

# CG体系を用いた EGS5入力ファイル作成入門

2022-8-1 IWASE

# 元となるファイル

以下の三つが必要

- simple.f
- simple.inp
- simple.data
  
- (+ egs5フォルダ一式)

# フォルダ構成

## おさらい

- egs5/

VERSION      auxcommons/    cgview-307/    docs/      egs5run\*  
extra\_ucodes/    pegs/      run5again\*    slac730.pdf    uccg-210721/  
auxcode/      calc/      data/      egs/      include/  
pegscommons/    samplecodes/    tutorcodes/

- egs5/calc/

egs5run\*      simple/

- egs5/calc/simple

simple.f      simple.inp      simple.data

# simple.f

CG体系を用いた最小構成プログラム

- 1つの主プログラムと2つの副プログラム（サブルーチン）
- program simple
- subroutine ausgab
- subroutine howfar

# simple.fのダウンロード



The screenshot shows a web browser window displaying the EGS Workshop website. The page is titled "EGS 研究会 EGS workshop" and includes a navigation menu with links for "新着情報", "研究会の概要", "参加手続き", "インストール", "講習会資料", "プロシーディング", and "リンク". The main content is divided into two sections: "EGS5インストール" and "講習会資料".

**EGS5インストール**

講習会前にインストールをお願いします。

1. FortranコンパイラとEGS5
  1. 動作環境の選択 (TXT)
  2. EGS5のWindowsへのインストール (PDF)
  3. EGS5のLinuxへのインストール (Headme, PPT, PDF, egs5run).
  4. EGS5のMacへのインストール (PDF)
2. egs5プログラムとマニュアル in English (リンク)
3. コマンドプロンプト用egs5run.bat | \*.batをダウンロードできない場合には、\*.txtをダウンロードし、\*.batと名前を変更してください。
  1. Windows Vista, Windows 7以降用 (egs5run.bat, egs5run.txt)
  2. Windows Vista, Windows 7以降用: 入力によるDebug modeへの切り替え可能なもの (egs5run\_db.bat, egs5run\_db.txt)
4. KEKサンプルユーザーコード(21JUL2021版): ucsource, ucnaicgv, uconantomegvとucionch\_cgv (uccg.zip)
5. KEKサンプルユーザーコード2(入門): ucshieldとucbend (isord5.zip)
6. Cgview のプログラム [English Manual included] (Link)

**講習会資料**

講習会の前にダウンロードし、必要に応じて印刷しご準備下さい。

- 講習会当日の資料
  1. モンテカルロ法による粒子輸送計算 (PDF, PDF [English], PPT, 📄)
  2. EGS5の概要 (PDF, PPT, 📄)
  3. 光子のMC計算 (PDF, 📄)
  4. 電子のMC計算 (PDF, 📄)
  5. 入門ユーザーコード | 概要 (PDF, PPT, PDF2, 📄), 導入 (PDF, PPT, 📄) | 練習問題 (PDF, PPT)
  6. 線源 (PDF, PDF, PPT, 📄)
  7. PEGS5 (PDF, PPT, PDF, 📄)
  8. 実用ユーザーコード | PDF, PPT, 📄
    1. Not検出器 (PDF, PDF, PPT, 📄)
    2. フォントム (PDF, PDF, PPT)
    3. 電磁気 (PDF)
    4. simple CG (simple.f)
    5. 相対論的粒子
  9. CGとCG/EW (PDF, PDF [1, 2], PPT [1, 2], 📄)

上記講習会資料の一括ダウンロード
- 参考資料
  1. テキストエディタについて (TXT)
  2. Fortranコンパイラ 関連

# simple.fの内容確認

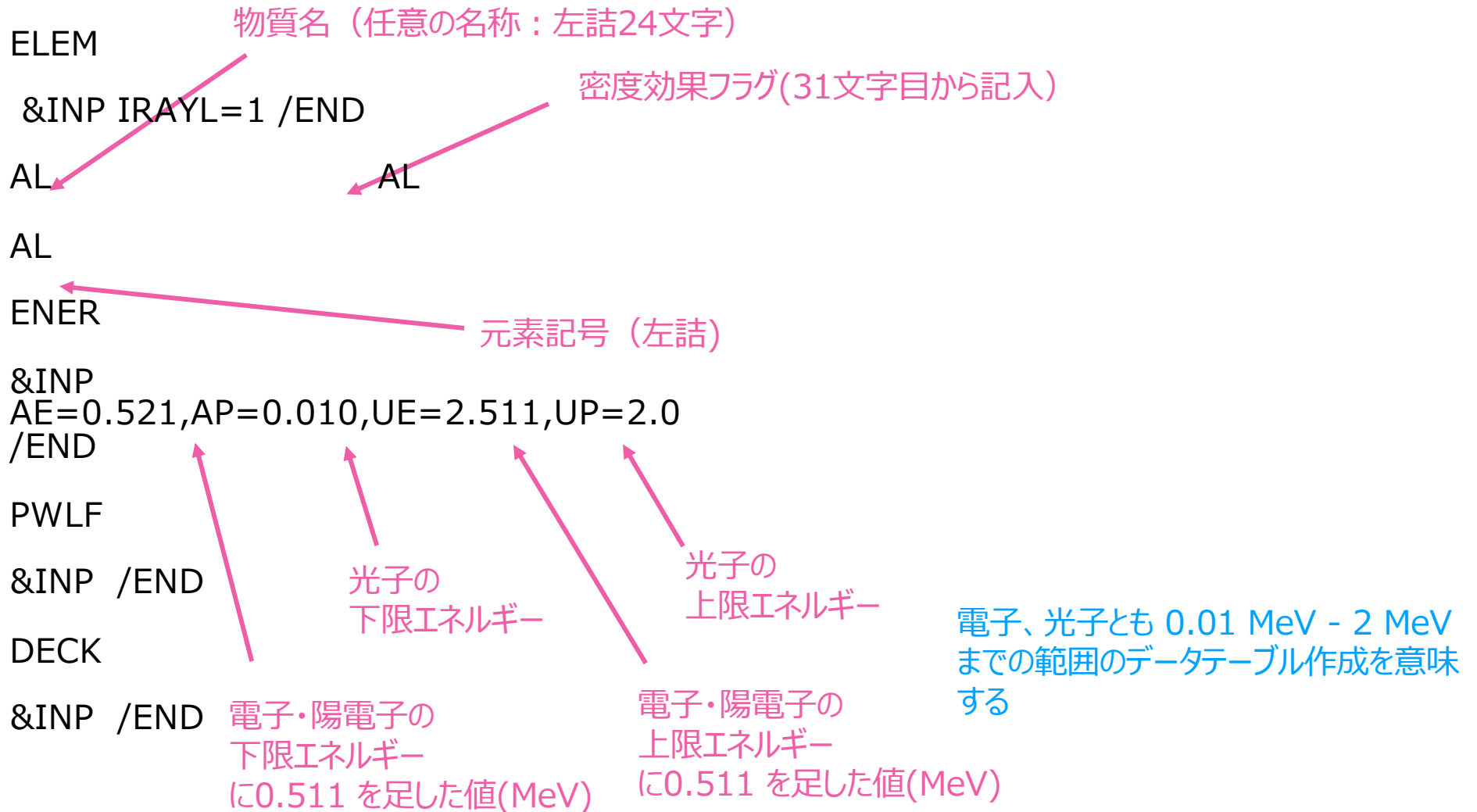
- $nmed = 1$  ! number of medium 物質数
- $medarr(1) = 'AL$  ' ! 物質名を任意で入力 (24文字)  
物質番号1はALという名称の物質 (simple.inpで定義される)
- $chard(1) = 7.62$  ! 物質1のcharacteristic dimension
- $call\ pegs5$  ! simple.inpを元に物質毎のテーブルを作成
- $iphter(i) = 0 \dots$  ! EGSオプション
- $iqin = 0 \dots$  ! 線源入力

# simple.fの内容確認その2

- `ncases = 1000`      ! 計算回数 (線源発生回数)
- `maxpict = 50`      ! CGVIEWプロット線源数
- `call shower`      ! EGSメインルーチンのcall

# simple.inpの作成

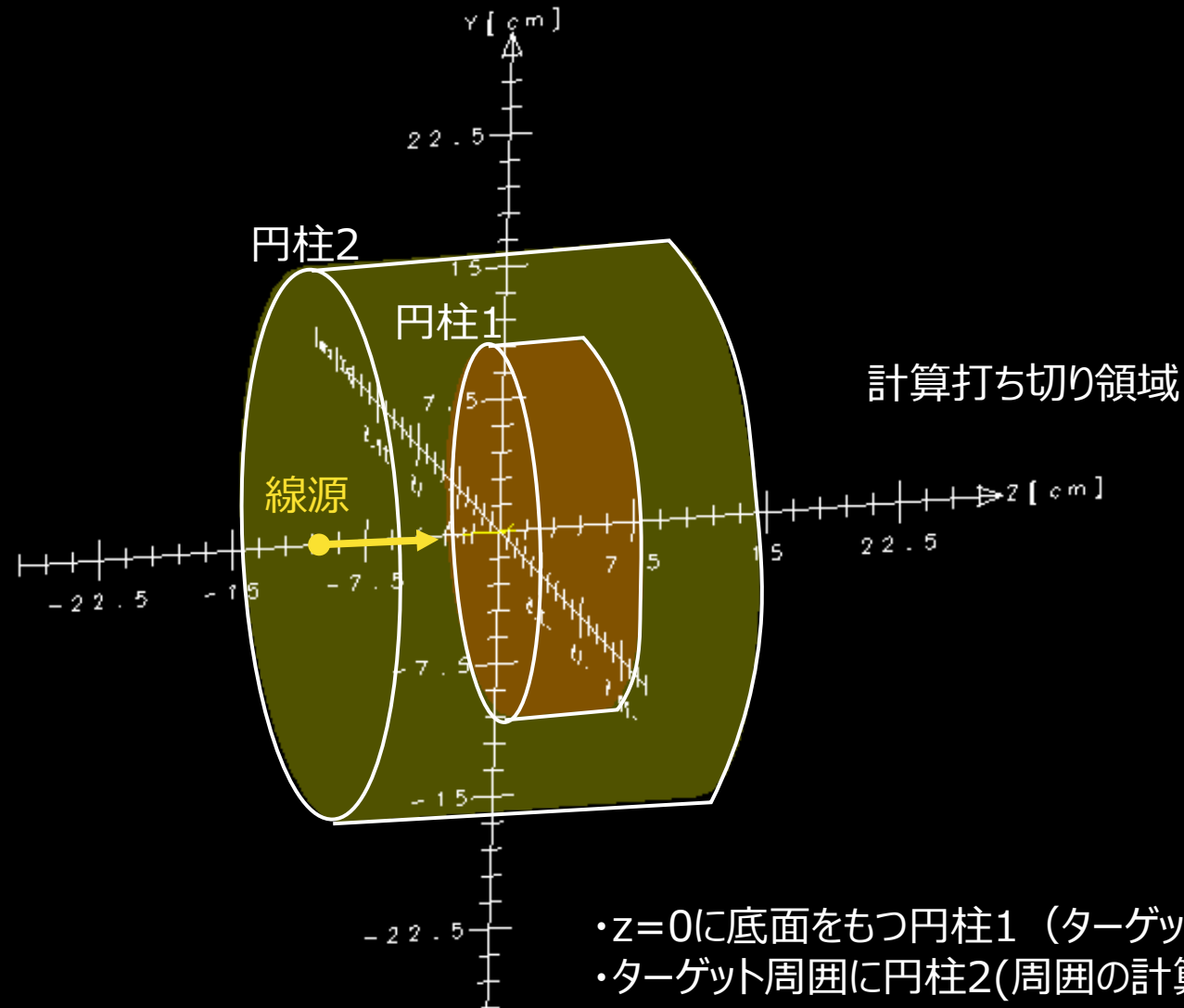
物質情報と、物質ごとの粒子輸送のパラメータの設定





# CG体系の作成

(simple.dataの作成)



- $z=0$ に底面をもつ円柱1 (ターゲット)
- ターゲット周囲に円柱2(周囲の計算領域)
- 線源は円柱2の範囲内に置く (simple.f)
- 円柱2の外側は計算打ち切り領域

