A User's Guide to the BRICE Code

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I. Introduction

This report describes the use of Brice's codes[1] COREL, RASE4 and DAMG2 on the NMFECC (National Magnetic Fusion Energy Computer Center) computers. The report should not be considered a substitute for the original reference[1] of these codes. Understanding of that reference is essential to be familiar with the functions of these codes, the theory on which they are based and the meanings of their input variables. The three codes constitute now only one code, henceforth named as the BRICE code, which has slightly different forms of input from that described in ref. 1.

An interactive program, HELPBR, was written to prepare the input for BRICE, to run the code, do the graphics and more importantly to perform the iteration procedure which is required for the case of compound targets. All that is required from the user is to know how to log in to the CRAY computers of NMFECC and to answer the questions of HELPBR. The resulting input for BRICE will obey all the required accuracy restrictions.

The next section of this report, Sec. II, will explain the constructions of the BRICE code and the input variables. Section III gives the input and the output for the sample problem described in ref. 1. Section IV describes briefly HELPBR and shows the iteration procedure to obtain the partition function of the compound target used in the same sample problem of ref. 1, and the obtained results. Section V describes how to obtain the codes and execute them.

II.1. BRICE Code

The BRICE code consists of three major routines, COREL, RASE4 and DAMG2. The main routine in the code MAIN controls the execution of each of the three subroutines according to the input instructions. Almost all of the input variables are read from the same entry in MAIN and remain unchanged until they are redefined by a new read.

MAIN reads one ASCII record, one namelist record and, depending on the value of a certain variable in the namelist record, might read another ASCII record. The namelist record read by MAIN should contain all the information of the target and the ion masses and charges and the composition of the target. This information is local in MAIN and is provided to other subroutines through common areas.

Following that an instruction card is read which instructs MAIN to perform specific tasks. This instruction card has one of the following forms: COREL, RASE, DAMG, NEW and END. Following this card the code expects a namelist record in its input which might define or redefine the namelist variables. In case of compound targets another title card (dummy title) and a namelist record are needed after reading the RASE instruction and the namelist record following it. After the "DAMG" instruction, a namelist record is read from the subroutine DAMG2. In the following is a description of the namelist variables and the sequence of the input records.

II.2. Inputs to BRICE Code

There are three different types of inputs to the BRICE code. These are: control instructions, namelist inputs and a maximum of two input cards which are read as text image; one is read at the very beginning and contains the name of the target and the other is read when the variable FRMT is set to nonzero values.

II.3. Control Instructions

These input instructions are:

a) corel m

This is to direct MAIN to call COREL. If there is nothing after "COREL" then MAIN will call COREL "NCOMP" times to calculate the range data for all the components in the target where NCOMP is the number of components in the target. In this case the maximum energy and the energy interval used in COREL will be the same for all the components and either LSS or Firsov theoretical expression for the electronic stopping power should be used for all the components. The program will read only one namelist record in this case.

On the other hand, if m is a number between 1 and NCOMP, i.e. ($1 \leq m \leq NCOMP$), COREL will be called to calculate the range data for the m_{th} components, and one has the choice in this case to have whatever electronic stopping formula for the mth component with the target components. In this case the values of NE, NMULT and NDIV can be different from one recoil to another, but NE(NMULT/NDIV) for a particular component should be $\geq$ the maximum recoil energy that component would have in a collision with an incident ion. Finally, if "corel" is followed by "Ø" or "ion", then corel will be called to calculate the ranges for the incident ion. In this case no information will be written on TAPE1Ø.

b) rase

This instruction record will cause MAIN to call RASE4. If a number "M" follows, e.g., "rase M", so that $1 \leq M \leq NCOMP$, then RASE4 will consider the mth component as the incident ion. This is used in the iteration procedure to evaluate the partition function of a component in a compound target.

c) damg.

This is exactly as for b) (rase).

e) end

To terminate the program.

f) new

To start from the beginning for a new case.

II.4. Namelist Inputs

II.4.1. Namelist Read by MAIN, COREL and RASE4

*ION — Default (none): contains the name of the incident ion and should be quoted, e.g., ion = "nickel". The name can contain up to eight characters. This variable as well as all the marked variables mentioned below should be set in the first read by MAIN.

*PI — Default (none): is the atomic mass (amu) of the incident ion.

*ZI — Default (none): is the atomic number of the ion.

*NCOMP — Default (1): the number of the components of atomic species in the target. In case of ncomp > 4, the BRICE code should be recompiled and reloaded. This is described in section V. HELPBR will do that automatically.

*ALAT — Default (none): as in ref. (1) is the value in Å of the cube root of the volume of a unit cell of the target material. This is used together with NFORM to evaluate the atomic density of each species in the target. However, other options exist; see ALATA and ALATD.

*ALATA — Default (0.0): the atomic density (atoms/cm^3) of the target is an alternative to ALAT or ALATD.

*ALATD Default (0.0): the gram density (gm/cm^3) of the target, and is an alternative to ALAT or ALATA.

*NFORM(I), I=1, NCOMP depending on which of the three variables ALAT, ALATD or ALATA is used.

- In case ALAT is used NFORM(I) is the number of atoms of the i_{th} component in the unit cell of the target.
- In case ALATA is used. NFORM(I) is the atomic fraction or percent of the i_{th} component in the target.
- In case that ALATD is used NFORM(I) is the weight fraction or percent of the i_{th} component in the target.

*TARGET(I), I=1, NCOMP is the name of the ith component of the target; up to eight characters can be used and should be quoted.

*P2(I), I=1, NCOMP is the atomic mass (amu) of the i_{th} component of the target.

*Z2(I), I=1, NCOMP is the atomic number of the i_{th} component of the target.

ED Default (0.0): displacement energy in keV.

NQTI Default (4): this variable sets the minimum value of the integration variable $u^{1/2}$. This should be increased to a larger value to avoid execution error in cases of very low energy (see p. 29, ref. 1).

NQTX Default (2): to allow for the change of the integration interval used in COREL and RASE4 (see p. 29, ref. 1).

FRMT Default (0): if this variable is set to any nonzero value the program will read (after the namelist record) a new ASCII record which is used as an output format in COREL and RASE4. The default form of this format is: (1X, 2 (2F8.2, F9.2, 3F12.2, 4X)).

LIB10 Default (0): this variable should be set to 1 if there is information on TAPE10 (COREL output) needed to be saved, otherwise, writing on TAPE10 will start at its beginning.

LIB20 Default (0): does the same thing as LIB10, but with respect to TAPE20 (RASE4 output).

LIB30 Default (0): as LIB20, but with respect to TAPE30 (DAMG2 output).

IPLTD Default (1): the code writes the damage distribution and some other information on an output file which could be used later by the graphic program XPLOT (see Sec. V). To suppress this output set ipltd=0.

IPRNTC Default (1): this variable was used for debugging to suppress the output from COREL if it is set to zero. If iprntc is set to a negative value, COREL will print |iprntc| lines at the beginning and at the end.

IPRNTR Default (1): set IPRNTR=0 to suppress all the print outputs of the averages of deposited energy (damage and electronic) in RASE4.

IPRNTD Default (1): if IPRNTD=0, no energy distribution will be output from DAMG2, only the headings will be output.

MODR Default (1): this variable is used to control the displacement model used in RASE4; if MODR=0 the original model is used, but for compound target execution error is expected in case that displacement energy > 0.0. If MODR=1 the model will be exactly as what was explained in ref. 1, p. 39. MODR=2 neglects any recoil energy less than the displacement energy.

NEXP(I), I=1, NCOMP: see ref. 1, p. 24.

CSE(I) — Used if NEXP(I) > 0.

SETA(I), ALP(I), EN(I) — Used if NEXP(I) is negative and ≠ - 50. (see Appendix E)

NE, NMULT, NDIV, NDIVE, NSTP, NDSKP — see ref. 1.

II.4.2 Namelist Read by RASE4 and Only for Compound Targets

The BRICE code now allows for different energy intervals for the recoils partition functions.

DE(I) is the energy interval in keV at which the partition function of the i_{th} component is given.

NDAM(I) is the number of intervals DE(I) in the partition function of the i_{th} component (NDAM(I) x DE(I)) should be greater than or equal to the maximum recoil energy of the i_{th} component.

PART(2,I) is the partition function of the i_{th} component in this target.

Note before this namelist there should be an identification card (it could be a blank card).

II.4.3 Namelist Read by DAMG2

NTYPE Default (1): NTYPE=1 gives damage distribution and NTYPE=2 gives electronic energy.

JSTP Default (0): if contour plot outputs are needed, BRICE should be recompiled and loaded. The default is no-contour plot outputs are produced (to save computer storage).

nxtnd
Ke
} See ref. 1, p. 60.

III. Sample Problem

In this section the case solved in ref. 1 for silicon ions incident on silicon dioxide is repeated to illustrate the new format of the input.

The following printed output shows the input for this case. The first line contains the name of the target line 2 to line 5 in the first namelist record. Line 6 is a central instruction "corel" followed by namelist record (lines 7 and 8). Line 9 is control instruction rase, and since the same parameters Ne, etc. are used for both COREL and RASE4 (and also LSS is used for both components), the namelist record line 10 does not define or redefine any parameter (note that the $ should be used to terminate the namelist record).

Line number 11 is a dummy title which is read and output to the user terminal to indicate that the program has reached this point. Lines 12-15 are the namelist record for the partition function. Line 16 is a control instruction "damg" followed by the namelist record read by DAMG2 (lines 17 and 18).

```
 1   silicon dioxide sio2
 2   ion="silicon"    pi=28.  zi=14.
 3   ncomp=2   target="silicon","oxygen"
 4   alat=3.566   p2=28. 16.  z2=14. 8.  nform=1 2
 5   $end main
 6   corel
 7   ne=30 nstp=10   ndiv=1 ndive=1 nmult=1 ndskp=1
 8   $end corel
 9   rase
10   $end rase
11   the following record is used for compound targets only ????
12   ndam=10 10   de=10. 10.
13   part(2,1)=.6616  .6539  .6385 .6162 .5945 .5742 .5555 .5382 .5221 .5072
14   part(2,2)=.6246  .5974  .5529 .5130 .4797 .4507 .4253 .4030 .3831 .3653
15   $end partition
16   damg
17   ntupe=1 jstp=50
18   $end damg2 namelist record
19   end
```

The output is given in Appendix A, and the results show complete agreement with those given in ref. 1. Note that in ref. 1 the results of COREL for the silicon recoils were not given. Here the complete results are presented.

In the next section, the same case will be considered again, but as being prepared by HELPBR, and also will show the iteration scheme necessary to obtain the partition function.

IV. The Interactive Program "HELPBR" and the Iteration Procedure for Compound Targets

The interactive program HELPBR was written to prepare the input for the BRICE code, and to make sure that this input satisfies all the accuracy requirements. The program can run the BRICE code itself, and if necessary compile and load the code if the required case needs more computer storage than the default one (see Section V). HELPBR also can prepare the input required for the graphic program and run it. For compound targets, HELPBR can carry out the iteration procedure to obtain the partition function of each component. In brief HELPBR takes care of everything the user might want as long as the answers of the user to HELPBR's questions are correct. The questions are all obvious and need not be explained.

In this section the case of Si-SiO_2 will be considered again to illustrate the procedure. Each iteration consists of two runs, one for Si recoils and one for O_2 recoils. Except for the first run in the first iteration, in each run, RASE4 and DAMG2 will be executed. In the first run COREL will be called first to calculate the ranges of the recoils.

The partition function for oxygen converged after the seventh iteration to an absolute accuracy of 1.E-5. The partition function of silicon converged to the same accuracy after the eighth iteration. The following is an example of an interactive session of HELPBR. See Section V for how to obtain the complete outputs. Partial outputs are given here in Appendices B-D. Appendix B contains the outputs from COREL [the recoil (Si and O_2) ranges]. Appendix C contains partial outputs from RASE4 and DAMG2 (for the damage energy deposition). Finally, Appendix D contains partial output from DAMG2 for the electronic energy deposition.

```
lbrice / 1 2
welcome
are you familiar with this program ?(yes or no):yes

details ?(yes or no): no



enter target name :sio2
enter number of components :2
enter       'name', 'atomic number', and 'atomic mass' of each component
comp.  1 :si  14. 28.
comp.  2 :o2  8.  16.



enter density option:1 for alat, 2 for alata, 3 for alatd: 1
enter lattice constant in angstroms : 3.566
enter number of atoms of comp.- 1 (si      ) :1
enter number of atoms of comp.- 2 (o2      ) :2


enter average displacement energy(ev) for the target atoms:0.
.
.
now the electronic energy loss data for the recoils,
mark 'x' under one of the following indicating your choice
recoil     target       lss   firsov   brice  exper
  si        si      :    x
recoil     target       lss   firsov   brice  exper
  si        o2      :    x
recoil     target       lss   firsov   brice  exper
  o2        si      :    x
recoil     target       lss   firsov   brice  exper
  o2        o2      :    x


now data relevant to the incident ion:::::::
enter ion name :si
enter atomic number, and atomic mass of the ion :14  28
enter ions 'energy', space, unit(e.g. mev kev ev) :30. kev


[                  lss max energy (kev) =     23431.1


.
.
now electronic energy loss for the ion with each comp.
as before mark 'x' under one of the followins
ion        target       lss   firsov   brice  exper
si          si      :    x
ion        target       lss   firsov   brice  exper
si          o2      :    x
.
.
```

```
this code guarantees that min. interval of integration is < el/n  where n=4
and el is char. energy, you can change the value of n to other value. (n>2)
enter value of n :4
.
.
do you know the part. func. of the recoil: si      in the target:sio2
answer yes or no :no
do you know the part. func. of the recoil: o2      in the target:sio2
answer yes or no :no


[ ion=si          with energy    30.000     (kev)
[ target       e-rec-max    elss-max     char.  energy
[    si          30.000         23431.         41.043
[    o2          27.769         6349.0         29.632
[ recoil     target       char. energy(kev)
[    si          si           41.043
[    si          o2           29.632
[    o2          si           16.932
[    o2          o2           11.121
.
.
.
enter min & max values of ne(100,1600):100 2000
enter min & max (ne/nstp) (10 30):10 20
enter min & max (nstp/ndive) (10 20):10 20


ne=101       nmult=3         ndiv=10        ndive=1   $

ne=101       nmult=27769     ndiv=100000    ndive=1   $

ne=120      nmult=1         ndiv=4         nstp=12      ndive=1       ndskp=1$
  raset$    iph, itry :     6  0
ne=120      nmult=1         ndiv=4         nstp=10      ndive=1       ndskp=1$
  raset$    iph, itry :     6  0
ne=120      nmult=27769     ndiv=120000    nstp=12      ndive=1       ndskp=1$
  raset$    iph, itry :     6  0
ne=120      nmult=27769     ndiv=120000    nstp=10      ndive=1       ndskp=1$
  raset$    iph, itry :     6  0
ne=120      nmult=1         ndiv=4         nstp=12      ndive=1       ndskp=1$
  rasei$    iph, itry :     6  0
ne=120      nmult=1         ndiv=4         nstp=10      ndive=1       ndskp=1$
  rasei$    iph, itry :     6  0
.
.
.
run ?(yes or no)yes


PLEASE WATCH VERY CAREFULLY  ****
FROM NOW ON whenever you get an ERROR message of any kind type :
         (ctrl-e)k
 this is done as follow:
 hold down button 'ctrl' and type 'e', release 'ctrl' and type 'k'
```

```
c 07/26/82 13:32:58 001450
.
.
.
enter max. numb. of iteration:10
enter abs accurcy value(.001 to 1.e-5):.1e-4



    5.63813e-03      9.2763          0.27625          28       4
corel     1

..end of program : corel      ..time consumed(seconds).. =   0.388465

corel     2

..end of program : corel      ..time consumed(seconds).. =   0.430218

rase    1
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    6.56179

dams   1

..end of program : damse2     ..time consumed(seconds).. =    1.34447

end brief

     partition function for si          in sio2              iteration no.    1

energy (kev)      old value      new value      difference

      2.50000      1.0000000      0.6555366      0.34446335
      5.00000      1.0000000      0.7767633      0.22323673
      7.50000      1.0000000      0.8128790      0.18712104
     10.00000      1.0000000      0.8250196      0.17498036
     12.50000      1.0000000      0.8285323      0.17146769
     15.00000      1.0000000      0.8278901      0.17210991
     17.50000      1.0000000      0.8251156      0.17488441
     20.00000      1.0000000      0.8211909      0.17880914
     22.50000      1.0000000      0.8165415      0.18345848
     25.00000      1.0000000      0.8113947      0.18860528
     27.50000      1.0000000      0.8060944      0.19390562
     30.00000      1.0000000      0.8007579      0.19924214
rase    2
* partition function <<<<<<<<<<


..end of program : rase4      ..time consumed(seconds).. =    7.30901

dams   2
```

```
..end of program : damse2     ..time consumed(seconds).. =    2.03137

end brief

     partition function for o2          in sio2              iteration no.    1

energy (kev)      old value      new value      difference

     2.31408      1.0000000      0.6728887      0.32711128
     4.62817      1.0000000      0.7310000      0.26900003
     6.94225      1.0000000      0.7335616      0.26643844
     9.25633      1.0000000      0.7255947      0.27440529
    11.57042      1.0000000      0.7144726      0.28552742
    13.88450      1.0000000      0.7023941      0.29760591
    16.19858      1.0000000      0.6900763      0.30992372
    18.51267      1.0000000      0.6778180      0.32218200
    20.82675      1.0000000      0.6659007      0.33409925
    23.14083      1.0000000      0.6543439      0.34565610
    25.45492      1.0000000      0.6431579      0.35684207
    27.76900      1.0000000      0.6323540      0.36764600
     16 lines (  80a)
rase   1
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    6.56395

dams  1

..end of program : damse2     ..time consumed(seconds).. =    1.34522

end brief

     partition function for si          in sio2              iteration no.    2

energy (kev)      old value      new value      difference

     2.50000      0.6555366      0.6012180      0.05431866
     5.00000      0.7767633      0.6717381      0.10502516
     7.50000      0.8128790      0.6843088      0.12857012
    10.00000      0.8250196      0.6858629      0.13915674
    12.50000      0.8285323      0.6829950      0.14553727
    15.00000      0.8278901      0.6791064      0.14878369
    17.50000      0.8251156      0.6740109      0.15110466
    20.00000      0.8211909      0.6683162      0.15287470
    22.50000      0.8165415      0.6624403      0.15410127
    25.00000      0.8113947      0.6565396      0.15485514
    27.50000      0.8060944      0.6506571      0.15543725
    30.00000      0.8007579      0.6449123      0.15584558
     16 lines (  80a)
rase   2
* partition function <<<<<<<<<<
..end of program : rase4      ..time consumed(seconds).. =    7.31333

dams  2

..end of program : damse2     ..time consumed(seconds).. =    2.03184
```

```
    27.76900      0.5186018      0.5183096      0.00029218
     16 lines (  80a)
rase   1
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    6.56143

dams  1

..end of program : damse2     ..time consumed(seconds).. =    1.34495

end brief

     partition function for si         in sio2              iteration no.   6

energy (kev)      old value      new value      difference

     2.50000      0.5933669      0.5933562      0.00001068
     5.00000      0.6549122      0.6548889      0.00002330
     7.50000      0.6593943      0.6593585      0.00003579
    10.00000      0.6545933      0.6545462      0.00004719
    12.50000      0.6467631      0.6467056      0.00005749
    15.00000      0.6389854      0.6389186      0.00006681
    17.50000      0.6307075      0.6306322      0.00007528
    20.00000      0.6224113      0.6223283      0.00008296
    22.50000      0.6143957      0.6143058      0.00008993
    25.00000      0.6066862      0.6065899      0.00009628
    27.50000      0.5992861      0.5991840      0.00010207
    30.00000      0.5922594      0.5921520      0.00010737
     16 lines (  80a)
rase   2
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    7.30317

dams  2

..end of program : damse2     ..time consumed(seconds).. =    2.03257

end brief

     partition function for o2         in sio2              iteration no.   6

energy (kev)      old value      new value      difference

     2.31408      0.6328951      0.6328897      0.00000539
     4.62817      0.6585506      0.6585401      0.00001055
     6.94225      0.6446321      0.6446171      0.00001499
     9.25633      0.6275234      0.6275048      0.00001860
    11.57042      0.6107113      0.6106897      0.00002158
    13.88450      0.5948667      0.5948426      0.00002409
    16.19858      0.5799769      0.5799507      0.00002623
    18.51267      0.5660181      0.5659901      0.00002805
    20.82675      0.5529940      0.5529644      0.00002959
    23.14083      0.5407564      0.5407255      0.00003089
    25.45492      0.5292165      0.5291845      0.00003200
    27.76900      0.5183096      0.5182767      0.00003295
     16 lines (  80a)
```

```
rase   1
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    6.55373

dams  1

..end of program : damse2     ..time consumed(seconds).. =    1.34601

end brief

     partition function for si        in sio2              iteration no.    7

energy (kev)      old value      new value      difference

     2.50000      0.5933562      0.5933550      0.00000120
     5.00000      0.6548889      0.6548863      0.00000262
     7.50000      0.6593585      0.6593545      0.00000402
    10.00000      0.6545462      0.6545408      0.00000531
    12.50000      0.6467056      0.6466991      0.00000647
    15.00000      0.6389186      0.6389110      0.00000752
    17.50000      0.6306322      0.6306237      0.00000848
    20.00000      0.6223283      0.6223190      0.00000936
    22.50000      0.6143058      0.6142956      0.00001015
    25.00000      0.6065899      0.6065790      0.00001088
    27.50000      0.5991840      0.5991725      0.00001154
    30.00000      0.5921520      0.5921399      0.00001215
     16 lines (  80a)
rase   2
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    7.30936

dams  2

..end of program : damse2     ..time consumed(seconds).. =    2.03098

end brief

     partition function for o2        in sio2              iteration no.    7

energy (kev)      old value      new value      difference

     2.31408      0.6328897      0.6328891      0.00000060
     4.62817      0.6585401      0.6585389      0.00000118
     6.94225      0.6446171      0.6446154      0.00000167
     9.25633      0.6275048      0.6275027      0.00000208
    11.57042      0.6106897      0.6106873      0.00000241
    13.88450      0.5948426      0.5948399      0.00000269
    16.19858      0.5799507      0.5799478      0.00000293
    18.51267      0.5659901      0.5659869      0.00000313
    20.82675      0.5529644      0.5529611      0.00000331
    23.14083      0.5407255      0.5407220      0.00000345
    25.45492      0.5291845      0.5291810      0.00000358
    27.76900      0.5182767      0.5182730      0.00000368
     16 lines (  80a)
```

```
rase   1
* partition function <<<<<<<<<<

..end of program : rase4      ..time consumed(seconds).. =    6.56083

damg  1

..end of program : damge2     ..time consumed(seconds).. =    1.34448

end brief

     partition function for si        in sio2             iteration no.   8

energy (kev)     old value      new value      difference

     2.50000     0.5933550      0.5933549      0.00000013
     5.00000     0.6548863      0.6548860      0.00000029
     7.50000     0.6593545      0.6593540      0.00000045
    10.00000     0.6545408      0.6545402      0.00000059
    12.50000     0.6466991      0.6466984      0.00000072
    15.00000     0.6389110      0.6389102      0.00000084
    17.50000     0.6306237      0.6306227      0.00000095
    20.00000     0.6223190      0.6223179      0.00000105
    22.50000     0.6142956      0.6142945      0.00000114
    25.00000     0.6065790      0.6065778      0.00000122
    27.50000     0.5991725      0.5991712      0.00000129
    30.00000     0.5921399      0.5921385      0.00000136
..
..
..
more iterations (yes or no) ?no

     16 lines (  80a)


ne=120     nmult=1        ndiv=4        nstp=10     ndive=1      ndskp=1$
rase
partition functions for recoils

..end of program : rase4      ..time consumed(seconds).. =    7.11785

damg

..end of program : damge2     ..time consumed(seconds).. =    1.52665

end brief



.
.
.
plot ? (yes or no):yes
.
.
```

```
.
damage energy distribution is done
do you want also electronic energy deposition(y or no):yes


ne=120      nmult=1          ndiv=4          nstp=10      ndive=1        ndskp=1$
dams


..end of program : damse2     ..time consumed(seconds).. =    2.07513

end brief
.
.
.
Job done, hopefully correct
after this program terminates, type the followins to set your outputs
netout o*
netplot f3* displa

 all done
```

V. Availability of the Codes

Everything related to the BRICE code is in the directory c-brice in the film space of user 14225. The source "sbrice", the controllee (the executable program) "xbrice" and the controllee of HELPBR "xhelpbr" are all contained in a lib[2] file "lbrice". The library file "lbrice" contains also the files "pbrice" which is a cliche file used by "precomp",[2] "xplot" which is the controllee for the graphics program and "iplot" which is the input for "xplot".

The complete output for the test case of ref. 1 is "orprtØØ. The complete outputs described in Sec. IV are "obriceØØ", "briceØ1" and "briceØ2". Also, the complete graphics outputs are the files "f3brieØx" and "f3brifØx".

