

---

# ADAS312: Post-process population data for hydrogen beam stopping and emission

Using ADAS310, very complete calculations of the excited population structure are in fact performed. The tabulated population structure and effective beam stopping coefficients are stored as a function of plasma parameters in the ADAS data format of ADF26. The rapid assembly of stopping or emission coefficients for experimental analysis warrants the need for fast look-up tables. ADAS312 is used to construct such tables by extracting beam stopping or beam emission data from the ADF26 files. The extracted data is tabulated and stored in a convenient format of type ADF21 or ADF22. Such data types consists of two dimensional arrays of coefficients in density and beam energy and then one dimensional scans in temperature.

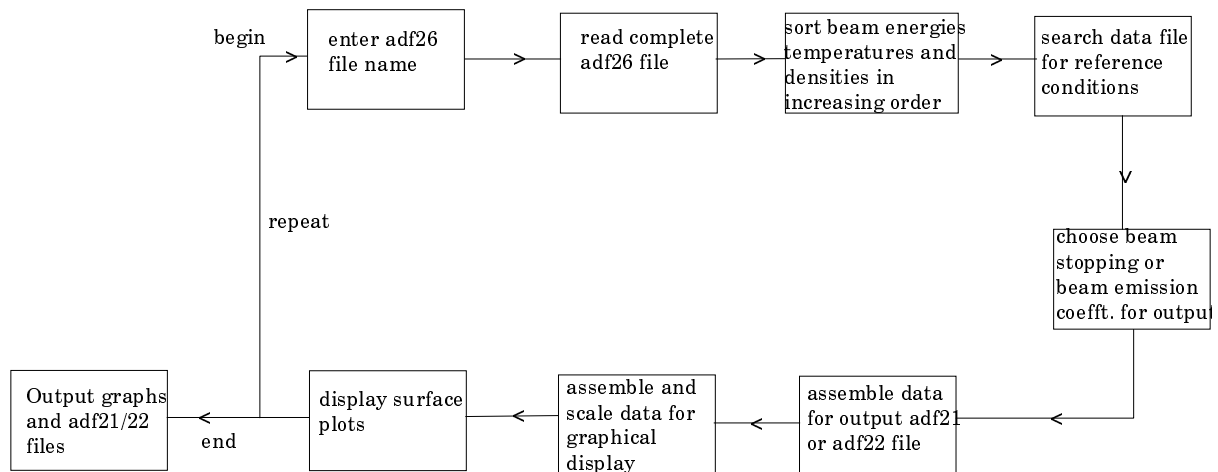
## Background theory:

The interactive code provides the facility to study the behaviour of the effective stopping and emission coefficients as a function of target density and neutral beam energy. The production of fast look-up tables of type ADF21 or ADF22 is also another feature of ADAS312. The construction of convenient look up tables to enable the fast assembly of stopping or emission coefficients is important for daily experimental analysis were the *ab initio* calculation of these quantities would be impractical.

## Program steps:

These are summarised in the figure below.

Figure 4.12



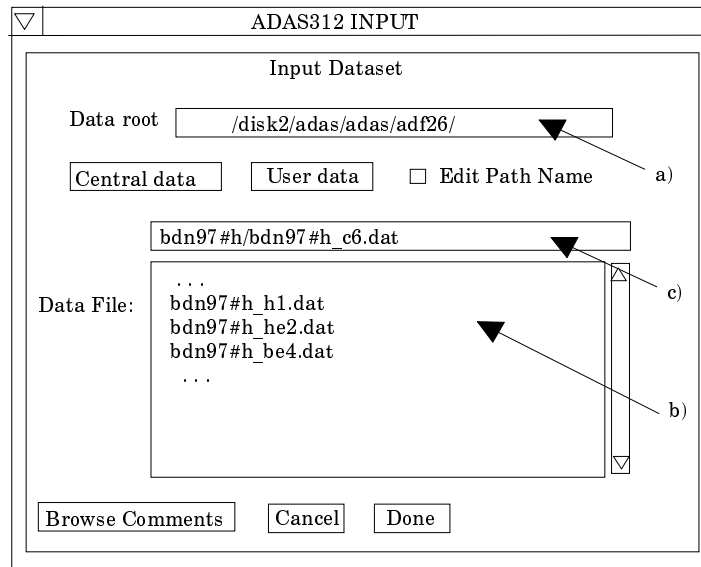
## Interactive parameter comments:

The program which makes use of data from archived ADAS data-sets initiates an interactive dialogue with the user in three parts, namely, input data file selection, entry of user data and disposition of output. The primary calculations may be conducted in foreground or background.