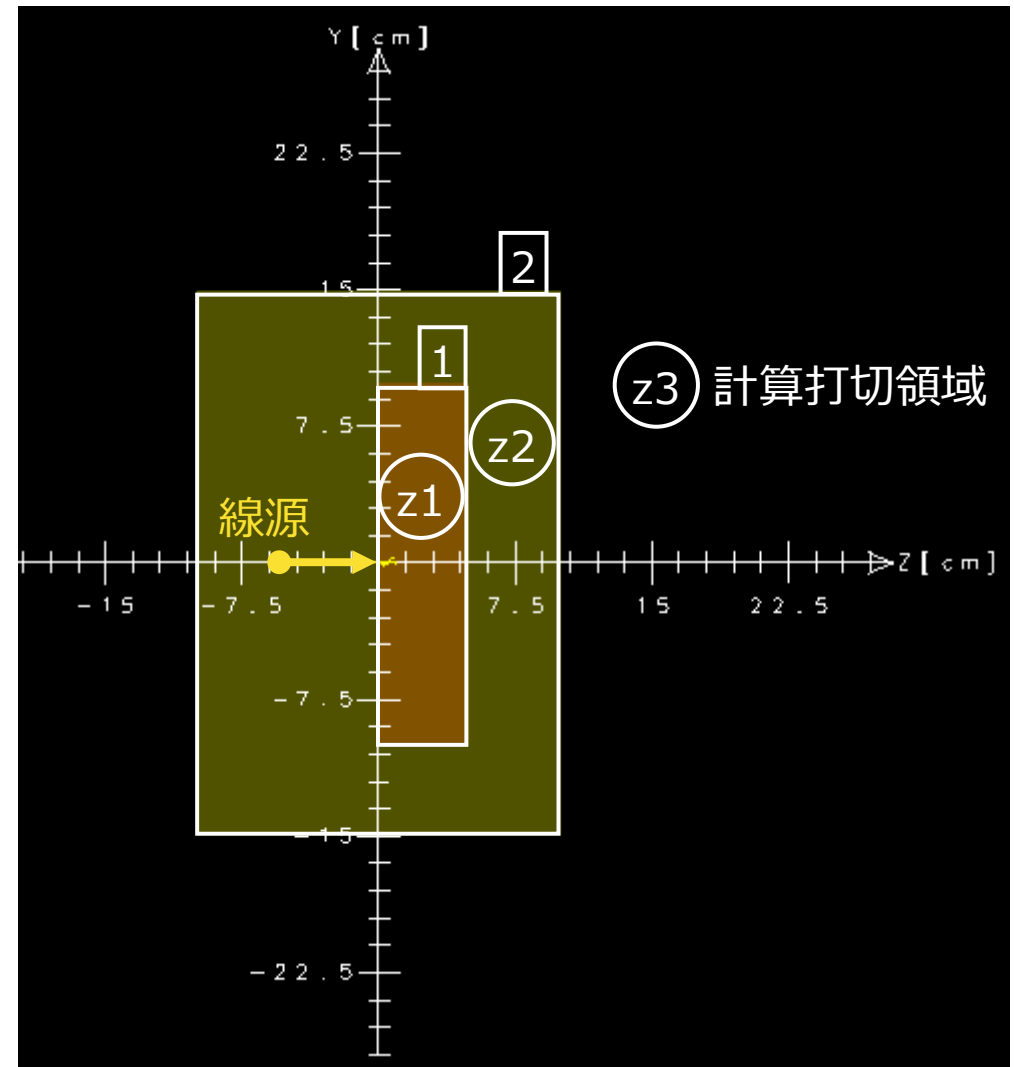
# simple.dataの作成

```
RCC 1 0 0 0 0 0 5 10
円筒1 底面z=0 5cm高 10cm半径
RCC 2 0 0 -10 0 0 20 15
円筒2 底面z=-10 20cm高 15cm半径
END
```

```
Z1 +1
Z2 +2 -1
Z3 -2
END
```

1 0 0  
↑ ↑ ↑  
z1, z2, z3の  
物質番号  
0は真空

一番最後の領域は  
自動的に計算打ち切り領域に  
設定される



# egs5runで実行

## ( ifortの場合)

```
-----  
Compiling (with -save -zero -L/Library/Developer/CommandLineTools/SDKs/MacOSX.sdk/usr/lib and O)
```

```
-----  
egs5job.f(6499): remark #8291: Recommended relationship between field width 'W' and the number of fractional digits 'D' in this edit descriptor is 'W>=D+7'.  
102  FORMAT(I6,' NEGATIVE USTEP=',E12.6,' IR,IRNEW,IROLD=',
```

```
-----^  
egs5job.f(22363): remark #8291: Recommended relationship between field width 'W' and the number of fractional digits 'D' in this edit descriptor is 'W>=D+7'.  
1510  format(2G10.5)
```

```
-----^  
egs5job.f(22355): remark #8291: Recommended relationship between field width 'W' and the number of fractional digits 'D' in this edit descriptor is 'W>=D+7'.  
1480  format(2G10.5)
```

```
-----^  
egs5job.f(24575): remark #8291: Recommended relationship between field width 'W' and the number of fractional digits 'D' in this edit descriptor is 'W>=D+7'.  
      write(31,'((1H ,7(1PE9.3,A)))' (ELECNI(I),' ',I=1,MXRAW)
```

```
-----^  
egs5job.f(24580): remark #8291: Recommended relationship between field width 'W' and the number of fractional digits 'D' in this edit descriptor is 'W>=D+7'.  
      write(31,'((1H ,5(1PE11.5,A)))' (CAPIN(I),' ',I=1,MXRAW)
```

```
-----^  
egs5job.f(24583): remark #8291: Recommended relationship between field width 'W' and the number of fractional digits 'D' in this edit descriptor is 'W>=D+7'.  
      write(31,'((1H ,7(1PE9.3,A)))' (SCPROF(j,i),' ',j=1,31)
```

```
-----  
Does this user code read from the terminal?  
(Enter 1 for yes, anything else for no)
```

```
-----  
1
```

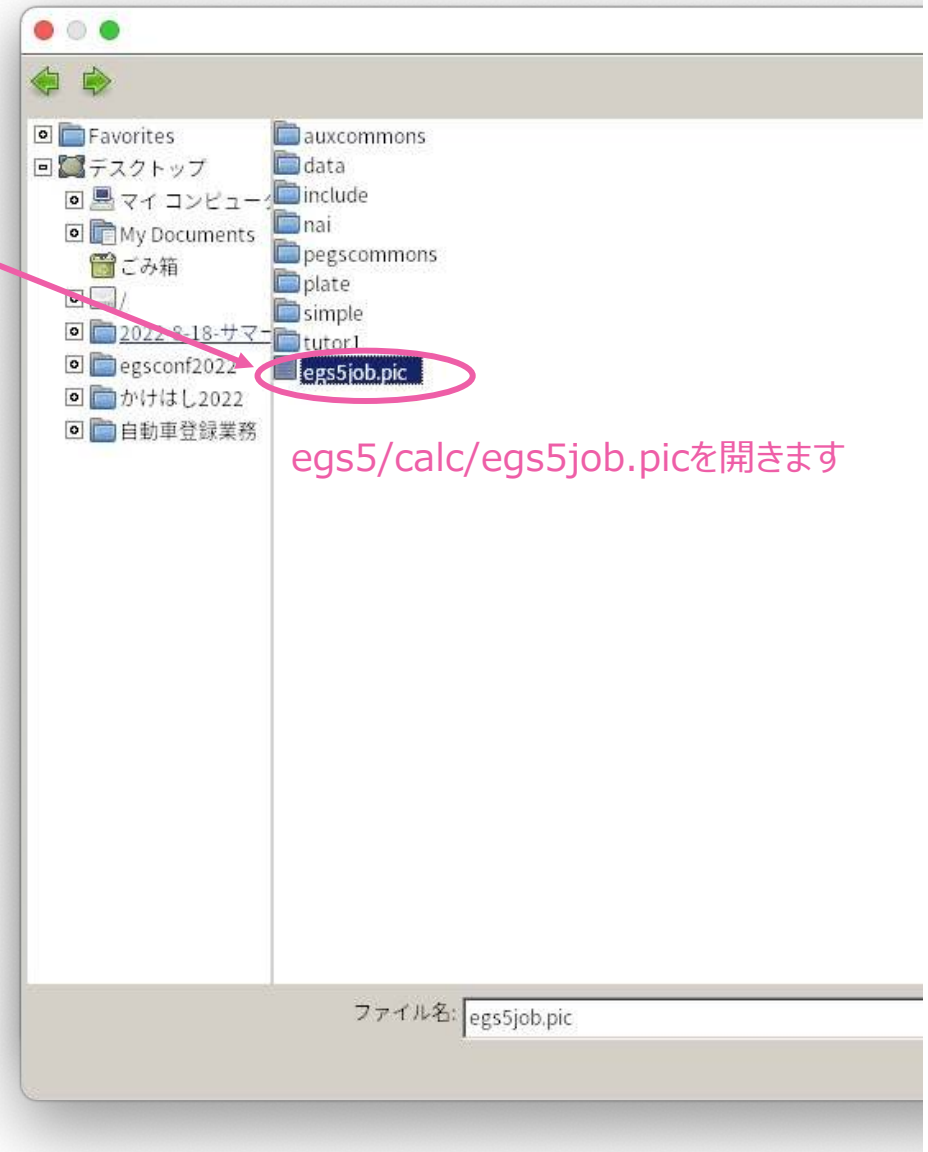
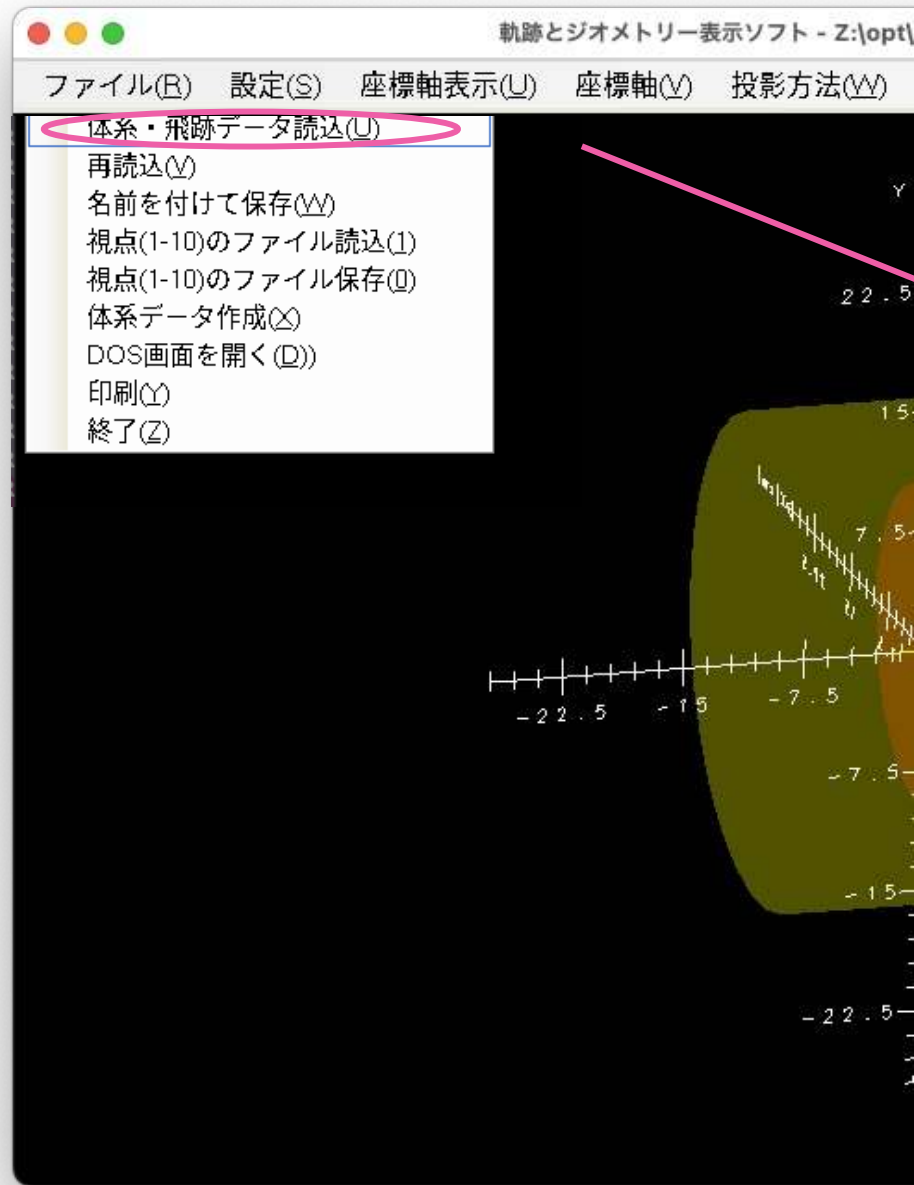
```
*****  
* User code simple/simple.f has been compiled and is starting *  
*****
```