To obtain one of the above file types:

```
filem/
rds 14225 .c-brice "file name"
end
```

where "file name" is any of the above mentioned files. After reading "lbrice", to obtain any file from it type:

```
lib lbrice
x "file name"
end.
```

To execute xbrice type

```
xbrice i=ifile / t
```

where "ifile" is the input file and t is the approximate time needed for the run.

Finally, to use HELPBR type:

```
lbrice.
```

The cliche file "pbrice" is listed below:

```
1       CLICHE PBRICE
2       PARAMETER (KM=  4)
3       PARAMETER (KM2=KM+4)
4       PARAMETER (IPNE= 1600)
5       PARAMETER (IPD=  30)
6       PARAMETER (IPRT=IPD+4)
7       PARAMETER (IPX=  50)
8       PARAMETER (IPRC= 4)
9       ENDCLICHE
.
```

This file is used to pre-compile the source code "sbrice". The parameters in this file set the dimension of almost all the arrays in the code. The effect of each is:

KM — sets the maximum number of components, i.e., the maximum value the variable NCOMP can take.

IPNE — sets the maximum number of the small energy interval (NMULT/NDIV), and is the limit of the variable NE.

IPD — sets the maximum number of the major energy interval NE/NSTP.

IPX — sets the limit for the value of NE/NSTP + NSTP/NDIVE + 3

IPRC — sets one of the three dimensions of the array used to store the value of the contour plotting data in DAMG2. Its default value was 250 and the array consumed a considerable amount of computer storage.

If any of the above underlined variables (or expressions) could take a value greater than the corresponding parameter the user should change that parameter to a value > the desired limit in the file "pbrice" with the aid of any editor [QED or TRIXGL[2]]. After that compile and load the code type:

trixgl o(sbrice) run end.

As mentioned before, HELPBR will do that for the user. If the loader "LDR" fails to load the program because the required storage exceeds the computer capacity switch to the D machine and try again.

Acknowledgment

Support for this work has been provided by the U.S. Department of Energy.

References

1. D.K. Brice, "Ion Implantation Range and Energy Deposition Codes COREL, RASE4 and DAMG2", SAND75-0622, July 1977.

2. See the online program on the NMFECC "document".

Appendix A

Results of BRICE Code for the Test Case of Reference 1

```
controllee: xbrice          controller:
loaded on : 07/22/82        at time    : 13:18:06
dropfile  : +xbricea        system     : a
user #    : 001450          account    : 862swi
program bank( min:sec ) :    0:59
pool    bank( minutes ) :         116

                                                                    date     : 07/27/82
                                                                    time     : 07:16:44 (pst)
                                                                    machine  : c

files:
          tape10      tape20      tape30      tape32      orprt00     arprt00

                          ***** input data  for  rprt00  run  *****

  1 -- :     0                                                                  - brice    rprt00
  2 -- :silicon dioxide sio2                                                    - brice    rprt00
  3 -- :ion="silicon"    pi=28.  zi=14.                                         - brice    rprt00
  4 -- :ncomp=2   target="silicon","oxygen"                                     - brice    rprt00
  5 -- :alat=3.566   p2=28. 16.  z2=14. 8.  nform=1 2                           - brice    rprt00
  6 -- :$end main                                                               - brice    rprt00
  7 -- :core1                                                                   - brice    rprt00
  8 -- :ne=30 nstp=10   ndiv=1 ndive=1 nmult=1 ndskp=1                          - brice    rprt00
  9 -- :$end core1                                                              - brice    rprt00
 10 -- :rase                                                                    - brice    rprt00
 11 -- :$end rase                                                               - brice    rprt00
 12 -- :the following record is used for compound targets only ????             - brice    rprt00
 13 -- :ndam=10 10   de=10. 10.                                                 - brice    rprt00
 14 -- :part(2,1)=.6616  .6539  .6385 .6162 .5945 .5742 .5555 .5382 .5221 .5072 - brice    rprt00
 15 -- :part(2,2)=.6246  .5974  .5529 .5135 .4797 .4507 .4253 .4030 .3831 .3653 - brice    rprt00
 16 -- :$end partition                                                          - brice    rprt00
 17 -- :dama                                                                    - brice    rprt00
 18 -- :ntupe=1 istp=50                                                         - brice    rprt00
```

```
        19 -- :$end damq2 namelist record                                - brice    rprt00
        20 -- :end                                                       - brice    rprt00
orel
```

*** begin of program : corel recoil no. 1..."silicon " ...in silicon dioxide target ***

date : 07/27/82
time : 07:16:44

range and straggling data for silicon ions incident on a/an silicon dioxide target

initial values

incident ion silicon
atomic number(z1) = 14.
atomic mass(m1) = 28.00 amu
energy maximum = 23431.06Kev

target - silicon dioxide

components	a-number	a-mass amu	t-f rad. cm	z-eff.	char. energy kev	density	nform	nexp
silicon	14.	28.00	1.375e-09	39.598	41.043	2.20524e+22	1.000	0
oxygen	8.	16.00	1.497e-09	30.720	29.632	4.41048e+22	2.000	0

characteristic length = 239.04 angstroms

atomic density = 6.61572e+22 atoms/cc

the following electronic stopping cross sections were used in the calculations

silicon - thomas-fermi atomic model
cse = 1.23221e-03

oxygen - thomas-fermi atomic model
cse = 1.81522e-03

ne	nstp	ncomp	ndiv	ndive	nmult	ndskp	nrpt
30	10	2	1	1	1	1	0

i	u(i)	f(u)	slope
1	0.002	0.162	0.06781
2	0.004	0.209	0.07749
3	0.010	0.280	0.07791
4	0.020	0.334	0.07069
5	0.040	0.383	0.05239
6	0.100	0.431	0.00987
7	0.150	0.435	-0.02433
8	0.200	0.428	-0.06204
9	0.400	0.385	-0.12005
10	1.000	0.275	-0.13129
11	2.000	0.184	-0.11109
12	4.000	0.107	-0.06221

- f(u) is universal thomas-fermi function - from lss

***** units *****
energy - kev
rp,r,delta,dp - angstroms
eps,de/dr - dimensionless
damage - ev/angstrom

e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp	e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp
1.00	0.00	14.98	16.54	13.52	1.00	2.00	0.00	31.06	20.65	33.91	9.76
3.00	0.00	45.45	25.41	51.97	19.09	4.00	0.00	58.92	30.53	68.90	26.33
5.00	0.00	71.82	35.56	85.15	33.08	6.00	0.00	84.39	40.66	100.96	39.36
7.00	0.00	96.75	45.68	116.49	45.43	8.00	0.00	108.97	50.64	131.81	51.36
9.00	0.00	121.11	55.59	146.99	57.13	10.00	0.00	133.19	60.48	162.06	62.83
11.00	0.00	145.24	65.32	177.05	68.46	12.00	0.00	157.25	70.16	191.97	74.00
13.00	0.00	169.26	74.96	206.85	79.50	14.00	0.00	181.26	79.72	221.70	84.97
15.00	0.00	193.28	84.47	236.52	90.39	16.00	0.00	205.30	89.20	251.34	95.77
17.00	0.00	217.34	93.89	266.14	101.14	18.00	0.00	229.40	98.58	280.95	106.47
19.00	0.00	241.49	103.24	295.76	111.79	20.00	0.00	253.60	107.88	310.58	117.09
21.00	0.00	265.75	112.50	325.40	122.37	22.00	0.00	277.92	117.10	340.24	127.64
23.00	0.00	290.12	121.68	355.10	132.89	24.00	0.00	302.35	126.25	369.97	138.13
25.00	0.00	314.62	130.80	384.85	143.35	26.00	0.00	326.91	135.33	399.75	148.56
27.00	0.00	339.23	139.85	414.66	153.76	28.00	0.00	351.58	144.36	429.59	158.94
29.00	0.00	363.96	148.84	444.53	164.11	30.00	0.00	376.37	153.31	459.49	169.27

...end of program : corel ...time consumed (seconds)... = 0.125124

task: corel

cpu time(millisec.) : 127
io " : 57

*** begin of program : corel recoil no. 2..."oxugen " ...in silicon dioxide target ***

date : 07/27/82
time : 07:16:44

range and straggling data for oxugen ions incident on a/an silicon dioxide target

initial values

incident ion oxugen
atomic number(z1) = 8.
atomic mass(m1) = 16.00 amu
energy maximum = 6348.97kev

target - silicon dioxide

components	a-number	a-mass amu	t-f rad. cm	z-eff.	char. energy kev	density	nform	nexp
silicon	14.	28.00	1.497e-09	30.720	16.932	2.20524e+22	1.000	0
oxugen	8.	16.00	1.657e-09	22.627	11.121	4.41048e+22	2.000	0

29 characteristic length = 190.76 angstroms

atomic density = 6.61572e+22 atoms/cc

the following electronic stopping cross sections were used in the calculations

silicon - thomas-fermi atomic model
cse = 1.09373e-03

oxugen - thomas-fermi atomic model
cse = 1.69703e-03

ne	nstp	ncomp	ndiv	ndive	nmult	ndskp	nrpt
30	10	2	1	1	1	1	0

i	u(i)	f(u)	slope	- f(u) is universal thomas-fermi function - from lss
1	0.002	0.162	0.06781	
2	0.004	0.209	0.07749	
3	0.010	0.280	0.07791	
4	0.020	0.334	0.07069	
5	0.040	0.383	0.05239	
6	0.100	0.431	0.00987	
7	0.150	0.435	-0.02433	
8	0.200	0.428	-0.06204	
9	0.400	0.385	-0.12005	
10	1.000	0.275	-0.13129	
11	2.000	0.184	-0.11109	
12	4.000	0.107	-0.06221	

***** units *****
energy - kev
rp,r,delta,dp - angstroms
eps,de/dr - dimensionless
damage - ev/angstrom

30

e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp	e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp
1.00	0.00	27.66	34.80	22.00	1.00	2.00	0.00	48.88	39.38	56.48	14.85
3.00	0.00	70.30	46.04	88.26	37.15	4.00	0.00	91.51	54.05	118.99	52.54
5.00	0.00	112.65	62.65	149.21	66.20	6.00	0.00	133.85	71.41	179.17	79.18
7.00	0.00	155.15	80.32	208.99	91.68	8.00	0.00	176.57	89.28	238.75	103.90
9.00	0.00	198.14	98.21	268.48	115.94	10.00	0.00	219.85	107.09	298.22	127.83
11.00	0.00	241.71	115.90	327.97	139.60	12.00	0.00	263.72	124.65	357.74	151.29
13.00	0.00	285.85	133.34	387.53	162.87	14.00	0.00	308.11	141.99	417.34	174.36
15.00	0.00	330.50	150.58	447.17	185.76	16.00	0.00	353.00	159.12	477.03	197.07
17.00	0.00	375.62	167.59	506.91	208.31	18.00	0.00	398.34	175.96	536.79	219.48
19.00	0.00	421.15	184.26	566.69	230.60	20.00	0.00	444.06	192.47	596.60	241.66
21.00	0.00	467.04	200.61	626.51	252.67	22.00	0.00	490.11	208.70	656.43	263.60
23.00	0.00	513.26	216.70	686.35	274.47	24.00	0.00	536.48	224.64	716.27	285.26
25.00	0.00	559.76	232.51	746.18	296.00	26.00	0.00	583.11	240.26	776.07	306.68
27.00	0.00	606.52	247.94	805.95	317.31	28.00	0.00	629.98	255.55	835.81	327.87
29.00	0.00	653.49	263.08	865.66	338.37	30.00	0.00	677.04	270.53	895.48	348.82

...end of program : corel ...time consumed (seconds)... = 0.138038

task: corel

cpu time(millisec.) : 138
io ,, : 57

*** begin of program : rase4 incident ion.. silicon ...target.. silicon dioxide ***

date : 07/27/82
time : 07:16:44

range and straggling data for silicon ions incident on a/an silicon dioxide target

initial values

incident ion silicon
atomic number(z1) = 14.
atomic mass(m1) = 28.00 amu
energy maximum = 23431.06kev

target - silicon dioxide

components	a-number	a-mass amu	t-f rad. cm	z-eff.	char. energy kev	density	nform	nexp
silicon	14.	28.00	1.375e-09	39.598	41.043	2.20524e+22	1.000	0
oxygen	8.	16.00	1.497e-09	30.720	29.632	4.41048e+22	2.000	0

characteristic length = 239.04 angstroms

atomic density = 6.61572e+22 atoms/cc

the following electronic stopping cross sections were used in the calculations

silicon - thomas-fermi atomic model , lindhard theory
cse = 1.23221e-03

oxygen - thomas-fermi atomic model , lindhard theory
cse = 1.81522e-03

ne	nstp	ncomp	ndiv	ndive	nmult	ndskp	nrpt
30	10	2	1	1	1	1	0

i	u(i)	f(u)	slope - f(u) is universal thomas-fermi function - from lss
1	0.002	0.162	0.06781
2	0.004	0.209	0.07749
3	0.010	0.280	0.07791
4	0.020	0.334	0.07069
5	0.040	0.383	0.05239
6	0.100	0.431	0.00987
7	0.150	0.435	-0.02433
8	0.200	0.428	-0.06204
9	0.400	0.385	-0.12005
10	1.000	0.275	-0.13129
11	2.000	0.184	-0.11109
12	4.000	0.107	-0.06221

***** units *****
energy - kev
lengths - angstroms
energy deposition rates - ev/angstrom

32

electronic stopping power , ev/angstrom ndskp= 1

e	de/dx	e	de/dx	e	de/dx	e	de/dx	e	de/dx	e	de/dx
1.0	3.0474e+00	2.0	4.3097e+00	3.0	5.2783e+00	4.0	6.0949e+00	5.0	6.8143e+00	6.0	7.4646e+00
7.0	8.0627e+00	8.0	8.6194e+00	9.0	9.1423e+00	10.0	9.6368e+00	11.0	1.0107e+01	12.0	1.0557e+01
13.0	1.0988e+01	14.0	1.1402e+01	15.0	1.1803e+01	16.0	1.2190e+01	17.0	1.2565e+01	18.0	1.2929e+01
19.0	1.3283e+01	20.0	1.3629e+01	21.0	1.3965e+01	22.0	1.4294e+01	23.0	1.4615e+01	24.0	1.4929e+01
25.0	1.5237e+01	26.0	1.5539e+01	27.0	1.5835e+01	28.0	1.6125e+01	29.0	1.6411e+01	30.0	1.6691e+01

deposited energy(ev/angstrom) , dep-e

e	dep-e	e	dep-e	e	dep-e	e	dep-e	e	dep-e	e	dep-e
1.0	3.9736e+01	2.0	4.5763e+01	3.0	4.8603e+01	4.0	5.0132e+01	5.0	5.0896e+01	6.0	5.1153e+01
7.0	5.1055e+01	8.0	5.0724e+01	9.0	5.0242e+01	10.0	4.9655e+01	11.0	4.9016e+01	12.0	4.8357e+01
13.0	4.7763e+01	14.0	4.7198e+01	15.0	4.6634e+01	16.0	4.6103e+01	17.0	4.5561e+01	18.0	4.5020e+01
19.0	4.4540e+01	20.0	4.4064e+01	21.0	4.3584e+01	22.0	4.3103e+01	23.0	4.2643e+01	24.0	4.2203e+01
25.0	4.1779e+01	26.0	4.1357e+01	27.0	4.0941e+01	28.0	4.0545e+01	29.0	4.0151e+01	30.0	3.9761e+01

average projected recoil range(angstroms) rp-rec

e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec

date : 07/27/82
time : 07:16:44

range and straggling data for silicon ions incident on a/an silicon dioxide target

e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp	e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp
10.00	1.00	114.45	53.38	124.66	41.67	20.00	1.00	238.78	102.27	273.37	99.36
30.00	1.00	363.32	148.30	422.32	153.42						
10.00	2.00	108.64	52.80	118.84	38.75	20.00	2.00	234.04	101.74	267.81	95.89
30.00	2.00	359.06	147.66	416.80	149.86						
10.00	3.00	100.18	50.63	108.13	33.17	20.00	3.00	227.31	100.41	257.52	90.37
30.00	3.00	353.04	146.46	406.56	144.53						
10.00	4.00	90.32	47.50	95.97	26.99	20.00	4.00	219.67	98.58	246.06	84.23
30.00	4.00	346.24	144.96	395.20	138.61						
10.00	5.00	79.19	43.50	82.85	20.68	20.00	5.00	211.31	96.36	234.07	77.79
30.00	5.00	338.84	143.20	383.36	132.36						
10.00	6.00	66.72	38.59	68.79	14.48	20.00	6.00	202.37	93.76	221.78	71.23
30.00	6.00	330.98	141.19	371.30	125.93						
10.00	7.00	52.57	32.75	53.47	8.46	20.00	7.00	192.87	90.77	209.24	64.63
30.00	7.00	322.68	138.94	359.07	119.39						
10.00	8.00	35.96	26.15	36.09	2.19	20.00	8.00	182.84	87.40	196.48	58.07
30.00	8.00	313.97	136.47	346.71	112.79						
10.00	9.00	14.57	20.01	14.35	1.00	20.00	9.00	172.28	83.64	183.48	51.57
30.00	9.00	304.90	133.76	334.24	106.18						
20.00	10.00	161.18	79.45	170.20	45.18	30.00	10.00	295.46	130.81	321.64	99.57

```
  20.00   20.00     0.00       0.00       0.00       0.00       30.00   20.00   179.81       86.54      185.27      37.40

  10.00    0.00   120.26      53.95      130.49      44.59       20.00    0.00   243.52      102.80      278.93     102.83
  30.00    0.00   367.58     148.95      427.85     156.99

                  ...end of program : rase4     ...time consumed (seconds)... =    1.23298

task: rase4

        cpu  time(millisec.) :       1232
        io        ,,         :        151
        sus       ,,         :          5
        time left (seconds)  :         58
        task time (minutes)  :    0.02055

amq
```

*** begin of program : damage2 incident ion.. silicon ...target.. silicon dioxide ***

date : 07/27/82
time : 07:16:44

damage and/or electronic energy calculations for silicon ions incident on a/an silicon dioxide target

	ion	target	(alat= 3.5660)
	silicon	1-silicon	2-oxygen
atomic number	14.	14.000	8.000
atomic mass	28.	28.000	16.000

ndam	ne	nstp	ndiv	ndive	nmult	ntype	istp	nxtnd	Ke	iter
3	30	10	1	1	1	1	50	1	0	1

damage and/or electronic energy calculations for silicon ions incident on a/an silicon dioxide target

**** units ****

energy - kev
depth,range,delta range - angstroms
energy partition,ion distribution,integrated energy distribution - dimensionless
energy distribution - ev/angstrom

incident energy	incident energy	incident energy
10.00-kev	20.00-kev	30.00-kev
proj. range	proj. range	proj. range
120.-angstroms	244.-angstroms	368. -angstroms
delta rp	delta rp	delta rp
54.-angstroms	103.-angstroms	149.-angstroms
delta perpindicular	delta perpindicular	delta perpindicular
45.-angstroms	103.-angstroms	157.-angstroms
total energy in distribution	total energy in distribution	total energy in distribution
5.86-kev	12.44-kev	18.23-kev
energy partition	energy partition	energy partition
0.6333	0.6596	0.6411

x/rp (pct)	final ion distr.	integrated energy distr.	energy distr.	final ion distr.	integrated energy distr.	energy distr.	final ion distr.	integrated energy distr.	energy distr.

0	0.0834	1.0000	16.03	0.0605	1.0000	15.29	0.0476	1.0000	14.07
2	0.0920	0.9932	17.07	0.0676	0.9938	16.53	0.0537	0.9941	15.25
4	0.1013	0.9860	18.14	0.0753	0.9870	17.82	0.0604	0.9877	16.47
6	0.1113	0.9783	19.23	0.0838	0.9798	19.15	0.0678	0.9808	17.74
8	0.1221	0.9702	20.35	0.0930	0.9720	20.52	0.0760	0.9734	19.06
10	0.1337	0.9616	21.49	0.1030	0.9637	21.94	0.0849	0.9654	20.42
12	0.1460	0.9525	22.64	0.1139	0.9549	23.38	0.0946	0.9569	21.81
14	0.1592	0.9430	23.81	0.1255	0.9454	24.85	0.1052	0.9478	23.23
16	0.1732	0.9330	24.99	0.1381	0.9354	26.35	0.1167	0.9382	24.67
18	0.1881	0.9225	26.17	0.1516	0.9248	27.85	0.1291	0.9279	26.13
20	0.2039	0.9115	27.35	0.1660	0.9136	29.37	0.1424	0.9171	27.61
22	0.2206	0.9000	28.53	0.1814	0.9018	30.88	0.1568	0.9056	29.08
24	0.2381	0.8881	29.70	0.1978	0.8894	32.39	0.1723	0.8936	30.56
26	0.2565	0.8757	30.86	0.2151	0.8764	33.87	0.1887	0.8810	32.02
28	0.2758	0.8627	32.00	0.2335	0.8629	35.34	0.2063	0.8678	33.46
30	0.2960	0.8494	33.11	0.2529	0.8488	36.77	0.2249	0.8540	34.88
32	0.3170	0.8356	34.20	0.2732	0.8341	38.15	0.2446	0.8397	36.26
34	0.3388	0.8213	35.25	0.2946	0.8189	39.49	0.2654	0.8248	37.61
36	0.3614	0.8066	36.27	0.3169	0.8032	40.77	0.2873	0.8093	38.90
38	0.3848	0.7915	37.25	0.3401	0.7870	41.99	0.3102	0.7934	40.14
40	0.4088	0.7761	38.17	0.3642	0.7703	43.13	0.3341	0.7770	41.31
42	0.4335	0.7602	39.05	0.3891	0.7532	44.20	0.3590	0.7601	42.41
44	0.4588	0.7440	39.87	0.4148	0.7357	45.18	0.3848	0.7428	43.44
46	0.4846	0.7275	40.63	0.4412	0.7179	46.07	0.4115	0.7251	44.38
48	0.5108	0.7107	41.33	0.4683	0.6997	46.86	0.4390	0.7070	45.24
50	0.5373	0.6936	41.97	0.4959	0.6812	47.56	0.4671	0.6886	46.01
52	0.5641	0.6762	42.53	0.5239	0.6624	48.16	0.4958	0.6699	46.68
54	0.5911	0.6587	43.02	0.5523	0.6435	48.65	0.5250	0.6510	47.25
56	0.6182	0.6409	43.44	0.5809	0.6244	49.03	0.5546	0.6318	47.73
58	0.6451	0.6230	43.79	0.6096	0.6051	49.31	0.5844	0.6125	48.10
60	0.6720	0.6050	44.05	0.6383	0.5858	49.47	0.6143	0.5930	48.37
62	0.6985	0.5869	44.24	0.6669	0.5664	49.54	0.6442	0.5735	48.53
64	0.7247	0.5687	44.35	0.6951	0.5470	49.49	0.6739	0.5539	48.59
66	0.7503	0.5505	44.38	0.7230	0.5276	49.35	0.7033	0.5343	48.55
68	0.7754	0.5322	44.33	0.7503	0.5084	49.10	0.7321	0.5148	48.41
70	0.7996	0.5141	44.21	0.7768	0.4892	48.75	0.7603	0.4953	48.16
72	0.8230	0.4960	44.01	0.8025	0.4702	48.31	0.7876	0.4759	47.82
74	0.8454	0.4780	43.73	0.8272	0.4514	47.79	0.8140	0.4567	47.39
76	0.8667	0.4601	43.38	0.8508	0.4328	47.17	0.8391	0.4377	46.87
78	0.8867	0.4424	42.95	0.8730	0.4145	46.48	0.8630	0.4189	46.26
80	0.9054	0.4248	42.46	0.8938	0.3964	45.71	0.8853	0.4004	45.57
82	0.9227	0.4075	41.91	0.9131	0.3787	44.87	0.9061	0.3822	44.80
84	0.9384	0.3904	41.28	0.9307	0.3613	43.97	0.9250	0.3643	43.96
86	0.9525	0.3736	40.60	0.9465	0.3443	43.00	0.9421	0.3467	43.05
88	0.9649	0.3571	39.87	0.9604	0.3276	41.99	0.9571	0.3296	42.08
90	0.9755	0.3409	39.08	0.9723	0.3114	40.93	0.9700	0.3128	41.06
92	0.9842	0.3250	38.24	0.9822	0.2956	39.83	0.9807	0.2965	39.98
94	0.9911	0.3095	37.36	0.9899	0.2802	38.69	0.9891	0.2806	38.86
96	0.9960	0.2944	36.44	0.9955	0.2653	37.52	0.9951	0.2651	37.70
98	0.9990	0.2796	35.48	0.9989	0.2509	36.32	0.9988	0.2502	36.50
100	1.0000	0.2652	34.49	1.0000	0.2369	35.11	1.0000	0.2357	35.28
102	0.9990	0.2513	33.47	0.9989	0.2234	33.88	0.9988	0.2217	34.03
104	0.9960	0.2378	32.43	0.9955	0.2103	32.64	0.9951	0.2082	32.76
106	0.9911	0.2247	31.37	0.9899	0.1978	31.40	0.9891	0.1953	31.49
108	0.9842	0.2120	30.30	0.9822	0.1857	30.15	0.9807	0.1828	30.20
110	0.9755	0.1998	29.21	0.9723	0.1742	28.91	0.9700	0.1709	28.91
112	0.9649	0.1880	28.12	0.9604	0.1631	27.67	0.9571	0.1595	27.63
114	0.9525	0.1767	27.02	0.9465	0.1525	26.45	0.9421	0.1486	26.35
116	0.9384	0.1658	25.93	0.9307	0.1424	25.23	0.9250	0.1383	25.09
118	0.9227	0.1554	24.84	0.9131	0.1327	24.04	0.9061	0.1284	23.84

