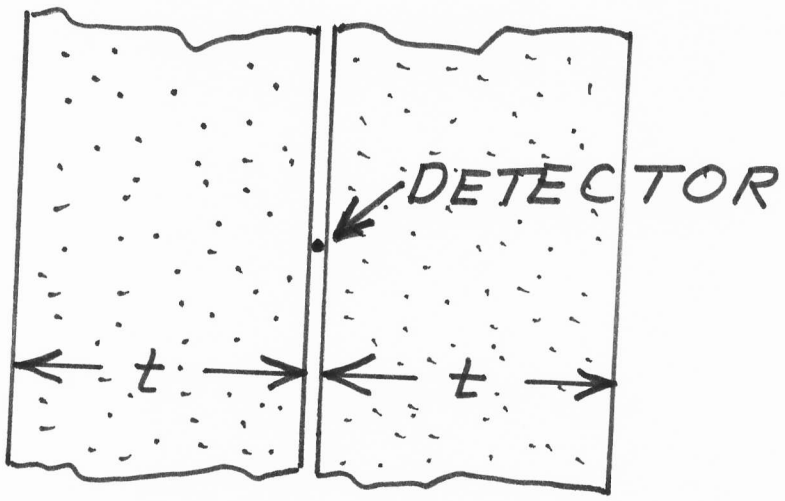
ID#,MTL,RHO,'HOL',X,Y,Z,A,L,W,H,U1,U2,V1,V2,W1,W2/ DESIGN 'HOL' INPUTS
X,Y,Z mid point; A degrees; L,W,H=len,wid,hgt; U1,U2=xwalls,V1,V2=y...
Corner points are labeled pre-rotation. Wall thicknesses not labeled

Magic Body Names and Data		
ELL	U V L	ellipsoid ellipsoid
SPH	V , R	sphere
RPP	X_1 X_2 Y_1 Y_2 Z_1 Z_2	right parallelepiped
RCC	V H R	right circular cylinder
TRC	V H R_1 R_2	truncated right cone
BOX	V L W H	box
RAW	or	
WED	V L W H	wedge
REC	V H A B	right elliptic cylinder
ARB	$X_1X_2X_3X_4$ …… X_8 F_1F_2…….F_6	arbitrary polyhedron
END	end of body inputs	

All coordinates/dimensions are in centimeters. The variable F_i for the ARB body is a 4 digit number where the digits are the point indices comprising the ith face listed clockwise or counter clockwise.

