3. Charge exchange spectroscopy

- Interrogating CXS effective emission coefficients using ADAS303.
- Calculating and examining effective emission coefficients using ADAS308.
- Mass production of CXS effective emission coefficients using ADAS309

Obtaining CXS effective emission coefficients

- Datasets of class adf12 contain CXS effective emission (qef) data as a function of beam and plasma parameters.
- Code ADAS303 interrogates adf12 data sets and displays results at beam and plasma conditions of your choice.

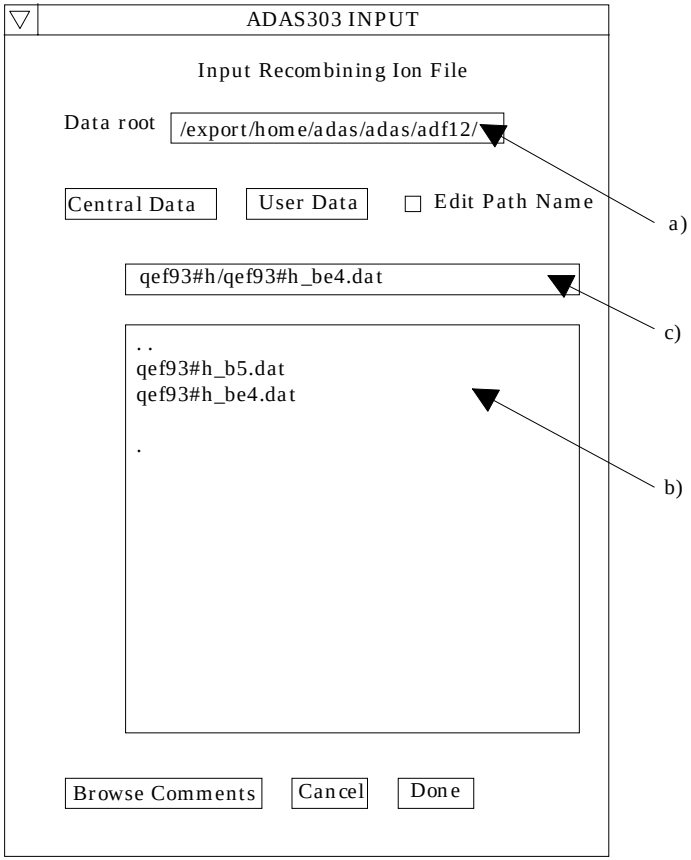
Obtaining CXS effective emission coefficients (contd.)

- Start ADAS303 as follows
  - » *Start ADAS*
  - » *Move to ADAS series 3*
  - » *Click button for ADAS303*
- ADAS303 has the standard sequential three screen structure, namely *file selection*, *processing options* & *output options* screens

Obtaining CXS effective emission coefficients (contd.)

- File selection
  - » *Path to central ADAS data of the correct class (adf12) is selected by button press.*
  - » *A display screen shows available files which are selected by clicking on them.*
  - » *Files have the .dat extension otherwise they are directories.*
  - » *Done means go to next screen, Cancel means return to the previous screen.*