120	0.9054	0.1454	23.76		0.8938	0.1236	22.86		0.8853	0.1190	22.60
122	0.8867	0.1359	22.68		0.8730	0.1148	21.70		0.8630	0.1102	21.39
124	0.8667	0.1268	21.63		0.8508	0.1066	20.57		0.8391	0.1018	20.21
126	0.8454	0.1182	20.58		0.8272	0.0987	19.47		0.8140	0.0939	19.06
128	0.8230	0.1099	19.56		0.8025	0.0913	18.39		0.7876	0.0864	17.93
130	0.7996	0.1021	18.56		0.7768	0.0843	17.35		0.7603	0.0794	16.84
132	0.7754	0.0947	17.58		0.7503	0.0777	16.33		0.7321	0.0728	15.79
134	0.7503	0.0877	16.62		0.7230	0.0715	15.35		0.7033	0.0666	14.77
136	0.7247	0.0810	15.70		0.6951	0.0657	14.41		0.6739	0.0609	13.79
138	0.6985	0.0748	14.80		0.6669	0.0602	13.49		0.6442	0.0555	12.85
140	0.6720	0.0689	13.93		0.6383	0.0551	12.62		0.6143	0.0505	11.94
142	0.6451	0.0633	13.08		0.6096	0.0503	11.78		0.5844	0.0459	11.09
144	0.6182	0.0581	12.28		0.5809	0.0459	10.97		0.5546	0.0416	10.27
146	0.5911	0.0532	11.50		0.5523	0.0417	10.20		0.5250	0.0376	9.489
148	0.5641	0.0487	10.75		0.5239	0.0379	9.473		0.4958	0.0339	8.752
150	0.5373	0.0444	10.04		0.4959	0.0343	8.778		0.4671	0.0305	8.056
152	0.5108	0.0404	9.356		0.4683	0.0310	8.119		0.4390	0.0274	7.401
154	0.4846	0.0367	8.707		0.4412	0.0280	7.495		0.4115	0.0245	6.784
156	0.4588	0.0333	8.090		0.4148	0.0251	6.907		0.3848	0.0219	6.206
158	0.4335	0.0301	7.504		0.3891	0.0225	6.353		0.3590	0.0195	5.665
160	0.4088	0.0271	6.949		0.3642	0.0202	5.832		0.3341	0.0173	5.161
162	0.3848	0.0244	6.425		0.3401	0.0180	5.343		0.3102	0.0153	4.692
164	0.3614	0.0218	5.931		0.3169	0.0160	4.886		0.2873	0.0135	4.256
166	0.3388	0.0195	5.466		0.2946	0.0141	4.460		0.2654	0.0119	3.852
168	0.3170	0.0173	5.029		0.2732	0.0125	4.063		0.2446	0.0104	3.480
170	0.2960	0.0153	4.619		0.2529	0.0109	3.694		0.2249	0.0091	3.137
172	0.2758	0.0135	4.236		0.2335	0.0096	3.352		0.2063	0.0079	2.821
174	0.2565	0.0119	3.878		0.2151	0.0083	3.035		0.1887	0.0068	2.532
176	0.2381	0.0103	3.545		0.1978	0.0072	2.743		0.1723	0.0058	2.267
178	0.2206	0.0089	3.235		0.1814	0.0062	2.474		0.1568	0.0050	2.026
180	0.2039	0.0077	2.947		0.1660	0.0052	2.227		0.1424	0.0042	1.807
182	0.1881	0.0065	2.680		0.1516	0.0044	2.001		0.1291	0.0035	1.607
184	0.1732	0.0055	2.433		0.1381	0.0037	1.794		0.1167	0.0029	1.427
186	0.1592	0.0045	2.206		0.1255	0.0030	1.605		0.1052	0.0024	1.264
188	0.1460	0.0037	1.996		0.1139	0.0024	1.433		0.0946	0.0019	1.117
190	0.1337	0.0029	1.803		0.1030	0.0019	1.277		0.0849	0.0015	0.9853
192	0.1221	0.0022	1.626		0.0930	0.0014	1.136		0.0760	0.0011	0.8670
194	0.1113	0.0015	1.464		0.0838	0.0010	1.008		0.0678	0.0008	0.7612
196	0.1013	0.0010	1.316		0.0753	0.0006	0.8929		0.0604	0.0005	0.6669
198	0.0920	0.0005	1.181		0.0676	0.0003	0.7892		0.0537	0.0002	0.5829
200	0.0834	0.0000	1.058		0.0605	0.0000	0.6961		0.0476	0.0000	0.5084

date : 07/27/82
time : 07:16:44

damage and/or electronic energy calculations for silicon ions incident on a/an silicon dioxide target

values for contour plot energy distribution(ev/angstrom) depth(angstroms)

energy(Kev)	10.		20.		30.
	20.0	9.	20.0	18.	15.0	6.
	25.0	19.	25.0	35.	20.0	35.
	30.0	29.	30.0	51.	25.0	60.
	35.0	40.	35.0	67.	30.0	85.
	40.0	53.	40.0	85.	35.0	111.
	40.0	105.	45.0	106.	40.0	139.
	35.0	119.	45.0	199.	45.0	174.
	30.0	131.	40.0	223.	45.0	300.
	25.0	142.	35.0	244.	40.0	338.
	20.0	153.	30.0	264.	35.0	369.
	15.0	165.	25.0	283.	30.0	398.
	10.0	181.	20.0	304.	25.0	427.
	5.0	202.	15.0	328.	20.0	457.
	0.0	0.	10.0	357.	15.0	491.
	0.0	0.	5.0	398.	10.0	532.
	0.0	0.	0.0	0.	5.0	591.

date : 07/27/82
time : 07:16:44

damage and/or electronic energy calculations for silicon ions incident on a/an silicon dioxide target

energy	x-average	delta x-sq average	energy partition	total energy in distribution
10	82.076	3218.9	0.63326	6.3326
			energy deposited in target =	5.8589
20	164.14	11298.	0.65959	13.192
			energy deposited in target =	12.439
30	249.45	24495.	0.64113	19.234
			energy deposited in target =	18.227

date : 07/27/82
time : 07:16:44

damage and/or electronic energy calculations for silicon ions incident on a/an silicon dioxide target

i	dpct	xmom3(i)	dxmom3(i)
1	0.633264	1.6023e+04	6.0347e+04
2	0.659591	1.9583e+05	4.0147e+05
3	0.641137	4.6916e+05	1.2600e+06

...end of program : damage2 ...time consumed (seconds)... = 0.445043

task: damage2

cpu time(millisec.)	:	445
io ,,	:	397
sus ,,	:	4
time left (seconds)	:	58
task time (minutes)	:	0.00742

nd

Appendix B

COREL Outputs

```
                                                                  date     : 07/26/82
                                                                  time     : 13:51:57 (pst)
                                                                  machine  : c

controllee: xbrice          controller: +1bricea
loaded on : 07/22/82        at time   : 13:18:06
dropfile  : +xbricea        system    : a
user #    : 001450          account   : 862swi
program bank( min:sec ) :    1:59
pool    bank( minutes ) :         126


files:
          tape10      tape20      tape30      tape32      obrice00    qbrice00


                          ***** input data  for  brice00 run   *****


   1 -- :     0                                                                - brice    brice00
   2 -- :sio2                                                                  - brice    brice00
   3 -- :ion="si              "   zi= 14.   pi= 28.0000  ncomp= 2               - brice    brice00
   4 -- :target( 1)="si       "  nform( 1)= 1.000  z2( 1)= 14.  p2( 1)= 28.0000 - brice    brice00
   5 -- :target( 2)="o2       "  nform( 2)= 2.000  z2( 2)=  8.  p2( 2)= 16.0000 - brice    brice00
   6 -- :alat=  3.5660   alata=   0.00000       alatd=    0.0000  ed=0.          - brice    brice00
   7 -- :nqti=4                                                                 - brice    brice00
   8 -- :$endmain                                                               - brice    brice00
   9 -- :corel    1                                                             - brice    brice00
  10 -- :nexp=   0   0                                                         - brice    brice00
  11 -- :cse=  0.          0.                                                  - brice    brice00
  12 -- :ne=101      nmult=3        ndiv=10       ndive=1  $                   - brice    brice00
  13 -- :corel    2                                                            - brice    brice00
  14 -- :nexp=   0   0                                                         - brice    brice00
  15 -- :cse=  0.          0.                                                  - brice    brice00
  16 -- :ne=101      nmult=27769    ndiv=100000   ndive=1  $                   - brice    brice00
  17 -- :rase   1                                                              - brice    brice00
  18 -- :ne=120     nmult=1        ndiv=4        nstp=10     ndive=1      ndskp=-2 $  - brice    brice00
```

```
19 -- :* partition function <<<<<<<<<<<
20 -- :ibin=1
21 -- :$end   partition function >>>>>>>>>>
22 -- :damq  1
23 -- :istp=0  ntupe=1  iprntd=0 ipltd=0 $
24 -- :end brief
orel    1
```

```
- brice    brice00
- brice    brice00
- brice    brice00
- brice    brice00
- brice    brice00
- brice    brice00
```

*** begin of program : corel recoil no. 1..."si " ...in sio2 target ***

date : 07/26/82
time : 13:51:57

range and straggling data for si ions incident on a/an sio2 target

initial values

incident ion si
atomic number(z1) = 14.
atomic mass(m1) = 28.00 amu
energy maximum = 2343i.06kev

target - sio2

components	a-number	a-mass amu	t-f rad. cm	z-eff.	char. energy kev	density	nform	nexp
si	14.	28.00	1.375e-09	39.598	41.043	2.20524e+22	1.000	0
o2	8.	16.00	1.497e-09	30.720	29.632	4.41048e+22	2.000	0

45

characteristic length = 239.04 angstroms

atomic density = 6.61572e+22 atoms/cc

the following electronic stopping cross sections were used in the calculations

si - thomas-fermi atomic model
cse = 1.23221e-03

o2 - thomas-fermi atomic model
cse = 1.81522e-03

ne	nstp	ncomp	ndiv	ndive	nmult	ndskp	nrpt
101	1	2	10	1	3	0	0

i	u(i)	f(u)	slope	- f(u) is universal thomas-fermi function - from lss
1	0.002	0.162	0.06781	
2	0.004	0.209	0.07749	
3	0.010	0.280	0.07791	
4	0.020	0.334	0.07069	
5	0.040	0.383	0.05239	
6	0.100	0.431	0.00987	
7	0.150	0.435	-0.02433	
8	0.200	0.428	-0.06204	
9	0.400	0.385	-0.12005	
10	1.000	0.275	-0.13129	
11	2.000	0.184	-0.11109	
12	4.000	0.107	-0.06221	

***** units *****
energy - kev
rp,r,delta,dp - angstroms
eps,de/dr - dimensionless
damage - ev/angstrom

e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp	e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp
0.30	0.00	6.57	7.27	5.90	1.00	0.60	0.00	13.12	8.93	14.37	4.12
0.90	0.00	18.73	10.74	21.55	8.11	1.20	0.00	23.84	12.65	28.11	11.10
1.50	0.00	28.62	14.56	34.26	13.74	1.80	0.00	33.19	16.45	40.14	16.19
2.10	0.00	37.59	18.31	45.81	18.51	2.40	0.00	41.87	20.13	51.32	20.73
2.70	0.00	46.04	21.92	56.69	22.88	3.00	0.00	50.13	23.69	61.94	24.96
3.30	0.00	54.14	25.44	67.10	26.99	3.60	0.00	58.09	27.18	72.18	28.96
3.90	0.00	61.99	28.89	77.19	30.91	4.20	0.00	65.84	30.58	82.13	32.82
4.50	0.00	69.66	32.23	87.03	34.73	4.80	0.00	73.44	33.83	91.87	36.62
5.10	0.00	77.20	35.47	96.67	38.46	5.40	0.00	80.93	37.09	101.44	40.28
5.70	0.00	84.64	38.70	106.18	42.09	6.00	0.00	88.32	40.28	110.88	43.89
6.30	0.00	92.00	41.84	115.56	45.68	6.60	0.00	95.66	43.42	120.22	47.44
6.90	0.00	99.31	44.98	124.86	49.18	7.20	0.00	102.95	46.54	129.48	50.91
7.50	0.00	106.58	48.07	134.08	52.66	7.80	0.00	110.21	49.58	138.67	54.39
8.10	0.00	113.82	51.11	143.24	56.11	8.40	0.00	117.43	52.64	147.80	57.80
8.70	0.00	121.04	54.17	152.36	59.49	9.00	0.00	124.64	55.66	156.90	61.19
9.30	0.00	128.24	57.14	161.43	62.89	9.60	0.00	131.83	58.64	165.95	64.56
9.90	0.00	135.42	60.14	170.46	66.23	10.20	0.00	139.01	61.63	174.97	67.89
10.50	0.00	142.60	63.10	179.47	69.56	10.80	0.00	146.18	64.57	183.96	71.22
11.10	0.00	149.77	66.04	188.45	72.87	11.40	0.00	153.35	67.51	192.93	74.51
11.70	0.00	156.93	68.99	197.40	76.14	12.00	0.00	160.51	70.44	201.87	77.79
12.30	0.00	164.09	71.88	206.34	79.43	12.60	0.00	167.67	73.34	210.80	81.05
12.90	0.00	171.25	74.80	215.26	82.67	13.20	0.00	174.83	76.25	219.72	84.29
13.50	0.00	178.41	77.69	224.17	85.91	13.80	0.00	181.99	79.12	228.63	87.54
14.10	0.00	185.58	80.56	233.08	89.15	14.40	0.00	189.16	82.00	237.53	90.75

14.70	0.00	192.75	83.44	241.98	92.35	15.00	0.00	196.33	84.86	246.42	93.97
15.30	0.00	199.92	86.28	250.87	95.57	15.60	0.00	203.51	87.71	255.31	97.17
15.90	0.00	207.11	89.14	259.75	98.77	16.20	0.00	210.70	90.57	264.20	100.35
16.50	0.00	214.30	91.98	268.64	101.96	16.80	0.00	217.89	93.39	273.08	103.55
17.10	0.00	221.49	94.81	277.52	105.14	17.40	0.00	225.10	96.22	281.96	106.72
17.70	0.00	228.70	97.64	286.40	108.30	18.00	0.00	232.31	99.04	290.84	109.89
18.30	0.00	235.92	100.44	295.29	111.48	18.60	0.00	239.53	101.84	299.73	113.06
18.90	0.00	243.15	103.25	304.17	114.64	19.20	0.00	246.77	104.65	308.62	116.21
19.50	0.00	250.39	106.04	313.06	117.80	19.80	0.00	254.01	107.43	317.51	119.37
20.10	0.00	257.64	108.83	321.95	120.95	20.40	0.00	261.27	110.22	326.40	122.52
20.70	0.00	264.90	111.62	330.85	124.08	21.00	0.00	268.53	113.00	335.30	125.66
21.30	0.00	272.17	114.38	339.75	127.23	21.60	0.00	275.81	115.77	344.20	128.80
21.90	0.00	279.45	117.15	348.66	130.36	22.20	0.00	283.10	118.54	353.11	131.93
22.50	0.00	286.75	119.91	357.57	133.50	22.80	0.00	290.40	121.28	362.02	135.06
23.10	0.00	294.06	122.66	366.48	136.62	23.40	0.00	297.72	124.04	370.94	138.18
23.70	0.00	301.38	125.42	375.40	139.74	24.00	0.00	305.04	126.78	379.86	141.30
24.30	0.00	308.71	128.15	384.33	142.86	24.60	0.00	312.38	129.51	388.79	144.42
24.90	0.00	316.05	130.88	393.26	145.97	25.20	0.00	319.72	132.25	397.72	147.52
25.50	0.00	323.40	133.61	402.19	149.08	25.80	0.00	327.08	134.97	406.66	150.63
26.10	0.00	330.77	136.33	411.13	152.19	26.40	0.00	334.45	137.69	415.61	153.73
26.70	0.00	338.14	139.05	420.08	155.28	27.00	0.00	341.83	140.40	424.56	156.83
27.30	0.00	345.53	141.75	429.03	158.38	27.60	0.00	349.23	143.10	433.51	159.93
27.90	0.00	352.93	144.46	437.99	161.47	28.20	0.00	356.63	145.81	442.47	163.01
28.50	0.00	360.33	147.15	446.96	164.56	28.80	0.00	364.04	148.50	451.44	166.11
29.10	0.00	367.75	149.84	455.92	167.65	29.40	0.00	371.47	151.19	460.41	169.18
29.70	0.00	375.18	152.53	464.90	170.72	30.00	0.00	378.90	153.87	469.39	172.27
30.00	0.00	378.90	153.87	469.39	172.27	30.30	0.00	382.63	155.21	473.88	173.81

...end of program : corel ...time consumed (seconds)... = 0.388465

47

task: corel

cpu time(millisec.)	:	392
io ,,	:	74
sus ,,	:	2
time left (seconds)	:	119
task time (minutes)	:	0.00683

orel 2

*** begin of program : corel recoil no. 2..."o2 " ...in sio2 target ***

date : 07/26/82
time : 13:51:57

range and straggling data for o2 ions incident on a/an sio2 target

initial values

incident ion o2
atomic number(z1) = 8.
atomic mass(m1) = 16.00 amu
energy maximum = 6348.97kev

target - sio2

components	a-number	a-mass amu	t-f rad. cm	z-eff.	char. energy kev	density	nform	nexp
si	14.	28.00	1.497e-09	30.720	16.932	2.20524e+22	1.000	0
o2	8.	16.00	1.657e-09	22.627	11.121	4.41048e+22	2.000	0

characteristic length = 190.76 angstroms

atomic density = 6.61572e+22 atoms/cc

the following electronic stopping cross sections were used in the calculations

si - thomas-fermi atomic model
cse = 1.09373e-03

o2 - thomas-fermi atomic model
cse = 1.69703e-03

ne	nstp	ncomp	ndiv	ndive	nmult	ndskp	nrpt
101	1	2	100000	1	27769	0	0

i	u(i)	f(u)	slope
			- f(u) is universal thomas-fermi function - from lss
1	0.002	0.162	0.06781
2	0.004	0.209	0.07749
3	0.010	0.280	0.07791
4	0.020	0.334	0.07069
5	0.040	0.383	0.05239
6	0.100	0.431	0.00987
7	0.150	0.435	-0.02433
8	0.200	0.428	-0.06204
9	0.400	0.385	-0.12005
10	1.000	0.275	-0.13129
11	2.000	0.184	-0.11109
12	4.000	0.107	-0.06221

***** units *****
energy - kev
rp,r,delta,dp - angstroms
eps,de/dr - dimensionless
damage - ev/angstrom

e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp	e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp
0.28	0.00	10.82	14.24	8.50	1.00	0.56	0.00	18.21	15.51	21.10	4.31
0.83	0.00	25.26	17.64	32.11	13.56	1.11	0.00	31.93	20.28	42.34	19.14
1.39	0.00	38.32	23.12	52.08	23.86	1.67	0.00	44.52	26.05	61.49	28.17
1.94	0.00	50.61	29.01	70.64	32.19	2.22	0.00	56.59	31.96	79.62	36.08
2.50	0.00	62.52	34.86	88.46	39.88	2.78	0.00	68.41	37.63	97.20	43.67
3.05	0.00	74.28	40.47	105.85	47.32	3.33	0.00	80.12	43.29	114.44	50.92
3.61	0.00	85.96	46.04	122.96	54.51	3.89	0.00	91.78	48.82	131.44	58.03
4.17	0.00	97.61	51.57	139.88	61.51	4.44	0.00	103.42	54.28	148.28	64.98
4.72	0.00	109.25	57.00	156.65	68.42	5.00	0.00	115.07	59.71	165.01	71.82
5.28	0.00	120.90	62.38	173.34	75.23	5.55	0.00	126.74	65.06	181.66	78.61
5.83	0.00	132.59	67.72	189.97	81.97	6.11	0.00	138.45	70.36	198.26	85.33
6.39	0.00	144.32	73.00	206.55	88.67	6.66	0.00	150.19	75.63	214.83	91.99
6.94	0.00	156.08	78.24	223.10	95.31	7.22	0.00	161.98	80.84	231.36	98.61
7.50	0.00	167.90	83.44	239.63	101.91	7.78	0.00	173.82	86.02	247.89	105.20
8.05	0.00	179.76	88.59	256.15	108.48	8.33	0.00	185.71	91.16	264.40	111.75
8.61	0.00	191.67	93.72	272.66	115.02	8.89	0.00	197.65	96.26	280.92	118.28
9.16	0.00	203.63	98.81	289.18	121.53	9.44	0.00	209.63	101.33	297.43	124.77
9.72	0.00	215.65	103.85	305.69	128.01	10.00	0.00	221.67	106.37	313.95	131.24
10.27	0.00	227.71	108.88	322.21	134.47	10.55	0.00	233.76	111.37	330.47	137.69
10.83	0.00	239.82	113.87	338.73	140.91	11.11	0.00	245.89	116.35	346.99	144.11
11.39	0.00	251.97	118.82	355.26	147.32	11.66	0.00	258.06	121.29	363.52	150.52
11.94	0.00	264.17	123.75	371.79	153.71	12.22	0.00	270.29	126.21	380.06	156.90
12.50	0.00	276.41	128.66	388.33	160.08	12.77	0.00	282.55	131.10	396.61	163.25
13.05	0.00	288.70	133.53	404.88	166.43	13.33	0.00	294.86	135.97	413.16	169.59

13.61	0.00	301.02	138.39	421.43	172.75	13.88	0.00	307.20	140.81	429.71	175.91
14.16	0.00	313.39	143.23	438.00	179.05	14.44	0.00	319.59	145.64	446.28	182.20
14.72	0.00	325.79	148.04	454.57	185.34	15.00	0.00	332.01	150.44	462.85	188.47
15.27	0.00	338.24	152.84	471.14	191.59	15.55	0.00	344.47	155.23	479.43	194.71
15.83	0.00	350.72	157.62	487.73	197.82	16.11	0.00	356.97	160.00	496.02	200.93
16.38	0.00	363.23	162.38	504.32	204.03	16.66	0.00	369.50	164.75	512.61	207.13
16.94	0.00	375.78	167.11	520.91	210.22	17.22	0.00	382.07	169.46	529.21	213.31
17.49	0.00	388.37	171.80	537.51	216.39	17.77	0.00	394.67	174.13	545.80	219.47
18.05	0.00	400.98	176.46	554.10	222.55	18.33	0.00	407.30	178.78	562.41	225.62
18.61	0.00	413.63	181.10	570.71	228.70	18.88	0.00	419.96	183.40	579.01	231.76
19.16	0.00	426.31	185.70	587.31	234.83	19.44	0.00	432.65	188.00	595.62	237.89
19.72	0.00	439.01	190.28	603.92	240.94	19.99	0.00	445.37	192.57	612.23	244.00
20.27	0.00	451.74	194.84	620.54	247.04	20.55	0.00	458.11	197.11	628.84	250.08
20.83	0.00	464.49	199.38	637.15	253.12	21.10	0.00	470.88	201.64	645.46	256.16
21.38	0.00	477.28	203.89	653.77	259.18	21.66	0.00	483.68	206.14	662.07	262.21
21.94	0.00	490.08	208.39	670.38	265.22	22.22	0.00	496.50	210.63	678.69	268.23
22.49	0.00	502.92	212.86	687.00	271.24	22.77	0.00	509.34	215.09	695.31	274.24
23.05	0.00	515.77	217.31	703.62	277.24	23.33	0.00	522.21	219.53	711.93	280.23
23.60	0.00	528.65	221.74	720.23	283.22	23.88	0.00	535.10	223.94	728.54	286.20
24.16	0.00	541.55	226.14	736.85	289.18	24.44	0.00	548.01	228.34	745.15	292.15
24.71	0.00	554.47	230.53	753.46	295.12	24.99	0.00	560.93	232.71	761.76	298.08
25.27	0.00	567.40	234.89	770.07	301.04	25.55	0.00	573.88	237.06	778.37	303.99
25.83	0.00	580.37	239.21	786.67	306.95	26.10	0.00	586.85	241.35	794.97	309.90
26.38	0.00	593.34	243.50	803.27	312.84	26.66	0.00	599.84	245.64	811.56	315.78
26.94	0.00	606.34	247.77	819.86	318.71	27.21	0.00	612.84	249.90	828.16	321.64
27.49	0.00	619.35	252.02	836.45	324.57	27.77	0.00	625.86	254.13	844.74	327.49
27.77	0.00	625.86	254.13	844.74	327.49	28.05	0.00	632.38	256.24	853.03	330.41