Move to the directory in which you wish the ADAS created files to appear. These include the output text file produced after executing any ADAS program (*paper.txt* is the default), and up to four further output data files. There is no graphical output from this program. Initiate ADAS312 from the program selection menus in the usual manner.

The **file selection window** has the appearance shown below

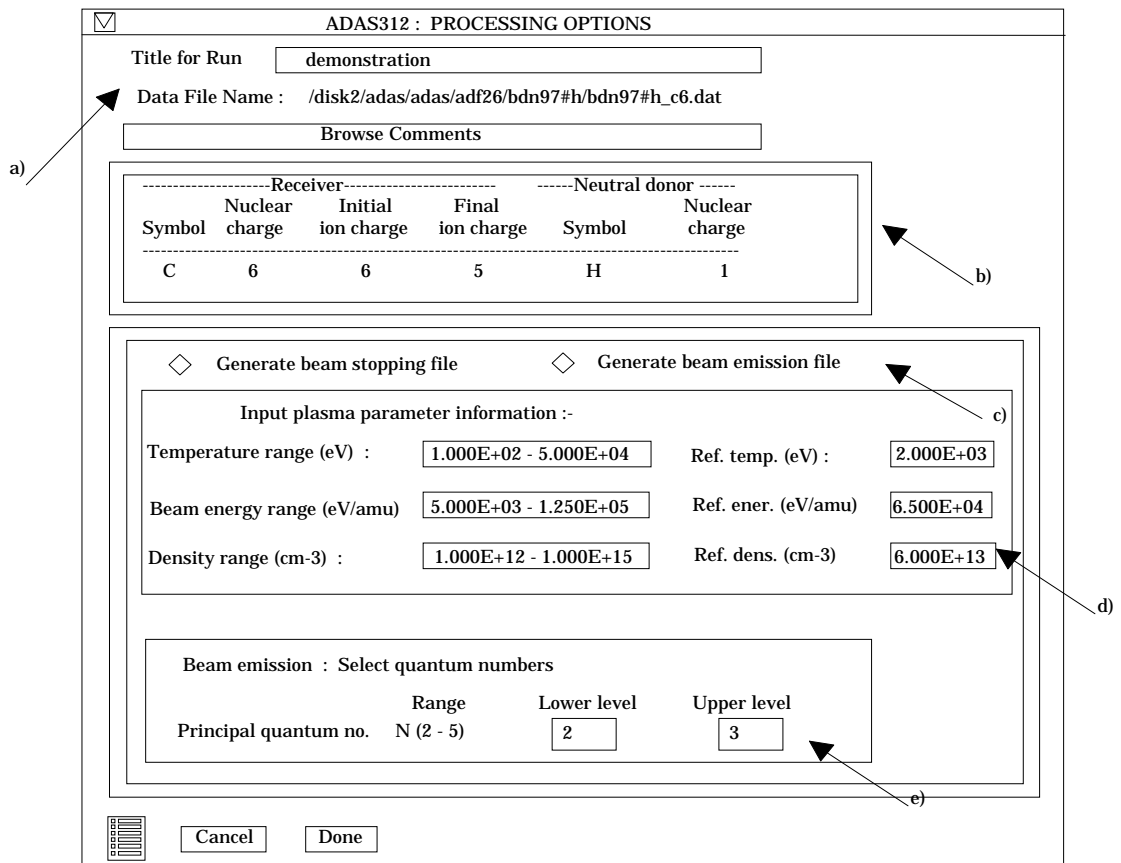
1. Data root a) shows the full pathway to the appropriate data sub directories. Click the *Central Data* button to insert the default central ADAS pathway to the correct data type. Click the *User Data* button to insert the pathway to your own data. Note that your data must be held in a similar file structure to central ADAS, but with your identifier replacing the first *adas*, to use this facility.
2. The Data root can be edited directly. Click the *Edit Path Name* button first to permit editing.



3. Available sub-directories are shown in the large file display window b). Scroll bars appear if the number of entries exceed the file display window size.
4. Click on a name to select it. The selected name appears in the smaller selection window c) above the file display window. Then its sub-directories in turn are displayed in the file display window. Ultimately the individual data-files are presented for selection. Data-files all have the termination *.dat*.
5. Once a data file is selected, the set of buttons at the bottom of the main window become active.
6. Clicking on the *Browse Comments* button displays any information stored with the selected data-file. It is important to use this facility to find out what is broadly available in the data-set. The possibility of browsing the comments appears in the subsequent main window also.
7. Clicking the *Done* button moves you forward to the next window. Clicking the *Cancel* button takes you back to the previous window.