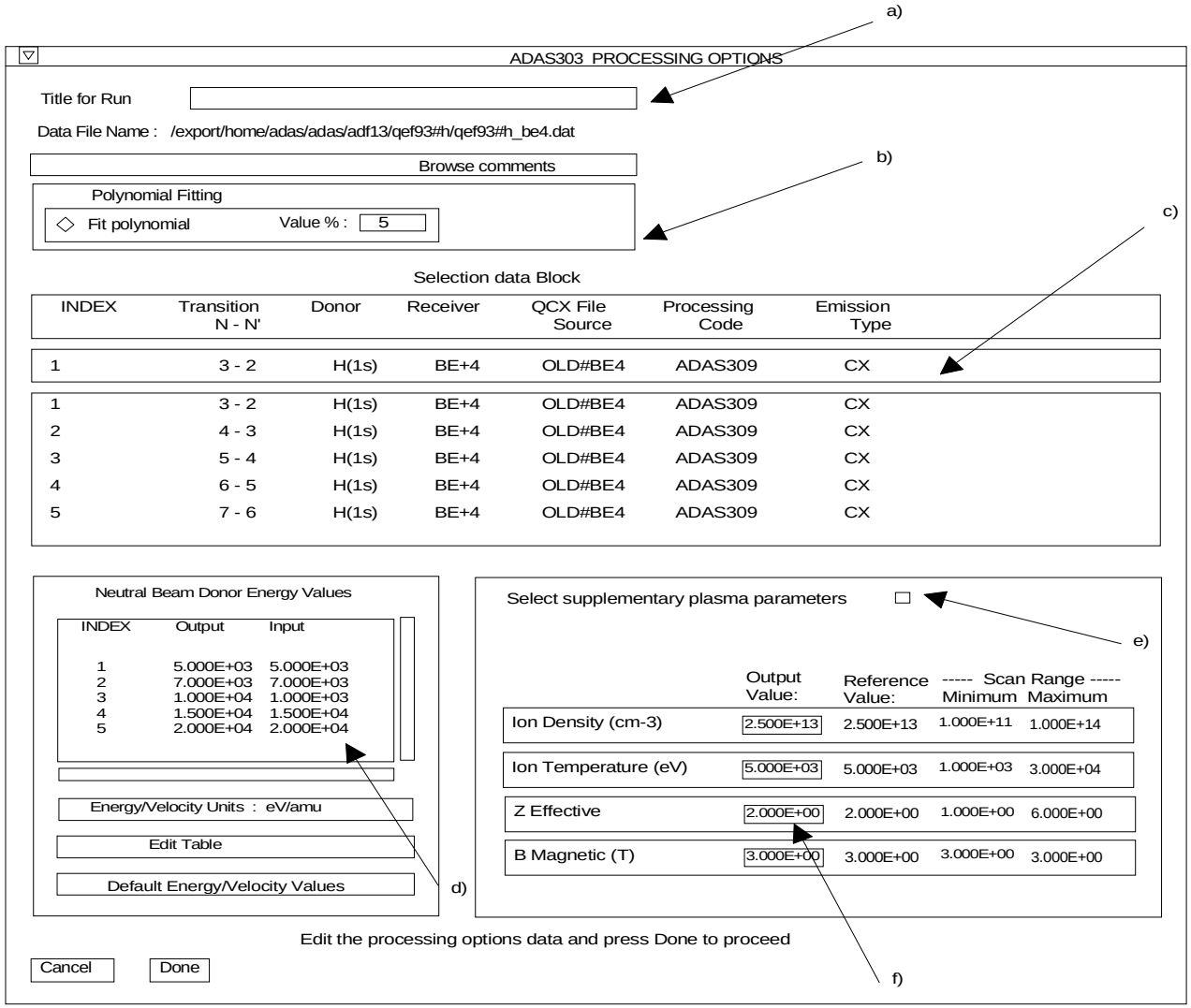
ADAS303 Input



Obtaining CXS effective emission coefficients (contd.)

- Processing options
  - » *First select the spectrum line required.*
  - » *Then the choice of temperatures and densities must be entered.*
  - » *The 'Table Editor' widget is activated by button press to allow this.*
  - » *Using the editor takes a little practice.*

ADAS303 Processing



Obtaining CXS effective emission coefficients (contd.)