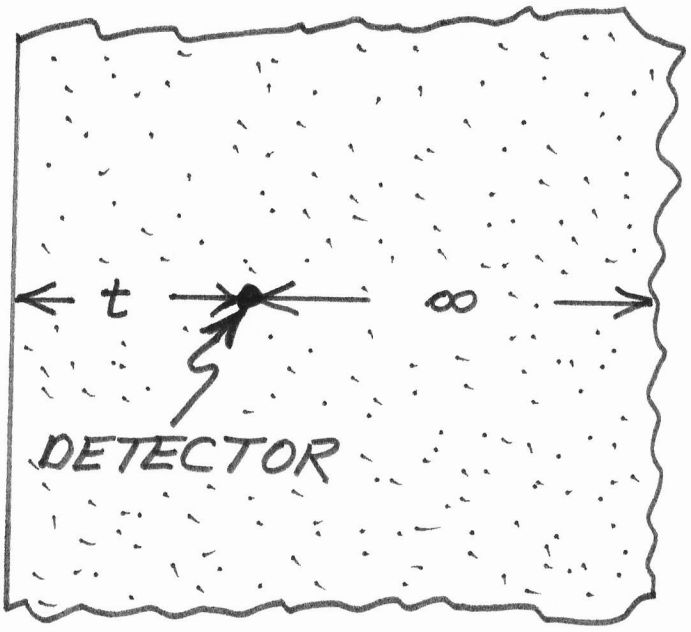

+Z
-Y
-X
+X
+Y
-Z

DOUBLE SLAB SHIELD



- PARTICLES INCIDENT BOTH SIDES
- $R_{=}(t)$ = INTEGRAL RESPONSE

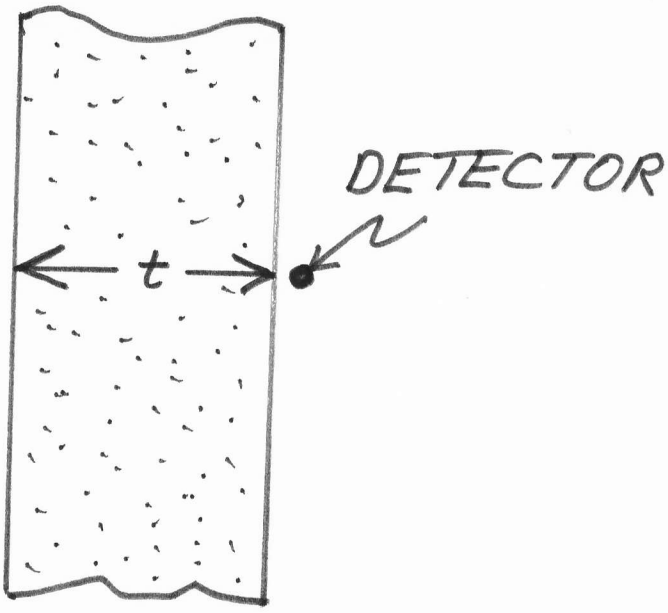
INFINITE BACKING SLAB



- PARTICLES INCIDENT FROM ONE SIDE

- $R_{\infty}(t)$ = 2* INTEGRAL RESPONSE

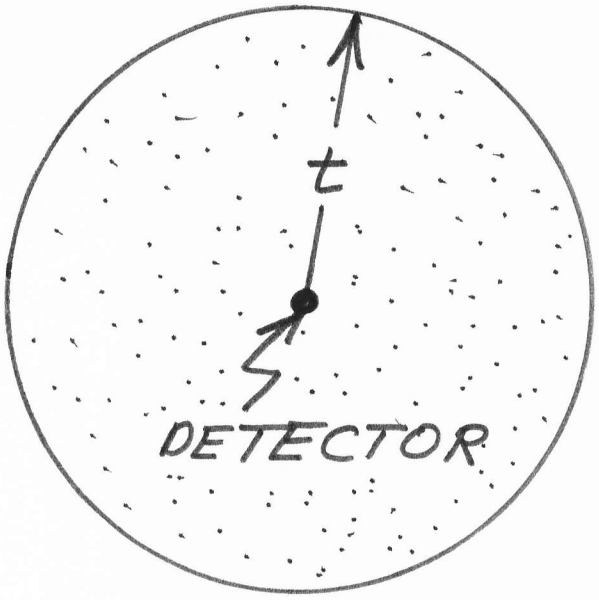
SINGLE SLAB



- PARTICLES INCIDENT FROM ONE SIDE

- $R\_(t) = 2 * \text{INTEGRAL RESPONSE}$

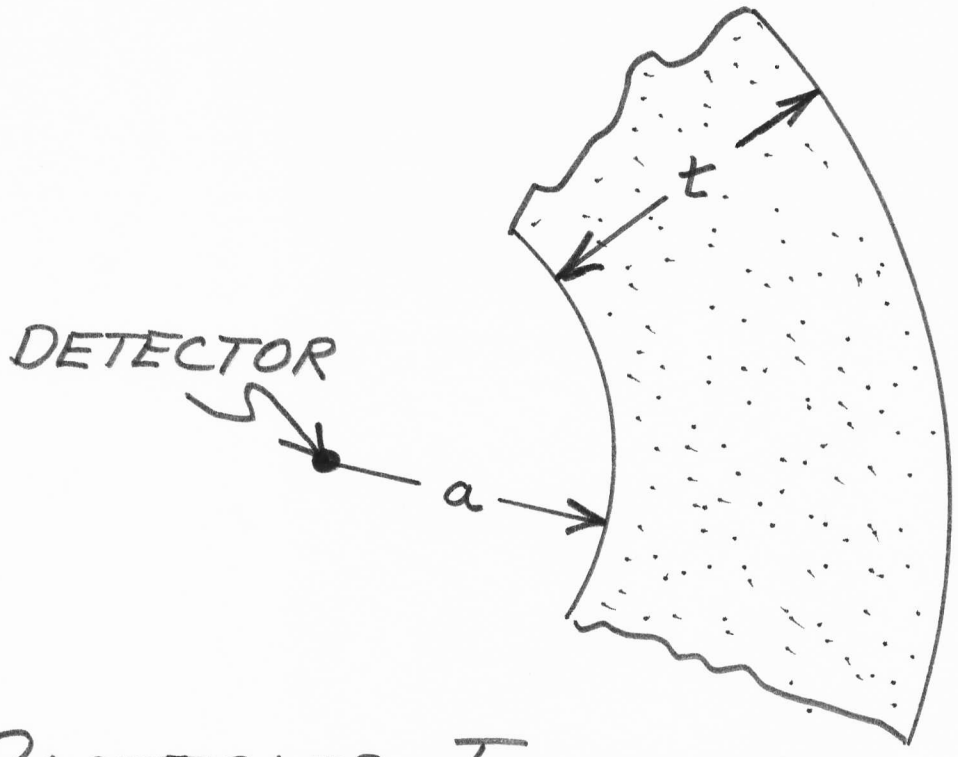
SOLID SPHERE SHIELD



- RADIATION INCIDENT OVER ENTIRE SURFACE

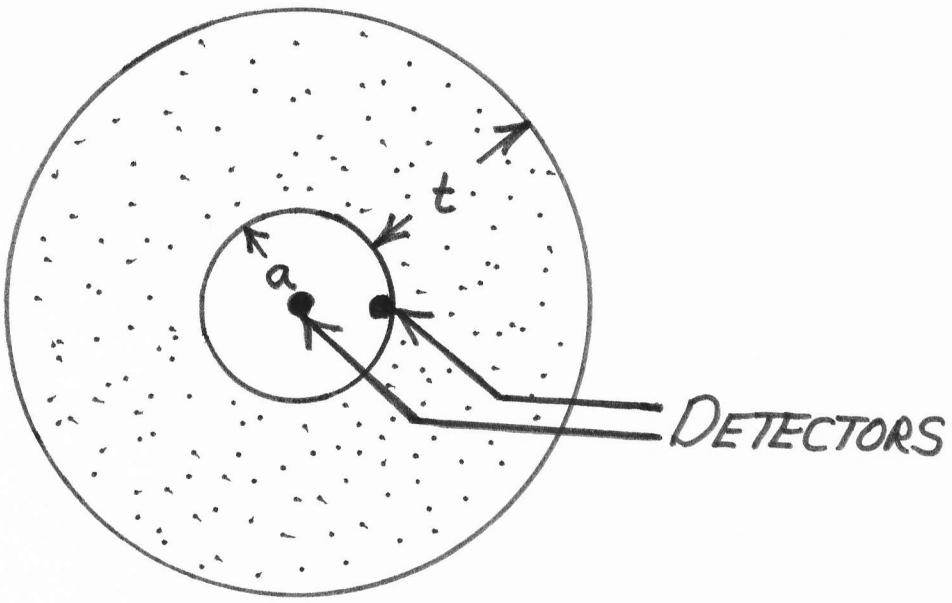
- $R_{\bullet}(t)$ = INTEGRAL RESPONSE

SHELL SPHERE CENTER

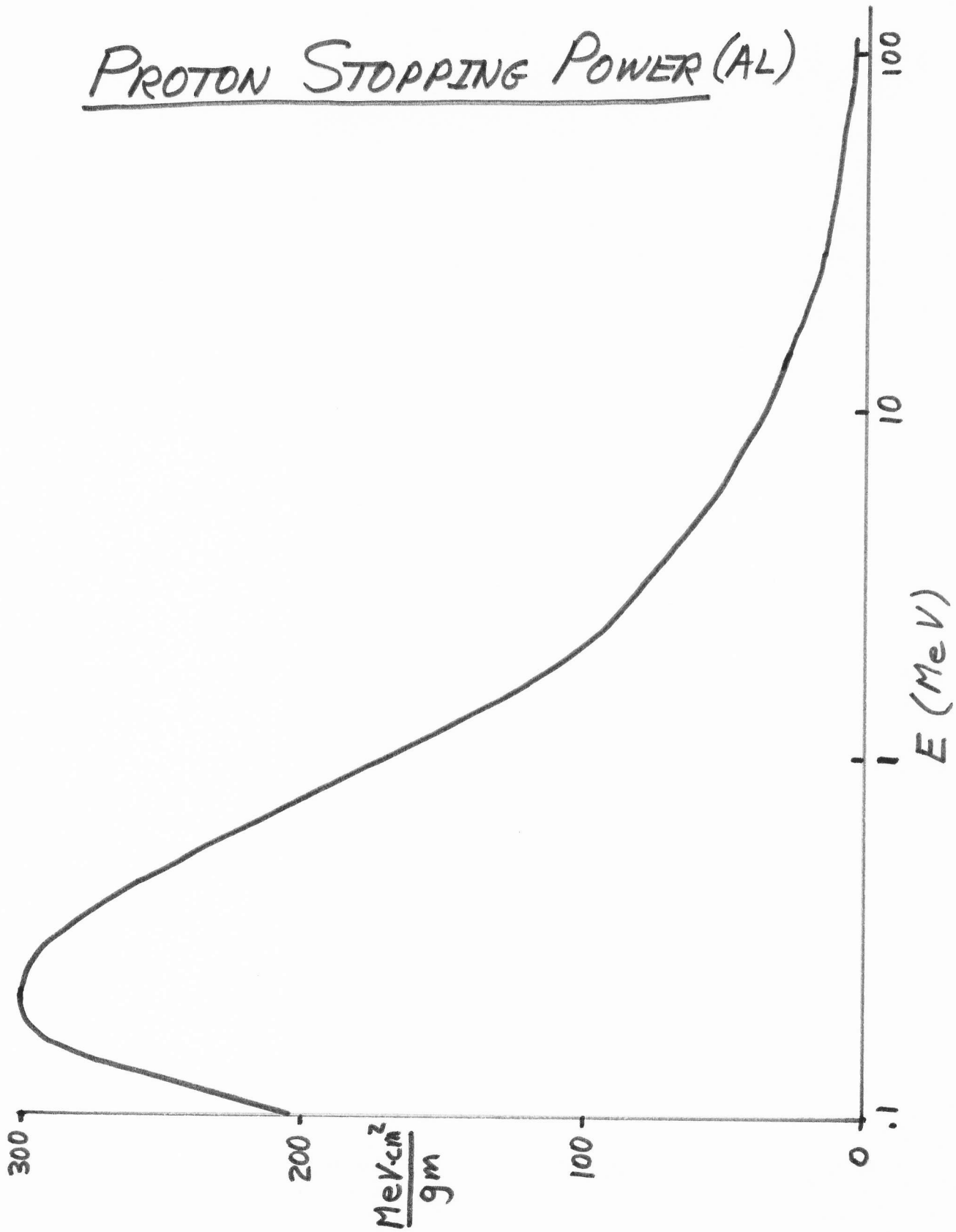


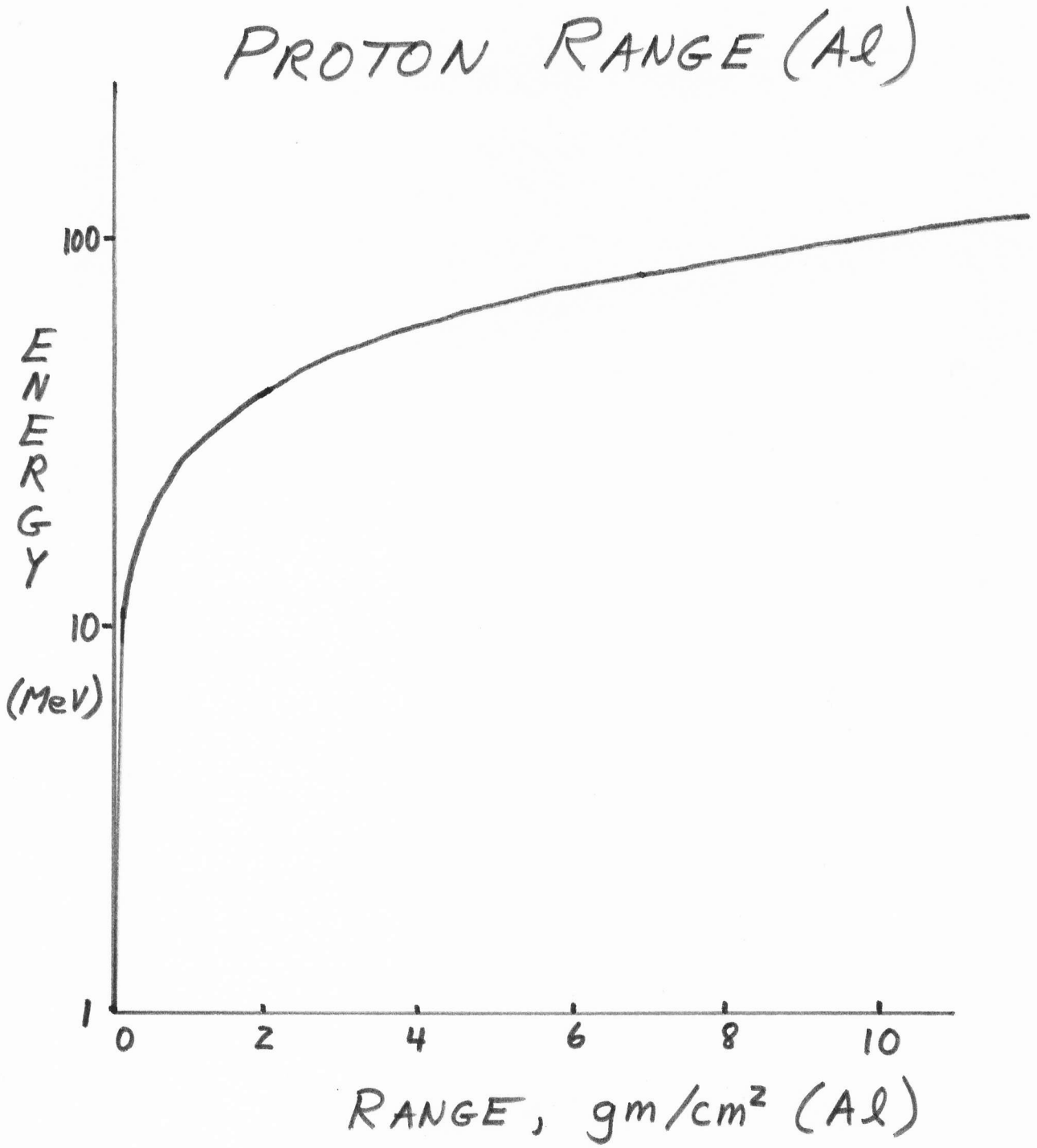
- PARTICLES INCIDENT OVER ENTIRE SURFACE
- RADIUS $a >> t$
- $R_o(t)$ = INTEGRAL RESPONSE

