2a. The interactive system - working with adf04 datasets

- Preliminaries
  - » Electron impact cross-sections and rate coefficients
  - » The ADF04 file format
  - » Interrogating adf04 collisional excitation data using ADAS201 and ADAS811

Electron impact cross-sections and rates

The excitation reaction $X_i^{+z}(E_i) + e(\varepsilon_i) \rightarrow X_j^{+z}(E_j) + e(\varepsilon_j)$

is described by an excitation cross-section $\sigma_{i\rightarrow j}(\varepsilon_i)$

More useful for tabulation is the collision strength Ω_{ij} with independent variable

$X = \varepsilon_i / \Delta E_{ij}$ with $X \in [1, \infty]$

$$\Omega_{ij} = \omega_i (E_i / I_H)(\sigma_{i\rightarrow j}(\varepsilon_i) / \pi a_0^2) = \omega_j (E_j / I_H)(\sigma_{j\rightarrow i}(\varepsilon_j) / \pi a_0^2)$$

ADAS principally deals with Maxwell averaged rate coefficients $q_{i\rightarrow j}(T_e)$

Υ_{ij} $\quad \Upsilon_{ij} = \int_0^\infty \Omega_{ij}(\varepsilon_j) \exp(-\varepsilon_j / kT_e)\, d(\varepsilon_j / kT_e)$

Electron impact cross-sections and rates (contd.)

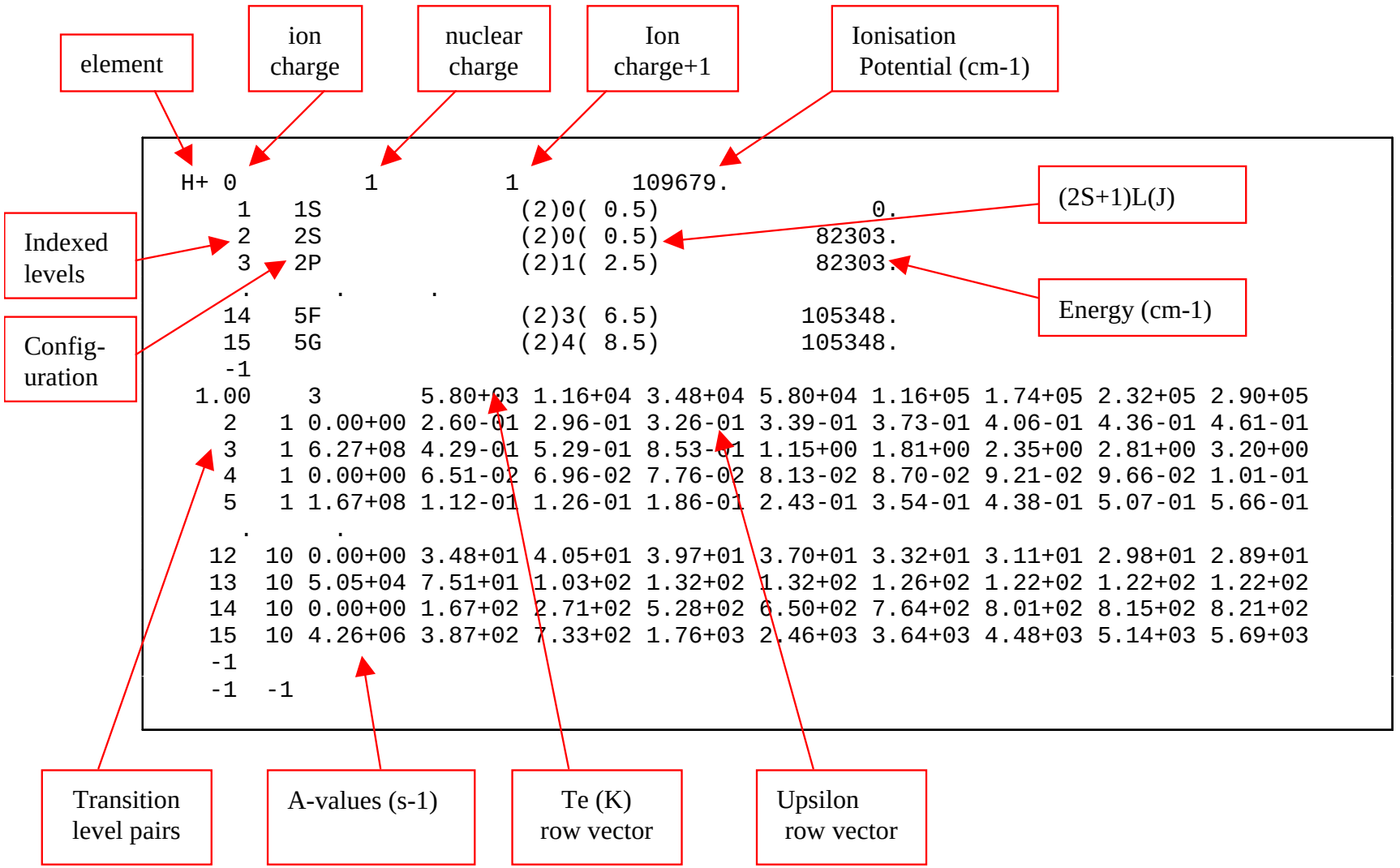
More useful for tabulation is the Maxwell averaged collision strength $\Upsilon_{ij}(T_e)$