- The driving reactions are

$$X^{+z_0} + D^0_{beam}(1) \rightarrow X^{+z_0}(nl) + D^+_{bean}$$

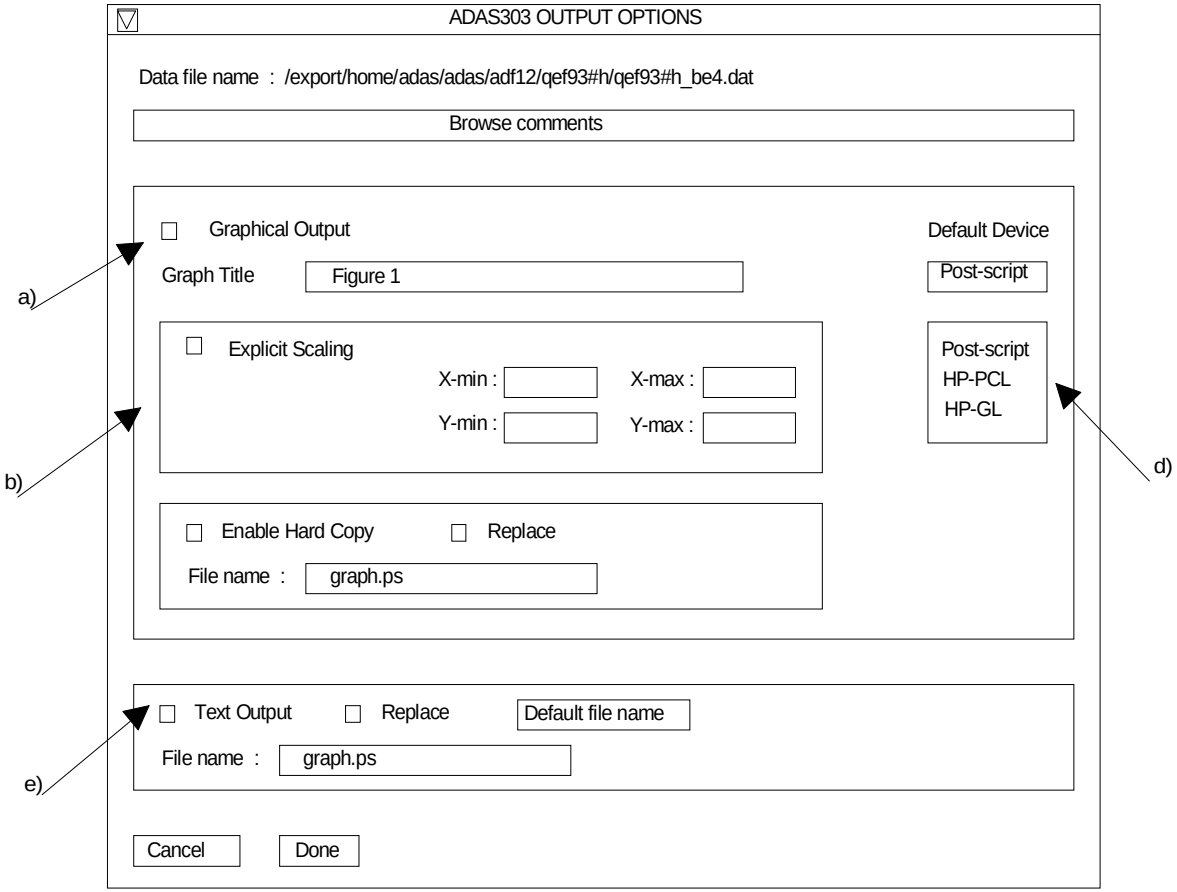
- Effective emission coefficient for n-n' transition is

$$q^{(eff)}_{n\rightarrow n'} = \sum_{l,l'} A_{nl\rightarrow n'l'} (N^{(z_0-1)}_{nl} / N_D N^{(z_0)})$$

Obtaining CXS effective emission coefficients (contd.)

- Output options
  - » *Graphical display is of qef as a function of beam energy.*
  - » *Graphical hard copy and a listing summary of the extracted and fitted data are available.*
  - » *Automatic or explicit scaling may be chosen.*

ADAS303 Output



Calculating CXS effective emission

- Datasets of class adf01 state selective charge exchange cross-section data for capture by fully ionised ions.
- Code ADAS308 computes effective emission coefficients, predicts CXS line positions and profiles and deduces the beam plasma emission measure.