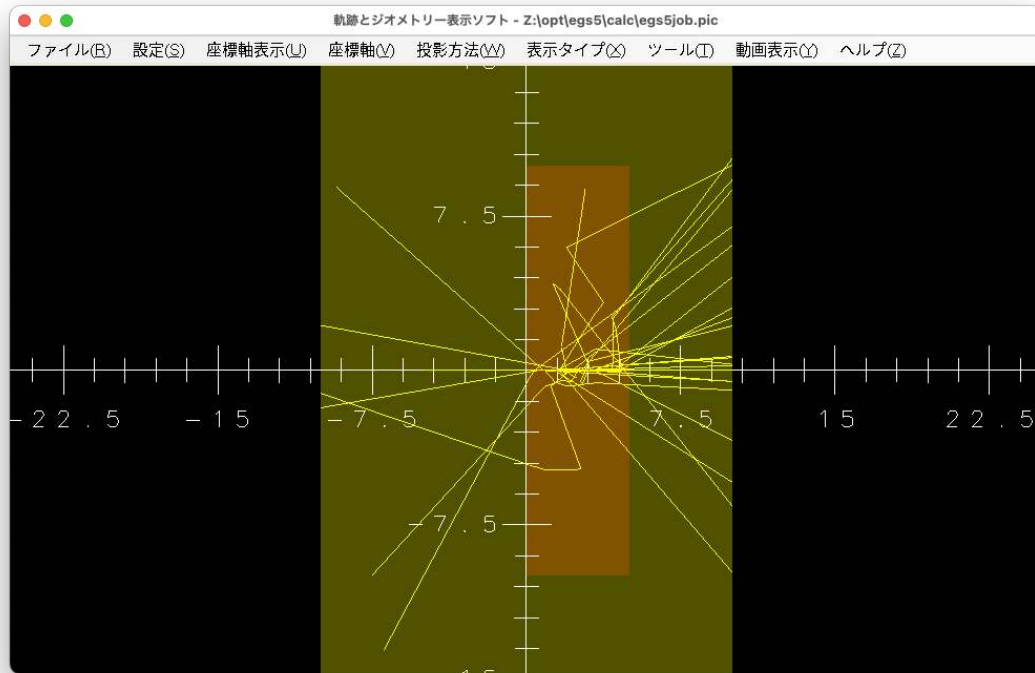
Ready for user input:

```
real          0m1.288s  
user          0m0.737s  
sys           0m0.076s
```

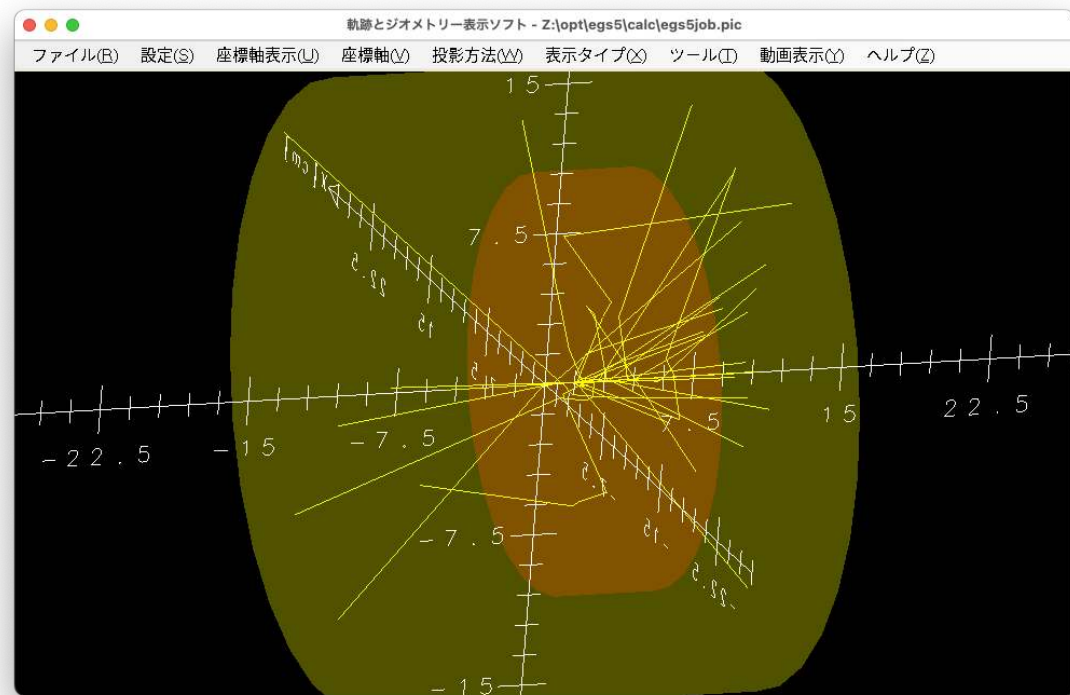
```
=====  
egs5run script has ended  
=====
```

# CGVIEWで飛跡の確認





円柱1に $z=-5$ から光子が50本真直に入射し  
5cmのアルミ内で半数程度が散乱している  
(散乱せず透過した光子は軸上を進むのみ)

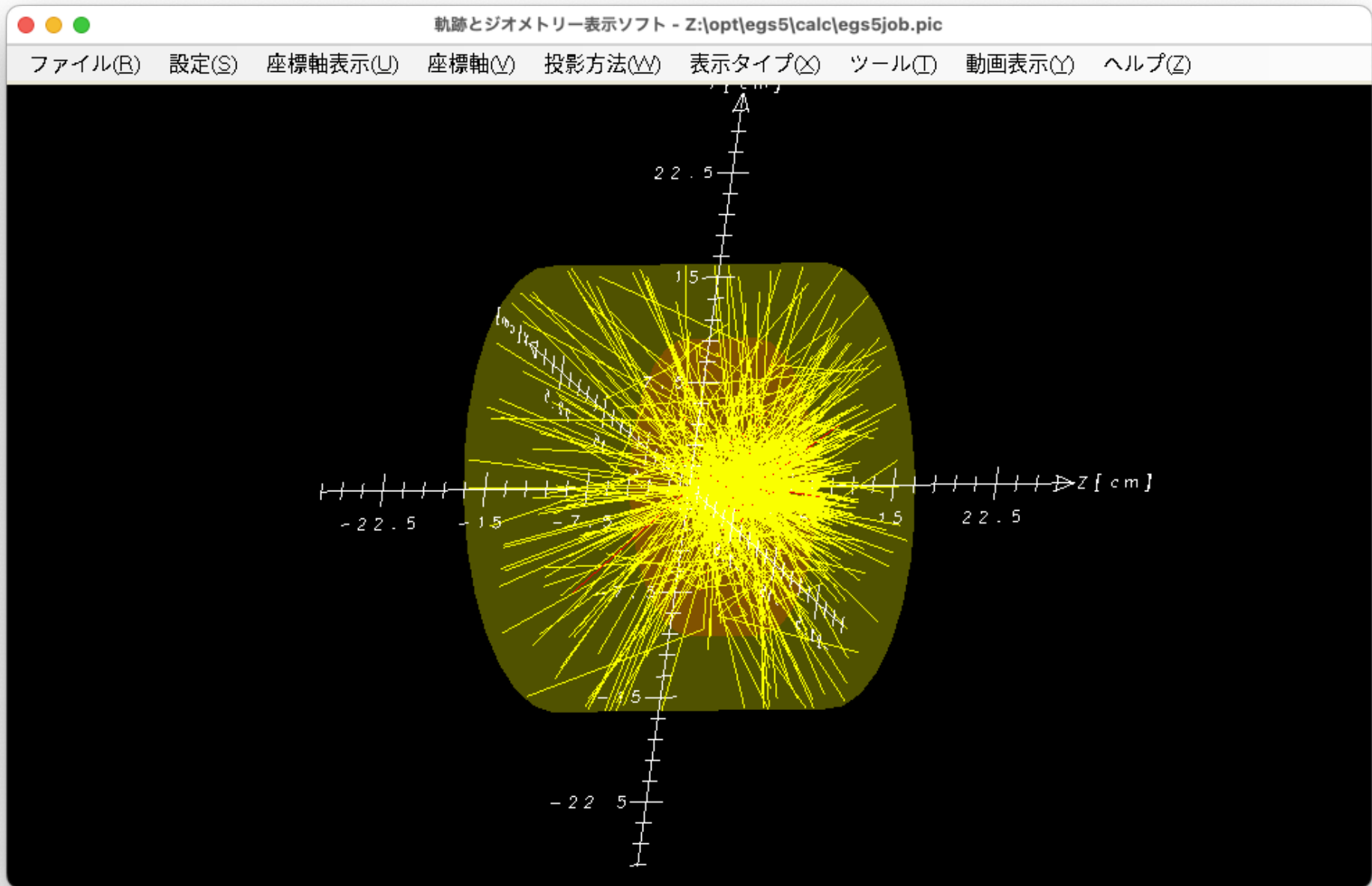


# エクセサイズ

simple.fにてmaxpict を50から大きめの数字にしてみる

```
144 |  
145 | call ecnsv1(0,nreg,totke)  
146 | call ntally(0,nreg)  
147 |  
148 |  
149 | ncases=10000  
150 | maxpict=1000  
151 |  
152 | write(39,fmt="( '0 1' )")  
153 | if(iwatch.gt.0) call swatch(-99,iwatch)  
154 |  
155 |  
156 | do i=1,ncases  
157 |  
158 |     wtin = 1.0
```

→ 実行してCGVIEWで飛跡を観察



maxpictは多すぎるとCGVIEWの動作が重くなるので注意

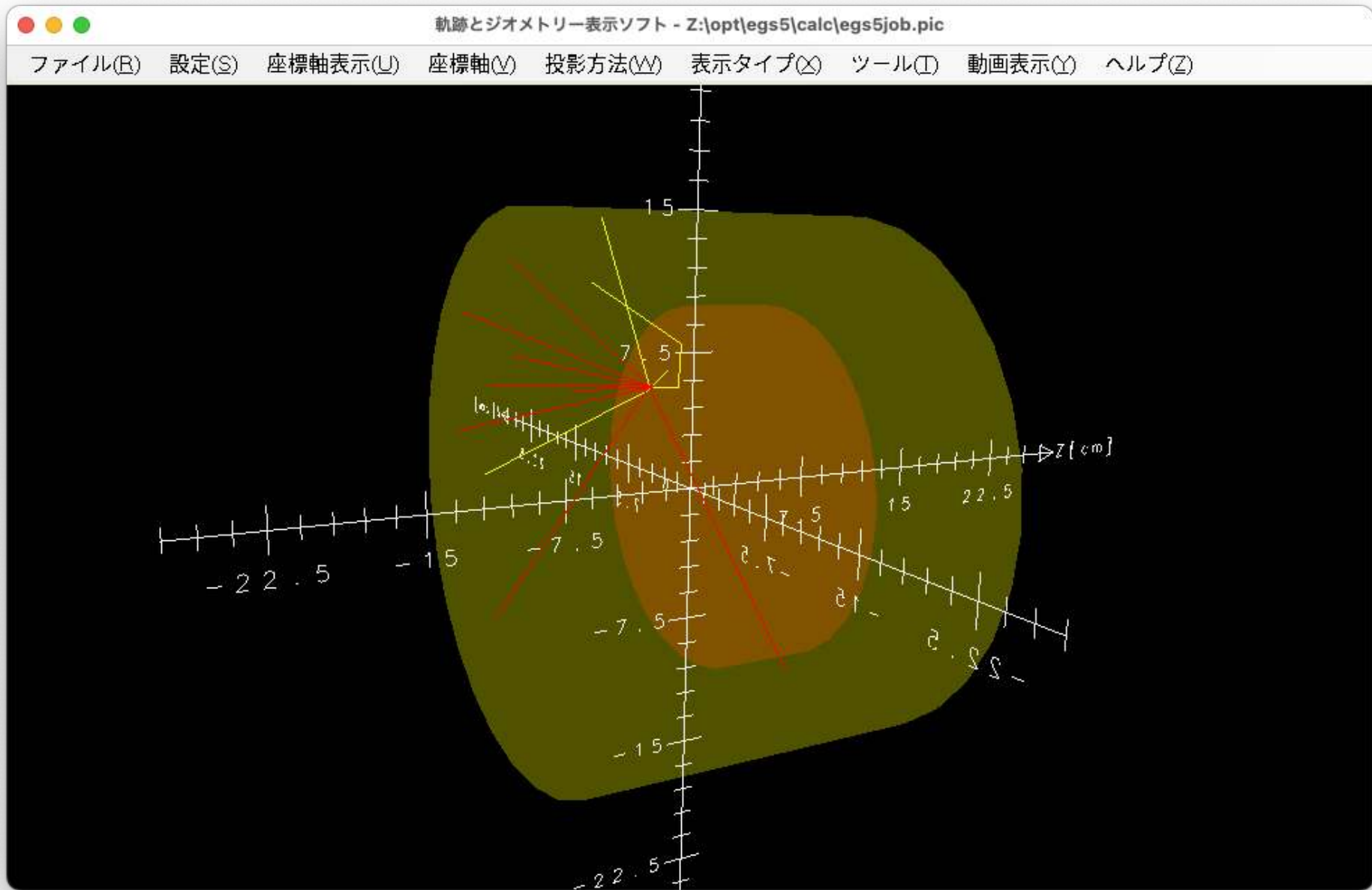
# エクセサイズ2

simple.fにて線源種類と位置を変更してみる

```
97
98   call rfluxinit           ! Initialize the Ranlux random-number generator
99
100 ! source
101   iqin = -1                ! Incident particle charge - photons
102   ekein = 1.253           ! Incident particle kinetic energy
103   xin = 5.0               ! Source position
104   yin = 5.0
105   zin = -5.0
106   uin = 0.0              ! Moving along z-axis (0: none)
107   vin = 0.0
108   win = 1.0
109   irin = 0                ! Starting region (0: Automatic search in CG)
110   wtin = 1.0              ! Weight = 1 since no variance reduction used
111
```