...end of program : corel ...time consumed (seconds)... = 0.430218

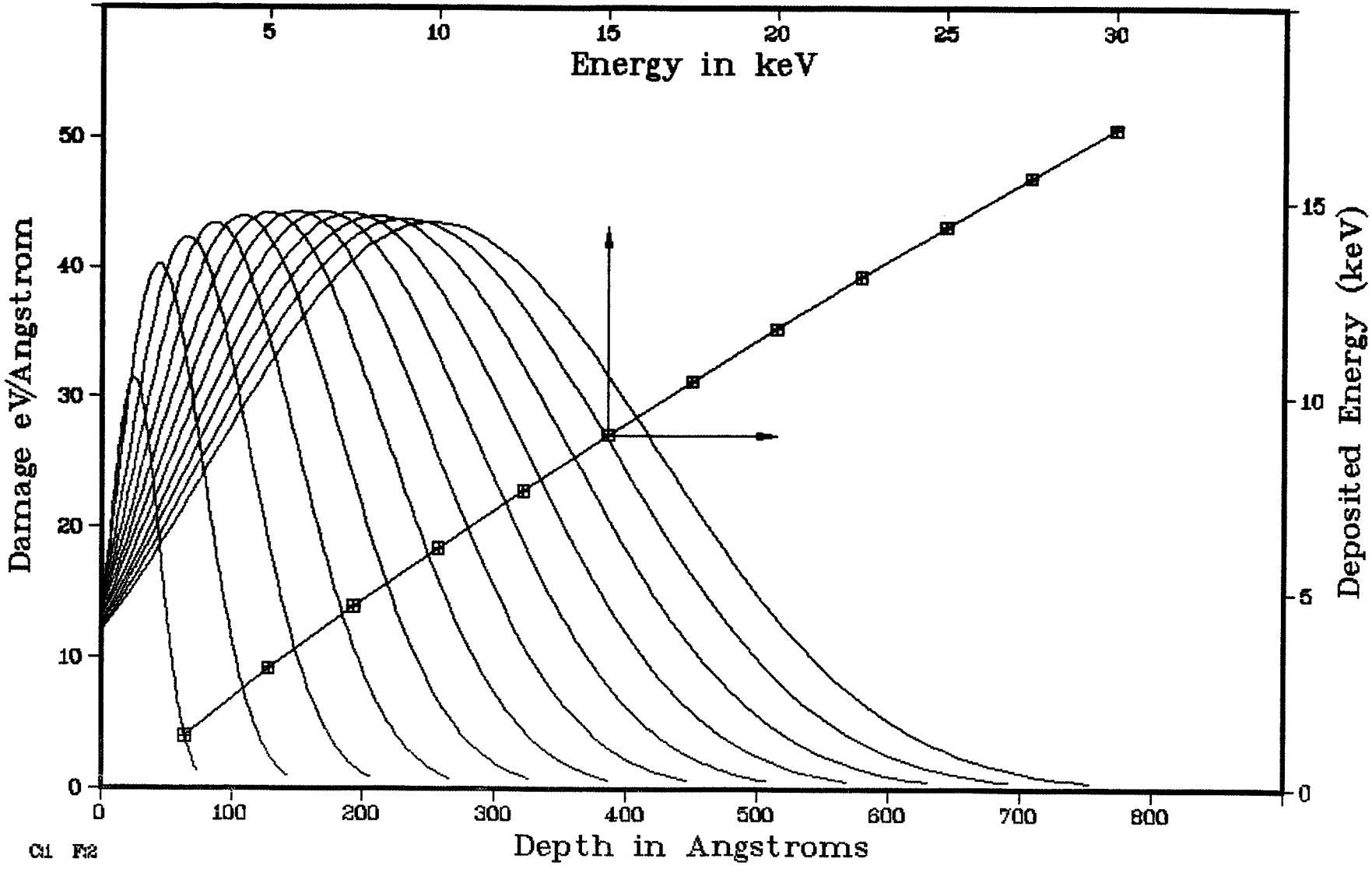
50 task: corel

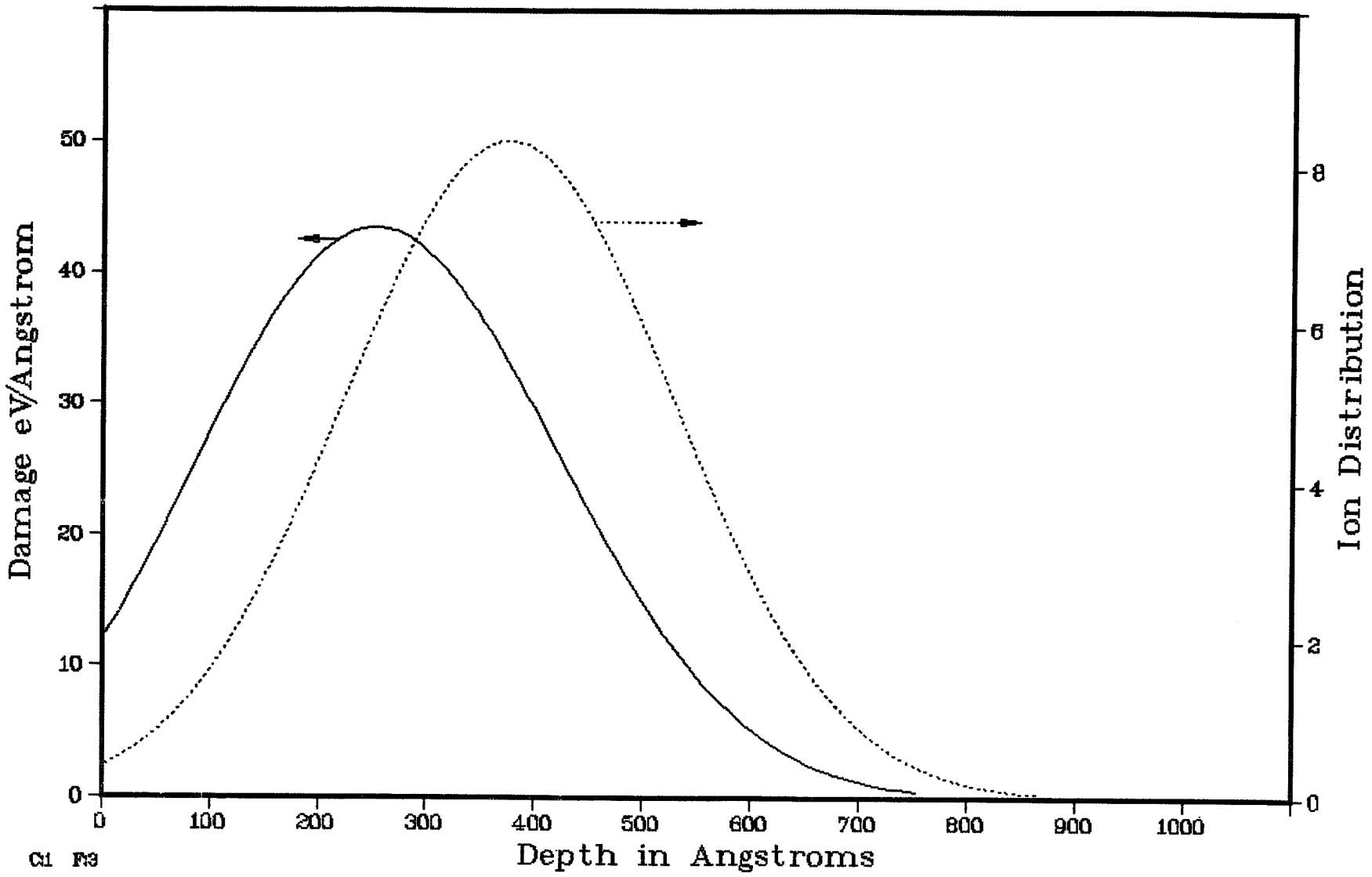
cpu time(millisec.)	:	430
io ,,	:	2
sus ,,	:	1
time left (seconds)	:	119
task time (minutes)	:	0.00717

ase 1

Appendix C

RASE4 and DAMG2 Outputs


DAMAGE DISTRIBUTION (BRICE)
ION : SI TARGET : SIO2
ENERGIES from 0.0 to 30.0 keV
Energy in keV
5
10
15
20
25
30
Damage eV/Angstrom
50
40
30
20
10
0
Deposited Energy (keV)
15
10
5
0
0
100
200
300
400
500
600
700
800
Depth in Angstroms
C1 F2


DAMAGE and ION DISTRIBUTIONS (BRICE)
ION :SI TARGET :SIO2 ENERGY : 30.0 keV
Damage eV/Angstrom
Ion Distribution
Depth in Angstroms
0
10
20
30
40
50
0
2
4
6
8
0
100
200
300
400
500
600
700
800
900
1000
C1 F3

```
                                                          date     : 07/26/82
                                                          time     : 14:19:25 (pst)
                                                          machine  : c

controllee: xbrice          controller: +lbricea
loaded on : 07/22/82        at time   : 13:18:06
dropfile  : +xbricea        system    : a
user #    : 001450          account   : 862swi
program bank( min:sec ) :    1:59
pool    bank( minutes ) :         122


files:
          tape10      tape20      tape30      tape32      obrice01    qbrice01


                          ***** input data  for  brice01 run   *****

  1 -- :     1                                                                  - brice    brice01
  2 -- :sio2                                                                    - brice    brice01
  3 -- :ion="si              "   zi= 14.   pi= 28.0000  ncomp= 2                - brice    brice01
  4 -- :target( 1)="si       "  nform( 1)= 1.000  z2( 1)= 14.  p2( 1)= 28.0000 - brice    brice01
  5 -- :target( 2)="o2       "  nform( 2)= 2.000  z2( 2)=  8.  p2( 2)= 16.0000 - brice    brice01
  6 -- :alat=  3.5660   alata=   0.00000       alatd=    0.0000  ed=0.          - brice    brice01
  7 -- :nqti=4                                                                  - brice    brice01
  8 -- :$endmain                                                                - brice    brice01
  9 -- :rase                                                                    - brice    brice01
 10 -- :nexp=   0   0                                                           - brice    brice01
 11 -- :cse=  0.          0.                                                    - brice    brice01
 12 -- :ne=120     nmult=1        ndiv=4        nstp=10     ndive=1      ndskp=1$ - brice    brice01
 13 -- :partition functions for recoils                                         - brice    brice01
 14 -- :ndam= 12 12                                                            - brice    brice01
 15 -- :de=    2.5000     2.3141                                               - brice    brice01
 16 -- :part(2, 1)=0.5934 0.6549 0.6594 0.6545 0.6467 0.6389 0.6306 0.6223 0.6143 - brice  brice01
 17 -- :0.6066 0.5992 0.5921                                                    - brice    brice01
 18 -- :part(2, 2)=0.6329 0.6585 0.6446 0.6275 0.6107 0.5948 0.5799 0.5660 0.5530 - brice  brice01
```

```
19 -- :0.5407 0.5292 0.5183                                    - brice    brice01
20 -- :ibin=1                                                  - brice    brice01
21 -- :                        $ end partition                 - brice    brice01
22 -- :damq                                                    - brice    brice01
23 -- :ntupe=1    istp=0  ipltd=1 $                            - brice    brice01
24 -- :end brief                                              - brice    brice01
ase
```

*** begin of program : rase4 incident ion.. si ...target.. sio2 ***

date : 07/26/82
time : 14:19:25

range and straggling data for si ions incident on a/an sio2 target

initial values

incident ion si
atomic number(z1) = 14.
atomic mass(m1) = 28.00 amu
energy maximum = 23431.06kev

target - sio2

components	a-number	a-mass amu	t-f rad. cm	z-eff.	char. energy kev	density	nform	nexp
si	14.	28.00	1.375e-09	39.598	41.043	2.20524e+22	1.000	0
o2	8.	16.00	1.497e-09	30.720	29.632	4.41048e+22	2.000	0

characteristic length = 239.04 angstroms

atomic density = 6.61572e+22 atoms/cc

the following electronic stopping cross sections were used in the calculations

si - thomas-fermi atomic model , lindhard theory
cse = 1.23221e-03

o2 - thomas-fermi atomic model , lindhard theory
cse = 1.81522e-03

ne	nstp	ncomp	ndiv	ndive	nmult	ndskp	nrpt
120	10	2	4	1	1	1	0

i	u(i)	f(u)	slope
1	0.002	0.162	0.06781
2	0.004	0.209	0.07749
3	0.010	0.280	0.07791
4	0.020	0.334	0.07069
5	0.040	0.383	0.05239
6	0.100	0.431	0.00987
7	0.150	0.435	-0.02433
8	0.200	0.428	-0.06204
9	0.400	0.385	-0.12005
10	1.000	0.275	-0.13129
11	2.000	0.184	-0.11109
12	4.000	0.107	-0.06221

- f(u) is universal thomas-fermi function - from lss

***** units *****
energy - kev
lengths - angstroms
energy deposition rates - ev/angstrom

electronic stopping power , ev/angstrom ndskp= 1

e	de/dx	e	de/dx	e	de/dx	e	de/dx	e	de/dx	e	de/dx
0.3	1.5237e+00	0.5	2.1549e+00	0.8	2.6392e+00	1.0	3.0474e+00	1.2	3.4071e+00	1.5	3.7323e+00
1.7	4.0314e+00	2.0	4.3097e+00	2.2	4.5711e+00	2.5	4.8184e+00	2.7	5.0536e+00	3.0	5.2783e+00
3.2	5.4938e+00	3.5	5.7012e+00	3.7	5.9013e+00	4.0	6.0949e+00	4.2	6.2824e+00	4.5	6.4646e+00
4.7	6.6417e+00	5.0	6.8143e+00	5.2	6.9825e+00	5.5	7.1469e+00	5.7	7.3075e+00	6.0	7.4646e+00
6.2	7.6186e+00	6.5	7.7695e+00	6.7	7.9175e+00	7.0	8.0627e+00	7.2	8.2055e+00	7.5	8.3457e+00
7.7	8.4837e+00	8.0	8.6194e+00	8.2	8.7531e+00	8.5	8.8847e+00	8.7	9.0144e+00	9.0	9.1423e+00
9.2	9.2684e+00	9.5	9.3928e+00	9.7	9.5156e+00	10.0	9.6368e+00	10.2	9.7565e+00	10.5	9.8748e+00
10.7	9.9917e+00	11.0	1.0107e+01	11.2	1.0221e+01	11.5	1.0334e+01	11.7	1.0446e+01	12.0	1.0557e+01
12.2	1.0666e+01	12.5	1.0774e+01	12.7	1.0882e+01	13.0	1.0988e+01	13.2	1.1093e+01	13.5	1.1197e+01
13.7	1.1300e+01	14.0	1.1402e+01	14.2	1.1504e+01	14.5	1.1604e+01	14.7	1.1704e+01	15.0	1.1803e+01
15.2	1.1901e+01	15.5	1.1998e+01	15.7	1.2094e+01	16.0	1.2190e+01	16.2	1.2285e+01	16.5	1.2379e+01
16.7	1.2472e+01	17.0	1.2565e+01	17.2	1.2657e+01	17.5	1.2748e+01	17.7	1.2839e+01	18.0	1.2929e+01
18.2	1.3019e+01	18.5	1.3107e+01	18.7	1.3196e+01	19.0	1.3283e+01	19.2	1.3371e+01	19.5	1.3457e+01
19.7	1.3543e+01	20.0	1.3629e+01	20.2	1.3713e+01	20.5	1.3798e+01	20.7	1.3882e+01	21.0	1.3965e+01
21.2	1.4048e+01	21.5	1.4130e+01	21.7	1.4212e+01	22.0	1.4294e+01	22.2	1.4375e+01	22.5	1.4455e+01
22.7	1.4535e+01	23.0	1.4615e+01	23.2	1.4694e+01	23.5	1.4773e+01	23.7	1.4851e+01	24.0	1.4929e+01
24.2	1.5007e+01	24.5	1.5084e+01	24.7	1.5161e+01	25.0	1.5237e+01	25.2	1.5313e+01	25.5	1.5389e+01
25.7	1.5464e+01	26.0	1.5539e+01	26.2	1.5613e+01	26.5	1.5688e+01	26.7	1.5761e+01	27.0	1.5835e+01
27.2	1.5908e+01	27.5	1.5981e+01	27.7	1.6053e+01	28.0	1.6125e+01	28.2	1.6197e+01	28.5	1.6269e+01
28.7	1.6340e+01	29.0	1.6411e+01	29.2	1.6481e+01	29.5	1.6552e+01	29.7	1.6622e+01	30.0	1.6691e+01

deposited energy(ev/angstrom) , dep-e

e	dep-e	e	dep-e	e	dep-e	e	dep-e	e	dep-e	e	dep-e
0.3	2.6270e+01	0.5	3.2292e+01	0.8	3.5709e+01	1.0	3.7897e+01	1.2	3.9389e+01	1.5	4.0411e+01
1.7	4.1106e+01	2.0	4.1559e+01	2.2	4.1831e+01	2.5	4.1963e+01	2.7	4.2034e+01	3.0	4.2112e+01
3.2	4.2210e+01	3.5	4.2284e+01	3.7	4.2354e+01	4.0	4.2389e+01	4.2	4.2420e+01	4.5	4.2431e+01
4.7	4.2436e+01	5.0	4.2429e+01	5.2	4.2414e+01	5.5	4.2407e+01	5.7	4.2543e+01	6.0	4.2653e+01
6.2	4.2712e+01	6.5	4.2739e+01	6.7	4.2752e+01	7.0	4.2747e+01	7.2	4.2726e+01	7.5	4.2694e+01
7.7	4.2651e+01	8.0	4.2599e+01	8.2	4.2541e+01	8.5	4.2474e+01	8.7	4.2401e+01	9.0	4.2317e+01
9.2	4.2222e+01	9.5	4.2124e+01	9.7	4.2025e+01	10.0	4.1925e+01	10.2	4.1823e+01	10.5	4.1712e+01
10.7	4.1640e+01	11.0	4.1614e+01	11.2	4.1582e+01	11.5	4.1542e+01	11.7	4.1496e+01	12.0	4.1444e+01
12.2	4.1388e+01	12.5	4.1326e+01	12.7	4.1259e+01	13.0	4.1188e+01	13.2	4.1113e+01	13.5	4.1030e+01
13.7	4.0945e+01	14.0	4.0857e+01	14.2	4.0768e+01	14.5	4.0677e+01	14.7	4.0585e+01	15.0	4.0492e+01
15.2	4.0397e+01	15.5	4.0302e+01	15.7	4.0206e+01	16.0	4.0110e+01	16.2	4.0013e+01	16.5	3.9915e+01
16.7	3.9817e+01	17.0	3.9718e+01	17.2	3.9614e+01	17.5	3.9508e+01	17.7	3.9403e+01	18.0	3.9311e+01
18.2	3.9221e+01	18.5	3.9129e+01	18.7	3.9035e+01	19.0	3.8940e+01	19.2	3.8844e+01	19.5	3.8749e+01
19.7	3.8653e+01	20.0	3.8557e+01	20.2	3.8461e+01	20.5	3.8365e+01	20.7	3.8275e+01	21.0	3.8191e+01
21.2	3.8107e+01	21.5	3.8022e+01	21.7	3.7936e+01	22.0	3.7850e+01	22.2	3.7764e+01	22.5	3.7678e+01
22.7	3.7591e+01	23.0	3.7505e+01	23.2	3.7418e+01	23.5	3.7331e+01	23.7	3.7245e+01	24.0	3.7157e+01
24.2	3.7070e+01	24.5	3.6982e+01	24.7	3.6895e+01	25.0	3.6806e+01	25.2	3.6717e+01	25.5	3.6629e+01
25.7	3.6538e+01	26.0	3.6448e+01	26.2	3.6359e+01	26.5	3.6269e+01	26.7	3.6185e+01	27.0	3.6104e+01
27.2	3.6022e+01	27.5	3.5941e+01	27.7	3.5859e+01	28.0	3.5778e+01	28.2	3.5697e+01	28.5	3.5616e+01
28.7	3.5535e+01	29.0	3.5455e+01	29.2	3.5374e+01	29.5	3.5294e+01	29.7	3.5214e+01	30.0	3.5134e+01

average projected recoil range(angstroms) rp-rec

e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec
0.3	2.3646e+00	0.5	4.3685e+00	0.8	6.0263e+00	1.0	7.5543e+00	1.2	8.9411e+00	1.5	1.0218e+01
1.7	1.1374e+01	2.0	1.2455e+01	2.2	1.3450e+01	2.5	1.4375e+01	2.7	1.5280e+01	3.0	1.6215e+01
3.2	1.7178e+01	3.5	1.8114e+01	3.7	1.9029e+01	4.0	1.9907e+01	4.2	2.0768e+01	4.5	2.1654e+01
4.7	2.2694e+01	5.0	2.3703e+01	5.2	2.4678e+01	5.5	2.5624e+01	5.7	2.6572e+01	6.0	2.7483e+01
6.2	2.8442e+01	6.5	2.9420e+01	6.7	3.0366e+01	7.0	3.1284e+01	7.2	3.2177e+01	7.5	3.3066e+01
7.7	3.3974e+01	8.0	3.4866e+01	8.2	3.5748e+01	8.5	3.6648e+01	8.7	3.7534e+01	9.0	3.8413e+01
9.2	3.9296e+01	9.5	4.0172e+01	9.7	4.1039e+01	10.0	4.1897e+01	10.2	4.2744e+01	10.5	4.3616e+01
10.7	4.4473e+01	11.0	4.5302e+01	11.2	4.6122e+01	11.5	4.6931e+01	11.7	4.7730e+01	12.0	4.8531e+01
12.2	4.9329e+01	12.5	5.0127e+01	12.7	5.0919e+01	13.0	5.1701e+01	13.2	5.2475e+01	13.5	5.3246e+01
13.7	5.4016e+01	14.0	5.4779e+01	14.2	5.5536e+01	14.5	5.6293e+01	14.7	5.7049e+01	15.0	5.7806e+01
15.2	5.8560e+01	15.5	5.9310e+01	15.7	6.0055e+01	16.0	6.0796e+01	16.2	6.1531e+01	16.5	6.2270e+01
16.7	6.3011e+01	17.0	6.3746e+01	17.2	6.4479e+01	17.5	6.5207e+01	17.7	6.5931e+01	18.0	6.6637e+01
18.2	6.7337e+01	18.5	6.8034e+01	18.7	6.8732e+01	19.0	6.9427e+01	19.2	7.0118e+01	19.5	7.0810e+01
19.7	7.1500e+01	20.0	7.2188e+01	20.2	7.2872e+01	20.5	7.3552e+01	20.7	7.4223e+01	21.0	7.4885e+01
21.2	7.5544e+01	21.5	7.6200e+01	21.7	7.6853e+01	22.0	7.7504e+01	22.2	7.8152e+01	22.5	7.8800e+01
22.7	7.9447e+01	23.0	8.0094e+01	23.2	8.0740e+01	23.5	8.1384e+01	23.7	8.2026e+01	24.0	8.2668e+01
24.2	8.3308e+01	24.5	8.3946e+01	24.7	8.4583e+01	25.0	8.5221e+01	25.2	8.5857e+01	25.5	8.6492e+01
25.7	8.7128e+01	26.0	8.7762e+01	26.2	8.8395e+01	26.5	8.9026e+01	26.7	8.9646e+01	27.0	9.0265e+01
27.2	9.0882e+01	27.5	9.1498e+01	27.7	9.2112e+01	28.0	9.2724e+01	28.2	9.3334e+01	28.5	9.3944e+01
28.7	9.4552e+01	29.0	9.5160e+01	29.2	9.5766e+01	29.5	9.6370e+01	29.7	9.6973e+01	30.0	9.7575e+01

rms spread in rp-rec

e	drp-rec	e	drp-rec	e	drp-rec	e	drp-rec	e	drp-rec	e	drp-rec
0.3	4.9113e+00	0.5	7.9229e+00	0.8	9.4616e+00	1.0	1.1042e+01	1.2	1.2620e+01	1.5	1.4174e+01
1.7	1.5695e+01	2.0	1.7171e+01	2.2	1.8604e+01	2.5	1.9992e+01	2.7	2.1387e+01	3.0	2.2830e+01
3.2	2.4281e+01	3.5	2.5610e+01	3.7	2.6810e+01	4.0	2.7898e+01	4.2	2.8903e+01	4.5	3.0102e+01