SHELL SPHERE GENERAL

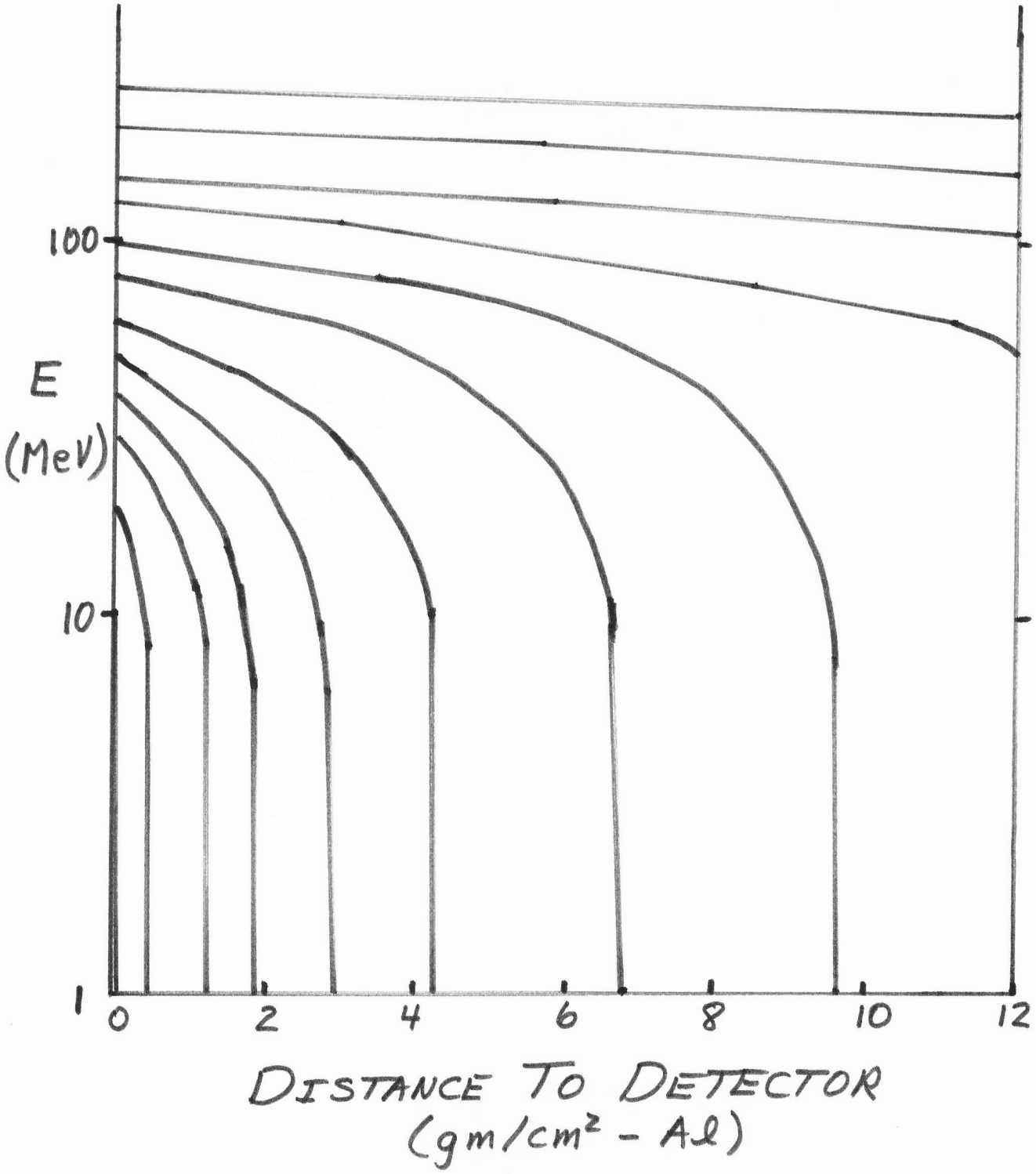


- PARTICLES INCIDENT OVER ENTIRE SURFACE
- $R_o(r, a, t)$ = INTEGRAL RESPONSE
- $0 \leq r \leq a$

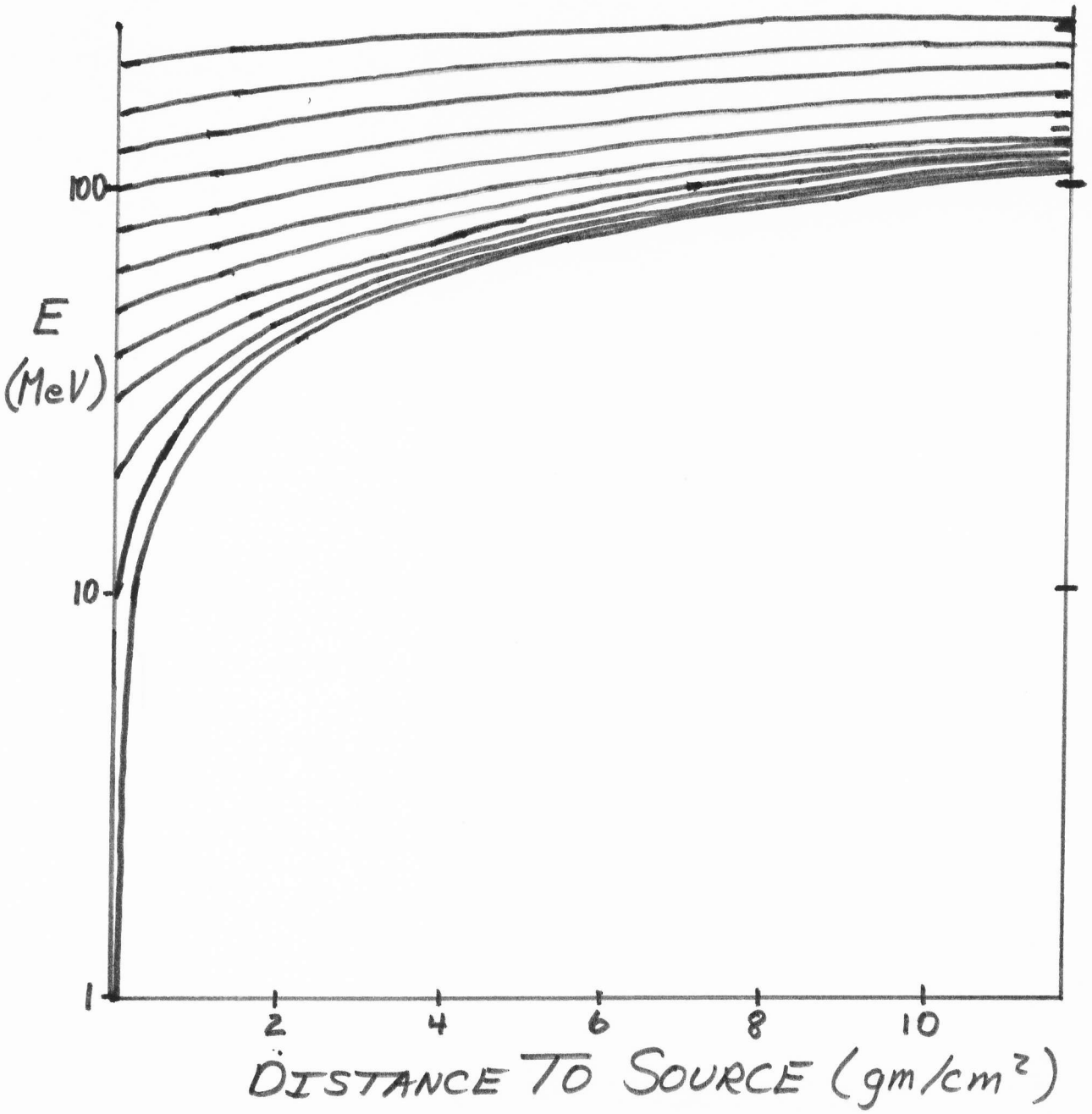

PROTON STOPPING POWER (AL)
300
200
100
0
MeV·cm²/gm
.1
1
10
100
E (MeV)

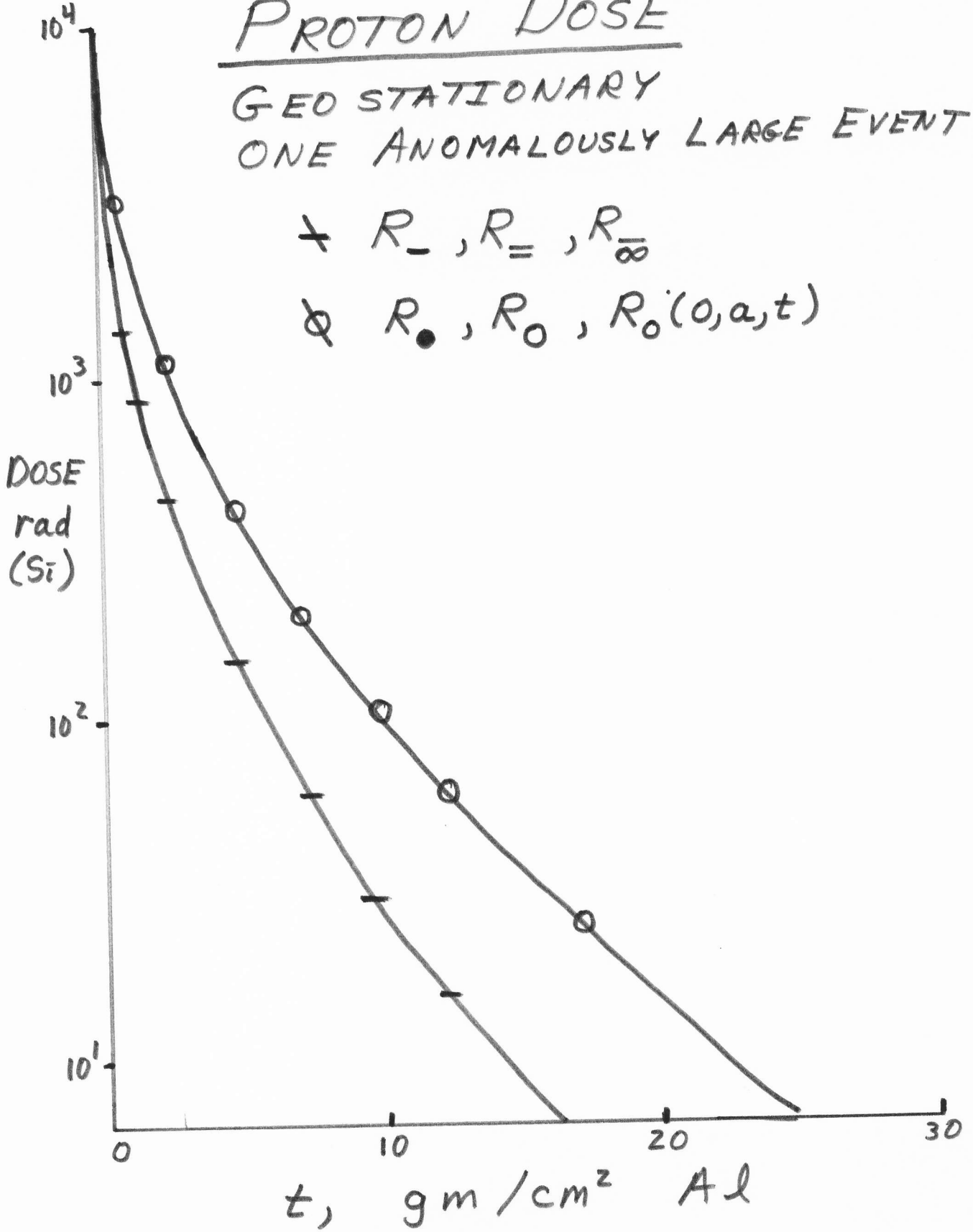

PROTON RANGE (Al)
100
10
1
ENERGY
(MeV)
0
2
4
6
8
10
RANGE, gm/cm² (Al)