→ 実行してCGVIEWで飛跡を観察





- 電子の大半はアルミの表面で止まっている
- 一部は後方へ散乱している
- 制動放射線（ガンマ線）を若干放出している

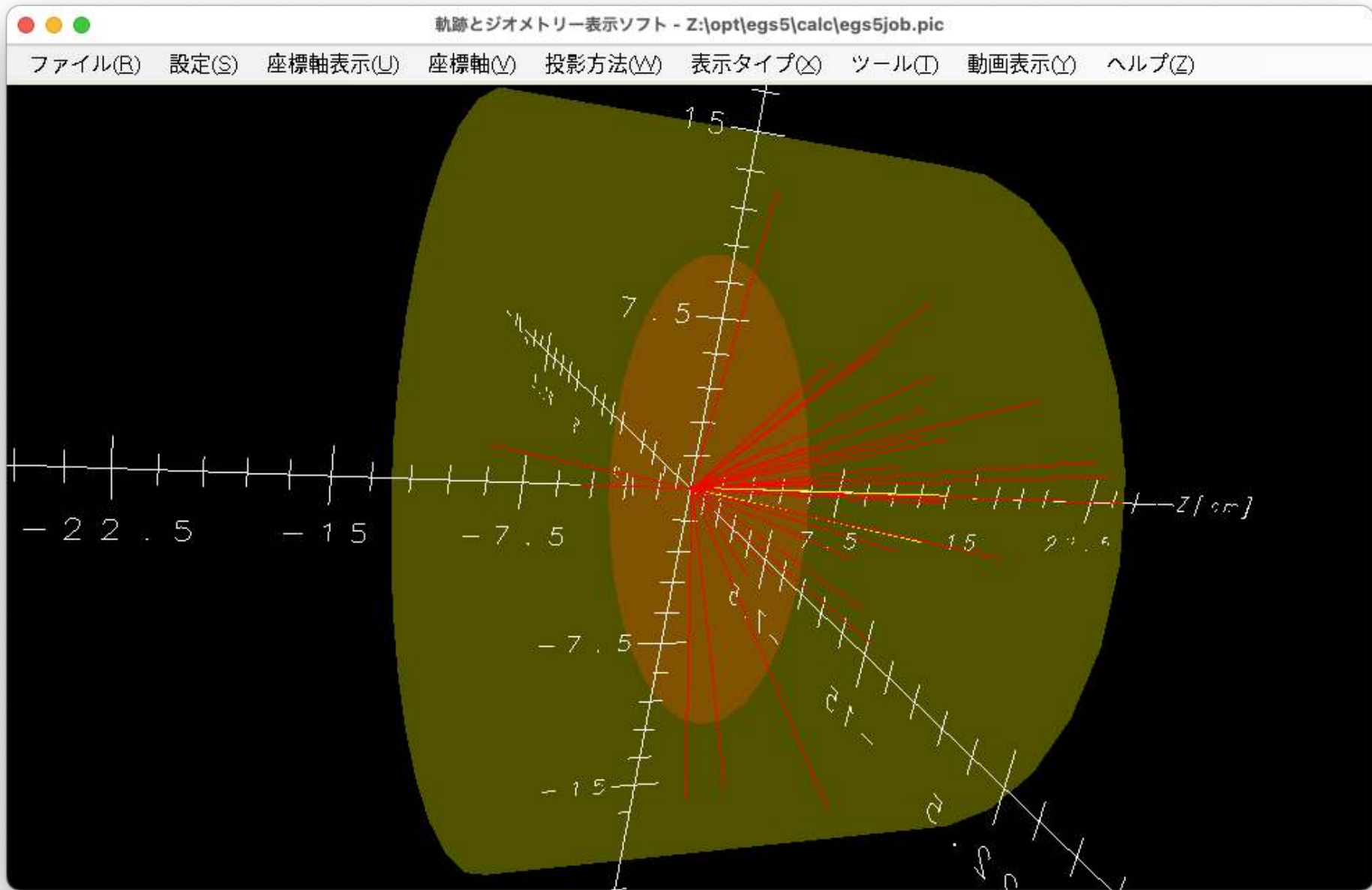
# ベータ線をアルミで遮へい

アルミを薄く、線源位置を戻してみる

```
98   call rluxinit      ! Initialize the RanLux random-number generator
99
100 ! source
101   iqin = -1          ! Incident particle charge - photons
102   ekein = 1.253     ! Incident particle kinetic energy
103   xin = 0.0         ! Source position
104   yin = 0.0
105   zin = -5.0
106   uin = 0.0        ! Moving along z axis
107   vin = 0.0
108   win = 1.0
109   irin = 0          ! Starting region (0: Automatic search in CG)
110   wtin = 1.0        ! Weight = 1 since no variance reduction used
111
112   if(irin.le.0.or.irin.gt.nreg) then
113     call srzone(xin,yin,zin,iqin+2,0,irin)
114     if(irin.le.0.or.irin.ge.nreg) then
115       write(6,fmt="( ' Stopped in MAIN. irin = ',i5)")irin
116       stop
117     end if
```

```
1  RCC  1  0 0 0  0 0 0.1 10
2  RCC  2  0 0 -10  0 0 20 15
3  END
4  Z1   +1
5  Z2   +2   -1
6  Z3   -2
7  END
8  1  0  0
```

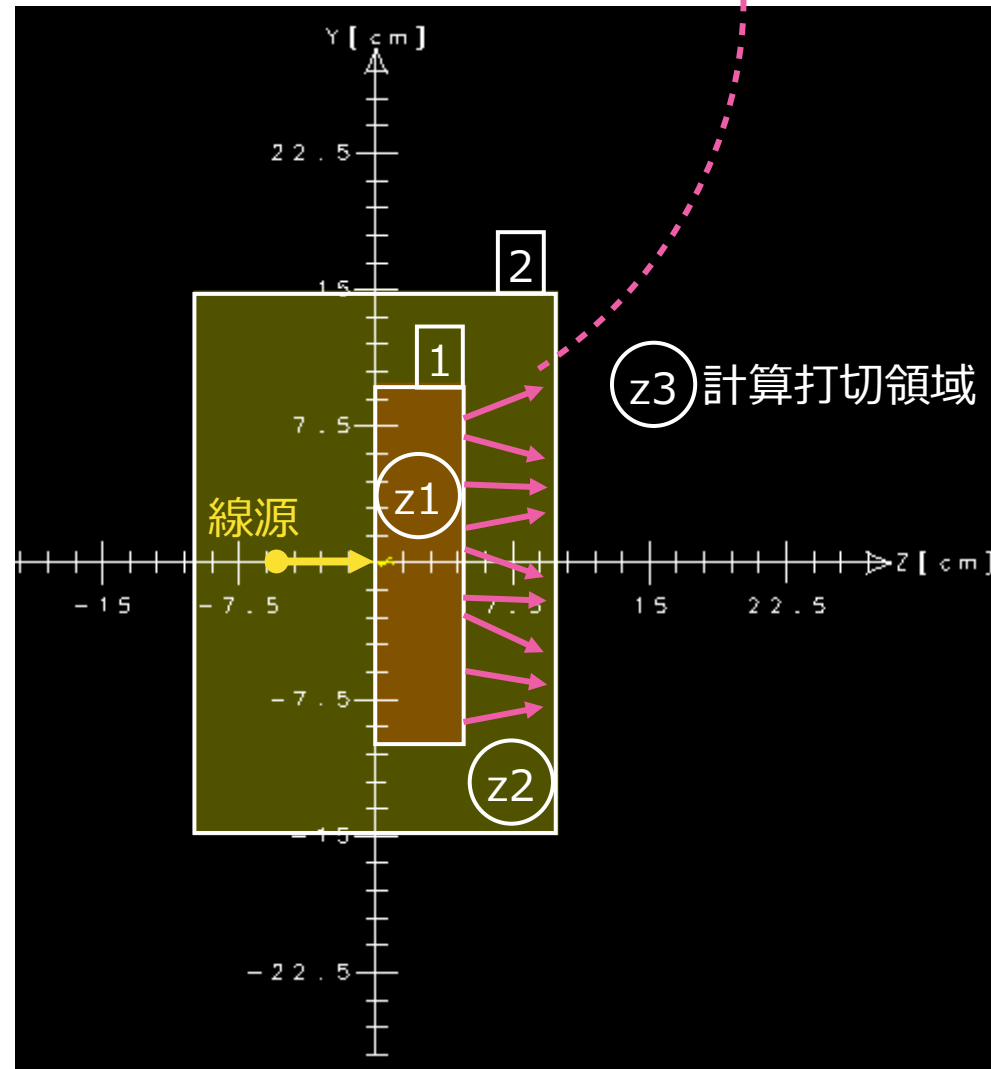
1ミリのアルミに1.253MeVのベータ線を入射



- 電子の大半はアルミを透過している
- 一部は後方へ散乱している
- 制動放射線（ガンマ線）を若干放出している

ターゲット背後から放出される放射線を書き出す

CG版tutor1



# CG版tutor1

tutor1/tutor1.fのausgabの一部をsimple/simple.fのausgabへ貼り付けて実行

```
236 integer ! Arguments
237 * iarg
238 common/totals/depe,deltae,spec(3,50),maxpict ! Variables to score
239 real*8 depe,deltae,spec
240 integer maxpict
241 real*8 angle,ekine ! tutor1:Local variables
242
243 ! Print out particle transport information (if switch is turned on)
244 if (iwatch .gt. 0) call swatch(iarg,iwatch)
245
246 if (iarg.eq.3.and.ir(np).eq.3) then ! tutor1
247   angle=acos(w(np))*180./3.14159
248   if (iq(np).eq.0) then
249     ekine=e(np)
250   else
251     ekine=e(np)-RM
252   end if
253   write(6,100) ekine,iq(np),angle
254 100 format(T21,F10.3,T33,I10,T49,F10.1)
255 endif
256
257 if(iarg .ge. 5) return
258
259 ! Output particle information for plot
260 if (ncount.le.maxpict) then
261   call plotxyz(iarg,np,iq(np),x(np),y(np),z(np),e(np),ir(np),
262 * wt(np),time(np))
263 end if
264
265 return
266 end
```

追記

追記

iarg=3かつir=3の条件については  
後で考察

```

1  RCC      1  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  0.0000E+00  1.0000E-01  1.0000E+01
2  RCC      2  0.0000E+00  0.0000E+00 -1.0000E+01  0.0000E+00  0.0000E+00  2.0000E+01  1.5000E+01
3  END
4  Z1          1
5  Z2          2      -1
6  Z3          -2
7  END
8  ranlux luxury level set by rluxgo : 1      p= 48
9  ranlux initialized by rluxgo from seed      1
10 RAYLEIGH DATA AVAILABLE FOR MEDIUM 1 BUT OPTION NOT REQUESTED.
11
12 EMAXE set i
13 EGS SUCCESSI
14      0.747      -1      41.6
15      0.540      -1      69.1
16      0.695      -1      43.2
17      0.405      -1      156.2
18      0.895      -1      10.3
19      0.701      -1      31.3
20      0.830      -1      26.4
21      0.203      -1      31.1
22      0.877      -1      19.2
23      0.808      -1      26.0
24      0.579      -1      67.2
25      0.887      -1      48.9
26      0.916      -1      41.5
27      0.423      -1      43.6
28      0.830      -1      36.5
29      0.912      -1      32.2
30      0.616      -1      54.4
31      0.781      -1      73.9
32      0.890      -1      28.4
33      0.107      0      25.2
34      0.855      -1      18.3
35      0.847      -1      32.8
36      0.102      0      20.0
37      0.814      -1      30.0
38      0.367      -1      107.6
39      0.186      -1      7.8
40      0.691      -1      19.4
41      0.801      -1      61.3
42      0.681      -1      23.5
43      0.414      -1      58.2
44      0.751      -1      35.0
45      0.288      -1      49.4

```

```

write(6,100) ekine,iq(np),angle
100 format(T21,F10.3,T33,I10,T49,F10.1)

```

運動エネルギー、粒子種、z軸からの角度（0のときz軸上）

0.747	-1	41.6
0.540	-1	69.1
0.695	-1	43.2
0.405	-1	156.2
0.895	-1	10.3
0.701	-1	31.3
0.830	-1	26.4
0.203	-1	31.1
0.877	-1	19.2
0.808	-1	26.0
0.579	-1	67.2
0.887	-1	48.9
0.916	-1	41.5
0.423	-1	43.6
0.830	-1	36.5
0.912	-1	32.2
0.616	-1	54.4
0.781	-1	73.9
0.890	-1	28.4
0.107	0	25.2
0.855	-1	18.3
0.847	-1	32.8
0.102	0	20.0
0.814	-1	30.0
0.367	-1	107.6
0.186	-1	7.8
0.691	-1	19.4
0.801	-1	61.3
0.681	-1	23.5
0.414	-1	58.2
0.751	-1	35.0
0.288	-1	49.4