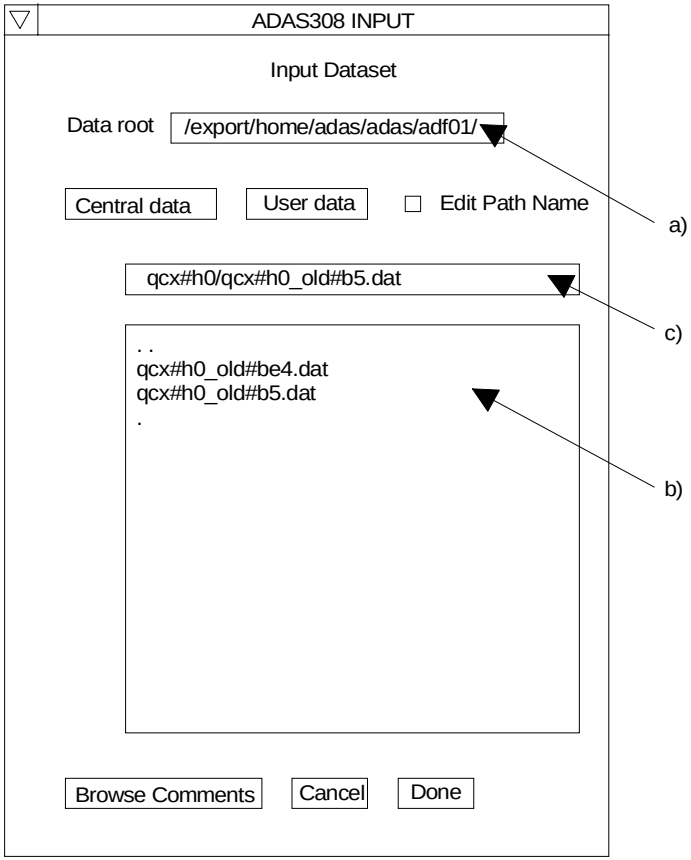
Calculating CXS effective emission (contd.)

- Start ADAS308 as follows
  - » *Start ADAS*
  - » *Move to ADAS series 3*
  - » *Click button for ADAS308*
- ADAS308 has the standard sequential three screen structure, namely *file selection*, *processing options* & *output options* screens

Calulating CXS effective emission (contd.)

- File selection
  - » *Path to central ADAS data of the correct class (adf01) is selected by button press.*
  - » *A display screen shows available files which are selected by clicking on them.*
  - » *Files have the .dat extension otherwise they are directories.*
  - » *Done means go to next screen, Cancel means return to the previous screen.*