FORWARD GROUP BROADENING

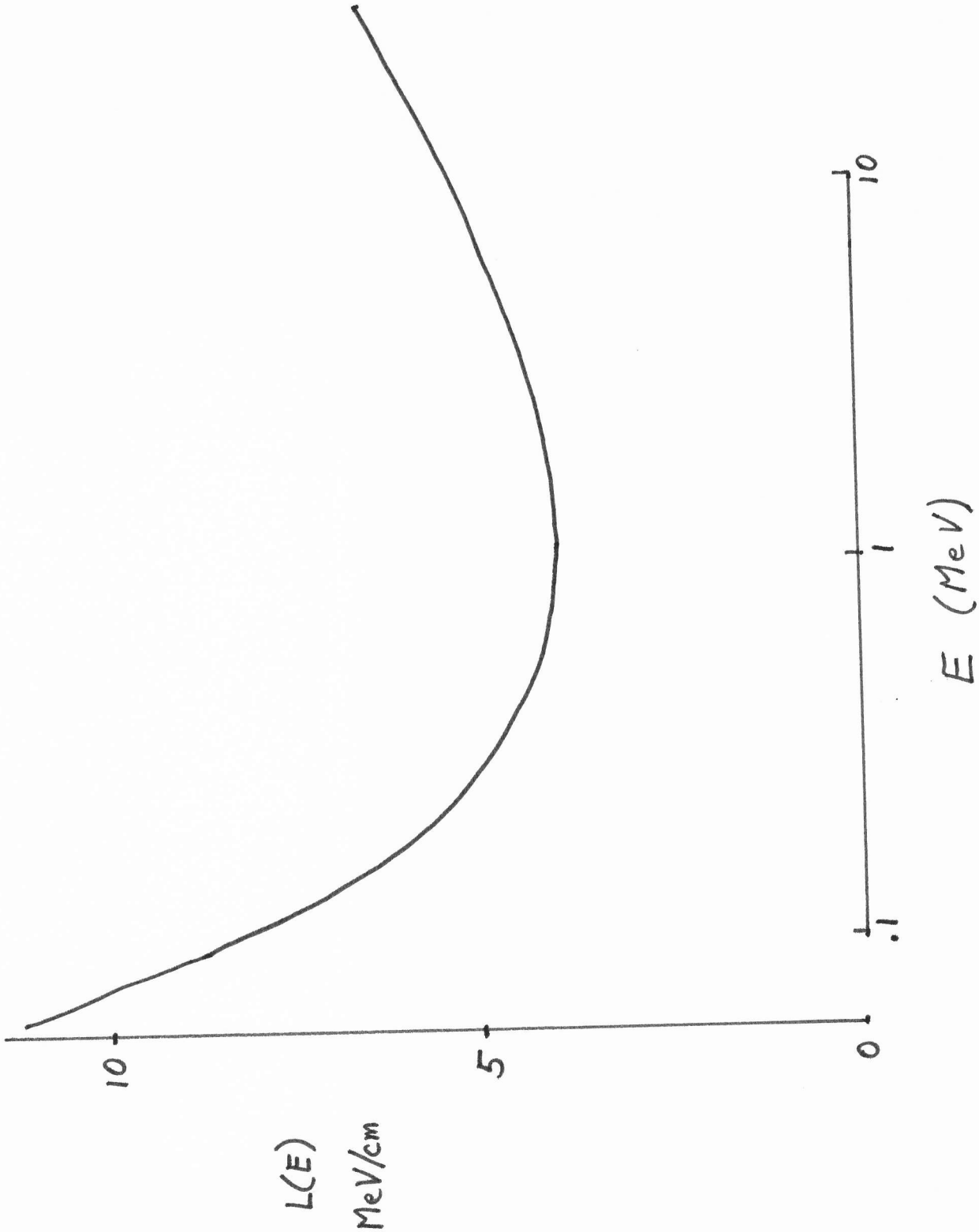


ADJOINT GROUP CONTRACTION

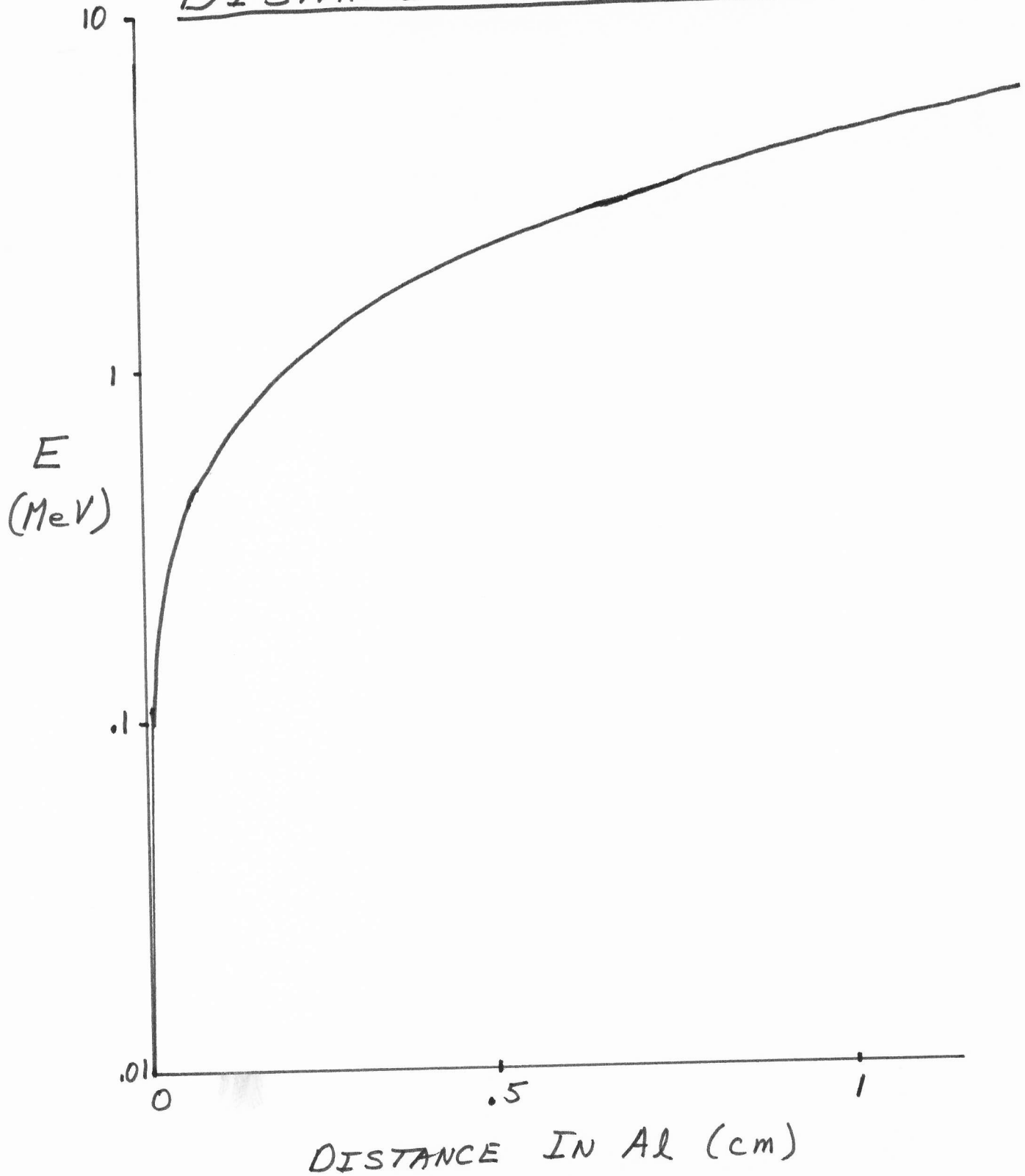



PROTON DOSE
GEO STATIONARY
ONE ANOMALOUSLY LARGE EVENT
+ R_- , $R_=$, $R_{\overline{\infty}}$
⊗ $R_\bullet$, R_0 , $R_0(0,a,t)$
10^4
10^3
10^2
10^1
DOSE
rad
(Si)
0
10
20
30
t, gm/cm² Al