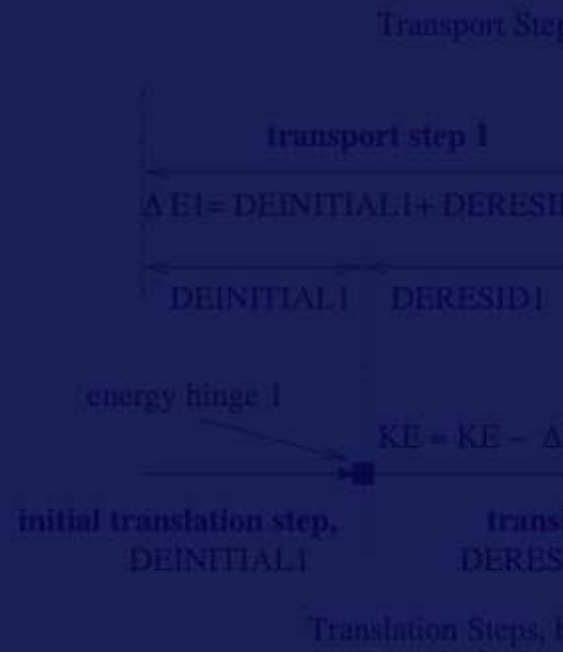


Figure 2.13: Translation steps and trans figure illustrates the step size (in terms of transport steps, with the energy loss set into a series of translation steps between the translation steps is mono-energetic,

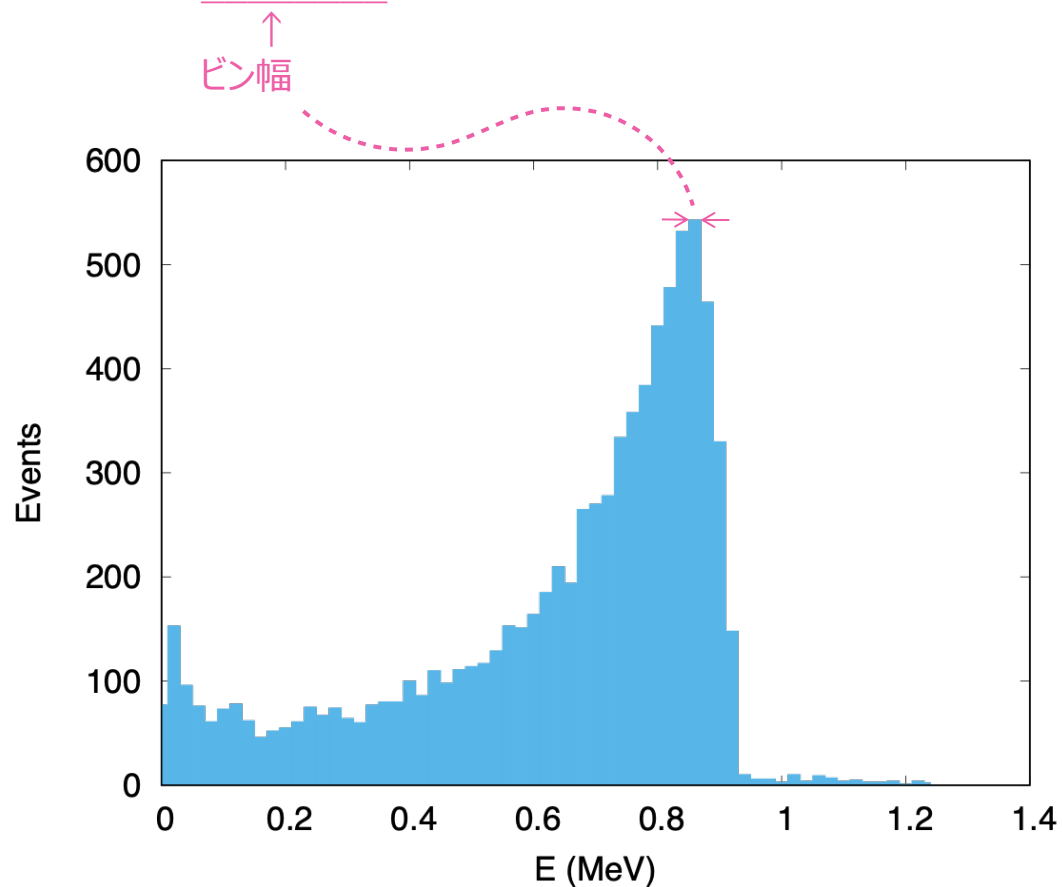
枠線内のデータでヒストグラムを作ってみる

# gnuplotを用いたヒストグラム作成

```
set style fill solid
```

```
filter(x,y)=floor(x/y)*y
```

```
plot 'out' u (filter($1,0.02)):(1) smooth frequency with boxes
```



# IARGについて

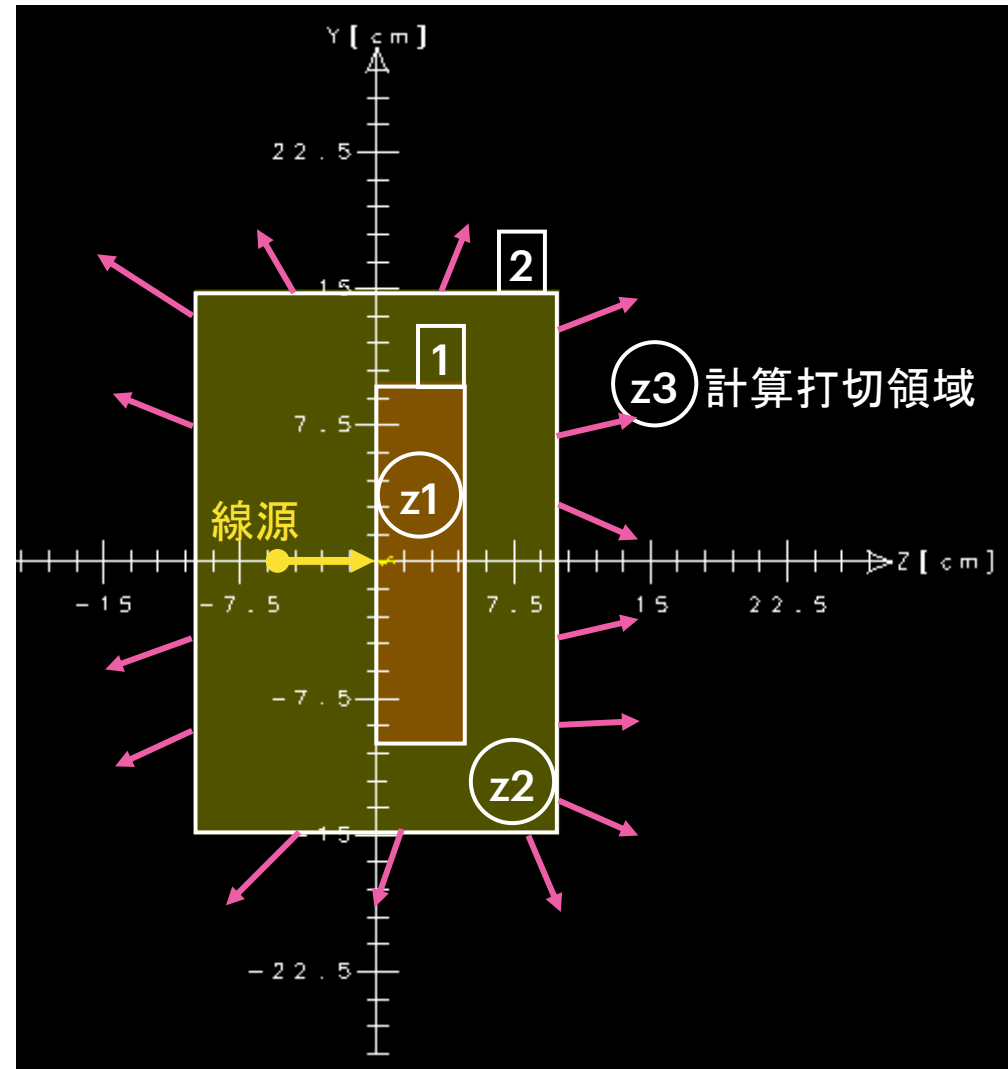
IARG	Situation
0	Particle is going to be transported by distance TVSTEP. <b>移動</b>
1	Particle is going to be discarded because its energy is below the cutoff ECUT (for charged particles) or PCUT (for photons)—but its energy is larger than the corresponding PEGS cutoff AE or AP, respectively. <b>エネルギーカット1</b>
2	Particle is going to be discarded because its energy is below both ECUT and AE (or PCUT and AP). <b>エネルギーカット2</b>
3	Particle is going to be discarded because the user requested it (in HOWFAR usually). <b>体系外など</b>
4	Part of particle energy is deposited due to the binding energy. This situation occurs in one of the following 3 cases: <b>エネルギー付与</b> <ol style="list-style-type: none"> <li>1. A photoelectric interaction has occurred and the difference in the electron binding energy and the secondary particle (X-ray or Auger electron) energy is deposited. <b>光電効果の後処理として</b></li> <li>2. Compton interaction has occurred and the electron binding energy is deposited locally. This is enabled only when the Doppler-broadening option is turned on. <b>コンプトン散乱の後処理として</b></li> <li>3. The K-shell EII has occurred and the difference between the electron binding energy and the secondary particle (K-X ray) energy is deposited. This is enabled only when the EII option is turned on. <b>K-shell EIIの後処理として</b></li> </ol>

IARG	IAUSFL	Situation
5	6	Particle has been transported by distance TVSTEP. <b>その他詳細</b>
6	7	A bremsstrahlung interaction is to occur and a call to BREMS is about to be made in ELECTR.
7	8	Returned to ELECTR after a call to BREMS was made.
8	9	A Møller interaction is to occur and a call to MOLLER is about to be made in ELECTR.
9	10	Returned to ELECTR after a call to MOLLER was made.
10	11	A Bhabha interaction is to occur and a call to BHABHA is about to be made in ELECTR.
11	12	Returned to ELECTR after a call to BHABHA was made.
12	13	An in-flight annihilation of the positron is to occur and a call to ANNIH is about to be made in ELECTR.
13	14	Returned to ELECTR after a call to ANNIH was made.
14	15	A positron has annihilated at rest.
15	16	A pair production interaction is to occur and a call to PAIR is about to be made in PHOTON.
16	17	Returned to PHOTON after a call to PAIR was made.
17	18	A Compton interaction is to occur and a call to COMPT is about to be made in PHOTON.
18	19	Returned to PHOTON after a call to COMPT was made.
19	20	A photoelectric interaction is to occur and a call to PHOTO is about to be made in PHOTON.
20	21	Returned to PHOTON after a call to PHOTO was made (assuming NP is non-zero).
21	22	Subroutine UPHI was just entered.
22	23	Subroutine UPHI was just exited.
23	24	A coherent (Rayleigh) interaction is about to occur.
24	25	A coherent (Rayleigh) interaction has just occurred.
25	26	An EII interaction is about to occur.
26	27	Returned to MOLLER after a call to EII was made.
27	28	An energy hinge is about to occur in ELECTR.
28	29	An energy hinge has just occurred in ELECTR.
29	30	A multiple-scattering hinge is about to occur in ELECTR.
30	31	A multiple-scattering hinge has just occurred in ELECTR.

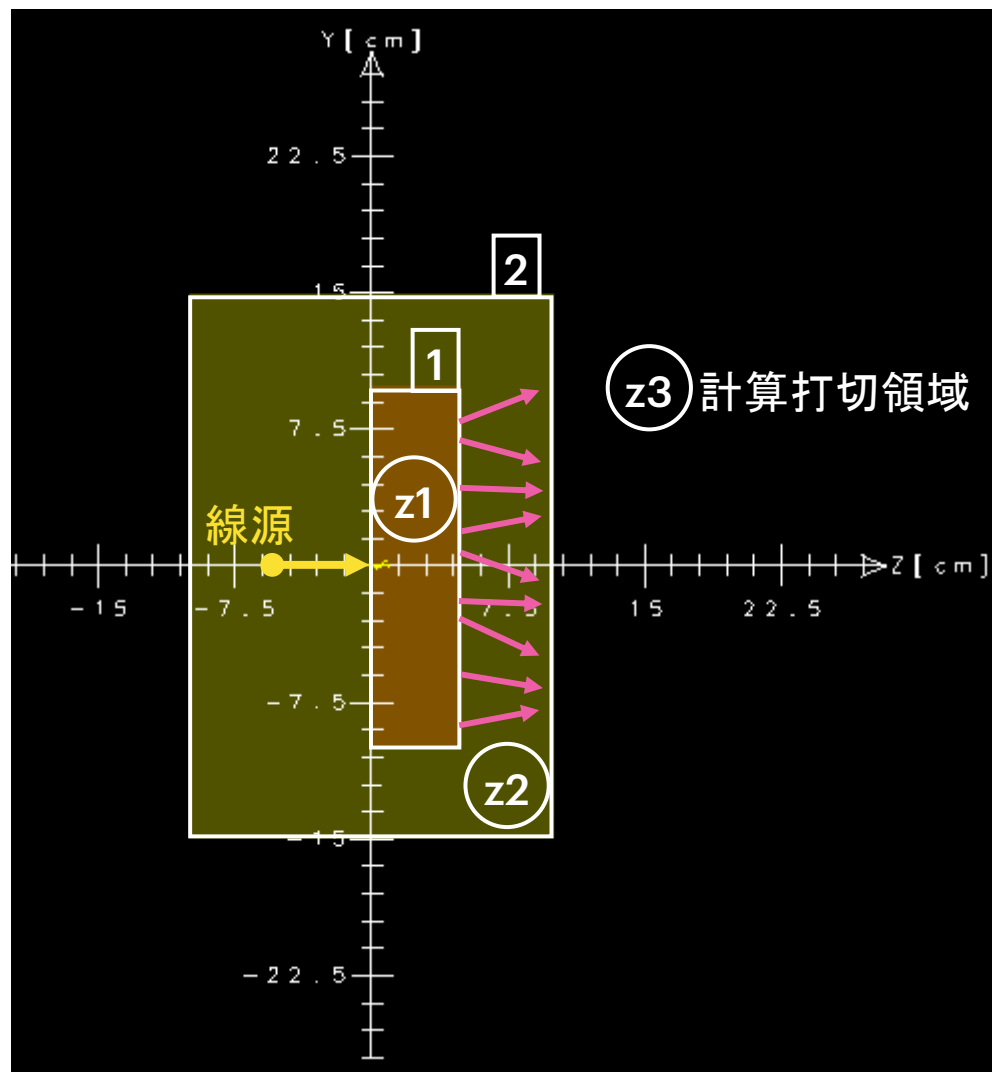


# iarg=3 かつ ir=3とは

```
245  
246   if (iarg.eq.3.and.ir(np).eq.3) then  
247     angle=acos(w(np))*180./3.14159  
248     if (iq(np).eq.0) then  
249       ekine=e(np)  
250     else  
251       ekine=e(np)-RM  
252     end if  
253     write(6,100) ekine,iq(np),angle  
254 100   format(T21,F10.3,T33,I10,T49,F10.1)  
255   endif  
256
```