The **processing options window** has the appearance shown below.

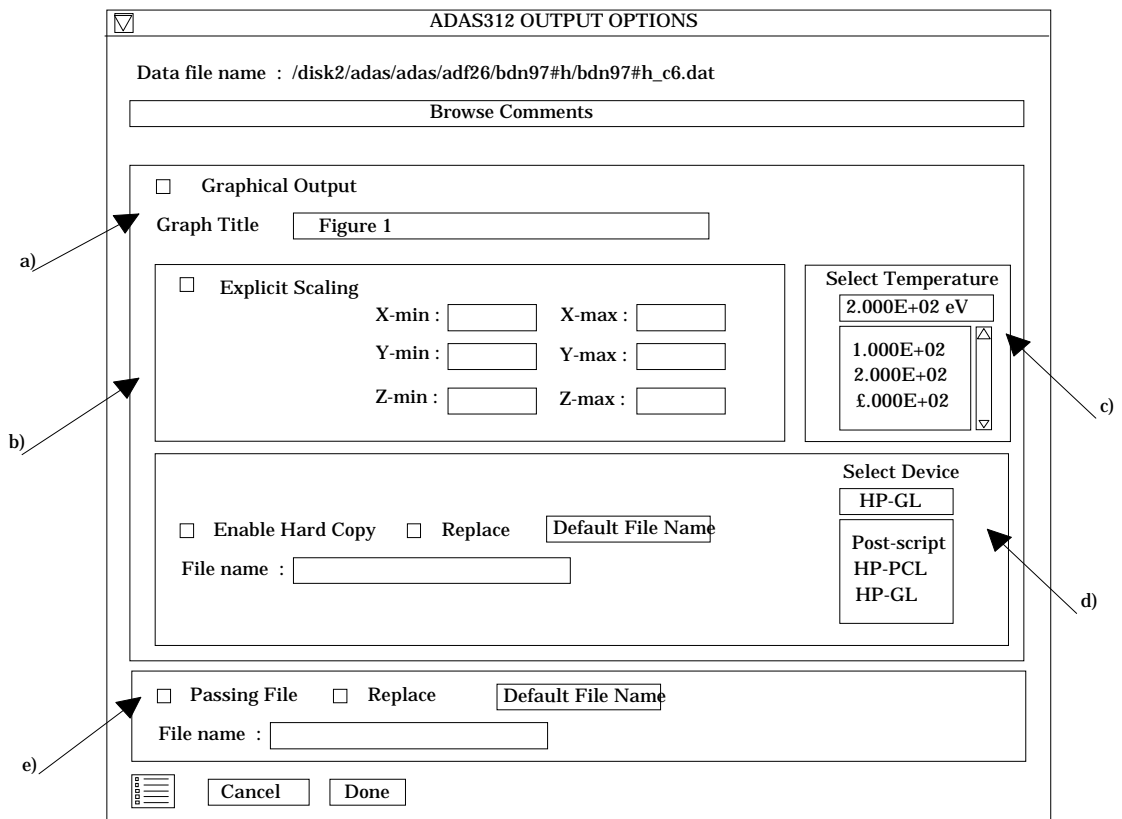
8. An arbitrary title may be given for the case being processed. For information the full pathway to the data-set being analysed is also shown at a). The button *Browse comments* again allows display of the information field section at the foot of the selected data-set, if it exists.
9. At b) some additional information on the beam donor species and the impurity in the plasma which is the receiver in charge exchange reactions. These data are extracted from the data set name. Note that a bundle-n population data set of type *adf26* being analysed is for a single plasma impurity.