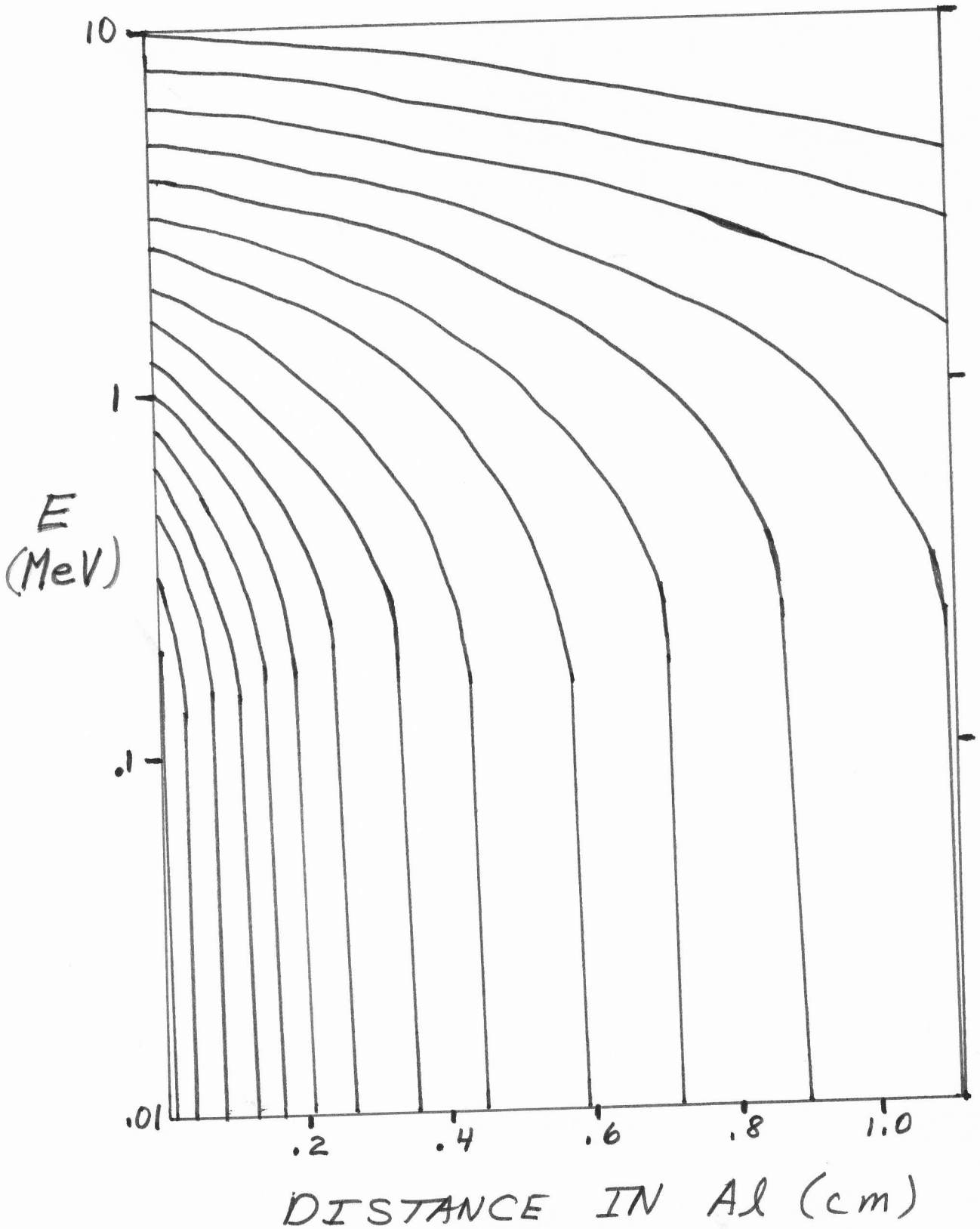
ELECTRON STOPPING, Al



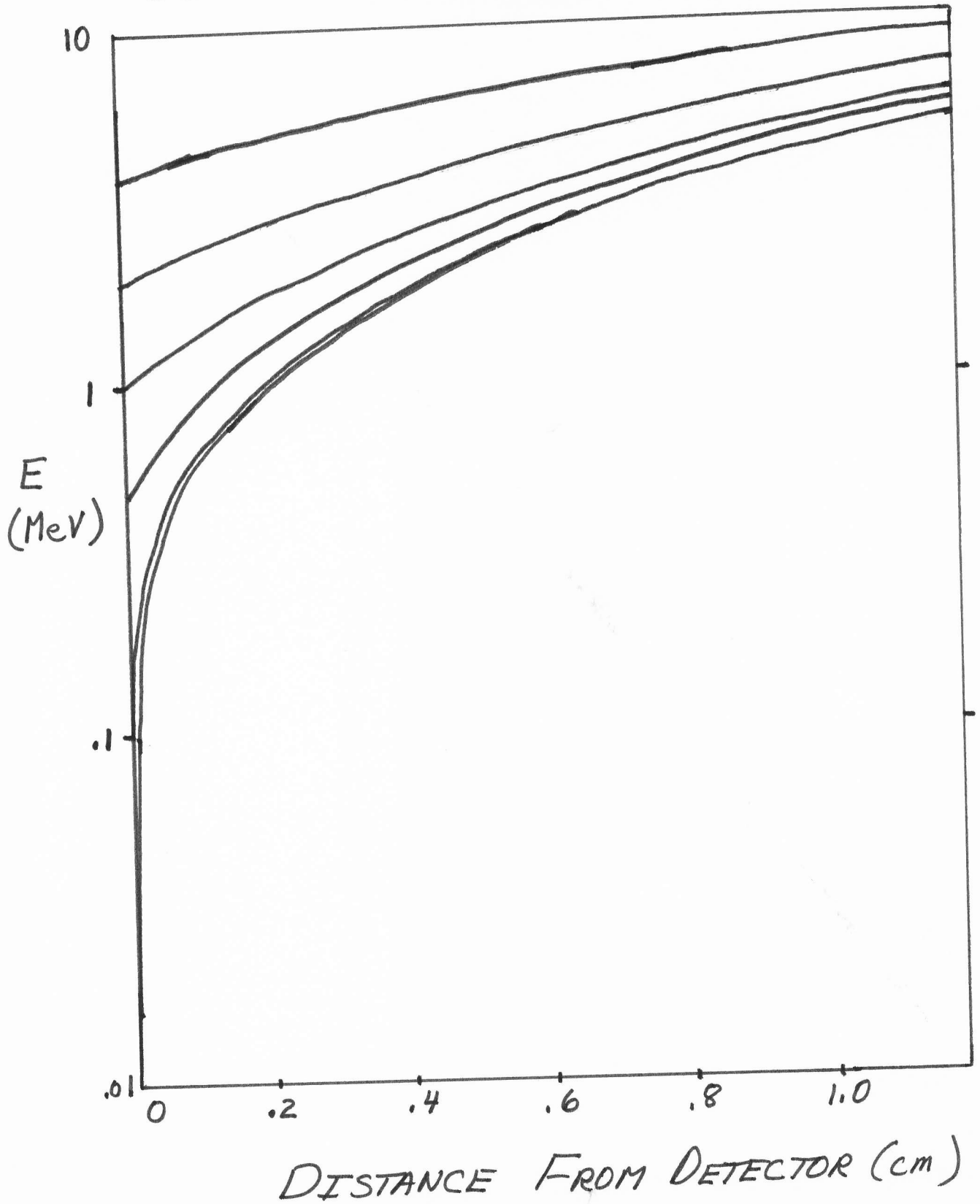
DISTANCE IN ALUMINUM



ELECTRON ENERGY DEGRADATION



ELECTRON ENERGY INCREASE



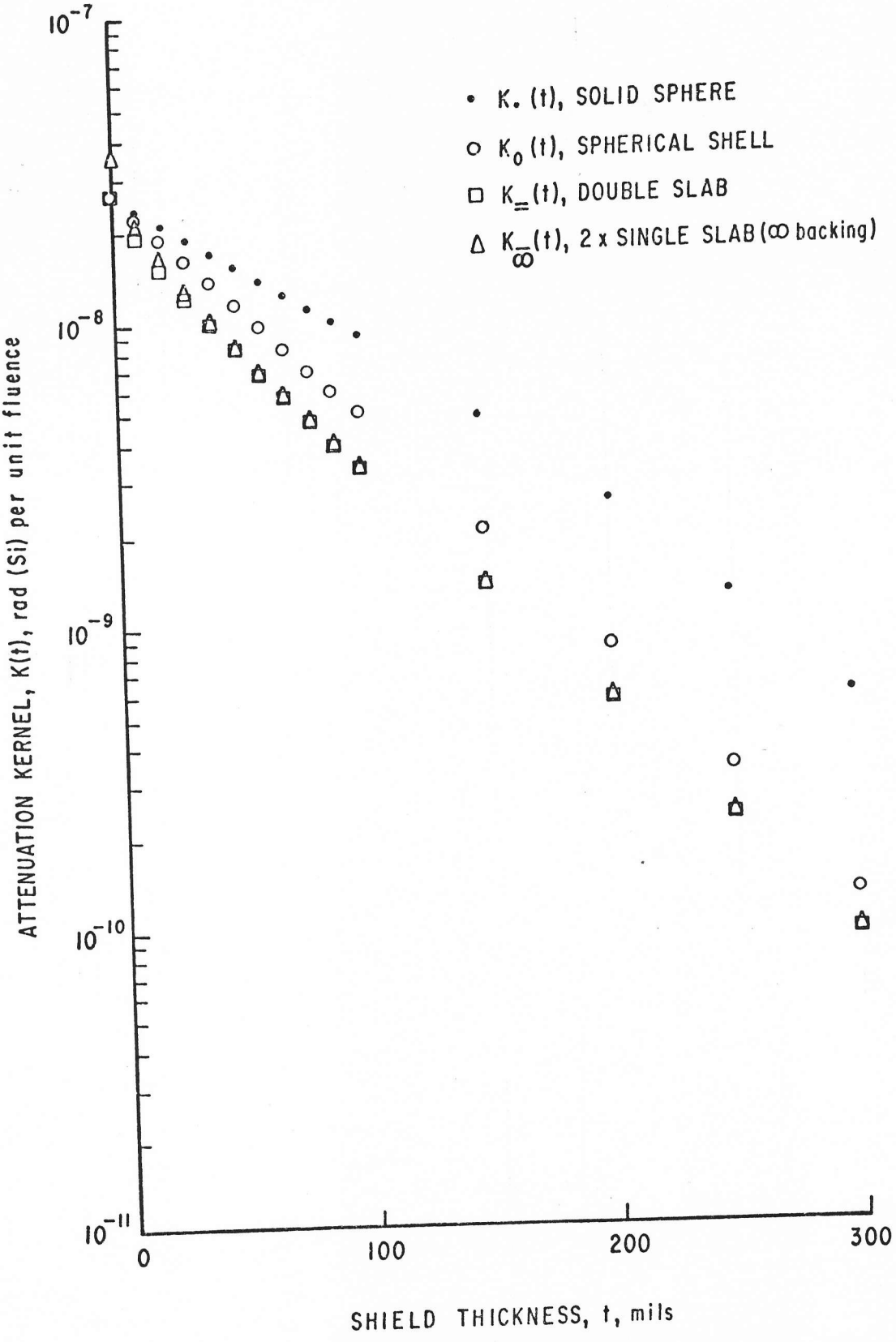


Figure 2. ALUMINUM DOSE ATTENUATION - GEOMETRY EFFECTS
Fission Electrons, Unit Free Space Fluence