ターゲット背後から放出される放射線を書き出すには



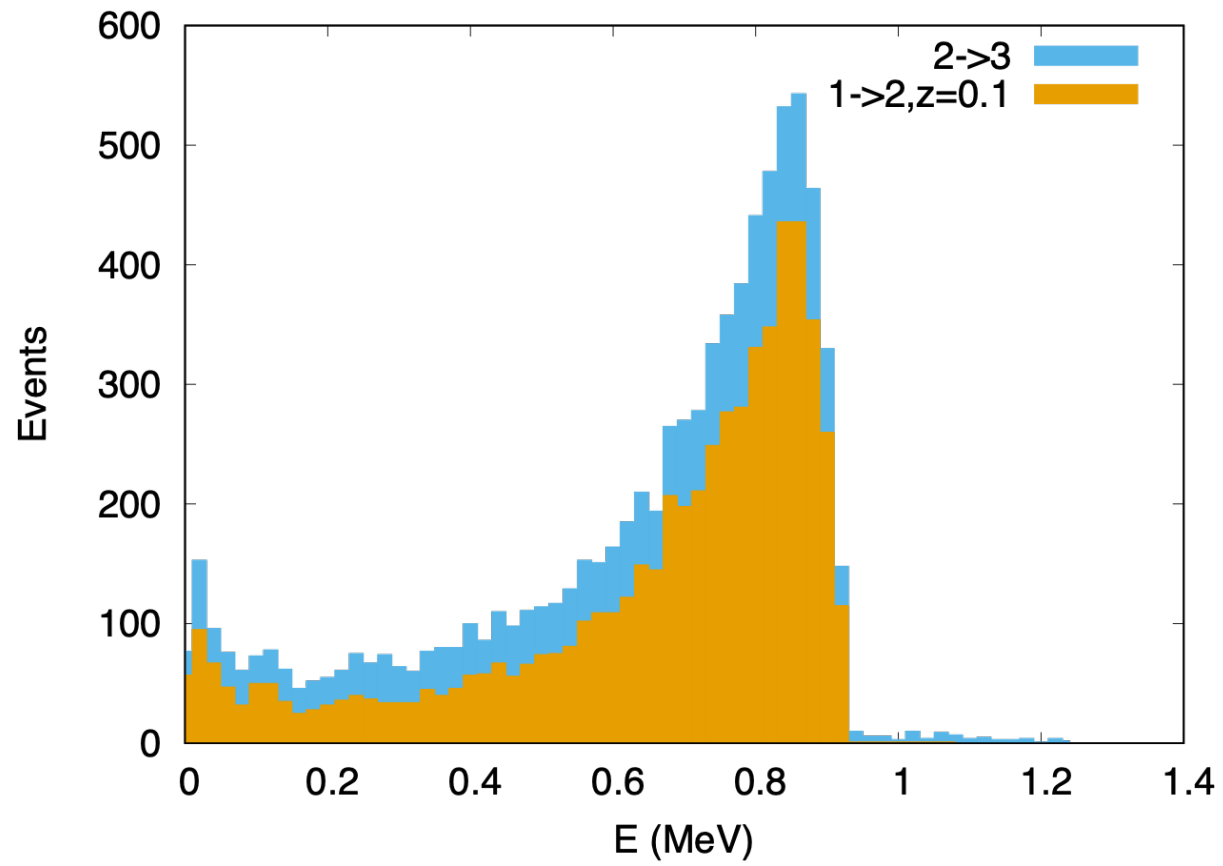
$i_{\text{rold}} = 1$  かつ  $i_r = 2$  かつ  $z = \text{アルミ厚}$  のとき

# surface crossing設定例

領域1から領域2へ移動する粒子

```
243 ! Print out particle transport information (if switch is turned on)
244 if (iwatch .gt. 0) call swatch(iarg,iwatch)
245
246 if (iroid.eq.1 .and. ir(np).eq.2 .and. z(np).eq.0.1d0 ) then
247     angle=acos(w(np))*180./3.14159
248     if (iq(np).eq.0) then
249         ekine=e(np)
250     else
251         ekine=e(np)-RM
252     end if
253     write(6,100) ekine,iq(np),z(np)
254 100 format(T21,F10.3,T33,I10,T49,F10.1)
255 endif
256
257 if(iarg .ge. 5) return
258
```

z=0.1d0と倍精度での指定がよい  
z=0.1と単精度の指定は条件を満たさない恐れ



# 電子と光子を分けて出力する

```
148
149  ncases=100000
150  maxpict=50
151
152  write(39,fmt="( '0  1' )")
153  if(iwatch.gt.0) call swatch(-99,iwatch)
154
155
156  do i=1,ncases                                ! Start of shower call-loop
157
243 !   Print out particle transport information (if switch is turned on)
244   if (iwatch .gt. 0) call swatch(iarg,iwatch)
245
246   if (iold.eq.1 .and. ir(np).eq.2 .and. z(np).eq.0.1d0 ) then
247     if (iq(np).eq.0) then
248       ekine=e(np)
249       write(91,*) ekine
250     else
251       ekine=e(np)-RM
252       write(92,*) ekine
253     end if
254   endif
255
256   if(iarg .ge. 5) return
```

# 結果

fort.91 (photon)

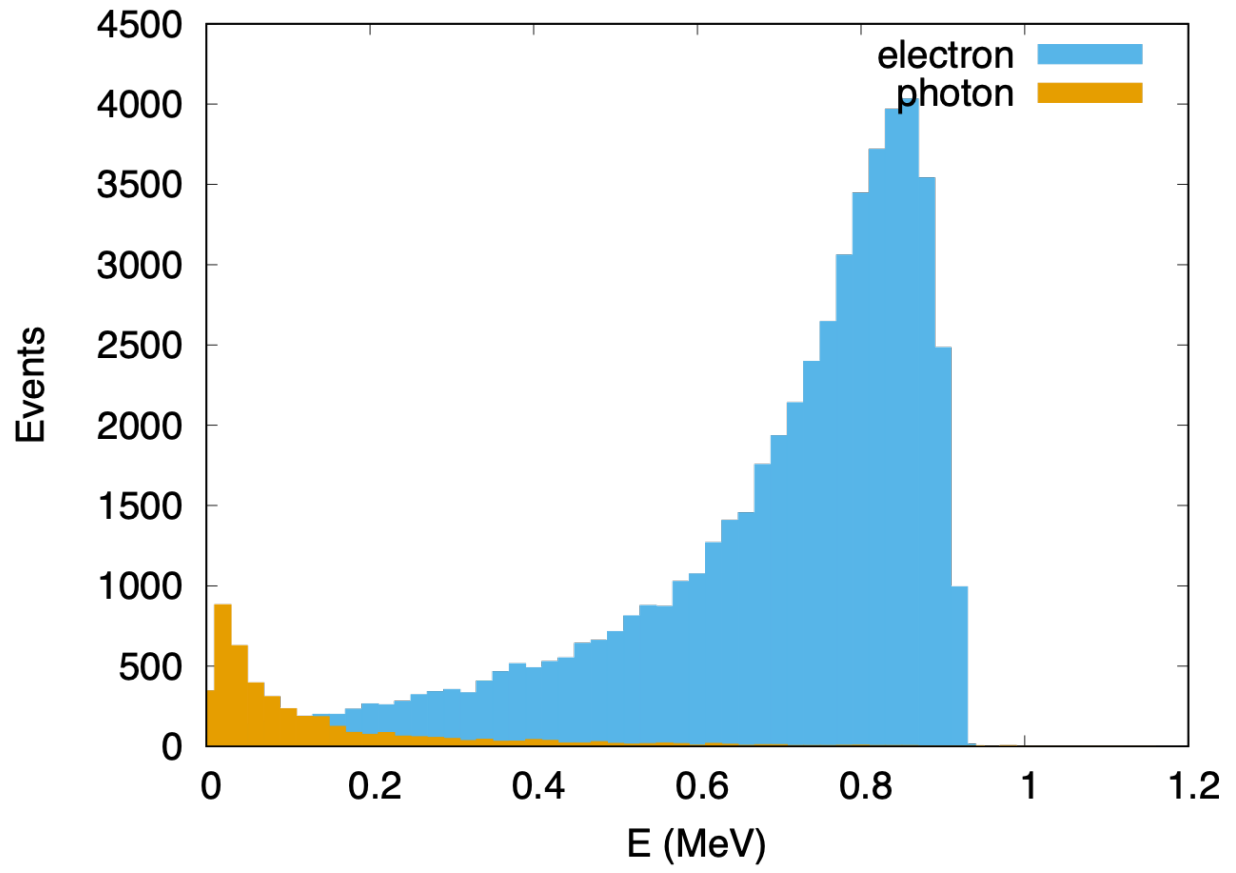
0.107140484629189  
0.102267272684809  
0.395397252626522  
0.639925780212798  
0.247087137482216  
0.267966328782001  
6.659264538373698E-002  
3.107949150083373E-002  
7.063016926108848E-002  
0.137363839686406  
0.120023201528415  
9.653519355772798E-002  
0.237160049495556  
4.857712306131567E-002  
4.395142113070239E-002  
0.134551177997255  
2.291256156484392E-002

:

fort.92 (electron)

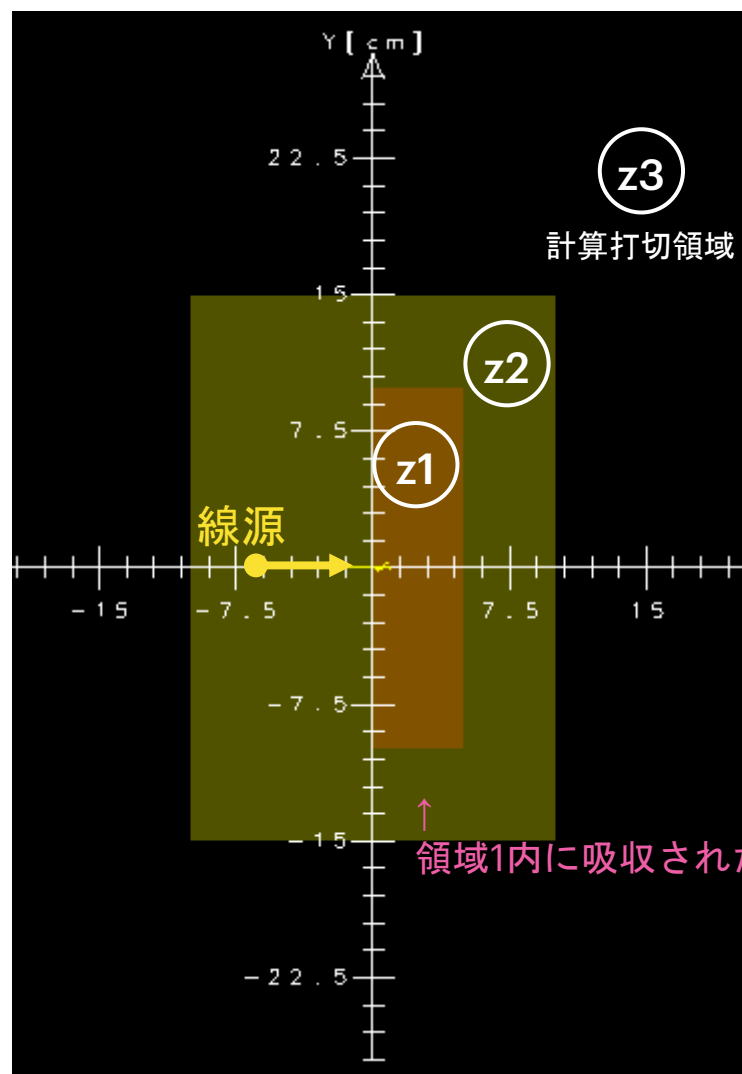
0.540271512664514  
0.694575869707918  
0.701306645181710  
0.829987733342612  
0.203134256948940  
0.807720792774279  
0.579118950986061  
0.886655119575416  
0.423448134695322  
0.829891512015685  
0.615723358845304  
0.781277070179265  
0.855219289021240  
0.846917379926870  
0.813741911554502  
0.185829413707758  
0.691270549925618