$$\Upsilon_{ij} = \int_0^\infty \Omega_{ij}(\varepsilon_j)\exp(-\varepsilon_j/kT_e)\,d(\varepsilon_j/kT_e)$$

$$q_{j\to i}(T_e) = \frac{\omega_i}{\omega_j}\exp(\Delta E_{ij}/kT_e)q_{i\to j}(T_e) = 2\sqrt{\pi}\alpha\, c a_0^2 \frac{1}{\omega_j}\left[I_H/kT_e\right]^{1/2}\Upsilon_{ij}$$

The ADAS adf04 format is used to archive sets of energy level lists, A-values and Maxwell averaged collision strengths for an ion sufficient to allow a population calculation.

The basic adf04 file




```
H+ 0          1          1         109679.
    1   1S               (2)0( 0.5)              0.
    2   2S               (2)0( 0.5)          82303.
    3   2P               (2)1( 2.5)          82303.
    .       .       .
   14   5F               (2)3( 6.5)         105348.
   15   5G               (2)4( 8.5)         105348.
   -1
1.00    3       5.80+03 1.16+04 3.48+04 5.80+04 1.16+05 1.74+05 2.32+05 2.90+05
  2   1 0.00+00 2.60-01 2.96-01 3.26-01 3.39-01 3.73-01 4.06-01 4.36-01 4.61-01
  3   1 6.27+08 4.29-01 5.29-01 8.53-01 1.15+00 1.81+00 2.35+00 2.81+00 3.20+00
  4   1 0.00+00 6.51-02 6.96-02 7.76-02 8.13-02 8.70-02 9.21-02 9.66-02 1.01-01
  5   1 1.67+08 1.12-01 1.26-01 1.86-01 2.43-01 3.54-01 4.38-01 5.07-01 5.66-01
    .       .
 12  10 0.00+00 3.48+01 4.05+01 3.97+01 3.70+01 3.32+01 3.11+01 2.98+01 2.89+01
 13  10 5.05+04 7.51+01 1.03+02 1.32+02 1.32+02 1.26+02 1.22+02 1.22+02 1.22+02
 14  10 0.00+00 1.67+02 2.71+02 5.28+02 6.50+02 7.64+02 8.01+02 8.15+02 8.21+02
 15  10 4.26+06 3.87+02 7.33+02 1.76+03 2.46+03 3.64+03 4.48+03 5.14+03 5.69+03
 -1
 -1  -1
```