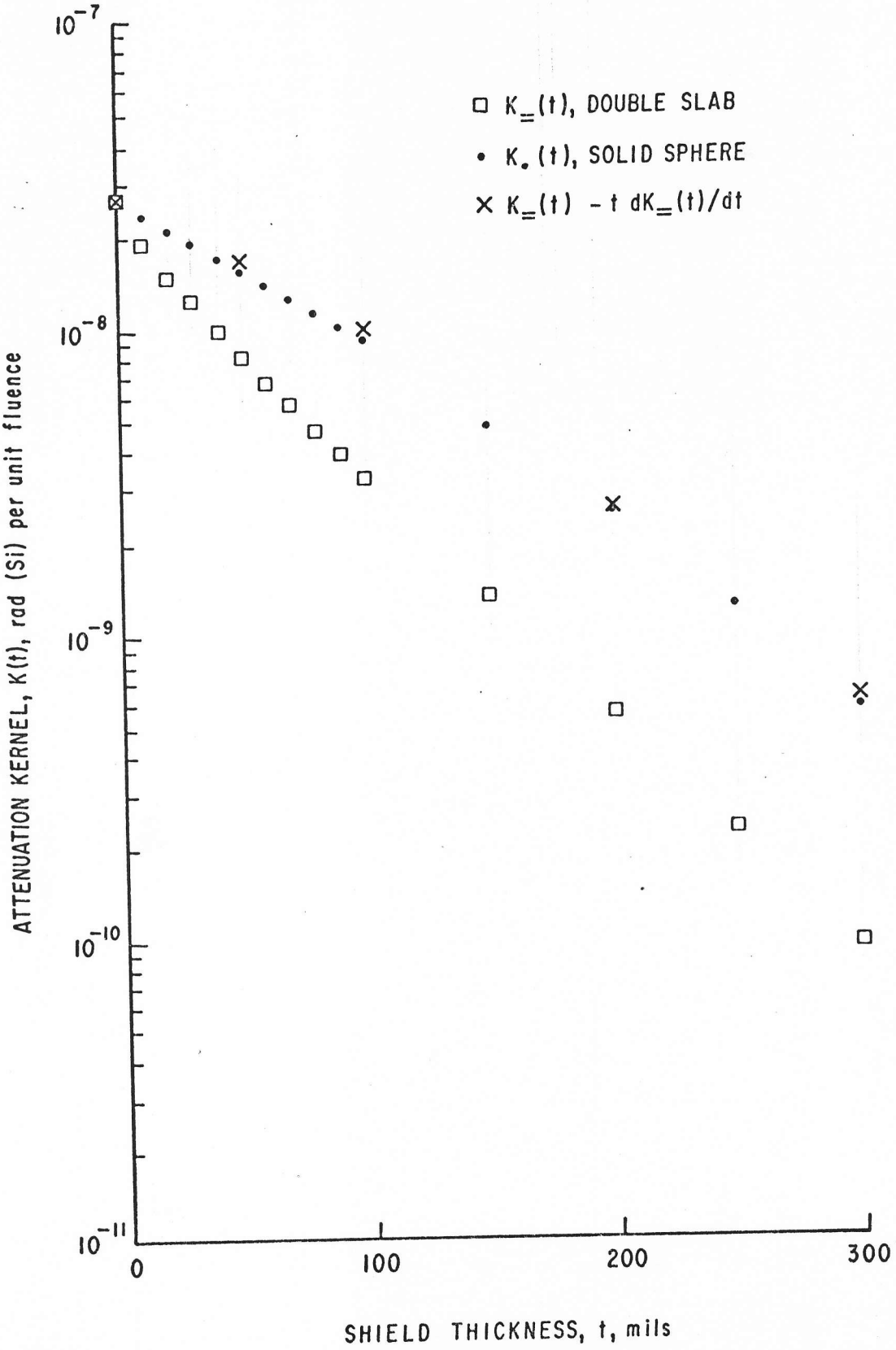
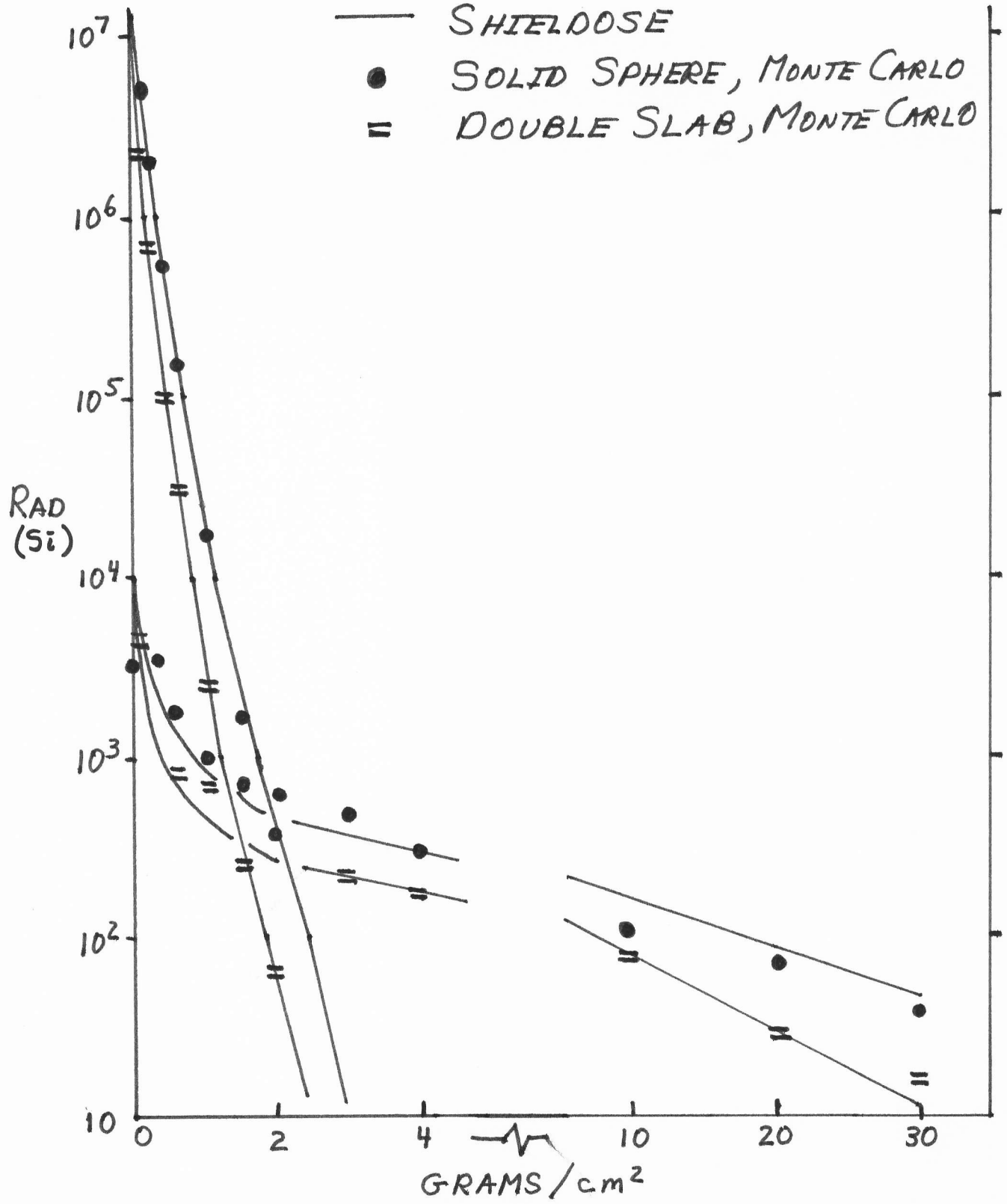
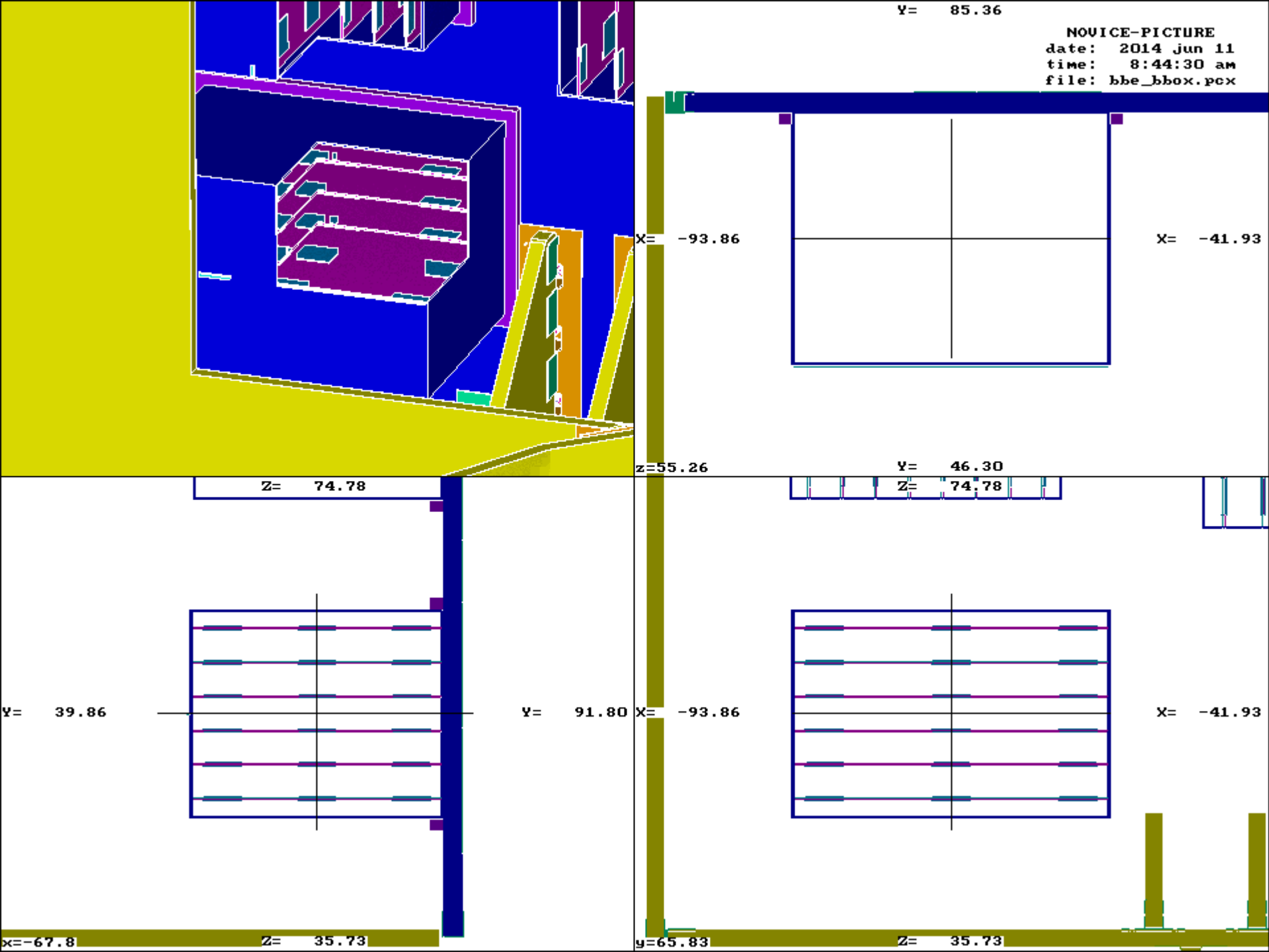
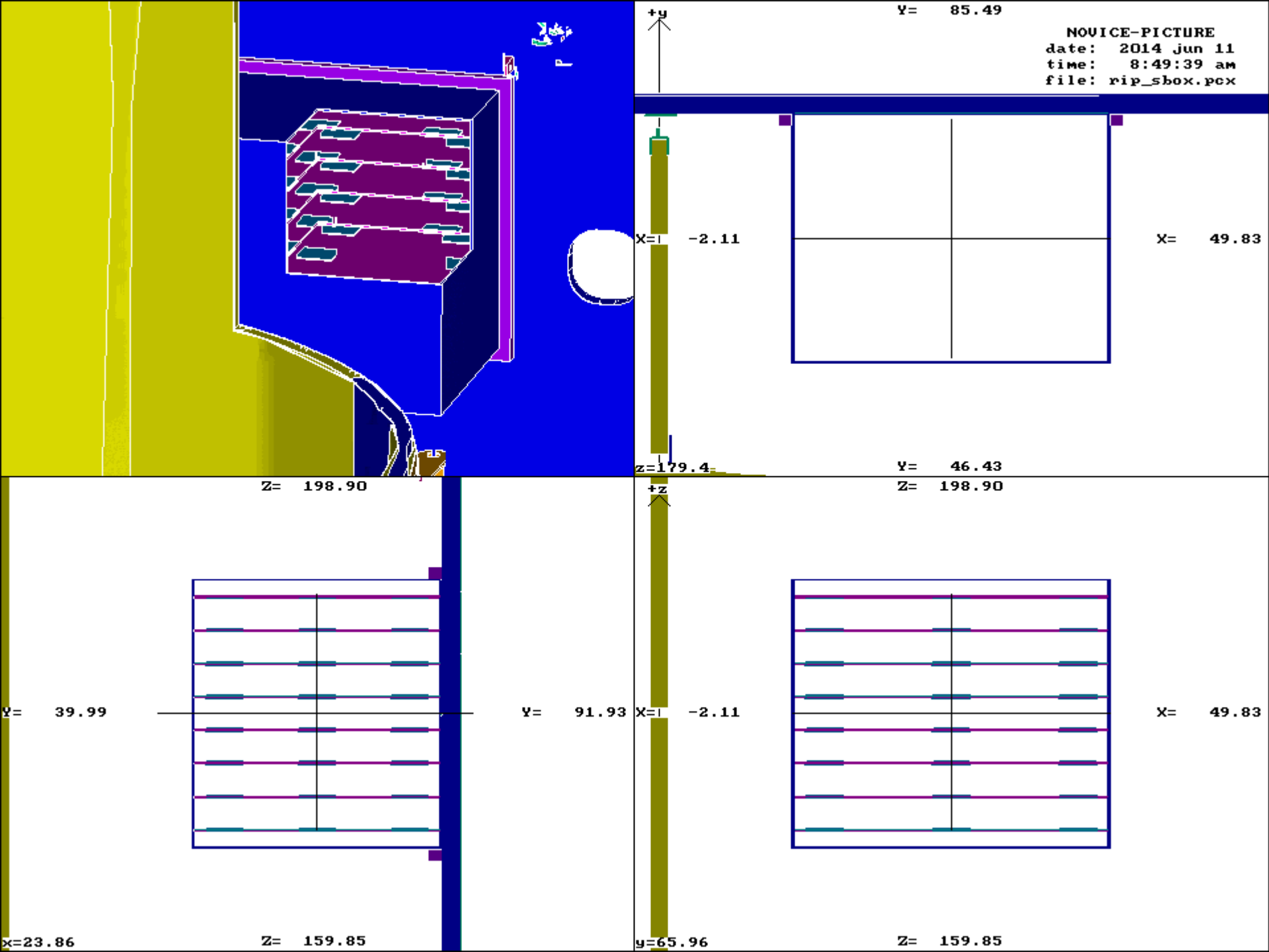