4.7	3.2046e+01	5.0	3.3730e+01	5.2	3.5190e+01	5.5	3.6467e+01	5.7	3.7572e+01	6.0	3.8745e+01
6.2	4.0407e+01	6.5	4.2108e+01	6.7	4.3645e+01	7.0	4.5038e+01	7.2	4.6305e+01	7.5	4.7629e+01
7.7	4.9145e+01	8.0	5.0570e+01	8.2	5.1932e+01	8.5	5.3355e+01	8.7	5.4687e+01	9.0	5.6071e+01
9.2	5.7567e+01	9.5	5.8998e+01	9.7	6.0362e+01	10.0	6.1658e+01	10.2	6.2886e+01	10.5	6.4296e+01
10.7	6.5758e+01	11.0	6.7146e+01	11.2	6.8484e+01	11.5	6.9771e+01	11.7	7.1005e+01	12.0	7.2298e+01
12.2	7.3626e+01	12.5	7.4975e+01	12.7	7.6304e+01	13.0	7.7589e+01	13.2	7.8830e+01	13.5	8.0123e+01
13.7	8.1435e+01	14.0	8.2716e+01	14.2	8.3964e+01	14.5	8.5210e+01	14.7	8.6452e+01	15.0	8.7743e+01
15.2	8.9043e+01	15.5	9.0319e+01	15.7	9.1568e+01	16.0	9.2790e+01	16.2	9.3981e+01	16.5	9.5235e+01
16.7	9.6522e+01	17.0	9.7791e+01	17.2	9.9043e+01	17.5	1.0027e+02	17.7	1.0148e+02	18.0	1.0271e+02
18.2	1.0394e+02	18.5	1.0515e+02	18.7	1.0638e+02	19.0	1.0759e+02	19.2	1.0879e+02	19.5	1.1003e+02
19.7	1.1125e+02	20.0	1.1247e+02	20.2	1.1367e+02	20.5	1.1485e+02	20.7	1.1604e+02	21.0	1.1725e+02
21.2	1.1846e+02	21.5	1.1966e+02	21.7	1.2085e+02	22.0	1.2202e+02	22.2	1.2318e+02	22.5	1.2437e+02
22.7	1.2557e+02	23.0	1.2676e+02	23.2	1.2795e+02	23.5	1.2913e+02	23.7	1.3029e+02	24.0	1.3149e+02
24.2	1.3267e+02	24.5	1.3384e+02	24.7	1.3502e+02	25.0	1.3619e+02	25.2	1.3736e+02	25.5	1.3855e+02
25.7	1.3974e+02	26.0	1.4092e+02	26.2	1.4208e+02	26.5	1.4324e+02	26.7	1.4439e+02	27.0	1.4557e+02
27.2	1.4674e+02	27.5	1.4791e+02	27.7	1.4907e+02	28.0	1.5022e+02	28.2	1.5136e+02	28.5	1.5252e+02
28.7	1.5367e+02	29.0	1.5483e+02	29.2	1.5599e+02	29.5	1.5713e+02	29.7	1.5828e+02	30.0	1.5943e+02

electronic stopping power , ev/angstrom ndskp= 2

e	de/dx	e	de/dx	e	de/dx	e	de/dx	e	de/dx	e	de/dx
0.3	1.5237e+00	0.5	2.1549e+00	0.8	2.6392e+00	1.0	3.0474e+00	1.2	3.4071e+00	1.5	3.7323e+00
1.7	4.0314e+00	2.0	4.3097e+00	2.2	4.5711e+00	2.5	4.8184e+00	2.7	5.0536e+00	3.0	5.2783e+00
3.2	5.4938e+00	3.5	5.7012e+00	3.7	5.9013e+00	4.0	6.0949e+00	4.2	6.2824e+00	4.5	6.4646e+00
4.7	6.6417e+00	5.0	6.8143e+00	5.2	6.9825e+00	5.5	7.1469e+00	5.7	7.3075e+00	6.0	7.4646e+00
6.2	7.6186e+00	6.5	7.7695e+00	6.7	7.9175e+00	7.0	8.0627e+00	7.2	8.2055e+00	7.5	8.3457e+00
7.7	8.4837e+00	8.0	8.6194e+00	8.2	8.7531e+00	8.5	8.8847e+00	8.7	9.0144e+00	9.0	9.1423e+00
9.2	9.2684e+00	9.5	9.3928e+00	9.7	9.5156e+00	10.0	9.6368e+00	10.2	9.7565e+00	10.5	9.8748e+00
10.7	9.9917e+00	11.0	1.0107e+01	11.2	1.0221e+01	11.5	1.0334e+01	11.7	1.0446e+01	12.0	1.0557e+01
12.2	1.0666e+01	12.5	1.0774e+01	12.7	1.0882e+01	13.0	1.0988e+01	13.2	1.1093e+01	13.5	1.1197e+01
13.7	1.1300e+01	14.0	1.1402e+01	14.2	1.1504e+01	14.5	1.1604e+01	14.7	1.1704e+01	15.0	1.1803e+01
15.2	1.1901e+01	15.5	1.1998e+01	15.7	1.2094e+01	16.0	1.2190e+01	16.2	1.2285e+01	16.5	1.2379e+01
16.7	1.2472e+01	17.0	1.2565e+01	17.2	1.2657e+01	17.5	1.2748e+01	17.7	1.2839e+01	18.0	1.2929e+01
18.2	1.3019e+01	18.5	1.3107e+01	18.7	1.3196e+01	19.0	1.3283e+01	19.2	1.3371e+01	19.5	1.3457e+01
19.7	1.3543e+01	20.0	1.3629e+01	20.2	1.3713e+01	20.5	1.3798e+01	20.7	1.3882e+01	21.0	1.3965e+01
21.2	1.4048e+01	21.5	1.4130e+01	21.7	1.4212e+01	22.0	1.4294e+01	22.2	1.4375e+01	22.5	1.4455e+01
22.7	1.4535e+01	23.0	1.4615e+01	23.2	1.4694e+01	23.5	1.4773e+01	23.7	1.4851e+01	24.0	1.4929e+01
24.2	1.5007e+01	24.5	1.5084e+01	24.7	1.5161e+01	25.0	1.5237e+01	25.2	1.5313e+01	25.5	1.5389e+01
25.7	1.5464e+01	26.0	1.5539e+01	26.2	1.5613e+01	26.5	1.5688e+01	26.7	1.5761e+01	27.0	1.5835e+01
27.2	1.5908e+01	27.5	1.5981e+01	27.7	1.6053e+01	28.0	1.6125e+01	28.2	1.6197e+01	28.5	1.6269e+01
28.7	1.6340e+01	29.0	1.6411e+01	29.2	1.6481e+01	29.5	1.6552e+01	29.7	1.6622e+01	30.0	1.6691e+01

deposited energy(ev/angstrom) , dep-e

e	dep-e	e	dep-e	e	dep-e	e	dep-e	e	dep-e	e	dep-e
0.3	4.0906e-01	0.5	1.0005e+00	0.8	1.6630e+00	1.0	2.3738e+00	1.2	3.1144e+00	1.5	3.8729e+00
1.7	4.6448e+00	2.0	5.4255e+00	2.2	6.2144e+00	2.5	7.0119e+00	2.7	7.7679e+00	3.0	8.4337e+00
3.2	8.9978e+00	3.5	9.5110e+00	3.7	9.9674e+00	4.0	1.0409e+01	4.2	1.0810e+01	4.5	1.1189e+01
4.7	1.1530e+01	5.0	1.1844e+01	5.2	1.2134e+01	5.5	1.2386e+01	5.7	1.2472e+01	6.0	1.2561e+01
6.2	1.2680e+01	6.5	1.2808e+01	6.7	1.2928e+01	7.0	1.3047e+01	7.2	1.3166e+01	7.5	1.3283e+01
7.7	1.3398e+01	8.0	1.3510e+01	8.2	1.3620e+01	8.5	1.3727e+01	8.7	1.3831e+01	9.0	1.3938e+01

9.2	1.4048e+01	9.5	1.4154e+01	9.7	1.4255e+01	10.0	1.4352e+01	10.2	1.4444e+01	10.5	1.4542e+01
10.7	1.4596e+01	11.0	1.4601e+01	11.2	1.4609e+01	11.5	1.4621e+01	11.7	1.4636e+01	12.0	1.4654e+01
12.2	1.4673e+01	12.5	1.4694e+01	12.7	1.4715e+01	13.0	1.4738e+01	13.2	1.4760e+01	13.5	1.4788e+01
13.7	1.4817e+01	14.0	1.4844e+01	14.2	1.4872e+01	14.5	1.4899e+01	14.7	1.4926e+01	15.0	1.4952e+01
15.2	1.4978e+01	15.5	1.5003e+01	15.7	1.5028e+01	16.0	1.5052e+01	16.2	1.5075e+01	16.5	1.5098e+01
16.7	1.5121e+01	17.0	1.5143e+01	17.2	1.5168e+01	17.5	1.5194e+01	17.7	1.5218e+01	18.0	1.5228e+01
18.2	1.5236e+01	18.5	1.5244e+01	18.7	1.5254e+01	19.0	1.5264e+01	19.2	1.5273e+01	19.5	1.5283e+01
19.7	1.5292e+01	20.0	1.5300e+01	20.2	1.5309e+01	20.5	1.5317e+01	20.7	1.5318e+01	21.0	1.5313e+01
21.2	1.5309e+01	21.5	1.5305e+01	21.7	1.5301e+01	22.0	1.5297e+01	22.2	1.5293e+01	22.5	1.5290e+01
22.7	1.5287e+01	23.0	1.5284e+01	23.2	1.5281e+01	23.5	1.5278e+01	23.7	1.5275e+01	24.0	1.5272e+01
24.2	1.5270e+01	24.5	1.5268e+01	24.7	1.5266e+01	25.0	1.5265e+01	25.2	1.5265e+01	25.5	1.5264e+01
25.7	1.5265e+01	26.0	1.5267e+01	26.2	1.5268e+01	26.5	1.5268e+01	26.7	1.5264e+01	27.0	1.5257e+01
27.2	1.5251e+01	27.5	1.5245e+01	27.7	1.5239e+01	28.0	1.5233e+01	28.2	1.5227e+01	28.5	1.5221e+01
28.7	1.5215e+01	29.0	1.5209e+01	29.2	1.5203e+01	29.5	1.5198e+01	29.7	1.5192e+01	30.0	1.5187e+01

average projected recoil range(angstroms) rp-rec

e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec	e	rp-rec
0.3	4.0088e+00	0.5	7.2909e+00	0.8	1.0263e+01	1.0	1.3219e+01	1.2	1.5994e+01	1.5	1.8637e+01
1.7	2.1168e+01	2.0	2.3628e+01	2.2	2.6009e+01	2.5	2.8367e+01	2.7	3.0539e+01	3.0	3.2438e+01
3.2	3.4091e+01	3.5	3.5582e+01	3.7	3.6945e+01	4.0	3.8183e+01	4.2	3.9304e+01	4.5	4.0381e+01
4.7	4.1608e+01	5.0	4.2733e+01	5.2	4.3764e+01	5.5	4.4729e+01	5.7	4.5738e+01	6.0	4.6845e+01
6.2	4.8144e+01	6.5	4.9450e+01	6.7	5.0700e+01	7.0	5.1879e+01	7.2	5.2996e+01	7.5	5.4105e+01
7.7	5.5260e+01	8.0	5.6374e+01	8.2	5.7457e+01	8.5	5.8558e+01	8.7	5.9619e+01	9.0	6.0702e+01
9.2	6.1823e+01	9.5	6.2909e+01	9.7	6.3962e+01	10.0	6.4981e+01	10.2	6.5969e+01	10.5	6.7005e+01
10.7	6.8201e+01	11.0	6.9519e+01	11.2	7.0819e+01	11.5	7.2097e+01	11.7	7.3349e+01	12.0	7.4613e+01
12.2	7.5877e+01	12.5	7.7142e+01	12.7	7.8392e+01	13.0	7.9618e+01	13.2	8.0819e+01	13.5	8.2018e+01
13.7	8.3212e+01	14.0	8.4387e+01	14.2	8.5542e+01	14.5	8.6689e+01	14.7	8.7829e+01	15.0	8.8981e+01
15.2	9.0131e+01	15.5	9.1268e+01	15.7	9.2392e+01	16.0	9.3501e+01	16.2	9.4594e+01	16.5	9.5703e+01
16.7	9.6824e+01	17.0	9.7934e+01	17.2	9.9020e+01	17.5	1.0009e+02	17.7	1.0115e+02	18.0	1.0229e+02
18.2	1.0344e+02	18.5	1.0458e+02	18.7	1.0572e+02	19.0	1.0684e+02	19.2	1.0796e+02	19.5	1.0908e+02
19.7	1.1020e+02	20.0	1.1131e+02	20.2	1.1242e+02	20.5	1.1351e+02	20.7	1.1465e+02	21.0	1.1584e+02
21.2	1.1703e+02	21.5	1.1821e+02	21.7	1.1938e+02	22.0	1.2055e+02	22.2	1.2171e+02	22.5	1.2287e+02
22.7	1.2404e+02	23.0	1.2521e+02	23.2	1.2636e+02	23.5	1.2751e+02	23.7	1.2866e+02	24.0	1.2981e+02
24.2	1.3095e+02	24.5	1.3209e+02	24.7	1.3323e+02	25.0	1.3435e+02	25.2	1.3548e+02	25.5	1.3661e+02
25.7	1.3772e+02	26.0	1.3884e+02	26.2	1.3994e+02	26.5	1.4104e+02	26.7	1.4219e+02	27.0	1.4335e+02
27.2	1.4451e+02	27.5	1.4566e+02	27.7	1.4682e+02	28.0	1.4797e+02	28.2	1.4911e+02	28.5	1.5026e+02
28.7	1.5141e+02	29.0	1.5256e+02	29.2	1.5370e+02	29.5	1.5485e+02	29.7	1.5599e+02	30.0	1.5713e+02

rms spread in rp-rec

e	drp-rec	e	drp-rec	e	drp-rec	e	drp-rec	e	drp-rec	e	drp-rec
0.3	6.4190e+00	0.5	9.7991e+00	0.8	1.1374e+01	1.0	1.3186e+01	1.2	1.5071e+01	1.5	1.6964e+01
1.7	1.8907e+01	2.0	2.0831e+01	2.2	2.2735e+01	2.5	2.4652e+01	2.7	2.6463e+01	3.0	2.8114e+01
3.2	2.9611e+01	3.5	3.0853e+01	3.7	3.1891e+01	4.0	3.2734e+01	4.2	3.3455e+01	4.5	3.4456e+01
4.7	3.6537e+01	5.0	3.8221e+01	5.2	3.9591e+01	5.5	4.0736e+01	5.7	4.1816e+01	6.0	4.3084e+01
6.2	4.5074e+01	6.5	4.7024e+01	6.7	4.8716e+01	7.0	5.0183e+01	7.2	5.1460e+01	7.5	5.2857e+01
7.7	5.4583e+01	8.0	5.6165e+01	8.2	5.7648e+01	8.5	5.9191e+01	8.7	6.0599e+01	9.0	6.2130e+01
9.2	6.3862e+01	9.5	6.5482e+01	9.7	6.6990e+01	10.0	6.8391e+01	10.2	6.9692e+01	10.5	7.1254e+01
10.7	7.3011e+01	11.0	7.4757e+01	11.2	7.6412e+01	11.5	7.7972e+01	11.7	7.9436e+01	12.0	8.1015e+01
12.2	8.2668e+01	12.5	8.4335e+01	12.7	8.5958e+01	13.0	8.7504e+01	13.2	8.8974e+01	13.5	9.0538e+01
13.7	9.2144e+01	14.0	9.3698e+01	14.2	9.5195e+01	14.5	9.6680e+01	14.7	9.8148e+01	15.0	9.9726e+01
15.2	1.0133e+02	15.5	1.0289e+02	15.7	1.0441e+02	16.0	1.0587e+02	16.2	1.0729e+02	16.5	1.0883e+02
16.7	1.1043e+02	17.0	1.1199e+02	17.2	1.1351e+02	17.5	1.1499e+02	17.7	1.1642e+02	18.0	1.1798e+02

18.2	1.1954e+02	18.5	1.2108e+02	18.7	1.2262e+02	19.0	1.2413e+02	19.2	1.2561e+02	19.5	1.2718e+02
19.7	1.2874e+02	20.0	1.3028e+02	20.2	1.3178e+02	20.5	1.3326e+02	20.7	1.3476e+02	21.0	1.3636e+02
21.2	1.3795e+02	21.5	1.3952e+02	21.7	1.4107e+02	22.0	1.4258e+02	22.2	1.4408e+02	22.5	1.4565e+02
22.7	1.4722e+02	23.0	1.4879e+02	23.2	1.5034e+02	23.5	1.5186e+02	23.7	1.5338e+02	24.0	1.5494e+02
24.2	1.5650e+02	24.5	1.5803e+02	24.7	1.5957e+02	25.0	1.6109e+02	25.2	1.6261e+02	25.5	1.6418e+02
25.7	1.6573e+02	26.0	1.6726e+02	26.2	1.6878e+02	26.5	1.7028e+02	26.7	1.7180e+02	27.0	1.7337e+02
27.2	1.7494e+02	27.5	1.7650e+02	27.7	1.7804e+02	28.0	1.7956e+02	28.2	1.8109e+02	28.5	1.8264e+02
28.7	1.8419e+02	29.0	1.8575e+02	29.2	1.8729e+02	29.5	1.8882e+02	29.7	1.9036e+02	30.0	1.9192e+02

date : 07/26/82
time : 14:19:25

range and straggling data for si ions incident on a/an sio2 target

e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp	e	ep	rp(e,ep)	spread in rp-para	r(e,ep)	spread in rp-perp
2.50	0.25	35.38	16.85	37.15	11.19	5.00	0.25	69.89	32.04	79.22	29.57
7.50	0.25	101.37	45.55	118.25	45.30	10.00	0.25	131.92	58.33	156.14	60.04
12.50	0.25	162.12	70.70	193.49	74.23	15.00	0.25	192.25	82.83	230.60	88.04
17.50	0.25	222.42	94.76	267.62	101.62	20.00	0.25	252.72	106.51	304.65	115.04
22.50	0.25	283.18	118.13	341.74	128.32	25.00	0.25	313.82	129.62	378.92	141.50
27.50	0.25	344.64	140.98	416.20	154.59	30.00	0.25	375.64	152.25	453.57	167.59
2.50	0.50	33.94	17.22	36.69	11.56	5.00	0.50	68.72	32.25	78.89	29.23
7.50	0.50	100.32	45.64	117.95	44.77	10.00	0.50	130.94	58.38	155.85	59.45
12.50	0.50	161.20	70.73	193.19	73.61	15.00	0.50	191.36	82.84	230.30	87.40
17.50	0.50	221.57	94.75	267.31	100.97	20.00	0.50	251.89	106.49	304.34	114.39
22.50	0.50	282.38	118.09	341.43	127.68	25.00	0.50	313.04	129.57	378.61	140.85
27.50	0.50	343.88	140.93	415.88	153.94	30.00	0.50	374.90	152.19	453.25	166.95
2.50	0.75	31.36	16.70	33.65	10.14	5.00	0.75	66.70	32.02	76.02	27.73
7.50	0.75	98.54	45.45	115.11	43.28	10.00	0.75	129.32	58.10	153.02	57.96
12.50	0.75	159.68	70.45	190.36	72.14	15.00	0.75	189.92	82.56	227.46	85.97
17.50	0.75	220.18	94.47	264.48	99.57	20.00	0.75	250.56	106.21	301.51	113.02
22.50	0.75	281.09	117.81	338.60	126.33	25.00	0.75	311.78	129.29	375.77	139.54
27.50	0.75	342.66	140.65	413.04	152.65	30.00	0.75	373.70	151.91	450.41	165.67
2.50	1.00	28.29	15.79	29.95	8.33	5.00	1.00	64.39	31.59	72.60	25.91
7.50	1.00	96.51	45.11	111.73	41.54	10.00	1.00	127.44	57.82	149.63	56.27
12.50	1.00	157.92	70.11	186.98	70.46	15.00	1.00	188.26	82.20	224.08	84.32
17.50	1.00	218.60	94.12	261.10	97.96	20.00	1.00	249.03	105.86	298.13	111.44
22.50	1.00	279.61	117.46	335.22	124.79	25.00	1.00	310.35	128.95	372.39	138.02
27.50	1.00	341.26	140.31	409.66	151.16	30.00	1.00	372.34	151.57	447.03	164.21
2.50	1.25	24.85	14.57	25.93	6.40	5.00	1.25	61.89	31.00	69.00	23.98
7.50	1.25	94.34	44.68	108.19	39.68	10.00	1.25	125.44	57.46	146.10	54.47
12.50	1.25	156.05	69.79	183.45	68.72	15.00	1.25	186.47	81.86	220.55	82.60
17.50	1.25	216.90	93.73	257.57	96.26	20.00	1.25	247.40	105.48	294.60	109.77
22.50	1.25	278.03	117.09	331.69	123.15	25.00	1.25	308.82	128.58	368.86	136.41
27.50	1.25	339.77	139.94	406.13	149.59	30.00	1.25	370.88	151.21	443.50	162.66
2.50	1.50	21.00	13.05	21.60	4.46	5.00	1.50	59.27	30.29	65.35	22.02
7.50	1.50	92.07	44.17	104.61	37.78	10.00	1.50	123.36	57.05	142.54	52.62
12.50	1.50	154.10	69.43	179.89	66.92	15.00	1.50	184.62	81.52	216.99	80.85

17.50	1.50	215.12	93.38	254.00	94.55	20.00	1.50	245.69	105.07	291.04	108.07
22.50	1.50	276.38	116.69	328.13	121.48	25.00	1.50	307.22	128.19	365.30	134.77
27.50	1.50	338.21	139.56	402.57	147.97	30.00	1.50	369.36	150.83	439.94	161.07
2.50	1.75	16.63	11.23	16.87	2.52	5.00	1.75	56.54	29.45	61.68	20.05
7.50	1.75	89.72	43.60	101.04	35.85	10.00	1.75	121.22	56.58	138.99	50.75
12.50	1.75	152.09	69.02	176.35	65.10	15.00	1.75	182.71	81.14	213.45	79.08
17.50	1.75	213.29	93.03	250.46	92.82	20.00	1.75	243.93	104.74	287.49	106.37
22.50	1.75	274.68	116.31	324.59	119.79	25.00	1.75	305.57	127.78	361.76	133.10
27.50	1.75	336.60	139.16	399.03	146.32	30.00	1.75	367.79	150.43	436.40	159.45
2.50	2.00	11.39	9.14	11.39	1.00	5.00	2.00	53.69	28.50	57.98	18.09
7.50	2.00	87.29	42.96	97.49	33.93	10.00	2.00	119.02	56.08	135.47	48.87
12.50	2.00	150.03	68.58	172.85	63.26	15.00	2.00	180.76	80.73	209.95	77.29
17.50	2.00	211.42	92.65	246.96	91.07	20.00	2.00	242.12	104.38	283.99	104.66
22.50	2.00	272.93	115.96	321.08	118.11	25.00	2.00	303.87	127.41	358.26	131.44
27.50	2.00	334.95	138.75	395.53	144.67	30.00	2.00	366.18	150.03	432.90	157.82
2.50	2.25	4.24	7.10	4.14	1.00	5.00	2.25	50.70	27.44	54.24	16.15
7.50	2.25	84.80	42.26	93.94	32.01	10.00	2.25	116.76	55.52	131.98	46.99
12.50	2.25	147.93	68.11	169.37	61.43	15.00	2.25	178.77	80.30	206.49	75.50
17.50	2.25	209.51	92.25	243.50	89.31	20.00	2.25	240.28	104.00	280.53	102.93
22.50	2.25	271.15	115.59	317.62	116.41	25.00	2.25	302.13	127.05	354.79	129.77
27.50	2.25	333.26	138.39	392.06	143.03	30.00	2.25	364.53	149.63	429.44	156.19
5.00	2.50	47.59	26.25	50.45	14.24	7.50	2.50	82.24	41.50	90.41	30.10
10.00	2.50	114.45	54.93	128.51	45.11	12.50	2.50	145.78	67.60	165.93	59.59
15.00	2.50	176.74	79.84	203.05	73.70	17.50	2.50	207.57	91.83	240.07	87.55
20.00	2.50	238.41	103.60	277.10	101.20	22.50	2.50	269.33	115.21	314.19	114.71
25.00	2.50	300.37	126.68	351.36	128.10	27.50	2.50	331.54	138.03	388.63	141.38
30.00	2.50	362.85	149.27	426.00	154.56						
7.50	5.00	52.14	29.51	53.95	12.14	10.00	5.00	88.46	46.27	94.12	26.92
12.50	5.00	121.96	60.57	132.26	41.49	15.00	5.00	154.37	73.77	169.73	55.79
17.50	5.00	186.28	86.37	206.93	69.86	20.00	5.00	217.97	98.56	244.07	83.74
22.50	5.00	249.59	110.48	281.23	97.47	25.00	5.00	281.21	122.18	318.44	111.07
27.50	5.00	312.88	133.70	355.74	124.56	30.00	5.00	344.63	145.08	393.13	137.95
10.00	7.50	55.46	31.24	56.76	10.62	12.50	7.50	93.43	49.37	97.74	24.46
15.00	7.50	128.20	64.58	136.33	38.50	17.50	7.50	161.69	78.41	174.13	52.50
20.00	7.50	194.54	91.45	211.62	66.40	22.50	7.50	227.07	103.97	249.00	80.19
25.00	7.50	259.44	116.12	286.38	93.89	27.50	7.50	291.73	127.99	323.79	107.49
30.00	7.50	324.02	139.64	361.26	120.99						
12.50	10.00	57.96	32.17	58.96	9.46	15.00	10.00	97.53	51.45	100.98	22.46
17.50	10.00	133.54	67.49	140.23	35.96	20.00	10.00	168.06	81.94	178.50	49.61

22.50	10.00	201.81	95.44	216.37	63.27	25.00	10.00	235.14	108.32	254.07	76.91
27.50	10.00	268.23	120.75	291.72	90.49	30.00	10.00	301.17	132.84	329.36	104.02
15.00	12.50	59.88	32.60	60.68	8.52	17.50	12.50	100.98	52.82	103.82	20.78
20.00	12.50	138.15	69.59	143.80	33.76	22.50	12.50	173.66	84.61	182.62	47.02
25.00	12.50	208.27	98.57	220.92	60.41	27.50	12.50	242.36	111.81	258.98	73.84
30.00	12.50	276.12	124.54	296.92	87.28						
17.50	15.00	61.40	32.70	62.05	7.75	20.00	15.00	103.88	53.69	106.28	19.33
22.50	15.00	142.16	71.09	147.02	31.80	25.00	15.00	178.59	86.63	186.41	44.69
27.50	15.00	214.01	101.02	225.17	57.78	30.00	15.00	248.82	114.61	263.60	70.98
20.00	17.50	62.57	32.58	63.11	7.09	22.50	17.50	106.33	54.18	108.39	18.06
25.00	17.50	145.64	72.12	149.88	30.05	27.50	17.50	182.94	88.12	189.84	42.56
30.00	17.50	219.12	102.89	229.06	55.34						
22.50	20.00	63.48	32.31	63.94	6.53	25.00	20.00	108.40	54.38	110.19	16.93
27.50	20.00	148.65	72.78	152.40	28.47	30.00	20.00	186.77	89.18	192.93	40.59
25.00	22.50	64.17	31.92	64.57	6.04	27.50	22.50	110.13	54.36	111.71	15.93
30.00	22.50	151.27	73.14	154.60	27.03						
27.50	25.00	64.68	31.46	65.02	5.61	30.00	25.00	111.58	54.17	112.98	15.02
27.50	27.50	0.00	0.00	0.00	0.00	30.00	27.50	65.04	30.96	65.34	5.24
2.50	0.00	36.82	16.48	37.61	10.82	5.00	0.00	71.07	31.83	79.55	29.90
7.50	0.00	102.41	45.47	118.55	45.82	10.00	0.00	132.89	58.28	156.44	60.63
12.50	0.00	163.05	70.67	193.79	74.85	15.00	0.00	193.13	82.82	230.91	88.67
17.50	0.00	223.27	94.77	267.93	102.26	20.00	0.00	253.54	106.53	304.96	115.68
22.50	0.00	283.98	118.16	342.05	128.97	25.00	0.00	314.60	129.66	379.23	142.15
27.50	0.00	345.40	141.03	416.51	155.23	30.00	0.00	376.39	152.31	453.88	168.23

...end of program : rase4 ...time consumed (seconds)... = 7.11785

task: rase4

cpu time(millisec.) : 7122
io " : 675

*** begin of program : damage2 incident ion.. si ...target.. sio2 ***

date : 07/26/82
time : 14:19:25

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

	ion	target	(alat= 3.5660)
	si	1-si	2-o2
atomic number	14.	14.000	8.000
atomic mass	28.	28.000	16.000

ndam	ne	nstp	ndiv	ndive	nmult	ntype	istp	nxtnd	ke	iter
12	120	10	4	1	1	1	0	1	0	1

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

**** units *****

energy - kev
depth,range,delta range - angstroms
energy partition,ion distribution,integrated energy distribution - dimensionless
energy distribution - ev/angstrom

incident energy	***	incident energy	***	incident energy
2.50-kev	***	5.00-kev	***	7.50-kev
proj. range	***	proj. range	***	proj. range
37.-angstroms	***	71.-angstroms	***	102. -angstroms
delta rp	***	delta rp	***	delta rp
18.-angstroms	***	33.-angstroms	***	46.-angstroms
delta perpindicular	***	delta perpindicular	***	delta perpindicular
11.-angstroms	***	30.-angstroms	***	46.-angstroms
total energy in distribution	***	total energy in distribution	***	total energy in distribution
1.35-kev	***	3.06-kev	***	4.64-kev
energy partition	***	energy partition	***	energy partition
0.5934	***	0.6549	***	0.6594

x/rp (pct)	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.