:



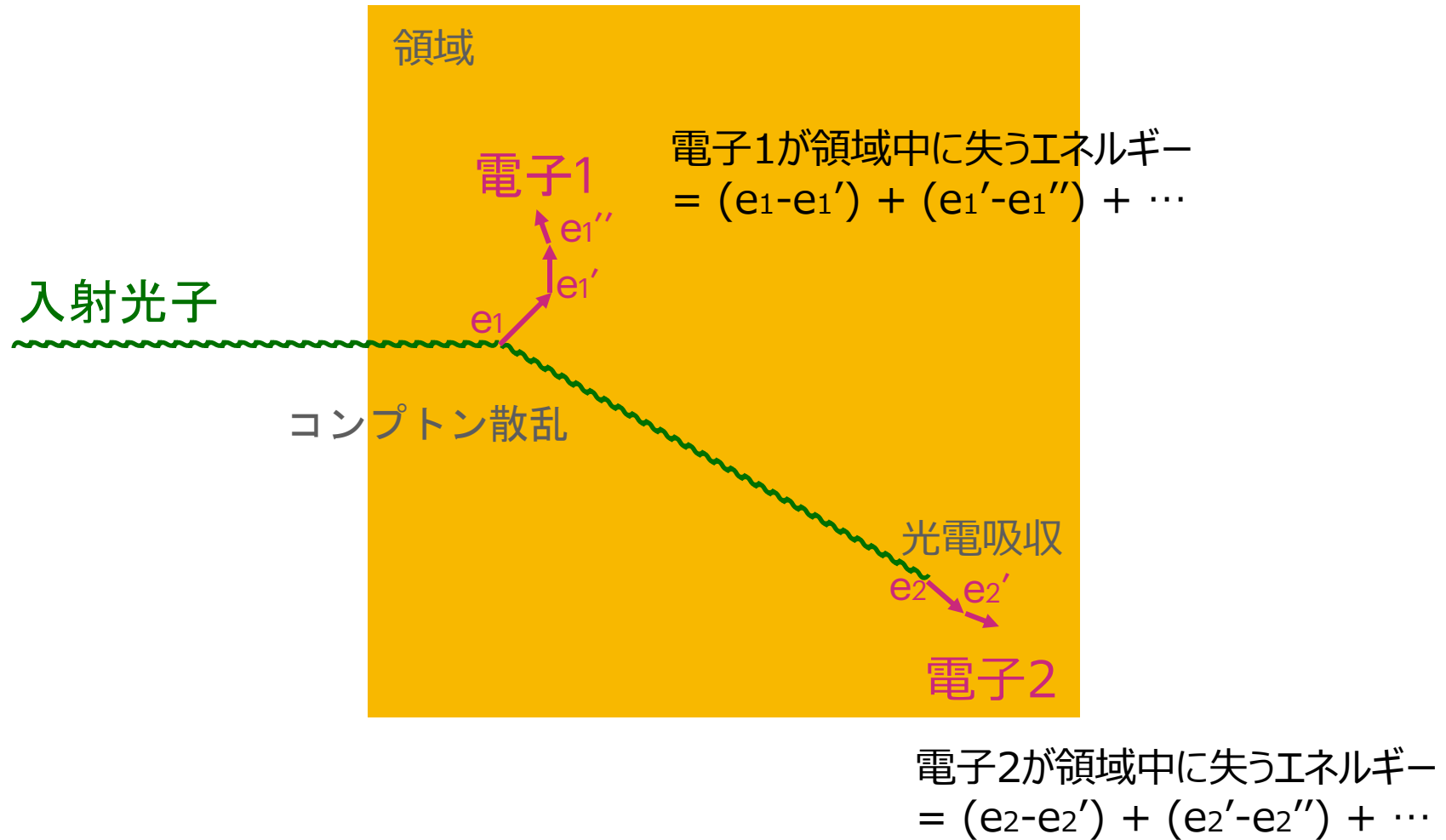
# シンチレータの応答、標的の熱計算

CG体系でtutor2  
energy deposit量とその分布の計算



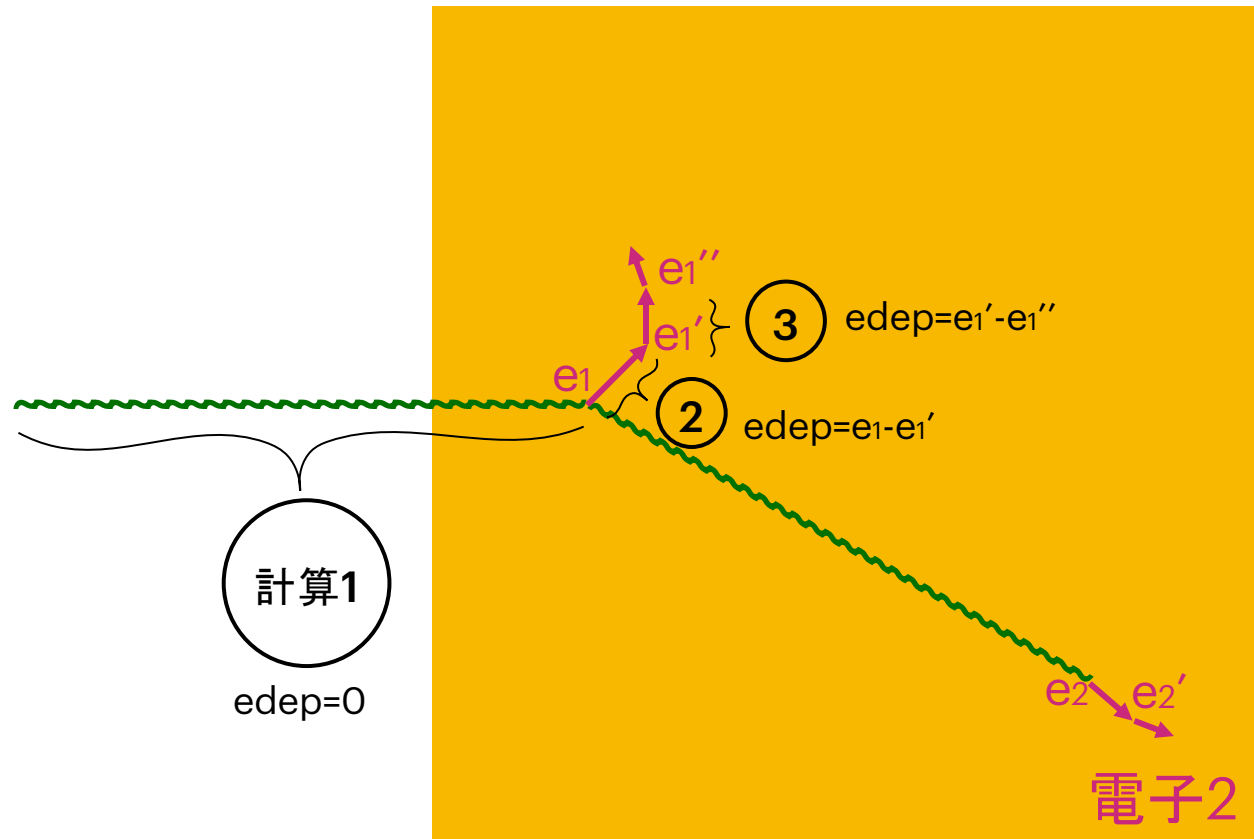


# EGS5の吸収エネルギー



# 1 ステップとdE

計算の段階ごとのedep



1 入射放射線あたりの吸収エネルギー = edep を足し合わせたもの

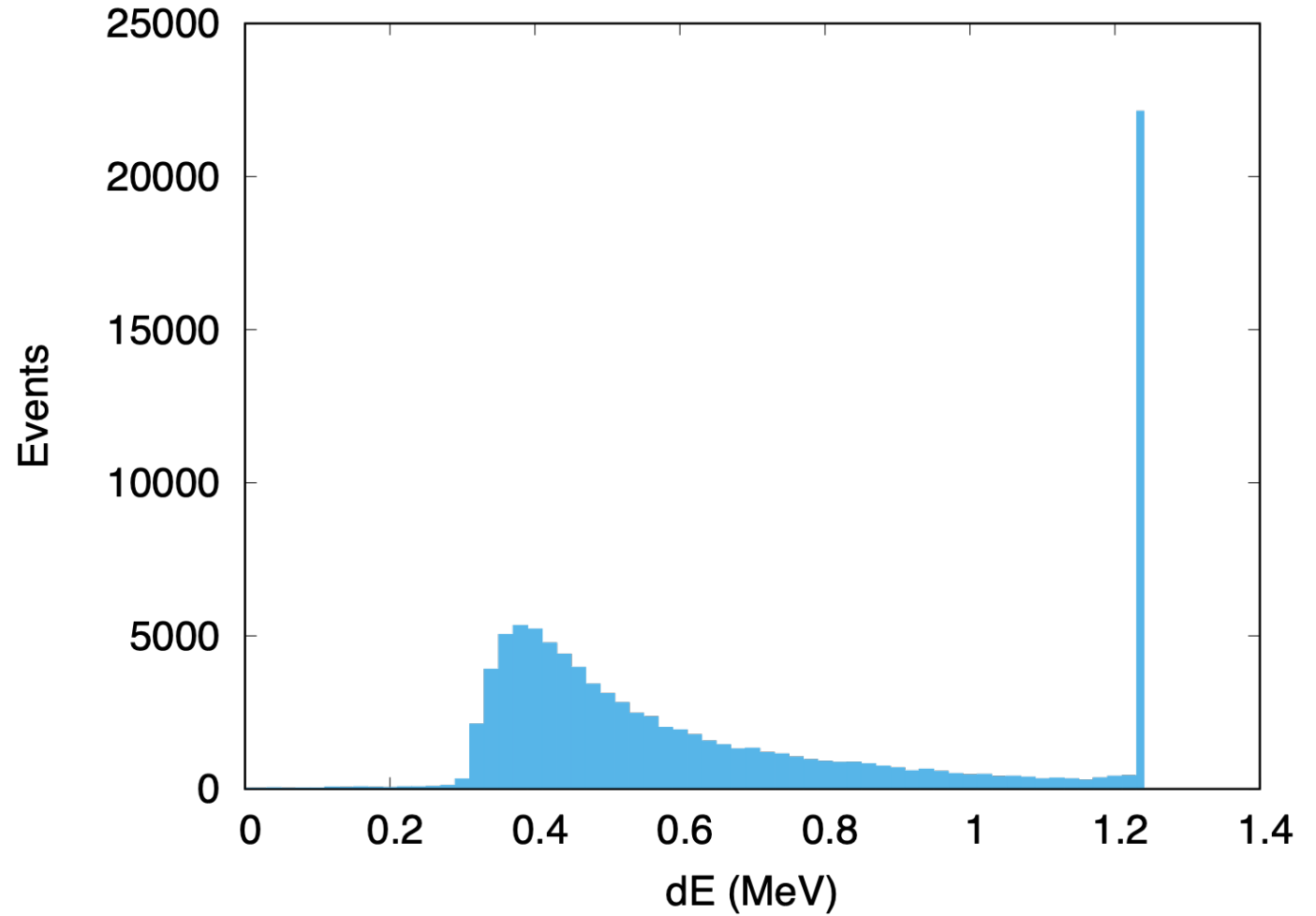
```
39 common/cmn1/de
40 real*8 de
41
42 open(6,FILE='egs5job.out',STATUS='unknown')
43 open(4,FILE='egs5job.inp',STATUS='old')
44 open(39,FILE='egs5job.pic',STATUS='unknown')
45
46 call counters_out(0)
```

```
185 uf(1)=0.0
186 vf(1)=0.0
187 wf(1)=0.0 ! Needed if lpolar(i)=1
188
189 de = 0d0
190
191 call shower (iqin,etot,xin,yin,zin,uin,vin,win,irin,wtin)
192
193 write(93,*)de
194
195 ncount = ncount + 1 ! Count total number of actual cases
196
197 if(iwatch.gt.0) call swatch(-1,iwatch)
198
199 end do ! End of CALL SHOWER loop
200
201 if(iwatch.gt.0) call swatch(-88,iwatch)
202
203 call plotxyz(99,0,0,0.D0,0.D0,0.D0,0.D0,0,0.D0,0.D0)
204
205 write(39,fmt="( '9' )") ! Set end of batch for CG View
206
```

```
247 common/cmn1/de
248 real*8 de
249
250 ! Print out particle transport information (if switch is turned on)
251 if (iwatch .gt. 0) call swatch(iarg,iwatch)
252
253 if (iarg.le.4 .and. ir(np).eq.1 ) then
254 de = de + edep
255 endif
256
257 if(iarg .ge. 5) return
258
```