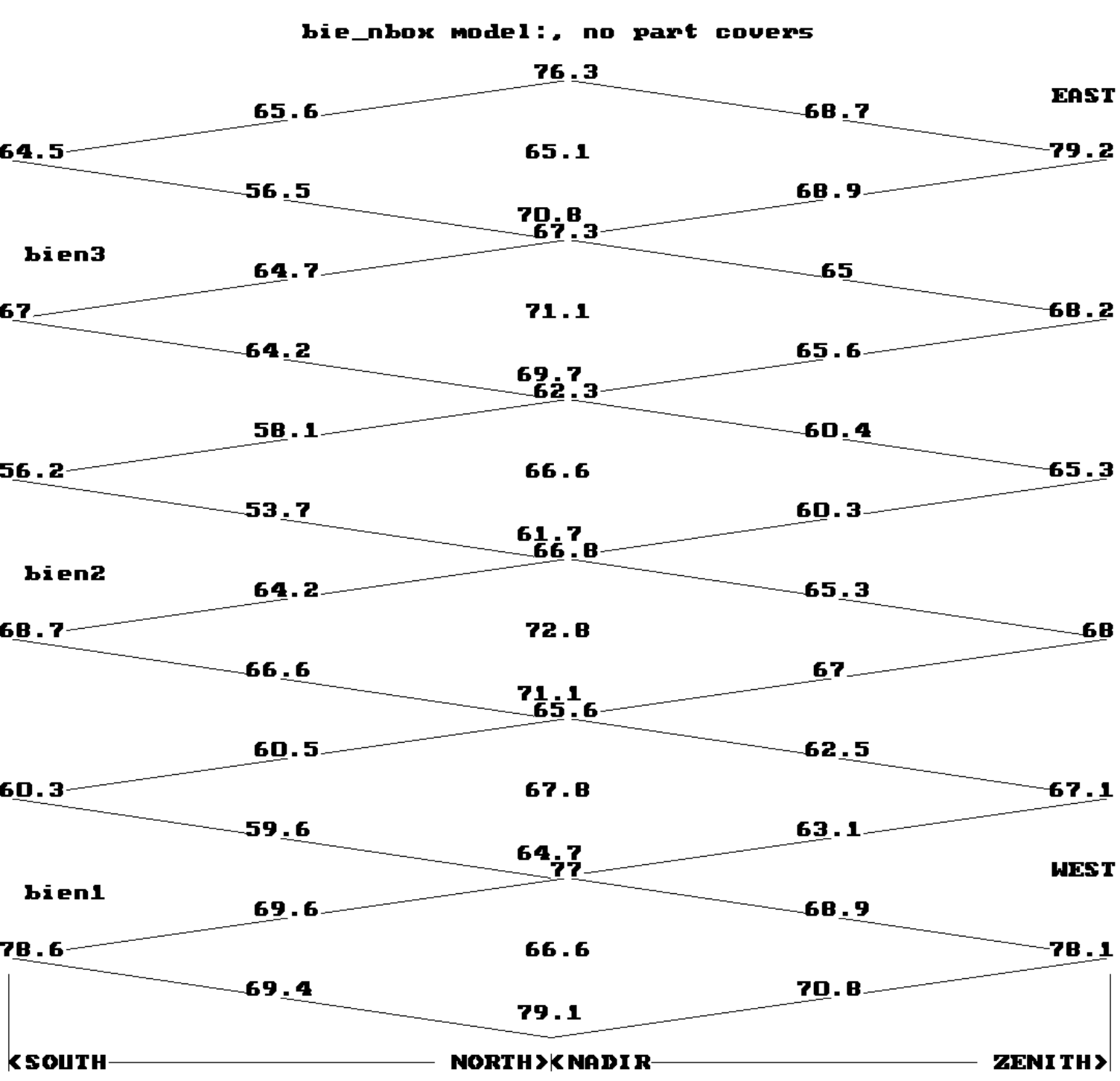
Figure 5. SOLID SPHERE KERNELS - FISSION ELECTRONS

ELECTRON / BREMSSTRAHLUNG DOSE




Y= 85.36
NOVICE-PICTURE
date: 2014 jun 11
time: 8:44:30 am
file: bbe_bbox.pcx
X= -93.86
X= -41.93
z=55.26
Y= 46.30
Z= 74.78
Z= 74.78
Y= 39.86
Y= 91.80
X= -93.86
X= -41.93
x=-67.8
Z= 35.73
y=65.83
Z= 35.73


Y= 85.49
+y
NOVICE-PICTURE
date: 2014 jun 11
time: 8:49:39 am
file: rip_sbox.pcx
X=| -2.11
X= 49.83
z=179.4
Y= 46.43
Z= 198.90
Z= 198.90
+z
Y= 39.99
Y= 91.93
X=| -2.11
X= 49.83
x=23.86
Z= 159.85
y=65.96
Z= 159.85



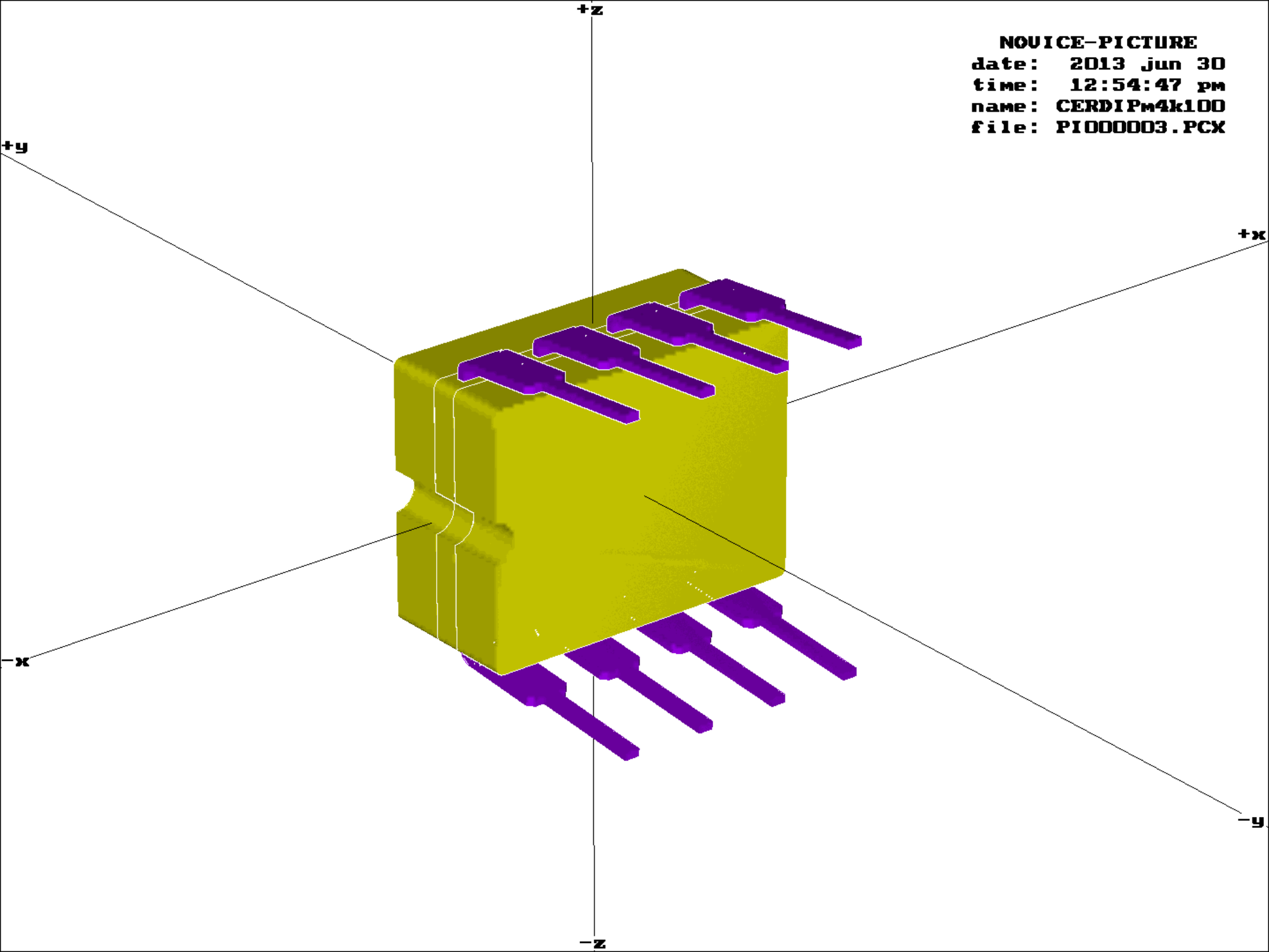
NOVICE-SIGMA
date: 2014 may 22
time: 9:13:53 pm
file: bie_n_000080

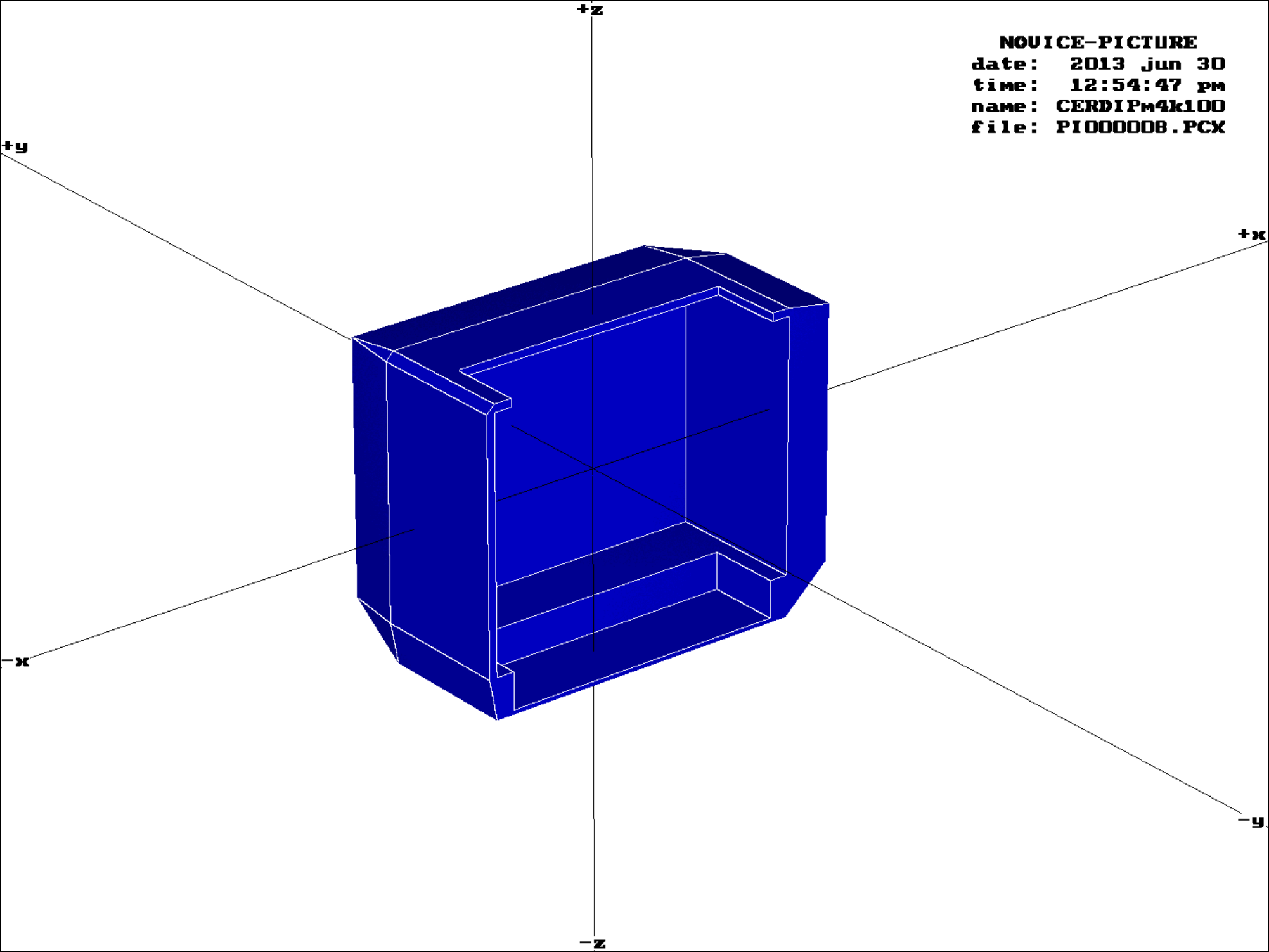
Total Dose Summary:
minimum: 5.37E+01
maximum: 7.92E+01
average: 6.67E+01
min/ave: 0.80
max/ave: 1.19