0	0.1235	1.0000	12.59		0.0929	1.0000	13.68		0.0832	1.0000	13.82
2	0.1342	0.9929	13.30		0.1020	0.9934	14.70		0.0918	0.9937	14.85
4	0.1455	0.9855	14.02		0.1119	0.9863	15.75		0.1011	0.9869	15.92
6	0.1576	0.9776	14.76		0.1225	0.9788	16.83		0.1112	0.9796	17.02
8	0.1703	0.9694	15.50		0.1338	0.9707	17.93		0.1219	0.9718	18.15
10	0.1838	0.9607	16.26		0.1459	0.9621	19.06		0.1335	0.9635	19.30
12	0.1980	0.9517	17.02		0.1587	0.9530	20.22		0.1458	0.9548	20.48
14	0.2129	0.9422	17.79		0.1724	0.9433	21.38		0.1590	0.9454	21.68
16	0.2286	0.9323	18.56		0.1869	0.9331	22.56		0.1730	0.9356	22.89
18	0.2451	0.9220	19.33		0.2023	0.9223	23.74		0.1879	0.9252	24.12
20	0.2623	0.9112	20.10		0.2185	0.9110	24.93		0.2037	0.9143	25.34
22	0.2802	0.9000	20.86		0.2355	0.8992	26.10		0.2203	0.9028	26.56
24	0.2988	0.8885	21.62		0.2534	0.8868	27.27		0.2379	0.8908	27.78
26	0.3182	0.8765	22.37		0.2721	0.8738	28.41		0.2563	0.8783	28.98
28	0.3382	0.8641	23.10		0.2917	0.8604	29.54		0.2756	0.8652	30.16
30	0.3589	0.8513	23.82		0.3121	0.8464	30.63		0.2958	0.8516	31.31
32	0.3802	0.8381	24.52		0.3332	0.8319	31.69		0.3168	0.8375	32.44
34	0.4021	0.8246	25.20		0.3551	0.8170	32.70		0.3386	0.8230	33.52
36	0.4246	0.8106	25.86		0.3778	0.8015	33.67		0.3612	0.8079	34.57
38	0.4476	0.7964	26.49		0.4011	0.7857	34.59		0.3845	0.7924	35.56
40	0.4710	0.7818	27.09		0.4250	0.7694	35.45		0.4086	0.7765	36.50
42	0.4948	0.7668	27.67		0.4496	0.7528	36.25		0.4333	0.7602	37.39
44	0.5190	0.7516	28.20		0.4746	0.7357	36.98		0.4586	0.7435	38.21
46	0.5435	0.7361	28.71		0.5001	0.7184	37.64		0.4843	0.7264	38.96
48	0.5681	0.7203	29.17		0.5259	0.7008	38.23		0.5106	0.7090	39.65
50	0.5928	0.7043	29.60		0.5520	0.6829	38.75		0.5371	0.6914	40.25
52	0.6177	0.6881	29.98		0.5784	0.6648	39.18		0.5639	0.6735	40.79
54	0.6424	0.6716	30.33		0.6048	0.6465	39.54		0.5909	0.6554	41.24
56	0.6671	0.6550	30.62		0.6312	0.6281	39.82		0.6180	0.6371	41.61
58	0.6915	0.6382	30.88		0.6575	0.6095	40.01		0.6450	0.6186	41.90
60	0.7156	0.6213	31.08		0.6837	0.5909	40.13		0.6718	0.6000	42.11
62	0.7394	0.6044	31.24		0.7095	0.5722	40.17		0.6984	0.5814	42.23
64	0.7626	0.5873	31.36		0.7349	0.5536	40.12		0.7245	0.5627	42.28
66	0.7853	0.5702	31.42		0.7598	0.5350	40.00		0.7502	0.5441	42.24
68	0.8072	0.5530	31.44		0.7840	0.5164	39.80		0.7752	0.5254	42.12
70	0.8284	0.5359	31.41		0.8074	0.4980	39.53		0.7995	0.5069	41.92
72	0.8488	0.5188	31.33		0.8300	0.4797	39.19		0.8229	0.4884	41.64
74	0.8682	0.5018	31.20		0.8516	0.4616	38.78		0.8453	0.4701	41.29
76	0.8865	0.4848	31.03		0.8721	0.4437	38.31		0.8666	0.4519	40.87
78	0.9037	0.4679	30.82		0.8913	0.4260	37.78		0.8866	0.4340	40.38
80	0.9198	0.4512	30.56		0.9093	0.4086	37.19		0.9053	0.4162	39.83
82	0.9345	0.4346	30.25		0.9259	0.3915	36.55		0.9226	0.3988	39.22
84	0.9479	0.4182	29.91		0.9410	0.3746	35.86		0.9383	0.3816	38.55
86	0.9598	0.4020	29.52		0.9545	0.3581	35.13		0.9524	0.3647	37.82
88	0.9703	0.3861	29.10		0.9664	0.3420	34.35		0.9648	0.3482	37.05
90	0.9793	0.3703	28.64		0.9765	0.3262	33.55		0.9754	0.3320	36.23
92	0.9867	0.3548	28.15		0.9849	0.3108	32.71		0.9842	0.3162	35.37
94	0.9925	0.3396	27.63		0.9915	0.2958	31.84		0.9911	0.3007	34.48
96	0.9967	0.3247	27.08		0.9962	0.2812	30.95		0.9960	0.2857	33.56
98	0.9992	0.3101	26.50		0.9990	0.2671	30.04		0.9990	0.2711	32.60
100	1.0000	0.2958	25.89		1.0000	0.2533	29.11		1.0000	0.2569	31.63
102	0.9992	0.2819	25.26		0.9990	0.2400	28.18		0.9990	0.2431	30.63
104	0.9967	0.2683	24.62		0.9962	0.2271	27.23		0.9960	0.2298	29.62
106	0.9925	0.2551	23.95		0.9915	0.2147	26.28		0.9911	0.2169	28.60
108	0.9867	0.2422	23.27		0.9849	0.2027	25.33		0.9842	0.2045	27.57
110	0.9793	0.2297	22.58		0.9765	0.1912	24.38		0.9754	0.1926	26.53
112	0.9703	0.2176	21.87		0.9664	0.1801	23.43		0.9648	0.1811	25.50
114	0.9598	0.2058	21.16		0.9545	0.1694	22.49		0.9524	0.1700	24.47
116	0.9479	0.1945	20.44		0.9410	0.1592	21.56		0.9383	0.1595	23.44
118	0.9345	0.1835	19.72		0.9259	0.1494	20.64		0.9226	0.1493	22.42

120	0.9198	0.1730	19.00	0.9093	0.1400	19.73	0.9053	0.1396	21.41
122	0.9037	0.1628	18.28	0.8913	0.1310	18.84	0.8866	0.1304	20.42
124	0.8865	0.1531	17.56	0.8721	0.1225	17.97	0.8666	0.1216	19.45
126	0.8682	0.1437	16.84	0.8516	0.1143	17.11	0.8453	0.1132	18.49
128	0.8488	0.1347	16.14	0.8300	0.1066	16.27	0.8229	0.1052	17.55
130	0.8284	0.1261	15.44	0.8074	0.0992	15.45	0.7995	0.0977	16.63
132	0.8072	0.1179	14.75	0.7840	0.0922	14.65	0.7752	0.0905	15.74
134	0.7853	0.1100	14.07	0.7598	0.0856	13.88	0.7502	0.0838	14.87
136	0.7626	0.1025	13.40	0.7349	0.0793	13.13	0.7245	0.0774	14.03
138	0.7394	0.0954	12.75	0.7095	0.0734	12.40	0.6984	0.0714	13.21
140	0.7156	0.0886	12.11	0.6837	0.0678	11.69	0.6718	0.0657	12.43
142	0.6915	0.0822	11.49	0.6575	0.0625	11.02	0.6450	0.0604	11.67
144	0.6671	0.0761	10.88	0.6312	0.0575	10.36	0.6180	0.0554	10.94
146	0.6424	0.0703	10.29	0.6048	0.0529	9.733	0.5909	0.0507	10.24
148	0.6177	0.0649	9.724	0.5784	0.0485	9.130	0.5639	0.0463	9.568
150	0.5928	0.0597	9.173	0.5520	0.0444	8.552	0.5371	0.0422	8.927
152	0.5681	0.0549	8.641	0.5259	0.0405	7.999	0.5106	0.0384	8.316
154	0.5435	0.0503	8.129	0.5001	0.0369	7.470	0.4843	0.0349	7.734
156	0.5190	0.0460	7.636	0.4746	0.0336	6.967	0.4586	0.0316	7.180
158	0.4948	0.0420	7.163	0.4496	0.0304	6.488	0.4333	0.0285	6.656
160	0.4710	0.0382	6.710	0.4250	0.0275	6.033	0.4086	0.0257	6.160
162	0.4476	0.0346	6.277	0.4011	0.0248	5.601	0.3845	0.0231	5.691
164	0.4246	0.0313	5.864	0.3778	0.0223	5.193	0.3612	0.0207	5.250
166	0.4021	0.0282	5.470	0.3551	0.0200	4.806	0.3386	0.0184	4.834
168	0.3802	0.0254	5.095	0.3332	0.0178	4.442	0.3168	0.0164	4.444
170	0.3589	0.0227	4.740	0.3121	0.0159	4.099	0.2958	0.0145	4.079
172	0.3382	0.0202	4.403	0.2917	0.0140	3.777	0.2756	0.0128	3.738
174	0.3182	0.0179	4.084	0.2721	0.0124	3.475	0.2563	0.0112	3.419
176	0.2988	0.0157	3.783	0.2534	0.0108	3.191	0.2379	0.0098	3.122
178	0.2802	0.0137	3.499	0.2355	0.0094	2.927	0.2203	0.0084	2.846
180	0.2623	0.0119	3.232	0.2185	0.0081	2.680	0.2037	0.0072	2.590
182	0.2451	0.0102	2.981	0.2023	0.0069	2.449	0.1879	0.0061	2.353
184	0.2286	0.0086	2.746	0.1869	0.0058	2.235	0.1730	0.0051	2.134
186	0.2129	0.0072	2.526	0.1724	0.0048	2.037	0.1590	0.0042	1.932
188	0.1980	0.0059	2.320	0.1587	0.0039	1.853	0.1458	0.0034	1.747
190	0.1838	0.0047	2.128	0.1459	0.0031	1.683	0.1335	0.0027	1.576
192	0.1703	0.0036	1.949	0.1338	0.0023	1.526	0.1219	0.0020	1.420
194	0.1576	0.0026	1.782	0.1225	0.0017	1.381	0.1112	0.0014	1.276
196	0.1455	0.0016	1.627	0.1119	0.0010	1.248	0.1011	0.0009	1.146
198	0.1342	0.0008	1.484	0.1020	0.0005	1.126	0.0918	0.0004	1.026
200	0.1235	0.0000	1.352	0.0929	0.0000	1.014	0.0832	0.0000	0.9181

date : 07/26/82
time : 14:19:25

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

date : 07/26/82
time : 14:19:25

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

**** units *****

energy - kev
depth,range,delta range - angstroms
energy partition,ion distribution,integrated energy distribution - dimensionless
energy distribution - ev/angstrom

incident energy	***	incident energy	***	incident energy
25.00-kev	***	27.50-kev	***	30.00-kev
proj. range	***	proj. range	***	proj. range
315.-angstroms	***	345.-angstroms	***	376. -angstroms
delta rp	***	delta rp	***	delta rp
130.-angstroms	***	141.-angstroms	***	152.-angstroms
delta perpindicular	***	delta perpindicular	***	delta perpindicular
142.-angstroms	***	155.-angstroms	***	168.-angstroms
total energy in distribution	***	total energy in distribution	***	total energy in distribution
14.37-kev	***	15.63-kev	***	16.87-kev
energy partition	***	energy partition	***	energy partition
0.6066	***	0.5992	***	0.5921

x/rp (pct)	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.

0	0.0527	1.0000	12.51	0.0498	1.0000	12.27	0.0472	1.0000	12.04
2	0.0592	0.9943	13.51	0.0561	0.9944	13.27	0.0533	0.9944	13.03
4	0.0663	0.9882	14.56	0.0630	0.9883	14.31	0.0600	0.9884	14.07
6	0.0742	0.9815	15.65	0.0707	0.9817	15.40	0.0673	0.9818	15.14
8	0.0828	0.9744	16.78	0.0790	0.9746	16.52	0.0754	0.9748	16.26
10	0.0922	0.9668	17.94	0.0881	0.9671	17.67	0.0843	0.9673	17.41
12	0.1023	0.9587	19.13	0.0980	0.9590	18.86	0.0940	0.9593	18.59
14	0.1134	0.9501	20.35	0.1088	0.9504	20.08	0.1045	0.9507	19.81
16	0.1253	0.9409	21.59	0.1205	0.9413	21.32	0.1160	0.9416	21.04
18	0.1382	0.9312	22.85	0.1331	0.9316	22.57	0.1283	0.9319	22.29
20	0.1520	0.9209	24.12	0.1467	0.9213	23.84	0.1417	0.9217	23.56
22	0.1668	0.9100	25.39	0.1613	0.9105	25.12	0.1560	0.9109	24.84
24	0.1826	0.8986	26.67	0.1769	0.8991	26.40	0.1714	0.8995	26.12
26	0.1995	0.8867	27.95	0.1935	0.8871	27.67	0.1878	0.8876	27.39
28	0.2174	0.8742	29.21	0.2113	0.8746	28.94	0.2054	0.8751	28.66
30	0.2364	0.8611	30.46	0.2300	0.8616	30.19	0.2240	0.8620	29.91
32	0.2564	0.8475	31.68	0.2499	0.8479	31.42	0.2437	0.8484	31.14
34	0.2774	0.8333	32.88	0.2708	0.8338	32.62	0.2644	0.8342	32.34
36	0.2995	0.8187	34.04	0.2928	0.8191	33.78	0.2863	0.8195	33.51
38	0.3225	0.8035	35.16	0.3157	0.8039	34.91	0.3092	0.8043	34.63
40	0.3466	0.7879	36.24	0.3397	0.7883	35.98	0.3331	0.7886	35.71
42	0.3715	0.7718	37.26	0.3646	0.7721	37.01	0.3580	0.7725	36.74
44	0.3973	0.7553	38.22	0.3904	0.7556	37.98	0.3838	0.7559	37.71
46	0.4239	0.7383	39.13	0.4171	0.7386	38.88	0.4105	0.7388	38.62
48	0.4512	0.7210	39.96	0.4444	0.7212	39.72	0.4379	0.7214	39.46
50	0.4791	0.7034	40.72	0.4725	0.7035	40.48	0.4661	0.7036	40.22
52	0.5075	0.6854	41.41	0.5011	0.6854	41.17	0.4948	0.6855	40.92
54	0.5364	0.6671	42.02	0.5302	0.6671	41.78	0.5241	0.6671	41.53
56	0.5656	0.6486	42.54	0.5596	0.6485	42.31	0.5537	0.6485	42.06
58	0.5950	0.6299	42.98	0.5892	0.6297	42.75	0.5835	0.6296	42.50
60	0.6244	0.6110	43.34	0.6189	0.6108	43.11	0.6135	0.6106	42.86
62	0.6537	0.5919	43.60	0.6485	0.5916	43.38	0.6434	0.5914	43.13
64	0.6828	0.5728	43.78	0.6780	0.5724	43.56	0.6732	0.5721	43.31
66	0.7116	0.5536	43.87	0.7070	0.5532	43.65	0.7026	0.5527	43.40
68	0.7398	0.5344	43.87	0.7356	0.5339	43.65	0.7315	0.5334	43.41
70	0.7673	0.5152	43.78	0.7634	0.5146	43.56	0.7597	0.5140	43.32
72	0.7939	0.4961	43.60	0.7905	0.4954	43.38	0.7871	0.4947	43.14
74	0.8196	0.4770	43.34	0.8165	0.4763	43.12	0.8135	0.4755	42.88
76	0.8440	0.4581	43.00	0.8414	0.4573	42.78	0.8387	0.4565	42.54
78	0.8672	0.4394	42.57	0.8649	0.4385	42.35	0.8626	0.4376	42.11
80	0.8889	0.4209	42.07	0.8870	0.4198	41.85	0.8850	0.4189	41.61
82	0.9090	0.4026	41.49	0.9074	0.4015	41.27	0.9058	0.4004	41.03
84	0.9274	0.3845	40.84	0.9261	0.3834	40.62	0.9248	0.3823	40.38
86	0.9439	0.3668	40.12	0.9429	0.3656	39.90	0.9419	0.3644	39.66
88	0.9585	0.3494	39.35	0.9577	0.3481	39.12	0.9570	0.3469	38.88
90	0.9710	0.3324	38.51	0.9705	0.3310	38.28	0.9699	0.3297	38.04
92	0.9813	0.3157	37.62	0.9810	0.3143	37.39	0.9806	0.3130	37.14
94	0.9895	0.2994	36.68	0.9893	0.2980	36.45	0.9891	0.2966	36.20
96	0.9953	0.2836	35.69	0.9952	0.2821	35.46	0.9951	0.2807	35.21
98	0.9988	0.2682	34.67	0.9988	0.2666	34.43	0.9988	0.2652	34.18
100	1.0000	0.2532	33.61	1.0000	0.2517	33.37	1.0000	0.2502	33.12
102	0.9988	0.2387	32.52	0.9988	0.2371	32.28	0.9988	0.2356	32.03
104	0.9953	0.2247	31.41	0.9952	0.2231	31.17	0.9951	0.2216	30.91
106	0.9895	0.2112	30.28	0.9893	0.2096	30.03	0.9891	0.2080	29.78
108	0.9813	0.1982	29.13	0.9810	0.1966	28.88	0.9806	0.1950	28.63
110	0.9710	0.1857	27.97	0.9705	0.1841	27.72	0.9699	0.1825	27.47
112	0.9585	0.1737	26.81	0.9577	0.1721	26.56	0.9570	0.1705	26.30
114	0.9439	0.1622	25.65	0.9429	0.1606	25.40	0.9419	0.1590	25.14
116	0.9274	0.1513	24.49	0.9261	0.1496	24.23	0.9248	0.1481	23.98
118	0.9090	0.1408	23.33	0.9074	0.1392	23.08	0.9058	0.1376	22.82

120	0.8889	0.1308	22.19	0.8870	0.1292	21.94	0.8850	0.1277	21.68
122	0.8672	0.1213	21.07	0.8649	0.1198	20.81	0.8626	0.1183	20.56
124	0.8440	0.1124	19.96	0.8414	0.1108	19.71	0.8387	0.1093	19.45
126	0.8196	0.1039	18.87	0.8165	0.1023	18.62	0.8135	0.1009	18.37
128	0.7939	0.0958	17.81	0.7905	0.0943	17.56	0.7871	0.0929	17.31
130	0.7673	0.0882	16.78	0.7634	0.0868	16.53	0.7597	0.0854	16.28
132	0.7398	0.0811	15.77	0.7356	0.0797	15.52	0.7315	0.0784	15.28
134	0.7116	0.0744	14.80	0.7070	0.0731	14.55	0.7026	0.0718	14.31
136	0.6828	0.0682	13.85	0.6780	0.0669	13.61	0.6732	0.0656	13.37
138	0.6537	0.0623	12.94	0.6485	0.0610	12.71	0.6434	0.0599	12.47
140	0.6244	0.0568	12.07	0.6189	0.0556	11.84	0.6135	0.0545	11.61
142	0.5950	0.0517	11.23	0.5892	0.0506	11.01	0.5835	0.0495	10.78
144	0.5656	0.0470	10.43	0.5596	0.0459	10.21	0.5537	0.0448	9.996
146	0.5364	0.0426	9.671	0.5302	0.0415	9.456	0.5241	0.0405	9.245
148	0.5075	0.0385	8.946	0.5011	0.0375	8.737	0.4948	0.0366	8.533
150	0.4791	0.0347	8.258	0.4725	0.0338	8.055	0.4661	0.0329	7.858
152	0.4512	0.0312	7.607	0.4444	0.0304	7.412	0.4379	0.0296	7.222
154	0.4239	0.0280	6.993	0.4171	0.0272	6.805	0.4105	0.0265	6.622
156	0.3973	0.0251	6.416	0.3904	0.0244	6.235	0.3838	0.0236	6.060
158	0.3715	0.0224	5.874	0.3646	0.0217	5.700	0.3580	0.0211	5.533
160	0.3466	0.0200	5.366	0.3397	0.0193	5.200	0.3331	0.0187	5.041
162	0.3225	0.0177	4.892	0.3157	0.0171	4.734	0.3092	0.0165	4.582
164	0.2995	0.0157	4.451	0.2928	0.0151	4.300	0.2863	0.0146	4.156
166	0.2774	0.0138	4.041	0.2708	0.0133	3.898	0.2644	0.0128	3.762
168	0.2564	0.0121	3.661	0.2499	0.0117	3.526	0.2437	0.0112	3.397
170	0.2364	0.0106	3.309	0.2300	0.0102	3.182	0.2240	0.0098	3.061
172	0.2174	0.0092	2.985	0.2113	0.0088	2.866	0.2054	0.0085	2.752
174	0.1995	0.0080	2.687	0.1935	0.0076	2.575	0.1878	0.0073	2.469
176	0.1826	0.0069	2.414	0.1769	0.0066	2.309	0.1714	0.0063	2.210
178	0.1668	0.0059	2.163	0.1613	0.0056	2.066	0.1560	0.0054	1.974
180	0.1520	0.0050	1.935	0.1467	0.0047	1.844	0.1417	0.0045	1.759
182	0.1382	0.0042	1.727	0.1331	0.0040	1.643	0.1283	0.0038	1.564
184	0.1253	0.0034	1.538	0.1205	0.0033	1.460	0.1160	0.0031	1.387
186	0.1134	0.0028	1.367	0.1088	0.0027	1.295	0.1045	0.0025	1.228
188	0.1023	0.0022	1.212	0.0980	0.0021	1.146	0.0940	0.0020	1.084
190	0.0922	0.0017	1.072	0.0881	0.0016	1.011	0.0843	0.0016	0.9552
192	0.0828	0.0013	0.9465	0.0790	0.0012	0.8910	0.0754	0.0012	0.8397
194	0.0742	0.0009	0.8337	0.0707	0.0009	0.7831	0.0673	0.0008	0.7365
196	0.0663	0.0006	0.7328	0.0630	0.0005	0.6868	0.0600	0.0005	0.6445
198	0.0592	0.0003	0.6427	0.0561	0.0002	0.6010	0.0533	0.0002	0.5627
200	0.0527	0.0000	0.5625	0.0498	0.0000	0.5247	0.0472	0.0000	0.4901

date : 07/26/82
time : 14:19:25

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

energy	x-average	delta x-sq average	energy partition	total energy in distribution
2	25.768	352.28	0.59335	1.4834
			energy deposited in target =	1.3509
5	48.544	1076.4	0.65488	3.2744
			energy deposited in target =	3.0590
7	70.578	2177.1	0.65935	4.9452
			energy deposited in target =	4.6351
10	92.072	3604.9	0.65454	6.5454
			energy deposited in target =	6.1471
12	113.35	5349.4	0.64669	8.0837
			energy deposited in target =	7.6050
15	134.41	7401.5	0.63891	9.5837
			energy deposited in target =	9.0296
17	155.49	9752.1	0.63062	11.036
			energy deposited in target =	10.414
20	176.63	12402.	0.62231	12.446
			energy deposited in target =	11.762
22	197.83	15355.	0.61429	13.822
			energy deposited in target =	13.079
25	219.07	18607.	0.60657	15.164
			energy deposited in target =	14.367
27	240.43	22156.	0.59917	16.477
			energy deposited in target =	15.629