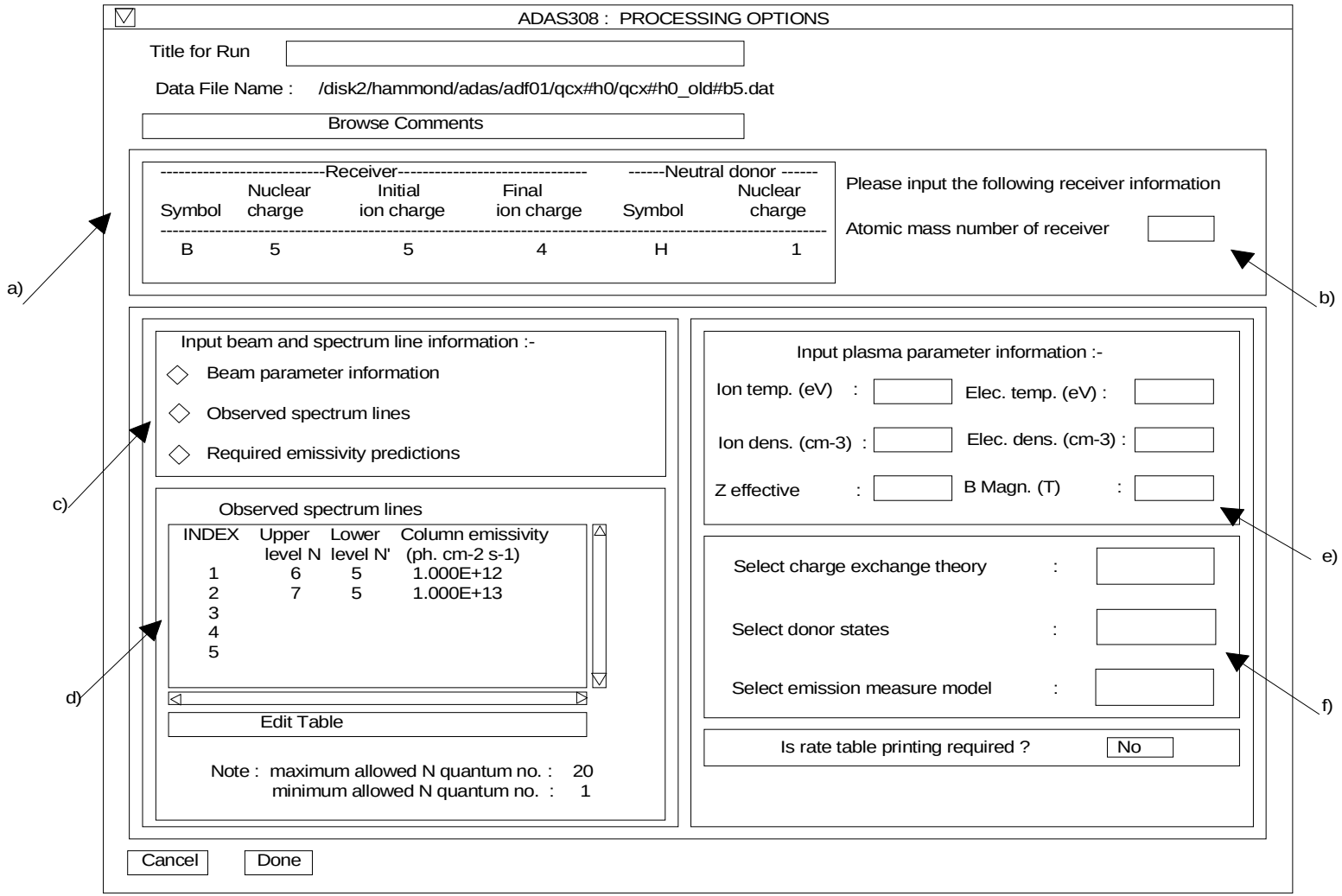
ADAS308 Input



Calculating CXS effective emission (contd.)

- Processing options
  - » *Beam parameter, observed spectrum lines and required emssivity predictions must be entered using Table Editor.*
  - » *Then plasma conditions msut be entered.*
  - » *Finally model for emission measure is chosen.*

ADAS308 Processing



Calculating CXS effective emission (contd.)