Configuration specification

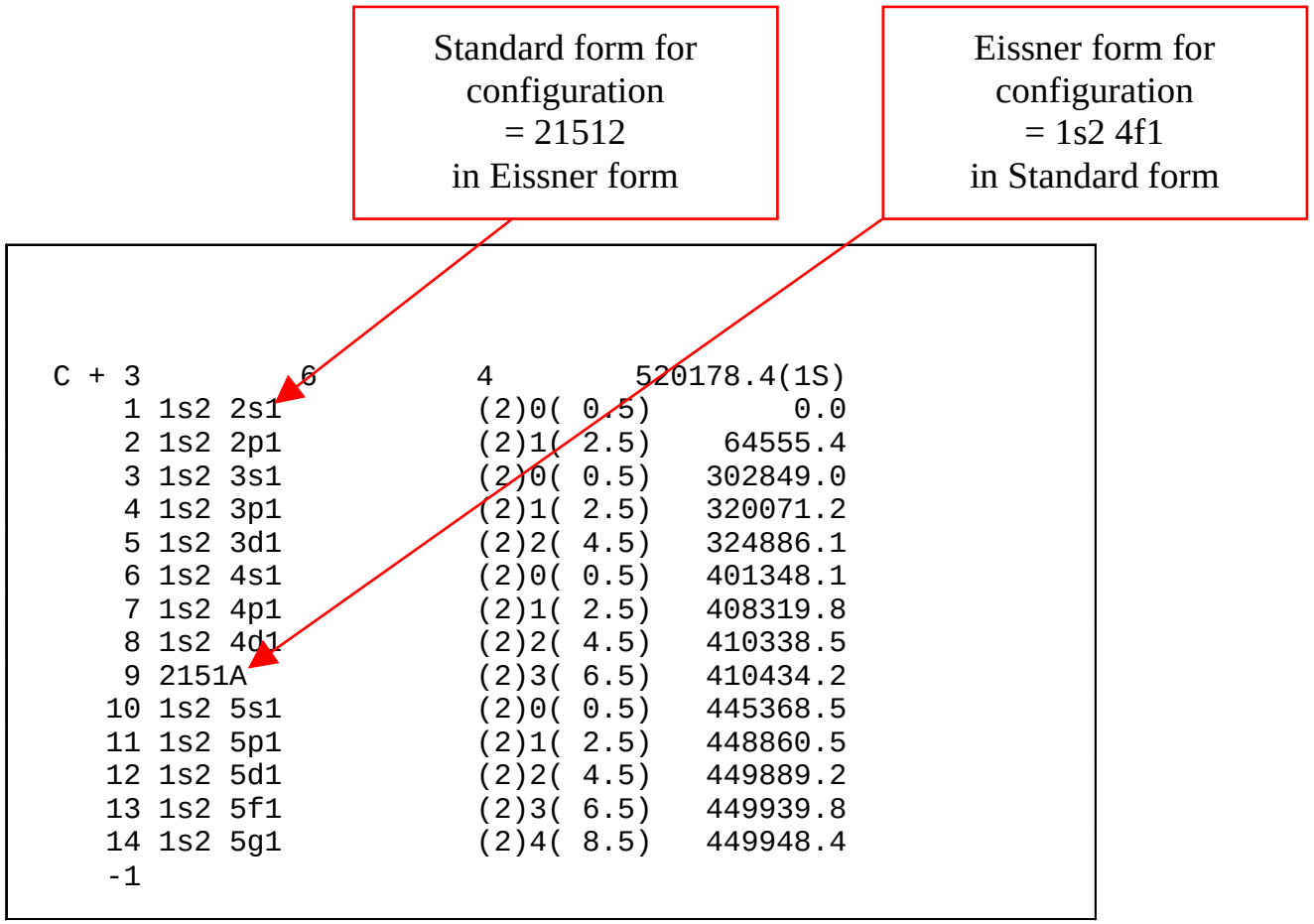
$$\Gamma = n_1 l_1^{q_1} n_2 l_2^{q_2} \ldots\ldots n_m l_m^{q_m}$$