30	261.91	26005.	0.59213	17.764

energy deposited in target =   16.868

date : 07/26/82
time : 14:19:25

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

i	dpct	xmom3(i)	dxmom3(i)
1	0.593355	5.0467e+02	2.0014e+03
2	0.654886	7.2957e+03	1.2238e+04
3	0.659354	1.6172e+04	3.6225e+04
4	0.654540	2.7938e+04	7.7192e+04
5	0.646698	4.3937e+04	1.3895e+05
6	0.638910	6.6138e+04	2.2451e+05
7	0.630623	9.5343e+04	3.3738e+05
8	0.622318	1.3211e+05	4.8074e+05
9	0.614294	1.7732e+05	6.5740e+05
10	0.606578	2.3181e+05	8.6997e+05
11	0.599171	2.9549e+05	1.1216e+06
12	0.592138	3.6895e+05	1.4150e+06

...end of program : damage2 ...time consumed (seconds)... = 1.52665

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task: damage2

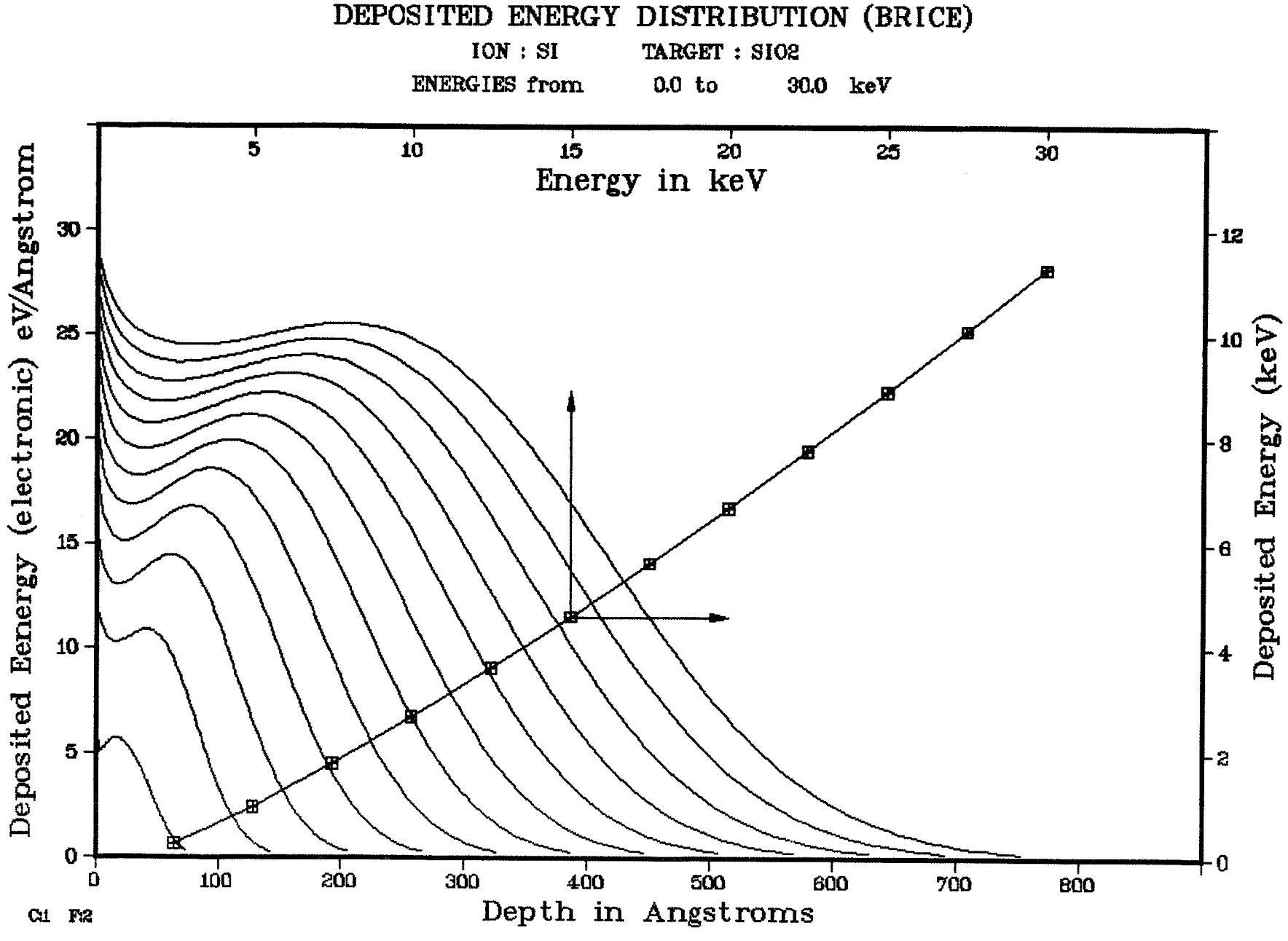
cpu time(millisec.)	:	1526
io ,,	:	309
sus ,,	:	5
time left (seconds)	:	113
task time (minutes)	:	0.02544

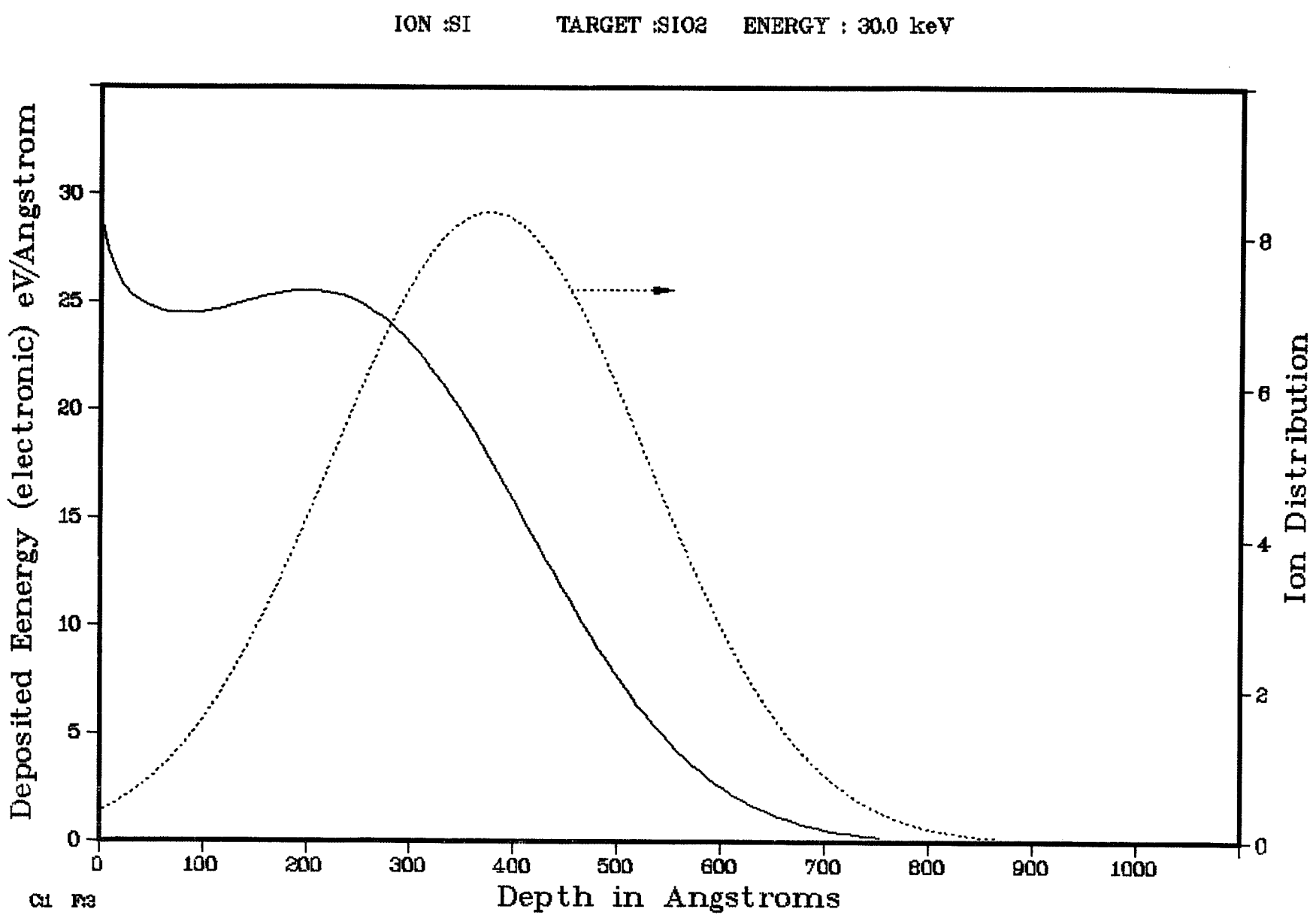
nd brief

014

Appendix D

DAMG2 Outputs for the Electronic Energy Deposition


DEPOSITED ENERGY DISTRIBUTION (BRICE)
ION : SI TARGET : SIO2
ENERGIES from 0.0 to 30.0 keV
Energy in keV
5
10
15
20
25
30
Deposited Eenergy (electronic) eV/Angstrom
0
5
10
15
20
25
30
Deposited Energy (keV)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
Depth in Angstroms
C1 F2


DEPOSITED ENERGY and ION DISTRIBUTIONS (BRICE)
ION :SI TARGET :SIO2 ENERGY : 30.0 keV
Deposited Eenergy (electronic) eV/Angstrom
Ion Distribution
Depth in Angstroms
0
5
10
15
20
25
30
0
2
4
6
8
0
100
200
300
400
500
600
700
800
900
1000
C1 F3

```
                                                          date     : 07/26/82
                                                          time     : 14:23:00 (pst)
                                                          machine  : c

controllee: xbrice          controller: +1bricea
loaded on : 07/22/82        at time   : 13:18:06
dropfile  : +xbricea        system    : a
user #    : 001450          account   : 862swi
program bank( min:sec ) :    1:59
pool    bank( minutes ) :         122


files:
          tape10      tape20      tape30      tape32      obrice02    qbrice02

                              ***** input data  for  brice02 run   *****

  1 -- :     2                                                                  - brice    brice02
  2 -- :sio2                                                                    - brice    brice02
  3 -- :ion="si               "   zi= 14.   pi= 28.0000  ncomp= 2               - brice    brice02
  4 -- :target( 1)="si        "  nform( 1)= 1.000  z2( 1)= 14.  p2( 1)= 28.0000 - brice    brice02
  5 -- :target( 2)="o2        "  nform( 2)= 2.000  z2( 2)=  8.  p2( 2)= 16.0000 - brice    brice02
  6 -- :alat=  3.5660   alata=   0.00000       alatd=    0.0000  ed=0.           - brice    brice02
  7 -- :nqti=4                                                                  - brice    brice02
  8 -- :ne=120     nmult=1        ndiv=4        nstp=10     ndive=1      ndskp=1$ - brice    brice02
  9 -- :damq                                                                    - brice    brice02
 10 -- :ntupe=2   istp=0  ipltd=1 $                                             - brice    brice02
 11 -- :end brief                                                               - brice    brice02
```

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ama

020

*** begin of program : damage2 incident ion.. si ...target.. sio2 ***

date : 07/26/82
time : 14:23:00

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

	ion si	target (alat= 3.5660) 1-si	2-o2
atomic number	14.	14.000	8.000
atomic mass	28.	28.000	16.000

ndam	ne	nstp	ndiv	ndive	nmult	ntape	istp	nxtnd	ke	iter
12	120	10	4	1	1	2	0	1	0	1

date : 07/26/82
time : 14:23:00

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

**** units *****

energy - kev
depth,range,delta range - angstroms
energy partition,ion distribution,integrated energy distribution - dimensionless
energy distribution - ev/angstrom

incident energy	***	incident energy	***	incident energy
2.50-kev	***	5.00-kev	***	7.50-kev
proj. range	***	proj. range	***	proj. range
37.-angstroms	***	71.-angstroms	***	102. -angstroms
delta rp	***	delta rp	***	delta rp
18.-angstroms	***	33.-angstroms	***	46.-angstroms
delta perpindicular	***	delta perpindicular	***	delta perpindicular
11.-angstroms	***	30.-angstroms	***	46.-angstroms
total energy in distribution	***	total energy in distribution	***	total energy in distribution
0.27-kev	***	0.97-kev	***	1.80-kev
energy partition	***	energy partition	***	energy partition
0.1183	***	0.2024	***	0.2505

x/rp (pct)	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.

0	0.1235	1.0000	7.183	0.0929	1.0000	11.52	0.0832	1.0000	17.23
2	0.1342	0.9812	6.501	0.1020	0.9830	11.67	0.0918	0.9814	15.44
4	0.1455	0.9644	5.830	0.1119	0.9659	11.56	0.1011	0.9645	14.30
6	0.1576	0.9493	5.172	0.1225	0.9492	11.20	0.1112	0.9485	13.83
8	0.1703	0.9353	5.040	0.1338	0.9329	10.91	0.1219	0.9329	13.53
10	0.1838	0.9214	5.089	0.1459	0.9170	10.71	0.1335	0.9176	13.32
12	0.1980	0.9074	5.138	0.1587	0.9014	10.57	0.1458	0.9026	13.19
14	0.2129	0.8933	5.174	0.1724	0.8859	10.46	0.1590	0.8876	13.10
16	0.2286	0.8790	5.210	0.1869	0.8706	10.39	0.1730	0.8727	13.05
18	0.2451	0.8647	5.254	0.2023	0.8554	10.34	0.1879	0.8579	13.03
20	0.2623	0.8502	5.305	0.2185	0.8402	10.31	0.2037	0.8430	13.04
22	0.2802	0.8356	5.362	0.2355	0.8251	10.29	0.2203	0.8282	13.07
24	0.2988	0.8208	5.420	0.2534	0.8100	10.29	0.2379	0.8133	13.11
26	0.3182	0.8059	5.475	0.2721	0.7948	10.30	0.2563	0.7983	13.17
28	0.3382	0.7908	5.526	0.2917	0.7797	10.32	0.2756	0.7833	13.25
30	0.3589	0.7756	5.571	0.3121	0.7645	10.35	0.2958	0.7682	13.33
32	0.3802	0.7603	5.609	0.3332	0.7492	10.39	0.3168	0.7529	13.42
34	0.4021	0.7449	5.641	0.3551	0.7339	10.43	0.3386	0.7376	13.52
36	0.4246	0.7294	5.667	0.3778	0.7186	10.48	0.3612	0.7222	13.62
38	0.4476	0.7138	5.686	0.4011	0.7031	10.53	0.3845	0.7066	13.72
40	0.4710	0.6982	5.699	0.4250	0.6876	10.58	0.4086	0.6909	13.83
42	0.4948	0.6826	5.706	0.4496	0.6720	10.62	0.4333	0.6751	13.93
44	0.5190	0.6670	5.707	0.4746	0.6564	10.67	0.4586	0.6592	14.02
46	0.5435	0.6514	5.703	0.5001	0.6407	10.72	0.4843	0.6432	14.11
48	0.5681	0.6357	5.694	0.5259	0.6249	10.76	0.5106	0.6271	14.20
50	0.5928	0.6201	5.680	0.5520	0.6090	10.80	0.5371	0.6109	14.27
52	0.6177	0.6046	5.662	0.5784	0.5931	10.83	0.5639	0.5946	14.33
54	0.6424	0.5891	5.640	0.6048	0.5772	10.85	0.5909	0.5783	14.38
56	0.6671	0.5737	5.615	0.6312	0.5613	10.87	0.6180	0.5619	14.42
58	0.6915	0.5584	5.585	0.6575	0.5453	10.87	0.6450	0.5455	14.44
60	0.7156	0.5431	5.553	0.6837	0.5293	10.87	0.6718	0.5290	14.45
62	0.7394	0.5279	5.517	0.7095	0.5133	10.86	0.6984	0.5126	14.44
64	0.7626	0.5129	5.478	0.7349	0.4974	10.83	0.7245	0.4961	14.42
66	0.7853	0.4979	5.436	0.7598	0.4815	10.80	0.7502	0.4798	14.37
68	0.8072	0.4831	5.391	0.7840	0.4657	10.75	0.7752	0.4635	14.31
70	0.8284	0.4684	5.343	0.8074	0.4499	10.69	0.7995	0.4472	14.22
72	0.8488	0.4538	5.292	0.8300	0.4342	10.62	0.8229	0.4311	14.12
74	0.8682	0.4394	5.238	0.8516	0.4187	10.53	0.8453	0.4151	14.00
76	0.8865	0.4251	5.181	0.8721	0.4033	10.43	0.8666	0.3992	13.86
78	0.9037	0.4110	5.121	0.8913	0.3880	10.32	0.8866	0.3836	13.70
80	0.9198	0.3970	5.058	0.9093	0.3730	10.20	0.9053	0.3681	13.52
82	0.9345	0.3832	4.992	0.9259	0.3581	10.06	0.9226	0.3528	13.32
84	0.9479	0.3697	4.923	0.9410	0.3434	9.909	0.9383	0.3378	13.10
86	0.9598	0.3563	4.851	0.9545	0.3290	9.748	0.9524	0.3230	12.87
88	0.9703	0.3431	4.776	0.9664	0.3148	9.575	0.9648	0.3085	12.62
90	0.9793	0.3301	4.698	0.9765	0.3008	9.391	0.9754	0.2943	12.36
92	0.9867	0.3173	4.617	0.9849	0.2872	9.197	0.9842	0.2803	12.08
94	0.9925	0.3048	4.534	0.9915	0.2738	8.992	0.9911	0.2668	11.79
96	0.9967	0.2925	4.448	0.9962	0.2607	8.779	0.9960	0.2535	11.49
98	0.9992	0.2804	4.359	0.9990	0.2480	8.558	0.9990	0.2406	11.18
100	1.0000	0.2686	4.268	1.0000	0.2356	8.330	1.0000	0.2281	10.86
102	0.9992	0.2570	4.175	0.9990	0.2235	8.094	0.9990	0.2159	10.53
104	0.9967	0.2457	4.080	0.9962	0.2118	7.854	0.9960	0.2041	10.19
106	0.9925	0.2347	3.983	0.9915	0.2004	7.608	0.9911	0.1927	9.850
108	0.9867	0.2239	3.884	0.9849	0.1894	7.358	0.9842	0.1817	9.504
110	0.9793	0.2134	3.784	0.9765	0.1788	7.106	0.9754	0.1711	9.155
112	0.9703	0.2032	3.682	0.9664	0.1686	6.851	0.9648	0.1608	8.804
114	0.9598	0.1932	3.579	0.9545	0.1587	6.595	0.9524	0.1510	8.453
116	0.9479	0.1835	3.475	0.9410	0.1492	6.338	0.9383	0.1416	8.103
118	0.9345	0.1742	3.370	0.9259	0.1400	6.082	0.9226	0.1326	7.754

120	0.9198	0.1651	3.265	0.9093	0.1313	5.827	0.9053	0.1240	7.408
122	0.9037	0.1563	3.160	0.8913	0.1229	5.574	0.8866	0.1157	7.066
124	0.8865	0.1478	3.054	0.8721	0.1149	5.323	0.8666	0.1079	6.729
126	0.8682	0.1395	2.948	0.8516	0.1073	5.076	0.8453	0.1004	6.397
128	0.8488	0.1316	2.843	0.8300	0.1000	4.832	0.8229	0.0933	6.072
130	0.8284	0.1239	2.739	0.8074	0.0931	4.594	0.7995	0.0866	5.754
132	0.8072	0.1166	2.635	0.7840	0.0865	4.360	0.7752	0.0802	5.444
134	0.7853	0.1095	2.531	0.7598	0.0802	4.131	0.7502	0.0742	5.142
136	0.7626	0.1027	2.429	0.7349	0.0743	3.909	0.7245	0.0685	4.849
138	0.7394	0.0962	2.329	0.7095	0.0687	3.693	0.6984	0.0631	4.565
140	0.7156	0.0899	2.229	0.6837	0.0635	3.483	0.6718	0.0581	4.291
142	0.6915	0.0840	2.132	0.6575	0.0585	3.280	0.6450	0.0534	4.027
144	0.6671	0.0783	2.036	0.6312	0.0538	3.085	0.6180	0.0489	3.773
146	0.6424	0.0728	1.942	0.6048	0.0494	2.896	0.5909	0.0448	3.529
148	0.6177	0.0676	1.850	0.5784	0.0453	2.715	0.5639	0.0409	3.296
150	0.5928	0.0627	1.760	0.5520	0.0414	2.541	0.5371	0.0373	3.073
152	0.5681	0.0580	1.672	0.5259	0.0378	2.375	0.5106	0.0339	2.860
154	0.5435	0.0535	1.587	0.5001	0.0345	2.217	0.4843	0.0307	2.658
156	0.5190	0.0493	1.504	0.4746	0.0313	2.065	0.4586	0.0278	2.466
158	0.4948	0.0452	1.424	0.4496	0.0284	1.922	0.4333	0.0251	2.285
160	0.4710	0.0415	1.346	0.4250	0.0257	1.785	0.4086	0.0226	2.113
162	0.4476	0.0379	1.271	0.4011	0.0231	1.656	0.3845	0.0203	1.951
164	0.4246	0.0345	1.198	0.3778	0.0208	1.534	0.3612	0.0182	1.798
166	0.4021	0.0313	1.128	0.3551	0.0186	1.418	0.3386	0.0162	1.655
168	0.3802	0.0283	1.061	0.3332	0.0166	1.310	0.3168	0.0144	1.520
170	0.3589	0.0255	0.9966	0.3121	0.0148	1.208	0.2958	0.0127	1.394
172	0.3382	0.0228	0.9348	0.2917	0.0130	1.112	0.2756	0.0112	1.277
174	0.3182	0.0203	0.8757	0.2721	0.0115	1.022	0.2563	0.0098	1.167
176	0.2988	0.0180	0.8192	0.2534	0.0100	0.9383	0.2379	0.0086	1.066
178	0.2802	0.0159	0.7654	0.2355	0.0087	0.8600	0.2203	0.0074	0.9709
180	0.2623	0.0138	0.7141	0.2185	0.0075	0.7871	0.2037	0.0063	0.8832
182	0.2451	0.0119	0.6654	0.2023	0.0064	0.7193	0.1879	0.0054	0.8021
184	0.2286	0.0102	0.6192	0.1869	0.0054	0.6563	0.1730	0.0045	0.7272
186	0.2129	0.0085	0.5754	0.1724	0.0045	0.5979	0.1590	0.0037	0.6583
188	0.1980	0.0070	0.5340	0.1587	0.0036	0.5439	0.1458	0.0030	0.5948
190	0.1838	0.0056	0.4949	0.1459	0.0029	0.4941	0.1335	0.0024	0.5366
192	0.1703	0.0043	0.4581	0.1338	0.0022	0.4481	0.1219	0.0018	0.4833
194	0.1576	0.0031	0.4234	0.1225	0.0015	0.4058	0.1112	0.0013	0.4345
196	0.1455	0.0020	0.3908	0.1119	0.0010	0.3670	0.1011	0.0008	0.3900
198	0.1342	0.0009	0.3602	0.1020	0.0005	0.3313	0.0918	0.0004	0.3495
200	0.1235	0.0000	0.3316	0.0929	0.0000	0.2987	0.0832	0.0000	0.3126

date : 07/26/82
time : 14:23:00

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

**** units *****

energy - kev
depth,range,delta range - angstroms
energy partition,ion distribution,integrated energy distribution - dimensionless
energy distribution - ev/angstrom

incident energy	***	incident energy	***	incident energy
25.00-kev	***	27.50-kev	***	30.00-kev
proj. range	***	proj. range	***	proj. range
315.-angstroms	***	345.-angstroms	***	376. -angstroms
delta rp	***	delta rp	***	delta rp
130.-angstroms	***	141.-angstroms	***	152.-angstroms
delta perpindicular	***	delta perpindicular	***	delta perpindicular
142.-angstroms	***	155.-angstroms	***	168.-angstroms
total energy in distribution	***	total energy in distribution	***	total energy in distribution
8.92-kev	***	10.08-kev	***	11.27-kev
energy partition	***	energy partition	***	energy partition
0.3700	***	0.3797	***	0.3886

x/rp (pct)	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.	***	final ion distr.	integrated energy distr.	energy distr.