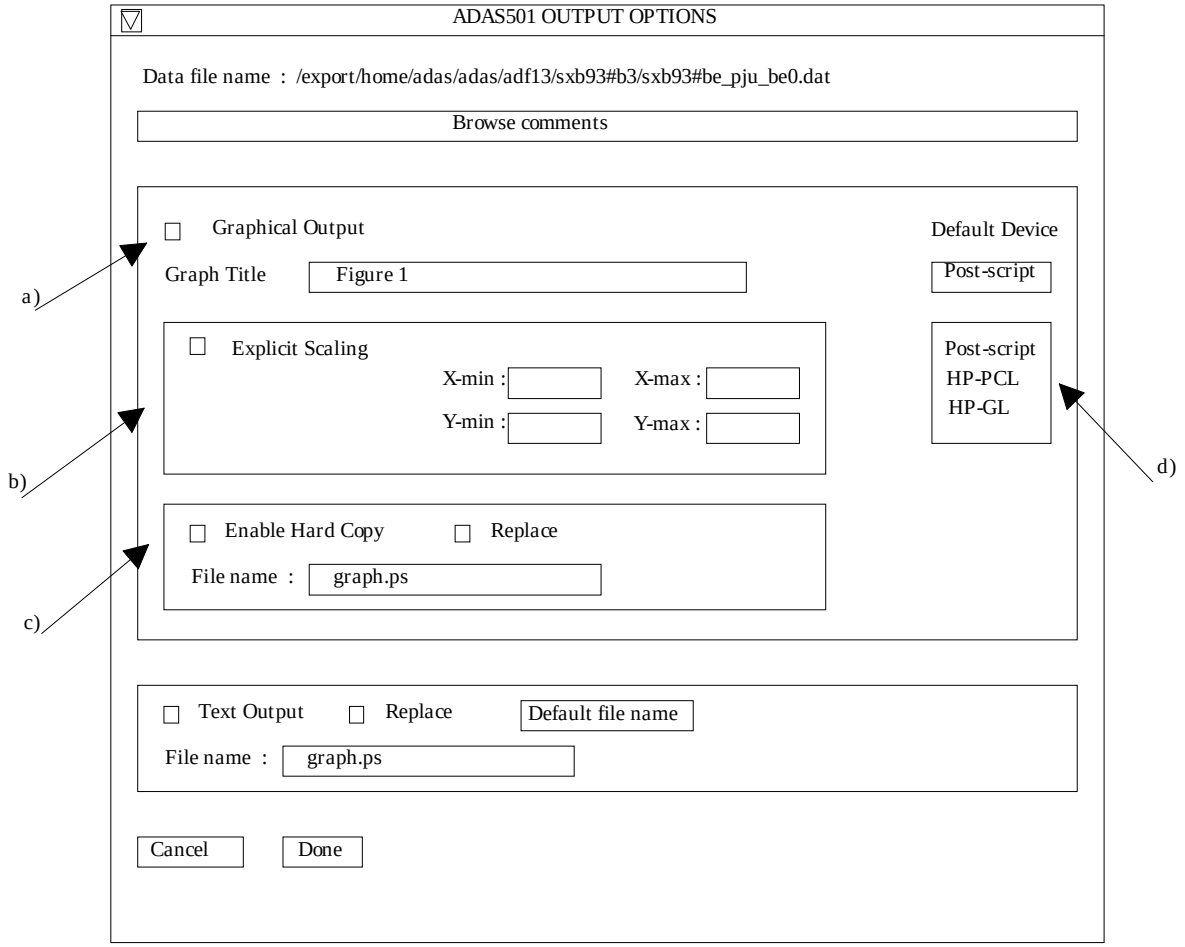
- The program computes the qef and solves for the emission measure given the line of sight intensity.

$$I_{n \to n'}^{(z_0 - 1)} \approx q_{n \to n'}^{(eff)} \int_S N_D N^{(z_0)} ds$$

Calculating CXS effective emission (contd.)

- Output options
  - » *Graphical display of the spectral position, intensity and shape of a designated n-n' transition is given.*
  - » *Tabulations of predicted intensities of other lines are given together with the estimated emission measure.*