where $q_i > 0$ for $i = 1,\ldots,m$ and $\sum_{i=1}^{m} q_i = N$

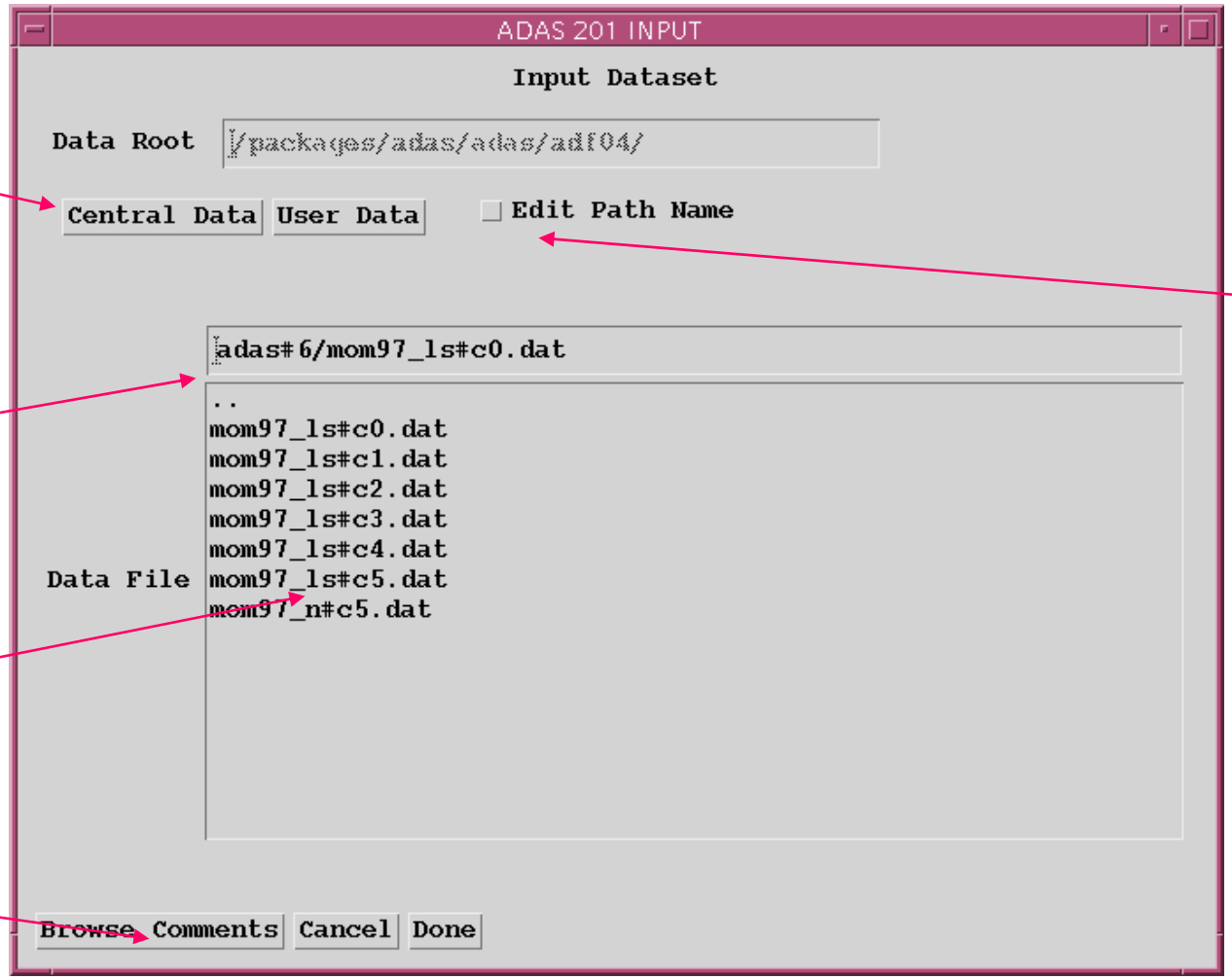
ADAS prefers Standard and Eissner configuration representations in ADF04 files for automatic processing and matching of levels between different data sets.

Configuration	Standard form	Eissner form
$1s^2 2s^2 2p^4$	1s2 2s2 2p4	21522543
$1s^2 2s^2 2p^6 6f^{11}$	1s2 2s2 2p6 6fb	2152254361J