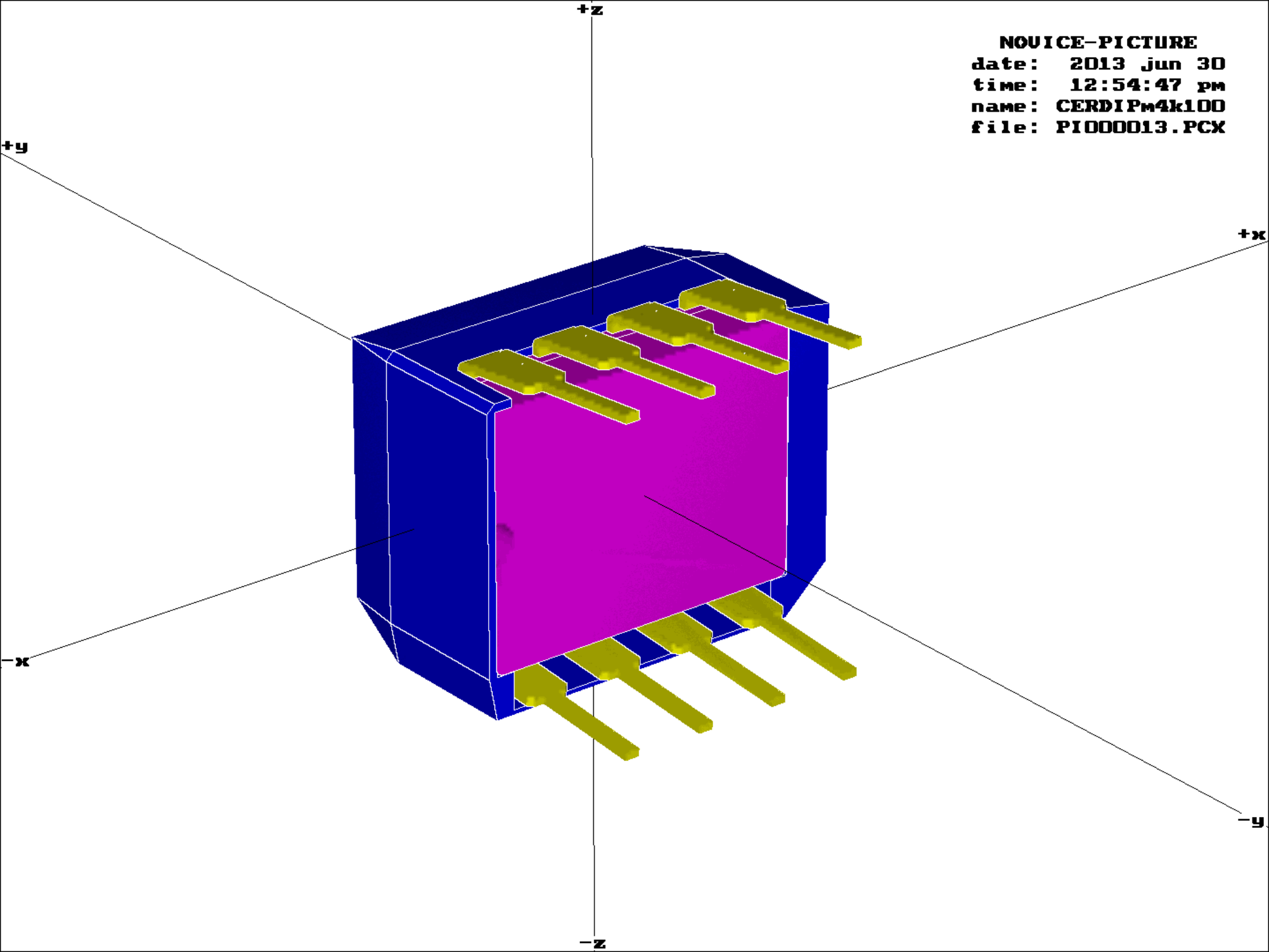
Box Information:
bie_nbox
Absolute
WEST EAST 5.500"
NORTH SOUTH 7.750"
ZENITHNADIR 7.939"
1059.0 g aluminum
WEST 80.00 mils
EAST 80.00 mils
NORTH 100.00 mils
SOUTH 100.00 mils
ZENITH 62.99 mils
NADIR 62.99 mils
932.7 g copper
WEST 25.49 mils
EAST 23.73 mils
NORTH 14.06 mils
SOUTH 13.62 mils
ZENITH 26.80 mils
NADIR 22.85 mils

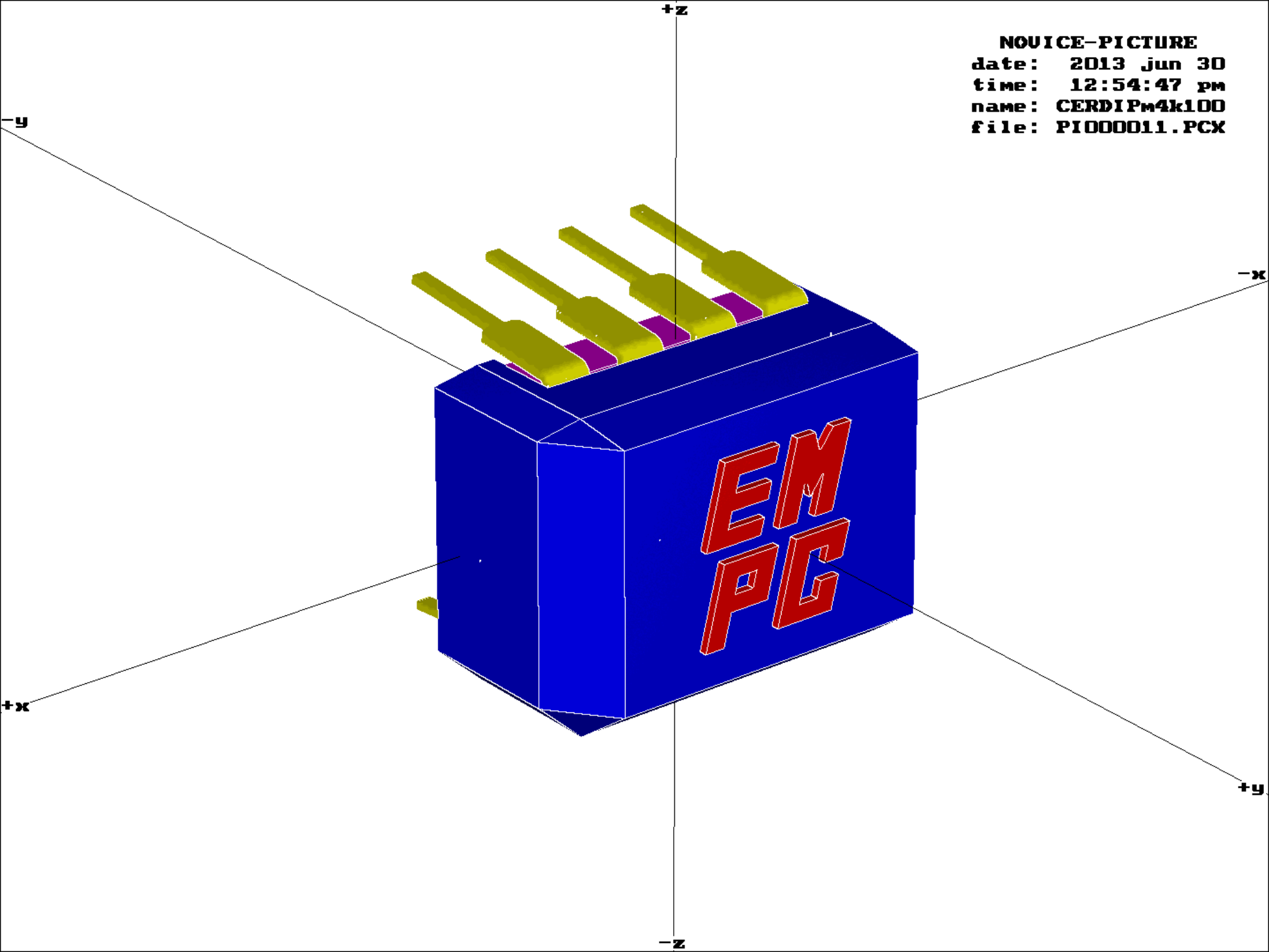
Boards, Top First:
bien3
bien2
bien1

BoxLocal => Global:
Box -U=WEST
Box +U=EAST
Box -V=NORTH
Box +V=SOUTH
Box -W=ZENITH
Box +W=NADIR


+z
+y
+x
-x
-y
-z
NOVICE-PICTURE
date: 2013 jun 30
time: 12:54:47 pm
name: CERDIPm4k100
file: PIOOOOO3.PCX


+z
+y
+x
-x
-y
-z
NOVICE-PICTURE
date: 2013 jun 30
time: 12:54:47 pm
name: CERDIPm4k100
file: PIOOOOO8.PCX


+z
+y
+x
-x
-y
-z
NOVICE-PICTURE
date: 2013 jun 30
time: 12:54:47 pm
name: CERDIPm4k100
file: PIOOOO13.PCX


+z
-y
-x
+x
+y
-z
NOVICE-PICTURE
date: 2013 jun 30
time: 12:54:47 pm
name: CERDIPm4k100
file: PIOOOO11.PCX
EM
PG