ADAS308 Output

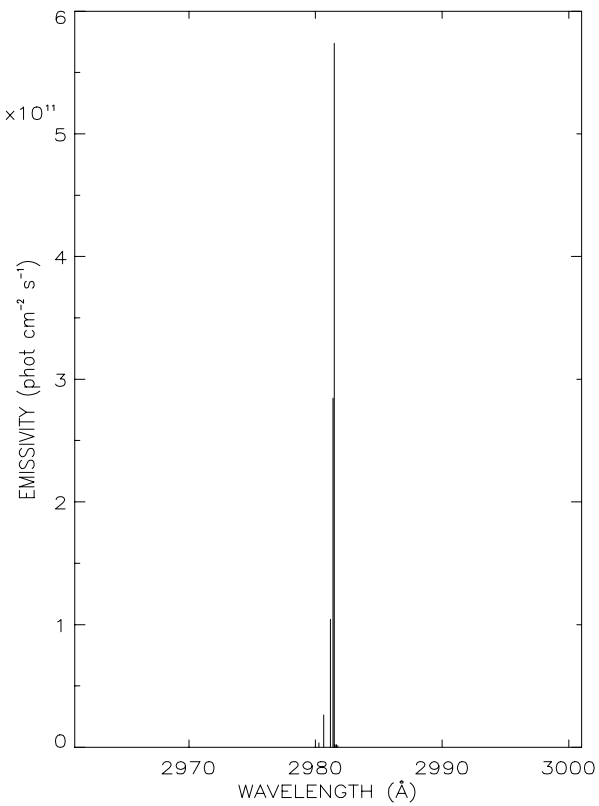


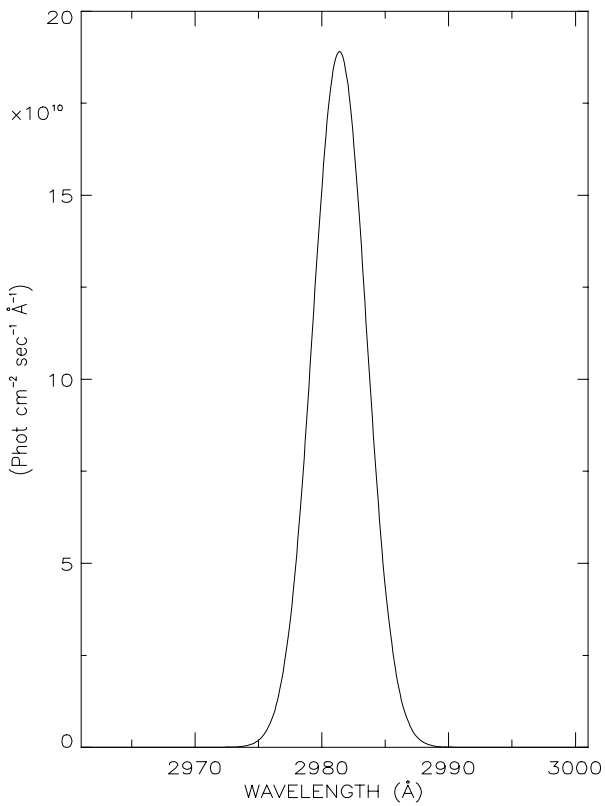
ADAS308 graph

J–RESOLVED CHARGE EXCHANGE EMISSIVITIES: cxs–manu demonstration

ADAS : ADAS RELEASE: ADAS93 V1.6 PROGRAM: ADAS308 V1.4 DATE: 08/07/96 TIME: 15:31
FILE :/export/home/adas/adas/adf01/qcx#h0/qcx#h0_old#b5.dat

TRANSITION : N = 6 –> N = 5
EFF. RATE COEFF. (cm^3 s^{-1}) = 1.9457E–08





------- USER INPUT DATA -------

------ DONOR INFORMATION ------

ELEMENT SYMBOL = H
NUCLEAR CHARGE = 1

----- RECEIVER INFORMATION -----

ELEMENT SYMBOL = B
NUCLEAR CHARGE = 5
INITIAL CHARGE = 5
FINAL CHARGE = 4
ATOMIC MASS NO = 11.00

------ PLASMA PARAMETERS ------

ION TEMP. = 5.00E+03eV
ELECTRON TEMP. = 5.00E+03eV
ION DENS. = 2.50E+13cm^{-3}
ELECTRON DENS. = 5.00E+13cm^{-3}
EFFECTIVE Z = 2.00
MAG. INDUCTION = 3.00T

------- BEAM PARAMETERS -------

INDEX	FRACTION	ENERGY (eV)
1	0.830	8.00E+04
2	0.100	4.00E+04
3	0.070	2.70E+04

--- OBSERVED SPECTRUM LINES ---

INDEX	NU	NL	COL. EMIS.(Ph cm^{-2} s^{-1})
1	6	5	1.00E+12

------ MODEL INFORMATION ------

CHARGE EXCHANGE MODEL : INPUT DATA SET
EMISSION MEASURE MODEL : CHARGE EXCHANGE

Mass production of CX effective emission coeffts.

- ADAS309 is the mass production code.
- The user input is similar to that for ADAS308 but there is no graphical output.
- Many transitions can be entered at the one time. An output file is delivered fully formatted to the adf12 specification.