The basic adf04 file



ADAS201 input



click to use central ADAS data

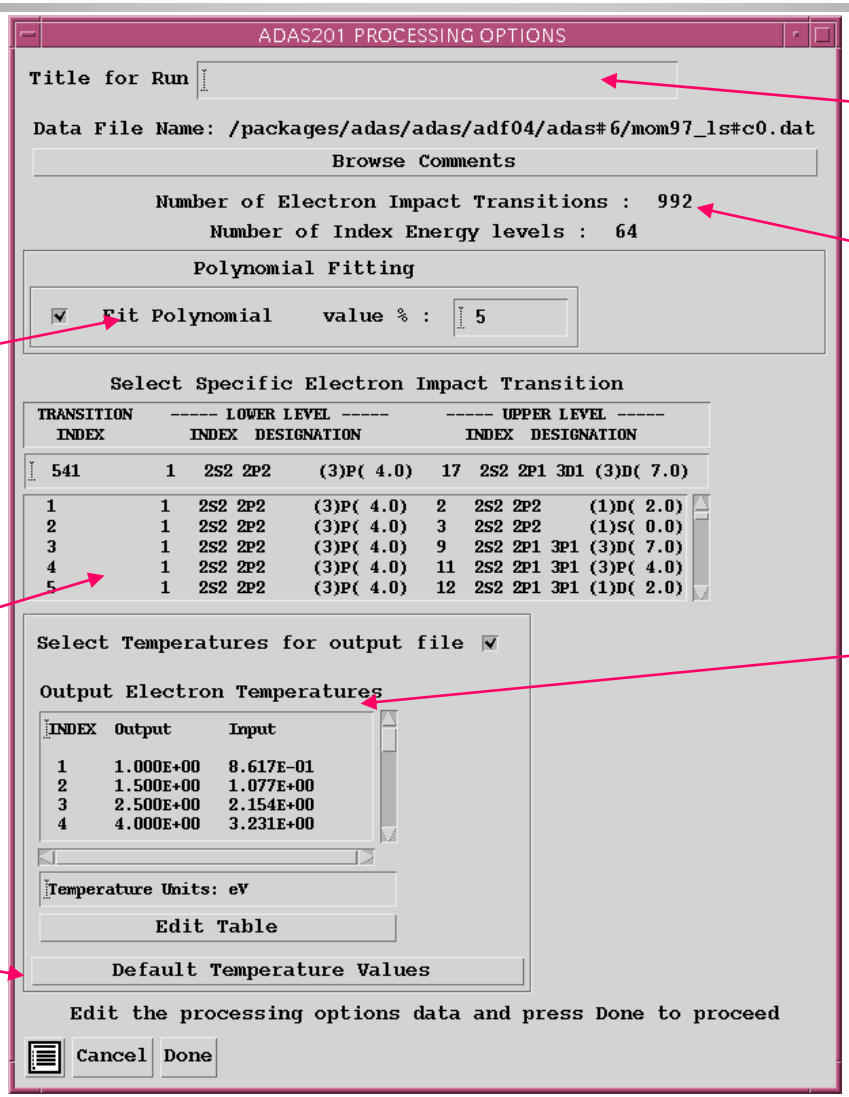
selected file for processing

ADF04 data file list

browse comments from selected data set

click to edit pathway

ADAS201 Processing



your title to appear on graphs & tables