10. The code scans the very extensive tabulations in the data set and extracts selected data from them according to the type of output file required by the user. The choices available at this time are beam stopping coefficients and beam emission coefficients. Select the output you wish to be generated at c). The *adf26* data sets in fact contain a large variety of other population information which may be provided at a later stage. With *Generate beam emission file* selected, additional information must be entered at e).
11. Additional information on the plasma temperature, beam energy and plasma density ranges used in the creation of the *adf26* data set is given at d) together with the reference conditions used. Note that the *adf26* data set contains two-dimensional arrays of beam energy and ion density data and a one dimensional array in ion temperature from a reference condition.
12. The sub-window at e) becomes active if generation of beam emission data is requested. The choices available are the upper and lower principal quantum numbers of the radiative transition of the hydrogen beam species. The range of choice has been restricted to principal quantum numbers less than or equal to five. The *adf26* data set contains results for much higher quantum shells also, so we can extended the available range in the future is desired.
13. At the base of the window, the icon for *Exit to Menu* is present. This quits the program and returns you to the ADAS series 3 menu. Remember that *Done* takes you forward to the next screen while *Cancel* takes you back to the previous screen.

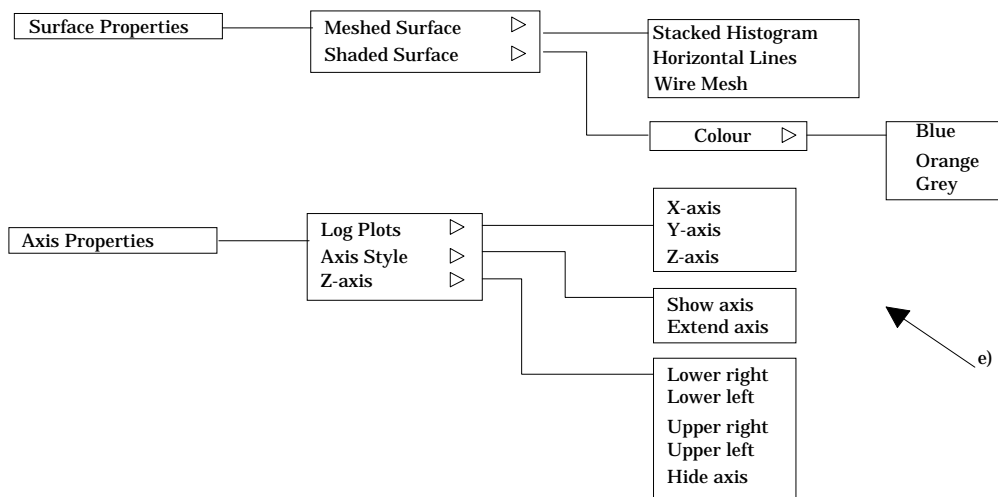
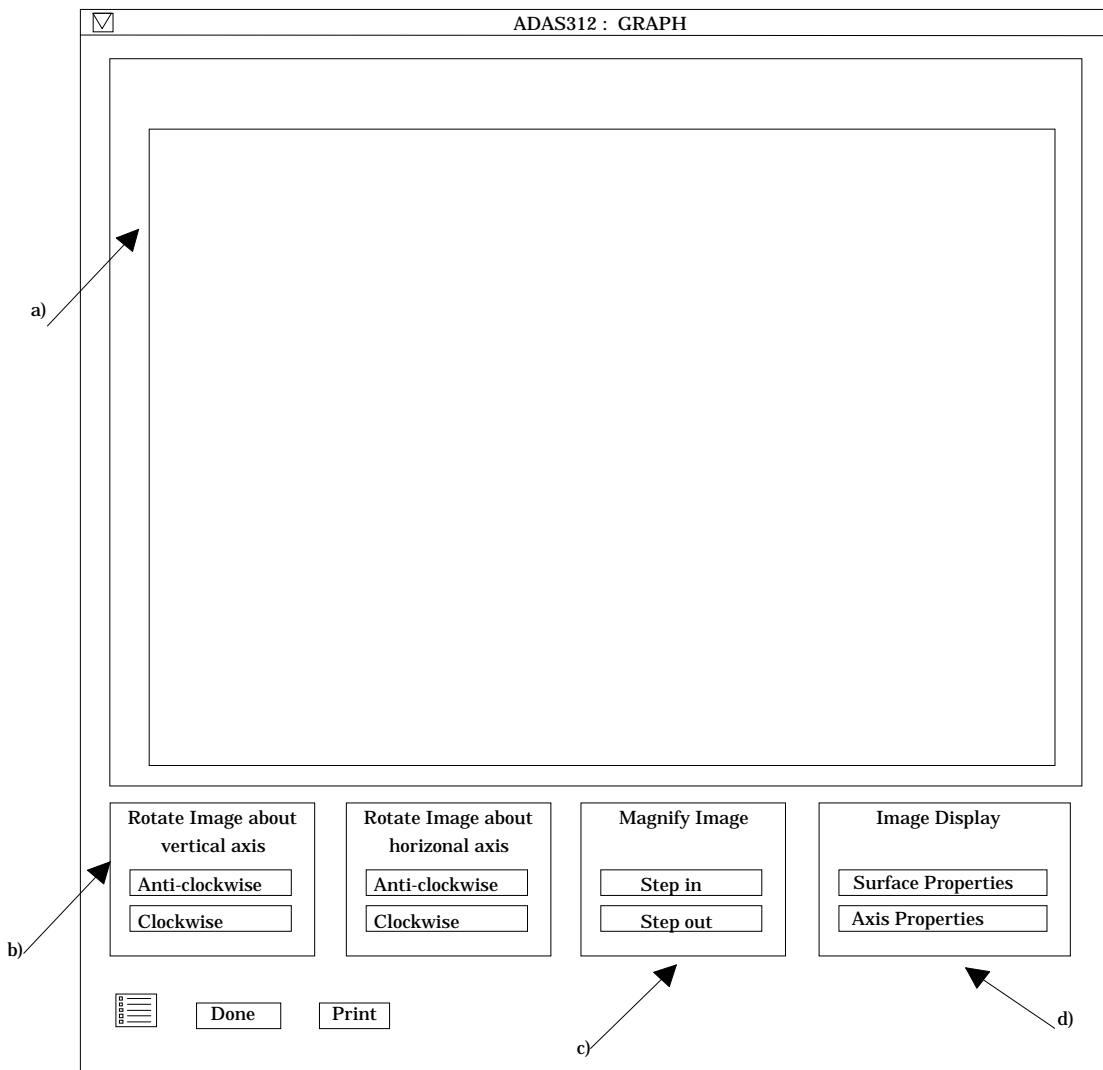
The **output options window** appearance is shown below