0	0.0527	1.0000	27.22	0.0498	1.0000	28.11	0.0472	1.0000	28.91
2	0.0592	0.9814	25.61	0.0561	0.9813	26.53	0.0533	0.9812	27.37
4	0.0663	0.9637	24.50	0.0630	0.9635	25.44	0.0600	0.9633	26.31
6	0.0742	0.9466	23.89	0.0707	0.9462	24.83	0.0673	0.9459	25.72
8	0.0828	0.9299	23.49	0.0790	0.9294	24.44	0.0754	0.9288	25.33
10	0.0922	0.9134	23.22	0.0881	0.9127	24.16	0.0843	0.9120	25.05
12	0.1023	0.8971	23.03	0.0980	0.8962	23.97	0.0940	0.8954	24.85
14	0.1134	0.8809	22.90	0.1088	0.8798	23.83	0.1045	0.8788	24.71
16	0.1253	0.8648	22.82	0.1205	0.8635	23.74	0.1160	0.8623	24.61
18	0.1382	0.8487	22.78	0.1331	0.8473	23.69	0.1283	0.8459	24.54
20	0.1520	0.8326	22.78	0.1467	0.8310	23.67	0.1417	0.8295	24.50
22	0.1668	0.8166	22.79	0.1613	0.8148	23.67	0.1560	0.8132	24.49
24	0.1826	0.8005	22.83	0.1769	0.7986	23.70	0.1714	0.7968	24.50
26	0.1995	0.7843	22.89	0.1935	0.7823	23.75	0.1878	0.7804	24.54
28	0.2174	0.7682	22.96	0.2113	0.7660	23.81	0.2054	0.7640	24.59
30	0.2364	0.7519	23.05	0.2300	0.7497	23.88	0.2240	0.7476	24.66
32	0.2564	0.7356	23.14	0.2499	0.7333	23.97	0.2437	0.7311	24.74
34	0.2774	0.7193	23.24	0.2708	0.7168	24.07	0.2644	0.7145	24.83
36	0.2995	0.7028	23.35	0.2928	0.7003	24.17	0.2863	0.6979	24.93
38	0.3225	0.6863	23.45	0.3157	0.6837	24.27	0.3092	0.6812	25.03
40	0.3466	0.6697	23.56	0.3397	0.6670	24.37	0.3331	0.6645	25.13
42	0.3715	0.6531	23.66	0.3646	0.6503	24.47	0.3580	0.6476	25.22
44	0.3973	0.6364	23.75	0.3904	0.6335	24.56	0.3838	0.6308	25.31
46	0.4239	0.6196	23.83	0.4171	0.6166	24.64	0.4105	0.6138	25.38
48	0.4512	0.6027	23.90	0.4444	0.5997	24.70	0.4379	0.5969	25.44
50	0.4791	0.5858	23.96	0.4725	0.5828	24.75	0.4661	0.5799	25.49
52	0.5075	0.5689	24.00	0.5011	0.5658	24.78	0.4948	0.5628	25.51
54	0.5364	0.5520	24.01	0.5302	0.5488	24.80	0.5241	0.5458	25.52
56	0.5656	0.5350	24.01	0.5596	0.5318	24.79	0.5537	0.5287	25.50
58	0.5950	0.5181	23.98	0.5892	0.5148	24.75	0.5835	0.5117	25.46
60	0.6244	0.5012	23.93	0.6189	0.4979	24.69	0.6135	0.4947	25.39
62	0.6537	0.4844	23.85	0.6485	0.4810	24.61	0.6434	0.4778	25.30
64	0.6828	0.4676	23.75	0.6780	0.4642	24.49	0.6732	0.4609	25.17
66	0.7116	0.4509	23.61	0.7070	0.4474	24.34	0.7026	0.4442	25.02
68	0.7398	0.4343	23.45	0.7356	0.4308	24.17	0.7315	0.4275	24.83
70	0.7673	0.4178	23.25	0.7634	0.4143	23.96	0.7597	0.4110	24.61
72	0.7939	0.4015	23.02	0.7905	0.3980	23.72	0.7871	0.3947	24.36
74	0.8196	0.3853	22.77	0.8165	0.3818	23.45	0.8135	0.3785	24.07
76	0.8440	0.3693	22.48	0.8414	0.3658	23.15	0.8387	0.3625	23.76
78	0.8672	0.3536	22.16	0.8649	0.3501	22.81	0.8626	0.3468	23.41
80	0.8889	0.3381	21.82	0.8870	0.3346	22.45	0.8850	0.3313	23.03
82	0.9090	0.3228	21.44	0.9074	0.3193	22.06	0.9058	0.3160	22.62
84	0.9274	0.3078	21.04	0.9261	0.3044	21.63	0.9248	0.3011	22.17
86	0.9439	0.2931	20.61	0.9429	0.2897	21.18	0.9419	0.2864	21.70
88	0.9585	0.2788	20.15	0.9577	0.2753	20.71	0.9570	0.2721	21.21
90	0.9710	0.2647	19.67	0.9705	0.2613	20.20	0.9699	0.2581	20.69
92	0.9813	0.2510	19.17	0.9810	0.2476	19.68	0.9806	0.2444	20.14
94	0.9895	0.2377	18.65	0.9893	0.2343	19.13	0.9891	0.2312	19.57
96	0.9953	0.2247	18.11	0.9952	0.2214	18.57	0.9951	0.2183	18.99
98	0.9988	0.2121	17.55	0.9988	0.2089	17.99	0.9988	0.2058	18.39
100	1.0000	0.2000	16.98	1.0000	0.1968	17.40	1.0000	0.1937	17.77
102	0.9988	0.1882	16.39	0.9988	0.1851	16.79	0.9988	0.1821	17.14
104	0.9953	0.1768	15.80	0.9952	0.1738	16.17	0.9951	0.1708	16.50
106	0.9895	0.1659	15.20	0.9893	0.1629	15.55	0.9891	0.1600	15.85
108	0.9813	0.1554	14.60	0.9810	0.1524	14.92	0.9806	0.1497	15.20
110	0.9710	0.1453	13.99	0.9705	0.1424	14.29	0.9699	0.1397	14.55
112	0.9585	0.1356	13.38	0.9577	0.1329	13.66	0.9570	0.1302	13.90
114	0.9439	0.1264	12.77	0.9429	0.1237	13.03	0.9419	0.1212	13.25
116	0.9274	0.1176	12.17	0.9261	0.1150	12.40	0.9248	0.1125	12.60
118	0.9090	0.1093	11.57	0.9074	0.1067	11.78	0.9058	0.1043	11.96

120	0.8889	0.1013	10.98	0.8870	0.0988	11.17	0.8850	0.0965	11.33
122	0.8672	0.0938	10.40	0.8649	0.0914	10.57	0.8626	0.0892	10.71
124	0.8440	0.0866	9.829	0.8414	0.0844	9.982	0.8387	0.0822	10.11
126	0.8196	0.0799	9.272	0.8165	0.0777	9.407	0.8135	0.0757	9.517
128	0.7939	0.0735	8.728	0.7905	0.0715	8.847	0.7871	0.0695	8.942
130	0.7673	0.0676	8.200	0.7634	0.0656	8.302	0.7597	0.0637	8.383
132	0.7398	0.0620	7.688	0.7356	0.0601	7.776	0.7315	0.0583	7.843
134	0.7116	0.0567	7.193	0.7070	0.0549	7.267	0.7026	0.0532	7.321
136	0.6828	0.0518	6.717	0.6780	0.0501	6.777	0.6732	0.0485	6.820
138	0.6537	0.0472	6.259	0.6485	0.0456	6.308	0.6434	0.0441	6.340
140	0.6244	0.0430	5.820	0.6189	0.0414	5.858	0.6135	0.0400	5.881
142	0.5950	0.0390	5.401	0.5892	0.0376	5.429	0.5835	0.0363	5.443
144	0.5656	0.0353	5.001	0.5596	0.0340	5.021	0.5537	0.0328	5.027
146	0.5364	0.0319	4.622	0.5302	0.0307	4.633	0.5241	0.0295	4.633
148	0.5075	0.0288	4.262	0.5011	0.0276	4.267	0.4948	0.0266	4.261
150	0.4791	0.0259	3.922	0.4725	0.0248	3.921	0.4661	0.0238	3.910
152	0.4512	0.0233	3.602	0.4444	0.0223	3.595	0.4379	0.0213	3.580
154	0.4239	0.0208	3.301	0.4171	0.0199	3.289	0.4105	0.0190	3.270
156	0.3973	0.0186	3.018	0.3904	0.0177	3.003	0.3838	0.0170	2.981
158	0.3715	0.0166	2.754	0.3646	0.0158	2.736	0.3580	0.0151	2.712
160	0.3466	0.0147	2.508	0.3397	0.0140	2.487	0.3331	0.0133	2.461
162	0.3225	0.0130	2.279	0.3157	0.0124	2.256	0.3092	0.0118	2.229
164	0.2995	0.0115	2.067	0.2928	0.0109	2.042	0.2863	0.0103	2.014
166	0.2774	0.0101	1.870	0.2708	0.0096	1.845	0.2644	0.0091	1.816
168	0.2564	0.0088	1.688	0.2499	0.0084	1.662	0.2437	0.0079	1.633
170	0.2364	0.0077	1.521	0.2300	0.0073	1.495	0.2240	0.0069	1.466
172	0.2174	0.0067	1.368	0.2113	0.0063	1.341	0.2054	0.0059	1.313
174	0.1995	0.0058	1.227	0.1935	0.0054	1.201	0.1878	0.0051	1.173
176	0.1826	0.0050	1.098	0.1769	0.0047	1.073	0.1714	0.0044	1.046
178	0.1668	0.0042	0.9812	0.1613	0.0040	0.9564	0.1560	0.0037	0.9307
180	0.1520	0.0036	0.8746	0.1467	0.0033	0.8507	0.1417	0.0031	0.8261
182	0.1382	0.0030	0.7780	0.1331	0.0028	0.7550	0.1283	0.0026	0.7316
184	0.1253	0.0025	0.6905	0.1205	0.0023	0.6686	0.1160	0.0021	0.6465
186	0.1134	0.0020	0.6115	0.1088	0.0019	0.5908	0.1045	0.0017	0.5700
188	0.1023	0.0016	0.5404	0.0980	0.0015	0.5209	0.0940	0.0014	0.5014
190	0.0922	0.0012	0.4765	0.0881	0.0011	0.4582	0.0843	0.0011	0.4401
192	0.0828	0.0009	0.4193	0.0790	0.0009	0.4022	0.0754	0.0008	0.3854
194	0.0742	0.0006	0.3681	0.0707	0.0006	0.3523	0.0673	0.0006	0.3367
196	0.0663	0.0004	0.3225	0.0630	0.0004	0.3078	0.0600	0.0003	0.2936
198	0.0592	0.0002	0.2819	0.0561	0.0002	0.2684	0.0533	0.0002	0.2553
200	0.0527	0.0000	0.2459	0.0498	0.0000	0.2335	0.0472	0.0000	0.2216

date : 07/26/82
time : 14:23:00

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

energy	x-average	delta x-sq average	energy partition	total energy in distribution
2	23.988	370.23	0.11832	0.29582
			energy deposited in target =	0.26873
5	46.060	1085.7	0.20238	1.0119
			energy deposited in target =	0.96708
7	65.857	2162.7	0.25045	1.8784
			energy deposited in target =	1.7997
10	84.529	3571.5	0.28037	2.8037
			energy deposited in target =	2.6839
12	102.76	5284.2	0.30289	3.7862
			energy deposited in target =	3.6248
15	120.98	7303.8	0.32008	4.8013
			energy deposited in target =	4.6035
17	138.95	9622.1	0.33487	5.8603
			energy deposited in target =	5.6267
20	156.80	12234.	0.34795	6.9591
			energy deposited in target =	6.6902
22	174.64	15136.	0.35957	8.0905
			energy deposited in target =	7.7887
25	192.50	18330.	0.37001	9.2504
			energy deposited in target =	8.9181
27	210.32	21816.	0.37966	10.441
			energy deposited in target =	10.079
30	228.15	25590.	0.38863	11.659
			energy deposited in target =	11.270

date : 07/26/82
time : 14:23:00

damage and/or electronic energy calculations for si ions incident on a/an sio2 target

i	dpct	xmom3(i)	dxmom3(i)
1	0.118329	2.9711e+03	1.5981e+03
2	0.202388	1.4866e+04	8.6191e+03
3	0.250452	3.8320e+04	2.6471e+04
4	0.280371	7.8217e+04	5.7773e+04
5	0.302899	1.3857e+05	1.0499e+05
6	0.320089	2.2342e+05	1.7107e+05
7	0.334875	3.3843e+05	2.5776e+05
8	0.347955	4.8794e+05	3.6710e+05
9	0.359578	6.7606e+05	5.0119e+05
10	0.370015	9.0701e+05	6.6194e+05
11	0.379669	1.1855e+06	8.5074e+05
12	0.388639	1.5164e+06	1.0693e+06

...end of program : damge2 ...time consumed (seconds)... = 2.07513

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task: damge2

cpu	time(millisec.) :	2080
io	,, :	558
sys	,, :	6
time left	(seconds) :	118
task time	(minutes) :	0.03483

nd brief

037

Appendix E

Values of the Three Parameters of Brice's Stopping Power Formula for Some Ion-Target Combinations

SETA

Values of Z to be Used in the Stopping Power Formula, Eq. (2.37)

ION \ TARGET	Be	C	Al	Ti	Ni	Ge	Zr	Ag	Eu	Ta	Au	U
He	1.245	1.444	1.342	1.423	2.236	1.988	1.798	2.671	2.313	3.166	3.272	2.745
Be	.8134	.9257	.8948	1.062	1.254	1.224	1.268	1.321	1.773	1.928	2.055	2.245
C	.7589	.8406	.7794	.9242	1.044	1.038	1.065	1.101	1.426	1.543	1.604	1.740
Al	.8093	.8238	.7332	.7934	.8717	.8581	.8653	.8828	1.099	1.170	1.222	1.302
Ti	.8530	.8524	.7179	.7479	.8066	.7869	.7814	.7890	.9597	1.012	1.051	1.131
Ni	.9002	.8921	.7349	.7349	.8052	.7819	.7701	.7740	.9318	.9780	1.013	1.085
Ge	.9365	.9232	.7522	.7632	.8127	.7871	.7733	.7736	.9258	.9692	1.024	1.071
Zr	1.004	.9819	.7859	.7846	.8303	.8006	.7804	.7773	.9489	.9826	1.012	1.054
Ag	1.055	1.047	.8121	.8035	.8700	.8380	.7878	.7817	.9470	.9774	1.005	1.043
Eu	1.172	1.137	.8589	.8366	.8960	.8584	.8014	.7898	.9436	.9678	.9913	1.022
Ta	1.229	1.184	.8871	.8563	.9142	.8737	.8131	.7987	.9478	.9690	.9908	1.018
Au	1.235	1.212	.9042	.8718	.9260	.8837	.8212	.8052	.9521	.9718	.9929	1.019
U	1.304	1.279	.9360	.8975	.9482	.9028	.8364	.8172	.9603	.9772	.9966	1.029

ALP

Values of a' to be Used in the Stopping Power Formula, Eq. (2.37)

ION \ TARGET	Be	C	Al	Ti	Ni	Ge	Zr	Ag	Eu	Ta	Au	U
He	.4439	.3707	.4538	.4078	.3318	.3925	.3832	.3125	.3701	.3223	.3163	.3490
Be	.4425	.3765	.4261	.3937	.3627	.3738	.3737	.3680	.3187	.3072	.2940	.2850
C	.4224	.3560	.4085	.3653	.3487	.3494	.3511	.3470	.3034	.2894	.2883	.2764
Al	.3582	.3089	.3453	.3169	.3018	.3025	.3054	.3025	.2627	.2523	.2453	.2358
Ti	.3452	.2921	.3337	.3034	.2880	.2889	.2931	.2909	.2501	.2399	.2331	.2160
Ni	.3318	.2787	.3213	.2902	.2749	.2759	.2805	.2786	.2377	.2276	.2211	.2037
Ge	.3215	.2693	.3116	.2808	.2653	.2663	.2693	.2694	.2286	.2187	.2028	.1948
Zr	.3041	.2533	.2955	.2667	.2494	.2504	.2555	.2541	.2003	.1934	.1879	.1804
Ag	.2923	.2304	.2847	.2540	.2249	.2248	.2450	.2438	.1902	.1834	.1780	.1705
Eu	.2653	.2145	.2690	.2373	.2091	.2091	.2289	.2281	.1746	.1680	.1627	.1553
Ta	.2536	.2062	.2609	.2286	.2009	.2009	.2204	.2199	.1663	.1598	.1546	.1473
Au	.2585	.2016	.2563	.2236	.1963	.1963	.2156	.2153	.1617	.1552	.1500	.1428
U	.2430	.1866	.2490	.2151	.1884	.1885	.2075	.2075	.1536	.1471	.1420	.1311

EN

Values of n to be Used in the Stopping Power Formula, Eq. (2.37)

ION \ TARGET	Be	C	Al	Ti	Ni	Ge	Zr	Ag	Eu	Ta	Au	U
He	3.395	3.639	3.040	3.246	3.232	2.994	3.280	3.258	3.071	3.065	2.963	3.069
Be	3.239	3.316	3.097	3.028	3.033	2.984	2.986	2.997	2.955	2.974	2.976	2.943
C	3.094	3.185	2.952	2.906	2.887	2.862	2.860	2.870	2.837	2.854	2.828	2.824
Al	2.839	2.934	2.702	2.650	2.637	2.610	2.605	2.616	2.601	2.607	2.614	2.615
Ti	2.619	2.725	2.479	2.431	2.420	2.393	2.384	2.393	2.384	2.390	2.398	2.431
Ni	2.539	2.653	2.398	2.358	2.344	2.316	2.306	2.315	2.311	2.320	2.328	2.370
Ge	2.501	2.619	2.359	2.319	2.310	2.282	2.281	2.279	2.281	2.290	2.343	2.348
Zr	2.440	2.568	2.296	2.248	2.254	2.224	2.212	2.220	2.294	2.298	2.308	2.317
Ag	2.394	2.576	2.248	2.214	2.261	2.235	2.167	2.174	2.261	2.268	2.280	2.290
Eu	2.316	2.489	2.145	2.117	2.169	2.142	2.068	2.075	2.181	2.190	2.206	2.221
Ta	2.281	2.441	2.087	2.063	2.118	2.090	2.013	2.020	2.136	2.148	2.165	2.182
Au	2.220	2.414	2.055	2.033	2.088	2.060	1.983	1.988	2.112	2.124	2.142	2.161
U	2.201	2.397	1.987	1.970	2.025	1.996	1.918	1.922	2.056	2.070	2.091	2.152

STOPPING POWER FORMULA PARAMETERS FOR INCIDENT HELIUM IONS BASED ON DATA OF ZIEGLER AND CHU.

TARGET	AT. NO.	SETA Z	ALP A	EN N	%
H	1	1.202	0.4384	3.683	2.0
He	2	1.438	0.3757	3.650	0.9
Li	3	1.283	0.4230	3.440	1.7
Be	4	1.245	0.4339	3.395	1.6
B	5	1.267	0.4124	3.512	0.9
C	6	1.444	0.3707	3.639	0.9
N	7	1.206	0.4064	3.521	0.7
O	8	1.358	0.3840	3.459	0.6
F	9	1.585	0.3582	3.364	0.7
Ne	10	1.677	0.3581	3.230	0.7
Na	11	1.627	0.3858	3.095	1.6
Mg	12	1.290	0.4458	3.073	0.8
Al	13	1.342	0.4538	3.040	1.9
Si	14	1.201	0.4562	3.236	0.6
P	15	1.403	0.4143	3.276	0.3
S	16	1.581	0.3772	3.378	0.4
Cl	17	1.242	0.4362	3.377	1.2
Ar	18	1.301	0.4237	3.428	1.8
K	19	1.461	0.3804	3.462	1.0
Ca	20	1.350	0.4030	3.398	1.0
Sc	21	1.398	0.4016	3.348	1.0
Ti	22	1.423	0.4078	3.246	0.7
V	23	1.494	0.4114	3.154	0.7
Cr	24	1.659	0.3909	3.116	0.7
Mn	25	1.722	0.3920	3.069	0.4
Fe	26	1.731	0.3868	3.118	1.2
Co	27	1.961	0.3655	3.067	0.7
Ni	28	2.236	0.3318	3.232	1.3
Cu	29	2.390	0.3327	2.962	0.9
Zn	30	2.264	0.3584	2.946	0.7
Ga	31	2.021	0.3889	2.949	0.7
Ge	32	1.988	0.3925	2.994	0.6
As	33	1.993	0.3845	3.055	0.4

TARGET	AT. NO.	Z	A	N	%
Se	34	1.965	0.3933	3.063	0.3
Br	35	1.753	0.4168	3.135	1.2
Kr	36	1.693	0.4218	3.144	1.3
Rb	37	1.926	0.3745	3.269	1.0
Sr	38	1.786	0.3911	3.264	0.7
Y	39	1.789	0.3921	3.233	1.3
Zr	40	1.798	0.3832	3.280	0.7
Nb	41	1.780	0.3889	3.236	0.5
Mo	42	1.945	0.3731	3.235	0.5
Te	43	1.911	0.3724	3.293	0.9
Ru	44	2.165	0.3481	3.283	0.9
Rh	45	2.254	0.3438	3.241	0.9
Pd	46	2.572	0.3182	3.255	2.5
Ag	47	2.671	0.3125	3.258	1.7
Cd	48	2.462	0.3354	3.144	1.0
In	49	2.280	0.3590	2.998	1.3
Su	50	2.162	0.3779	2.983	0.7
Sb	51	1.933	0.4198	2.865	0.3
Te	52	1.870	0.4294	2.897	0.1
I	53	1.718	0.4424	3.049	1.9
Xe	54	1.627	0.4565	2.985	1.1
Cs	55	2.010	0.3850	3.105	0.7
Ba	56	1.882	0.3994	3.116	0.6
La	57	1.882	0.3957	3.160	1.0
Ce	58	2.010	0.3880	3.110	0.5
Pr	59	2.073	0.3832	3.106	0.5
Nd	60	2.135	0.3791	3.099	0.5
Pm	61	2.199	0.3752	3.093	0.5
Sm	62	2.254	0.3729	3.081	0.4
Eu	63	2.313	0.3701	3.071	0.4
Gd	64	2.284	0.3708	3.083	0.4
Tb	65	2.433	0.3651	3.051	0.4
Dy	66	2.764	0.3347	3.086	0.5
Ho	67	2.894	0.3317	3.077	0.4

TARGET	AT. NO.	Z	A	N	%
Er	68	2.962	0.3300	3.064	0.4
Tm	69	3.030	0.3286	3.051	0.3
Yb	70	3.098	0.3271	3.040	0.3
Lu	71	3.052	0.3300	3.048	0.3
Hf	72	3.015	0.3297	3.062	0.3
Ta	73	3.166	0.3223	3.065	0.4
W	74	3.265	0.3210	3.028	0.2
Re	75	3.015	0.3291	3.065	0.2
Os	76	3.123	0.3216	3.073	0.2
Ir	77	3.230	0.3145	3.076	0.2
Pt	78	3.573	0.2916	3.105	0.3
Au	79	3.272	0.3163	2.963	0.3
Hg	80	3.587	0.2982	3.036	0.1
T	81	3.240	0.3218	2.978	0.1
Pb	82	2.914	0.3398	2.963	0.1
Bi	83	2.949	0.3437	2.957	0.1
Po	84	2.918	0.3447	2.974	0.3
At	85	2.950	0.3396	3.005	0.6
Rn	86	3.025	0.3310	3.044	0.9
Fr	87	2.687	0.3553	3.044	0.6
Rg	88	3.503	0.3699	3.050	0.5
Ac	89	2.509	0.3664	3.078	0.6
Th	90	2.544	0.3604	3.106	0.6
Pa	91	3.669	0.3538	3.076	0.5
U	92	2.745	0.3490	3.069	0.5