number of transitions and levels

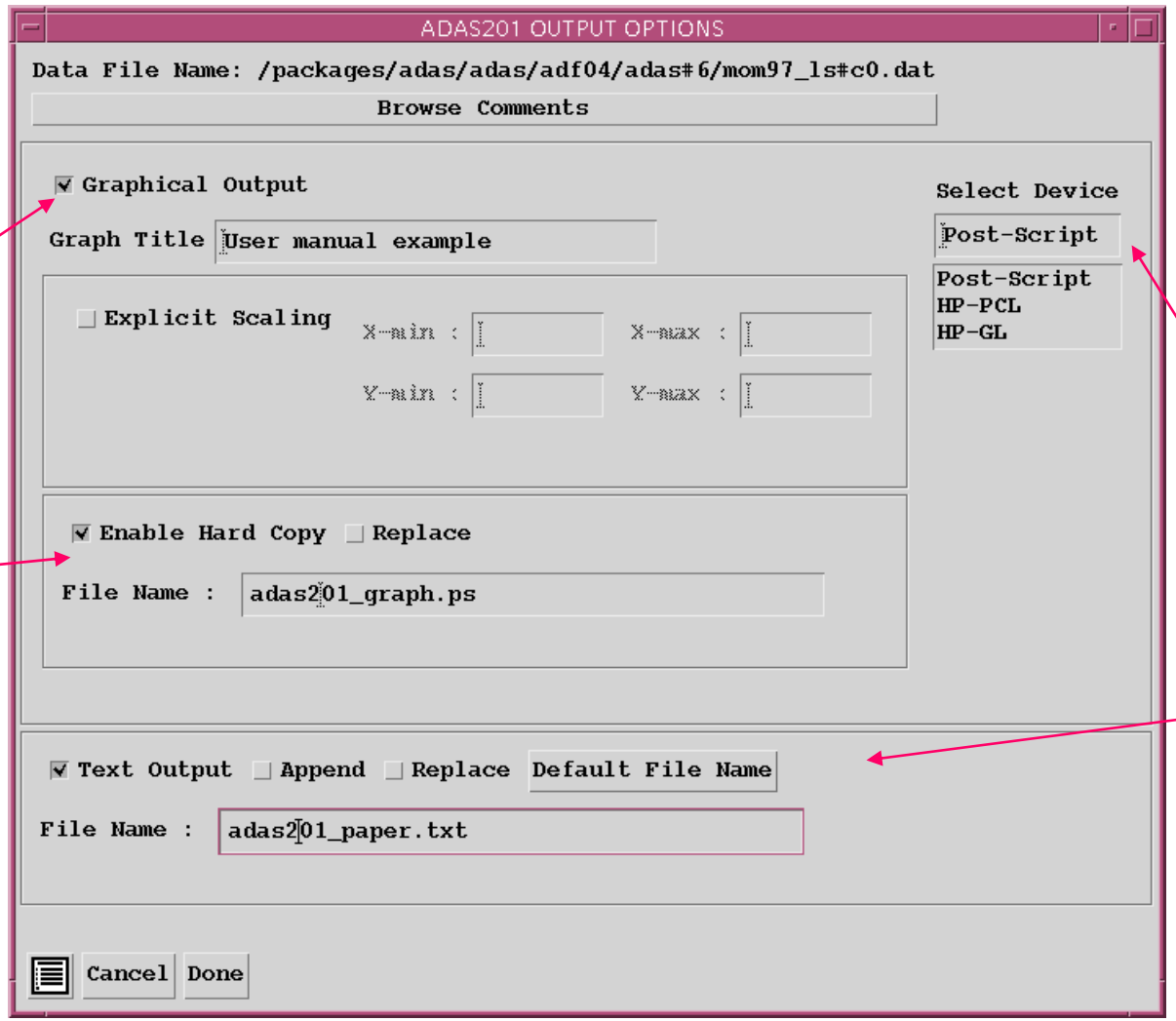
make polynomial fit to data

select transition for analysis

Select & enter Te values for output

set default output values

ADAS201 Output



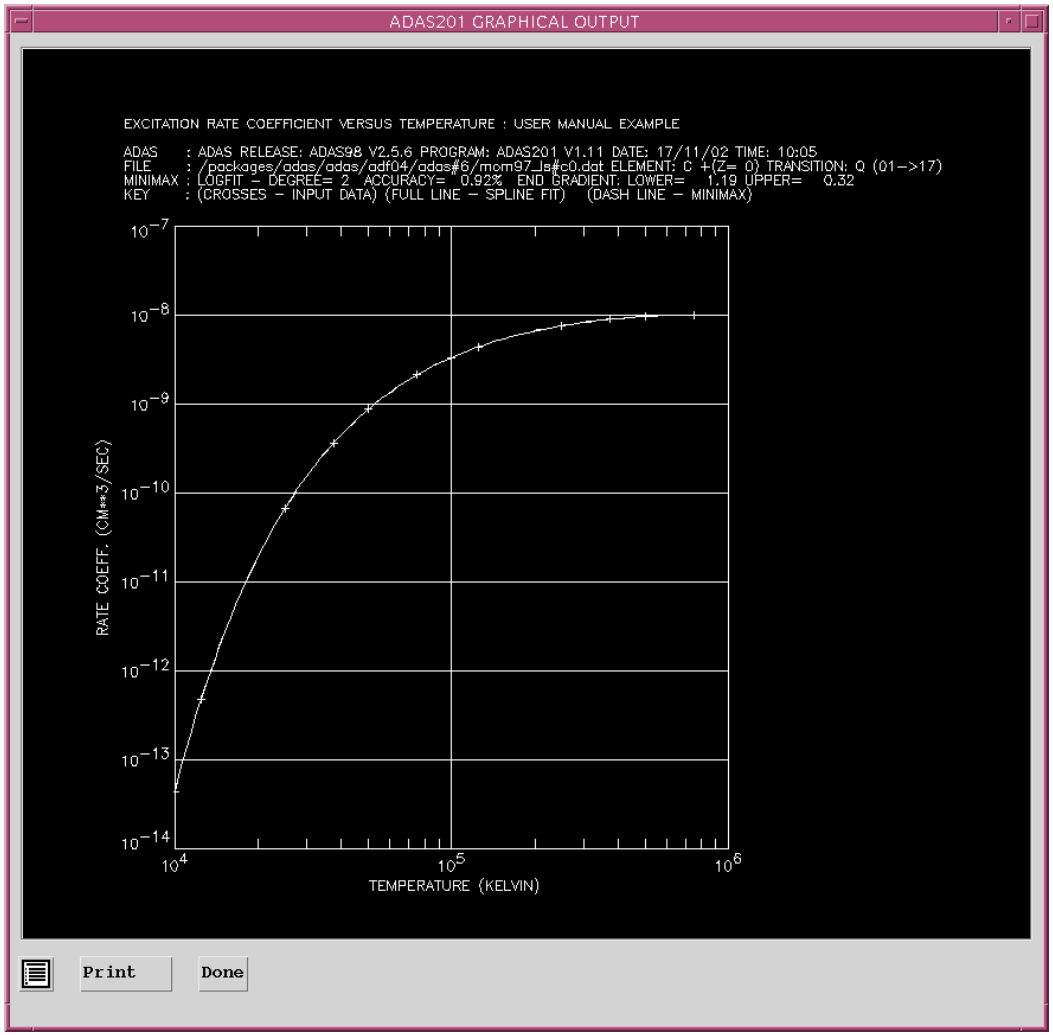