14. As in the previous window, the full pathway to the file being analysed is shown for information at a). Also the *Browse comments* button is available.



15. Graphical display is activated by the *Graphical Output* button a). This will cause a graph to be displayed following completion of this window. When graphical display is active, an arbitrary title may be entered which appears on the top line of the displayed graph.
16. By default, graph scaling is adjusted to match the required outputs. Press the *Explicit Scaling* button at b) to allow explicit minima and maxima for the graph axes to be inserted. Activating this button makes the minimum and maximum boxes editable. In this case, a three-dimensional surface plot is presented with x-axis: beam energy, y-axis: density, z-axis: selected coefficient.
17. The surface plot is produced at a selected plasma ion temperature. Make this choice at c).
18. Hard copy is activated by the *Enable Hard Copy* button. The File name box then becomes editable. If the output graphic file already exists and the *Replace* button has not been activated, a 'pop-up' window issues a warning.
19. A choice of output graph plotting devices is given in the Device list window at d). Clicking on the required device selects it. It appears in the selection window above the Device list window.
20. At e) output of the *Passing File* of results is enabled. This is of *adf21* or *adf22* format according to earlier choices.. The *passing* is written on exiting ADAS312 and is placed by default in your */pass* directory as *adas312.pass*. It is fully structured for reassignment into your personal ADAS data base of the appropriate data format.

The **graphical output window** appearance is shown below



21. This is a new style of graphical output widget to ADAS. A three-dimensional surface plot is given at a). There is much more control over it than in our usual graph displays.
22. At b), there are the controls for the orientation of the figure. By clicking repeatedly on a button, the figure may be rotated clockwise or anti-clockwise in small steps. You may rotate about a vertical or horizontal axis.
23. At c), there are two buttons to zoom in or out on the figure.

24. At d), the controls on the appearance of the figure are available. Note the nesting of menu buttons in more than one layer. The choices are laid out at e) below the main figure. Thus one may choose a meshed surface or shaded surface, the colour of the shaded surface may be selected and so on. You may feel we have gone to overkill here.
25. Then there are choices on the axes, whether they are linear or logarithmic, whether they are to be displayed or not etc. There is an additional point. At b) when the figure is rotated the position of the axis of rotation matters. For rotations about a vertical axis, the figure Z-axis is used and it may be moved to any corner of the projected area on the X/Z plane.
26. Finally note that when the figure is printed, it is the figure as displayed in the graphic output window which you get.
27. At the base of the window, the icon for *Exit to Menu* is present. This quits the program and returns you to the ADAS series 3 menu. Remember that *Done* takes you back to the previous screen. The *Print* button appears if graphical hard-copy is selected on the output options window.