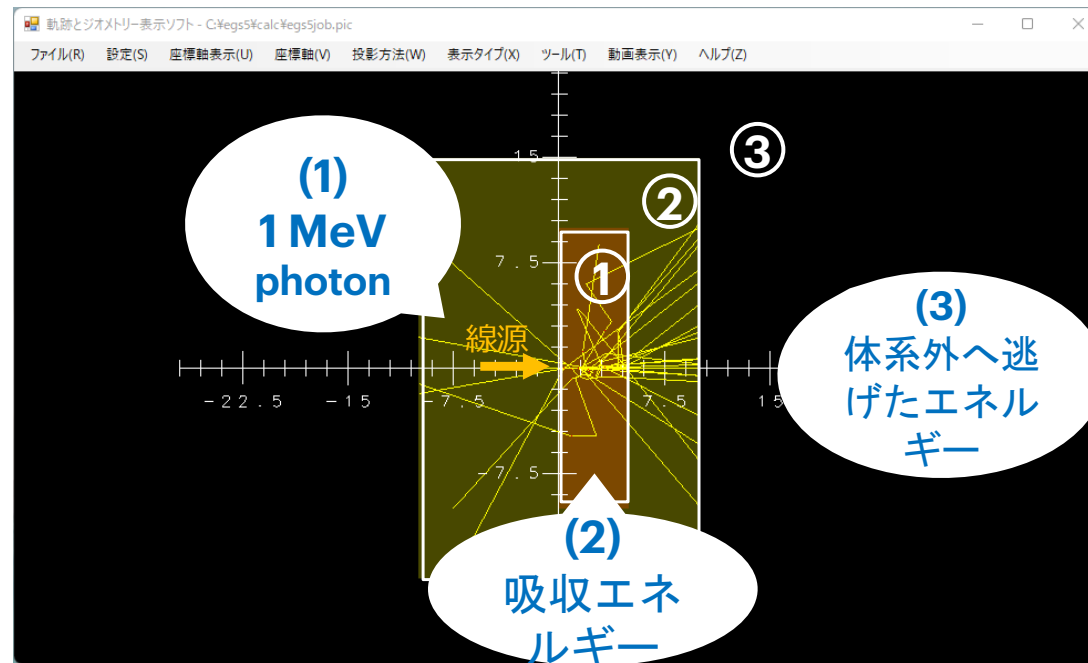
fort.93の中身

1.25300002098084  
1.25300002098083  
0.506240130558479  
0.712728508316322  
0.558424151272919  
0.847693228025980  
1.25300002098083  
1.25300002098083  
0.357737686830670  
0.551693375799125  
1.25300002098084  
0.423012287638223  
1.25300002098083  
1.04986576403189  
1.25300002098083  
0.376270297827966  
0.445279228206556  
0.673881069994773  
0.366344901405419  
0.336851243980807  
0.829551886285513  
0.423108508965151  
0.340862623567150  
0.637276662135530



# エネルギー収支を確認する (tutor2)

- 線源エネルギー (1) = 吸収エネルギー (2) + 体系外へ逃げたエネルギー (3)



- エネルギー収支の取れていない計算はどこかにミスがある可能性

# メインルーチンの変更点

```
program simple
#####

a frame of EGS5 CG calculation
based on ucnaicgv ver. 28Jul2012/
#####

implicit none

include 'include/egs5_h.f'
include 'include/egs5_bounds.f'
include 'include/egs5_brempr.f'
include 'include/egs5_edge.f'
include 'include/egs5_media.f'
include 'include/egs5_misc.f'
include 'include/egs5_stack.f'
include 'include/egs5_thresh.f'
include 'include/egs5_uphiot.f'
include 'include/egs5_useful.f'
include 'include/egs5_usersc.f'
include 'include/egs5_userxt.f'
include 'include/randomm.f'
include 'auxcommons/aux_h.f'
include 'auxcommons/edata.f'
include 'auxcommons/etaly1.f'
include 'auxcommons/instuf.f'
include 'auxcommons/lines.f'
include 'auxcommons/nfac.f'
include 'auxcommons/watch.f'
include 'auxcommons/geom_common.f'

common/cmnl/maxpict,escore(3)
integer maxpict
real*8 escore
```

```
! source
iqin = 0
ekein = 1d0
xin = 0.0
yin = 0.0
zin = -5.0
uin = 0.0
vin = 0.0
win = 1.0
irin = 0
wtin = 1.0
```

```
do i=1,ncases ! Start of shower call
escore(1)=escore(1)+ekein ! source kinetic energy
wtin = 1.0

wtsum = wtsum + wtin ! Keep running sum of weights
etot = ekein + iabs(iqin)*RM ! Incident total energy
```

```
call shower (iqin,etot,xin,yin,zin,uin,vin,win,irin,wtin)

ncount = ncount + 1 ! Count total number of actual cases

if(iwatch.gt.0) call swatch(-1,iwatch)

end do ! End of CALL SHOWER loop

write(6,*)"escore results"
write(6,*)escore(1), escore(2), escore(3), escore(2)+ escore(3)
```

# ausgabの変更点

```
integer
* iarg
common/cmnl/maxpict,escore(3)
integer maxpict
real*8 escore

Print out particle transport information (if switch i
if (iwatch .gt. 0) call swatch(iarg,iwatch)

if (iarg.le.4) then
  if(   ir(np).eq.1)then
    escore(2)=escore(2)+edep    ! deposit in z1

  elseif(ir(np).eq.3)then
    escore(3)=escore(3)+edep    ! escape to z3
  endif
endif
end if
```

# 結果

```
EMAXE set in HATCH to MIN(UE,UP+RM), = 2.5110E+00
FGS SUCCESSFULLY 'HATCHED' FOR ONE MEDIUM.
escore results
10000. 3434.14214 6565.85786 10000.
ENERGY DEPOSITION SUMMARY FOR PARTICLES WITH IQ=-1
```

(1) 線源エネルギー  
(1 MeV x 10,000回)

(2) 領域1の吸収エネルギー  
(約34%, 厚みによる)

(3) 体系外へ逃げたエネルギー

(2) + (3) = (1) となった  
⇒ エネルギー収支が確認できた



# 測定器の応答計算 (tutor3)

- 3インチのNaIの応答を計算する (簡易版)
- 結晶に直接光子を入射

# simple.inp (PEGS入力:物質とデータテーブル作成)

```
COMP
&INP NE=2,RHO=3.67, PZ=1,1 IRAYL=1 /END
NAI          NAI
NA I
ENER
&INP AE=0.521,AP=0.01,UE=2.511,UP=2.0 /END
PWLF
&INP /END
DECK
&INP /END
```

EGS研究会ホームページ

講習会資料 8-7 materials 参照

<https://rcwww.kek.jp/egsconf/2015-nm/materials.html>

# simple.data (計算体系)

```
RCC 1 0 0 0 0 0 7.62 3.81
RCC 2 0 0 -10 0 0 20 15
END
Z1 +1
Z2 +2 -1
Z3 -2
END
1 0 0
```

# メインルーチン

```
48  nmed=1
49  if(nmed.gt.MXMED) then
50    write(*,*)'error:nmed exceeds MXMED'
51    stop
52  end if
53
54  call block_set      ! Initialize some general variables
55  medarr(1)='NAI'
56
```

```
102 ! source
103  iqin = 0      ! Incident particle charge - photons
104  ekein = 0.662d0 ! Incident particle kinetic energy
105  xin = 0.0    ! Source position
106  yin = 0.0
107  zin = -5.0
108  uin = 0.0    ! Moving along z axis
109  vin = 0.0
110  win = 1.0
111  irin = 0     ! Starting region (0: Automatic search in CG)
112  wtin = 1.0   ! Weight = 1 since no variance reduction
used
113
```

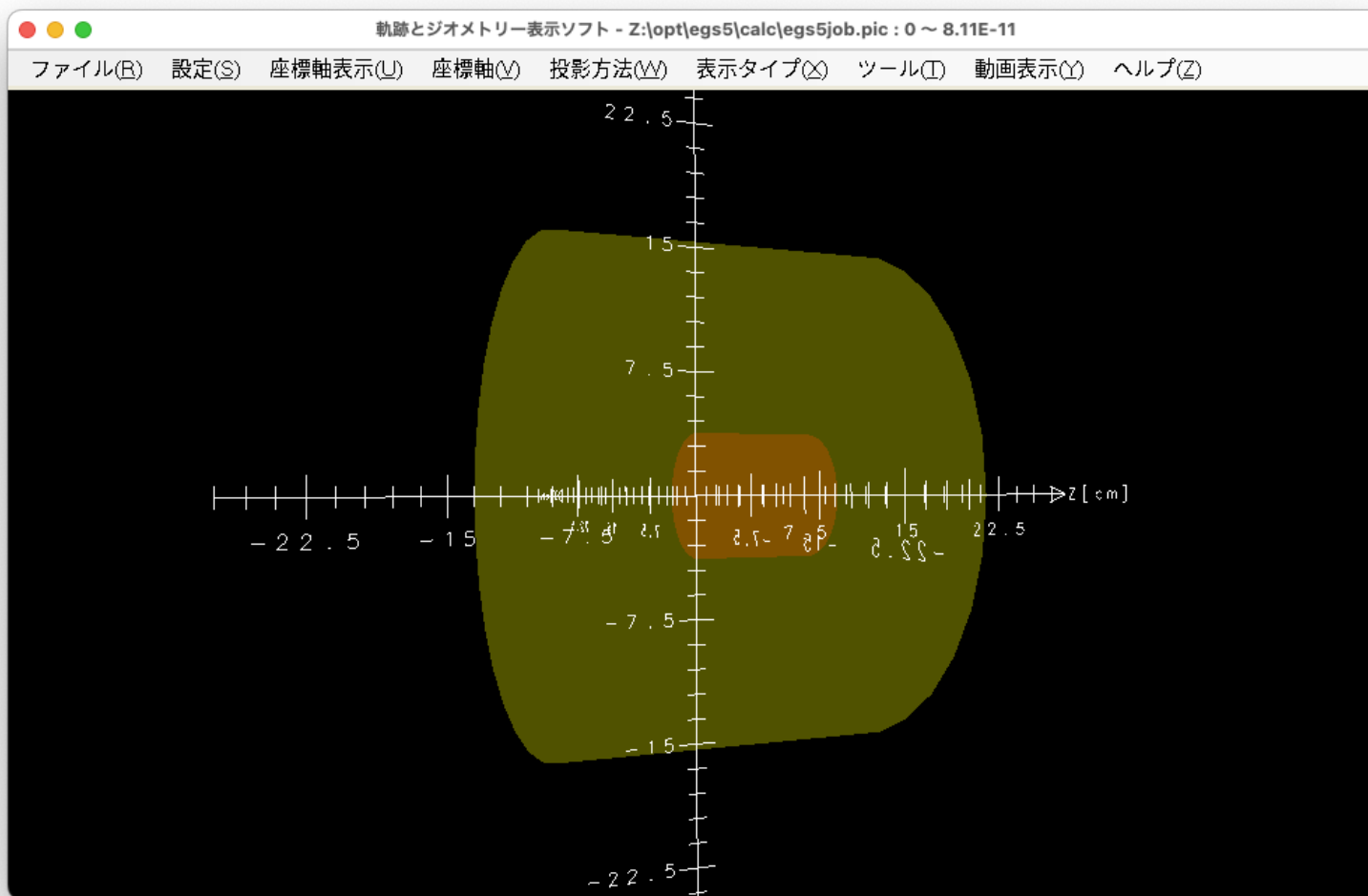
```
185  uf(1)=0.0
186  vf(1)=0.0
187  wf(1)=0.0 ! Needed if lpolar(i)=1
188
189  de = 0d0
190
191  call shower (iqin,etot,xin,yin,zin,uin,vin,win,irin,wtin)
192
193  if(de.ne.0) write(93,'(1pe13.5)') de
194
195  ncount = ncount + 1 ! Count total number of actual
cases
196
197  if(iwatch.gt.0) call swatch(-1,iwatch)
198
199  end do ! End of CALL SHOWER loop
```

# ausgab

```
48  nmed=1
49  if(nmed.gt.MXMED) then
50    write(*,*)'error:nmed exceeds MXMED'
51    stop
52  end if
53
54  call block_set      ! Initialize some general variables
55  medarr(1)='NAI'
56
```

```
102 ! source
103  iqin = 0      ! Incident particle charge - photons
104  ekein = 0.662d0 ! Incident particle kinetic energy
105  xin = 0.0    ! Source position
106  yin = 0.0
107  zin = -5.0
108  uin = 0.0    ! Moving along z axis
109  vin = 0.0
110  win = 1.0
111  irin = 0     ! Starting region (0: Automatic search in CG)
112  wtin = 1.0  ! Weight = 1 since no variance reduction
used
113
```

```
185  uf(1)=0.0
186  vf(1)=0.0
187  wf(1)=0.0 ! Needed if lpolar(i)=1
188
189  de = 0d0
190
191  call shower (iqin,etot,xin,yin,zin,uin,vin,win,irin,wtin)
192
193  if(de.ne.0) write(93,'(1pe13.5)') de
194
195  ncount = ncount + 1 ! Count total number of actual
cases
196
197  if(iwatch.gt.0) call swatch(-1,iwatch)
198
199  end do ! End of CALL SHOWER loop
```



# 3インチNaIの応答, $E_{\gamma}=622\text{keV}$