provide graphical output

allow graphical hard copy

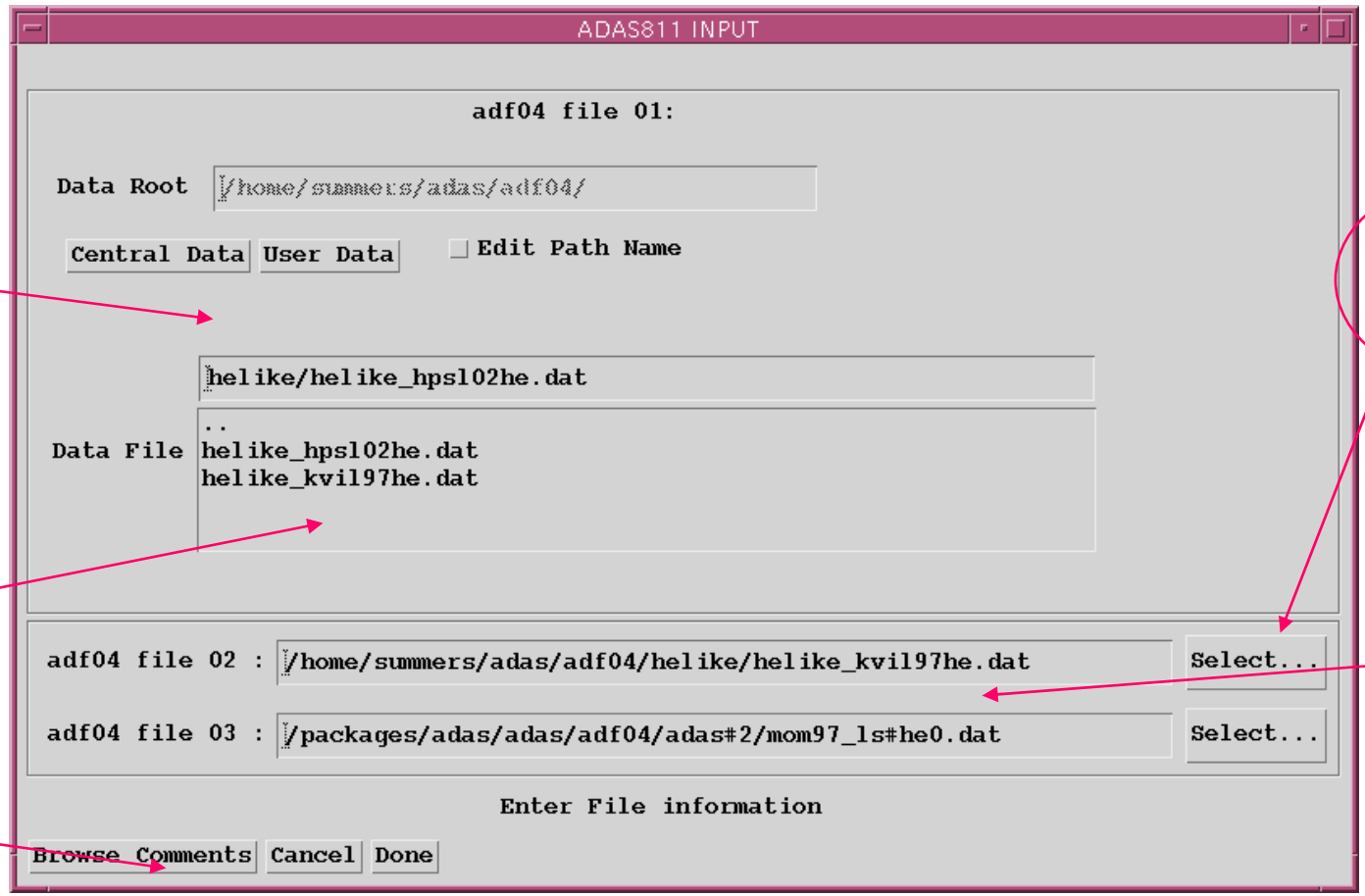
graphical output file coding

tabular output of results

ADAS201 Graph



ADAS811 input



Select first file

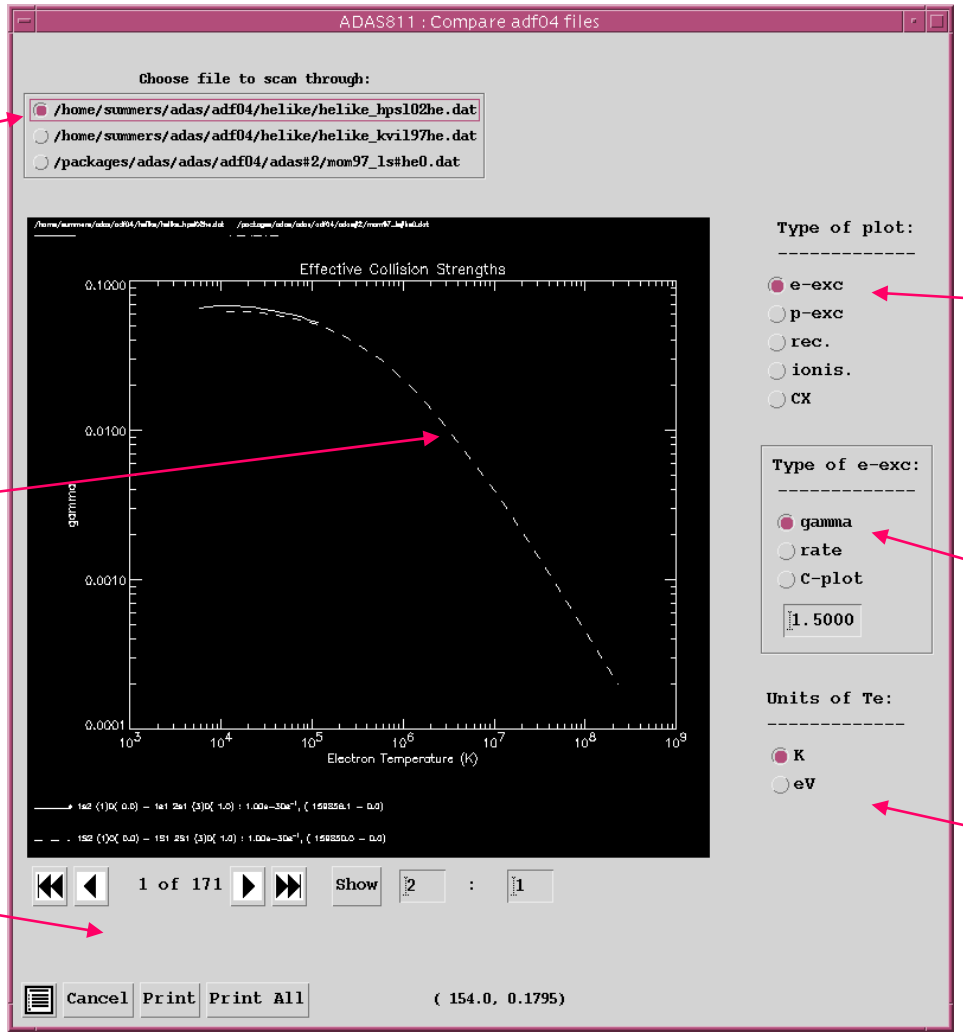
ADF04 data file list

browse comments from first data set

Click to show file chooser pop-up

Second and third files

ADAS811 Processing



select file to cycle through

comparative graph for matched transitions

tape recorder keys

select type e-exc

select type of e-exc display

select Te units