### Illustration:

The output from the programme is illustrated in figure 4.12a for the behaviour of the effective stopping coefficient for a pure hydrogen target plasma. The behaviour of the beam emission coefficient for a pure hydrogen target plasma is shown in figure 4.12b.

The tabulated output for the effective stopping and emission coefficients are respectively shown in tables 4.12a and 4.12b.

Figure 4.12a

BEAM STOPPING COEFFICIENT SURFACE PLOT :  
 ADAS RELEASE: ADAS93 V1.13 PROGRAM: ADAS312 V1.2 DATE : 15/04/98 TIME :18:09  
 FILE : /packages/adas/adas/adf26/bdn97#h/bdn97#h\_h1.dat

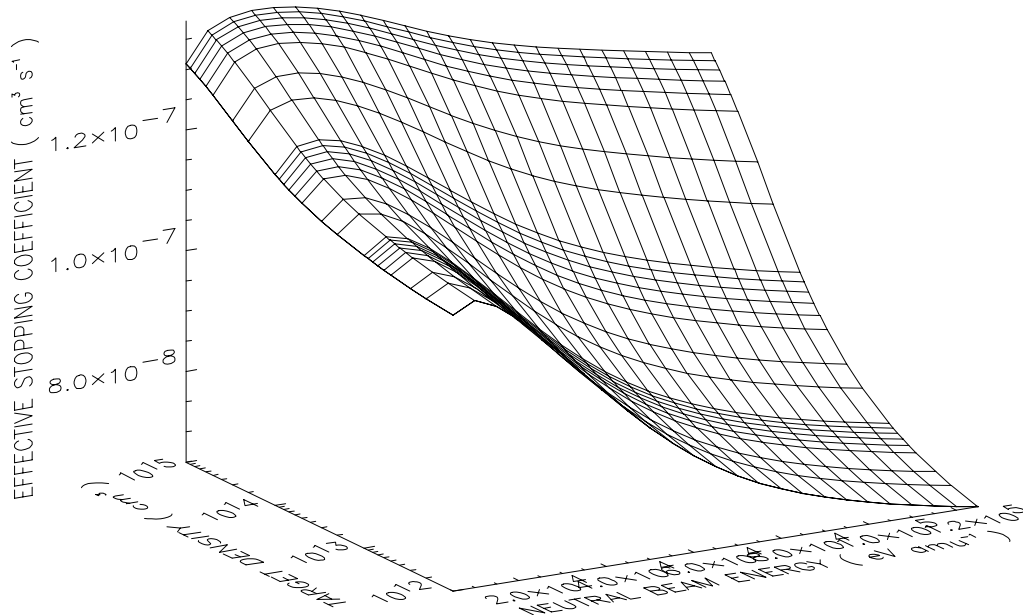


Table 4.12a

```

1 /SCREF=1.081E-07 /SPEC=H /DATE=09/04/98 /CODE=ADAS312
-----
25 25 /TREF=2.000E+03
-----
5.000E+03 1.000E+04 1.500E+04 2.000E+04 2.500E+04 3.000E+04 3.500E+04 4.000E+04
4.500E+04 5.000E+04 5.500E+04 6.000E+04 6.500E+04 7.000E+04 7.500E+04 8.000E+04
8.500E+04 9.000E+04 9.500E+04 1.000E+05 1.050E+05 1.100E+05 1.150E+05 1.200E+05
1.250E+05
1.000E+12 2.000E+12 3.000E+12 5.000E+12 6.000E+12 7.000E+12 8.000E+12 9.000E+12
1.000E+13 2.000E+13 3.000E+13 5.000E+13 6.000E+13 7.000E+13 8.000E+13 9.000E+13
1.000E+14 2.000E+14 3.000E+14 5.000E+14 6.000E+14 7.000E+14 8.000E+14 9.000E+14
1.000E+15
-----
1.225E-07 1.246E-07 1.229E-07 1.198E-07 1.160E-07 1.120E-07 1.079E-07 1.038E-07
9.981E-08 9.607E-08 9.272E-08 8.966E-08 8.704E-08 8.473E-08 8.274E-08 8.104E-08
7.953E-08 7.823E-08 7.706E-08 7.601E-08 7.506E-08 7.418E-08 7.338E-08 7.264E-08
7.195E-08
1.232E-07 1.254E-07 1.239E-07 1.210E-07 1.173E-07 1.134E-07 1.094E-07 1.053E-07
1.014E-07 9.766E-08 9.432E-08 9.128E-08 8.867E-08 8.636E-08 8.437E-08 8.266E-08
8.115E-08 7.984E-08 7.867E-08 7.761E-08 7.665E-08 7.576E-08 7.495E-08 7.420E-08
7.350E-08
.. .. .. .. .. .. .. ..
.. .. .. .. .. .. .. ..
.. .. .. .. .. .. .. ..
1.446E-07 1.500E-07 1.518E-07 1.524E-07 1.523E-07 1.517E-07 1.508E-07 1.495E-07
1.481E-07 1.464E-07 1.448E-07 1.431E-07 1.416E-07 1.402E-07 1.389E-07 1.378E-07
1.368E-07 1.359E-07 1.351E-07 1.343E-07 1.335E-07 1.327E-07 1.319E-07 1.312E-07
1.305E-07
1.450E-07 1.505E-07 1.523E-07 1.529E-07 1.528E-07 1.523E-07 1.514E-07 1.502E-07
1.488E-07 1.472E-07 1.456E-07 1.439E-07 1.425E-07 1.411E-07 1.399E-07 1.388E-07
1.378E-07 1.369E-07 1.361E-07 1.353E-07 1.345E-07 1.337E-07 1.330E-07 1.323E-07
1.316E-07
-----
20 /EREF=6.500E+04 /NREF=6.000E+13
-----
1.000E+02 2.000E+02 3.000E+02 5.000E+02 6.000E+02 7.000E+02 8.000E+02 8.966E+02
1.000E+03 2.000E+03 3.000E+03 5.000E+03 6.000E+03 7.000E+03 8.000E+03 8.966E+03
1.000E+04 2.000E+04 3.000E+04 5.000E+04
-----
1.302E-07 1.294E-07 1.268E-07 1.222E-07 1.203E-07 1.187E-07 1.173E-07 1.161E-07
1.150E-07 1.081E-07 1.045E-07 1.003E-07 9.883E-08 9.763E-08 9.659E-08 9.570E-08
9.484E-08 8.903E-08 8.517E-08 7.971E-08
-----
C
C
C ADAS FILE TYPE : ADF21
C SOURCE FILE : /packages/adas/adas/adf26/bdn97#h/bdn97#h_h1.dat
C
C USER ID : anderson
C
-----

```

Figure 4.12b

BEAM EMISSION COEFFICIENT SURFACE PLOT :  
 ADAS RELEASE: ADAS93 V1.13 PROGRAM: ADAS312 V1.2 DATE : 15/04/98 TIME :18:08  
 FILE : /packages/adas/adas/adf26/bdn97#h/bdn97#h\_h1.dat

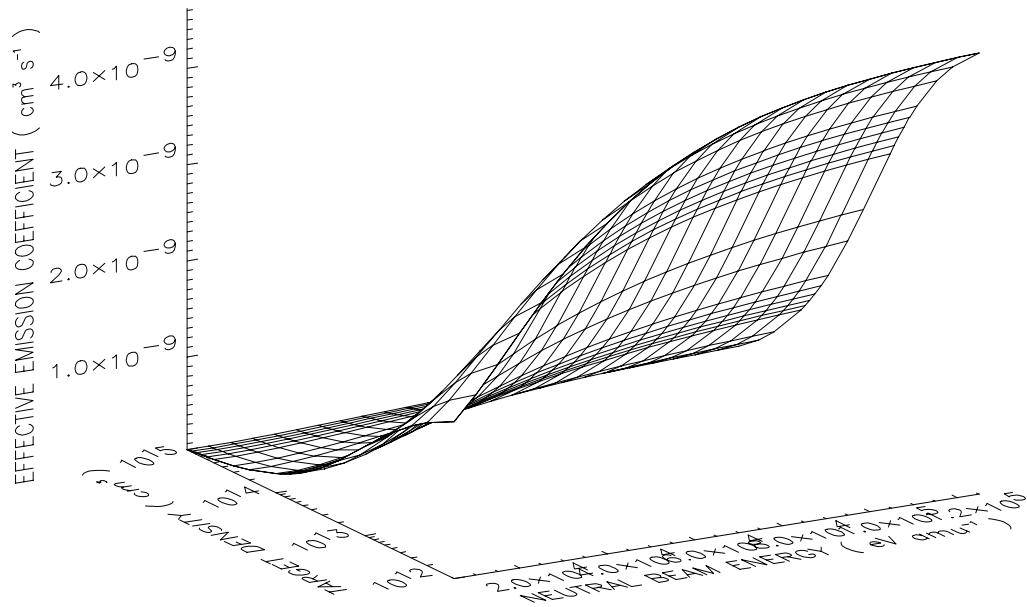


Table 4.12b

1 / ECREF=1.164E-09 / SPEC=H / DATE=09/04/98 / CODE=ADAS312								
-----								
25 25 / TREF=2.000E+03								
-----								
5.000E+03	1.000E+04	1.500E+04	2.000E+04	2.500E+04	3.000E+04	3.500E+04	4.000E+04	
4.500E+04	5.000E+04	5.500E+04	6.000E+04	6.500E+04	7.000E+04	7.500E+04	8.000E+04	
8.500E+04	9.000E+04	9.500E+04	1.000E+05	1.050E+05	1.100E+05	1.150E+05	1.200E+05	
1.250E+05								
1.000E+12	2.000E+12	3.000E+12	5.000E+12	6.000E+12	7.000E+12	8.000E+12	9.000E+12	
1.000E+13	2.000E+13	3.000E+13	5.000E+13	6.000E+13	7.000E+13	8.000E+13	9.000E+13	
1.000E+14	2.000E+14	3.000E+14	5.000E+14	6.000E+14	7.000E+14	8.000E+14	9.000E+14	
1.000E+15								
-----								
1.880E-09	2.153E-09	2.469E-09	2.797E-09	3.114E-09	3.410E-09	3.678E-09	3.916E-09	
4.126E-09	4.307E-09	4.461E-09	4.591E-09	4.703E-09	4.795E-09	4.873E-09	4.939E-09	
4.995E-09	5.042E-09	5.081E-09	5.114E-09	5.142E-09	5.165E-09	5.184E-09	5.200E-09	
5.213E-09								
1.718E-09	1.939E-09	2.211E-09	2.503E-09	2.793E-09	3.069E-09	3.326E-09	3.557E-09	
3.763E-09	3.943E-09	4.099E-09	4.231E-09	4.345E-09	4.441E-09	4.522E-09	4.592E-09	
4.651E-09	4.702E-09	4.745E-09	4.782E-09	4.814E-09	4.840E-09	4.862E-09	4.882E-09	
4.898E-09								
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
..	..	..	..	..	..	..	..	
4.829E-11	4.565E-11	4.904E-11	5.568E-11	6.476E-11	7.576E-11	8.828E-11	1.017E-10	
1.155E-10	1.292E-10	1.424E-10	1.550E-10	1.668E-10	1.779E-10	1.883E-10	1.981E-10	



```
2.072E-10 2.157E-10 2.236E-10 2.309E-10 2.377E-10 2.440E-10 2.497E-10 2.550E-10
2.600E-10
4.406E-11 4.155E-11 4.459E-11 5.061E-11 5.886E-11 6.889E-11 8.030E-11 9.256E-11
1.052E-10 1.177E-10 1.298E-10 1.413E-10 1.522E-10 1.623E-10 1.719E-10 1.809E-10
1.892E-10 1.971E-10 2.044E-10 2.111E-10 2.173E-10 2.231E-10 2.284E-10 2.333E-10
2.379E-10
```

```
-----
20 /EREF=6.500E+04 /NREF=6.000E+13
-----
```

```
1.000E+02 2.000E+02 3.000E+02 5.000E+02 6.000E+02 7.000E+02 8.000E+02 8.966E+02
1.000E+03 2.000E+03 3.000E+03 5.000E+03 6.000E+03 7.000E+03 8.000E+03 8.966E+03
1.000E+04 2.000E+04 3.000E+04 5.000E+04
-----
```

```
1.288E-09 1.337E-09 1.337E-09 1.308E-09 1.292E-09 1.278E-09 1.264E-09 1.252E-09
1.240E-09 1.164E-09 1.119E-09 1.064E-09 1.046E-09 1.032E-09 1.020E-09 1.011E-09
1.003E-09 9.779E-10 9.861E-10 1.024E-09
-----
```

```
C
C
C
C
C
C
C
```

```
ADAS FILE TYPE : ADF22
SOURCE FILE : /packages/adas/adas/adf26/bdn97#h/bdn97#h_h1.dat
USER ID : anderson
```

## Notes: