4. Beam stopping and beam emission spectroscopy

- Extracting effective beam stopping coefficients or beam emission coefficients using ADAS304.
- Calculating the beam population structure isung ADAS310
- Post-processing stopping and beam emission using ADAS312

Obtaining effective beam stopping coefficients

- Datasets of class ADF21 contain effective stopping data as a function of beam and plasma parameters for different plasma species.
- Datasets of class ADF22 contain effective beam emission data as a function of beam and plasma parameters for different plasma species.
- Code ADAS304 interrogates ADF21 or ADF22 data sets to provide coefficients at beam and plasma conditions of your choice.

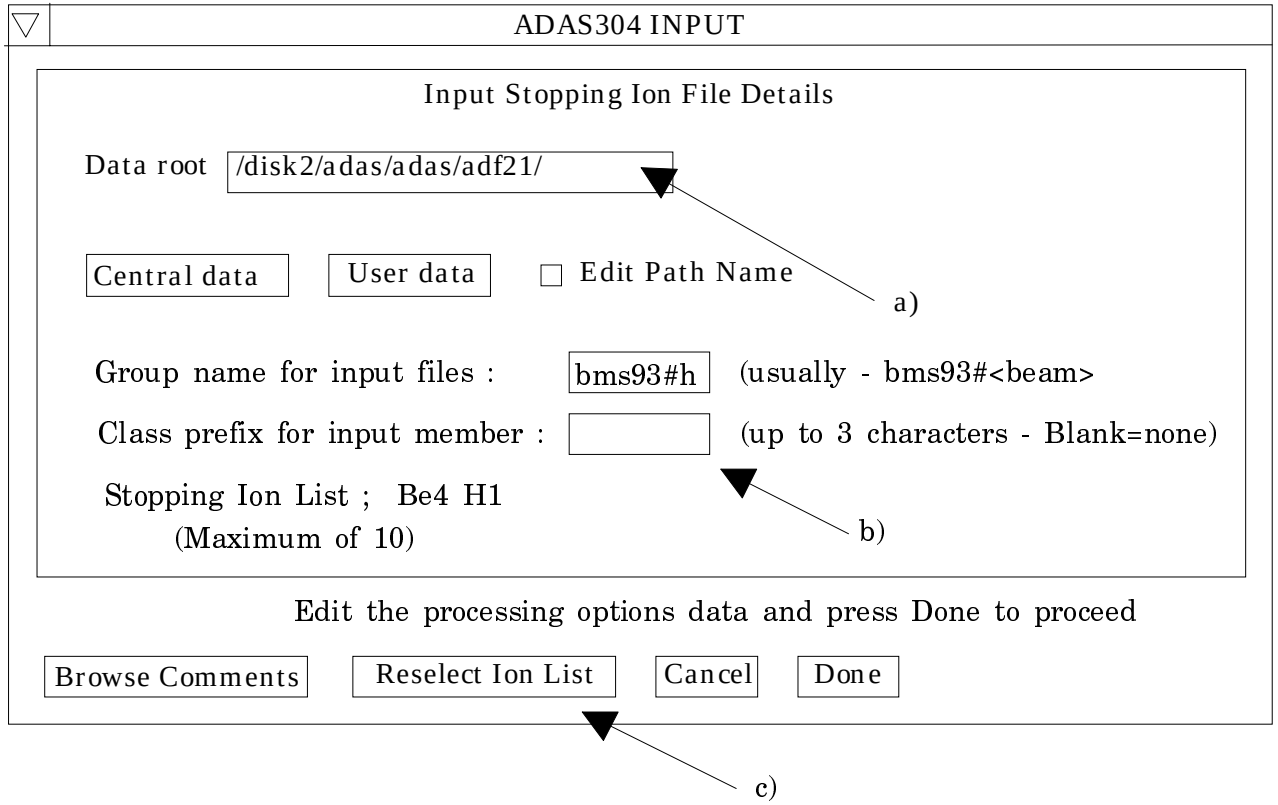
Obtaining effective beam stopping coefficients (contd.)

- Start ADAS304 as follows
  - » *Start ADAS*
  - » *Move to ADAS series 3*
  - » *Click button for ADAS304*
- ADAS304 has the standard sequential three screen structure, namely *file selection*, *processing options* & *output options* screens

Obtaining effective beam stopping coefficients (contd.)

- File selection
  - » *Path to central ADAS data of the correct class (ADF21 or ADF22) is selected by button press.*
  - » *A group name for input files is given.*
  - » *Then the collection of impurity species participating in the stopping are selected.*
  - » *Use the Reselect Ion List button for this, which pops-up an impurity selection list.*

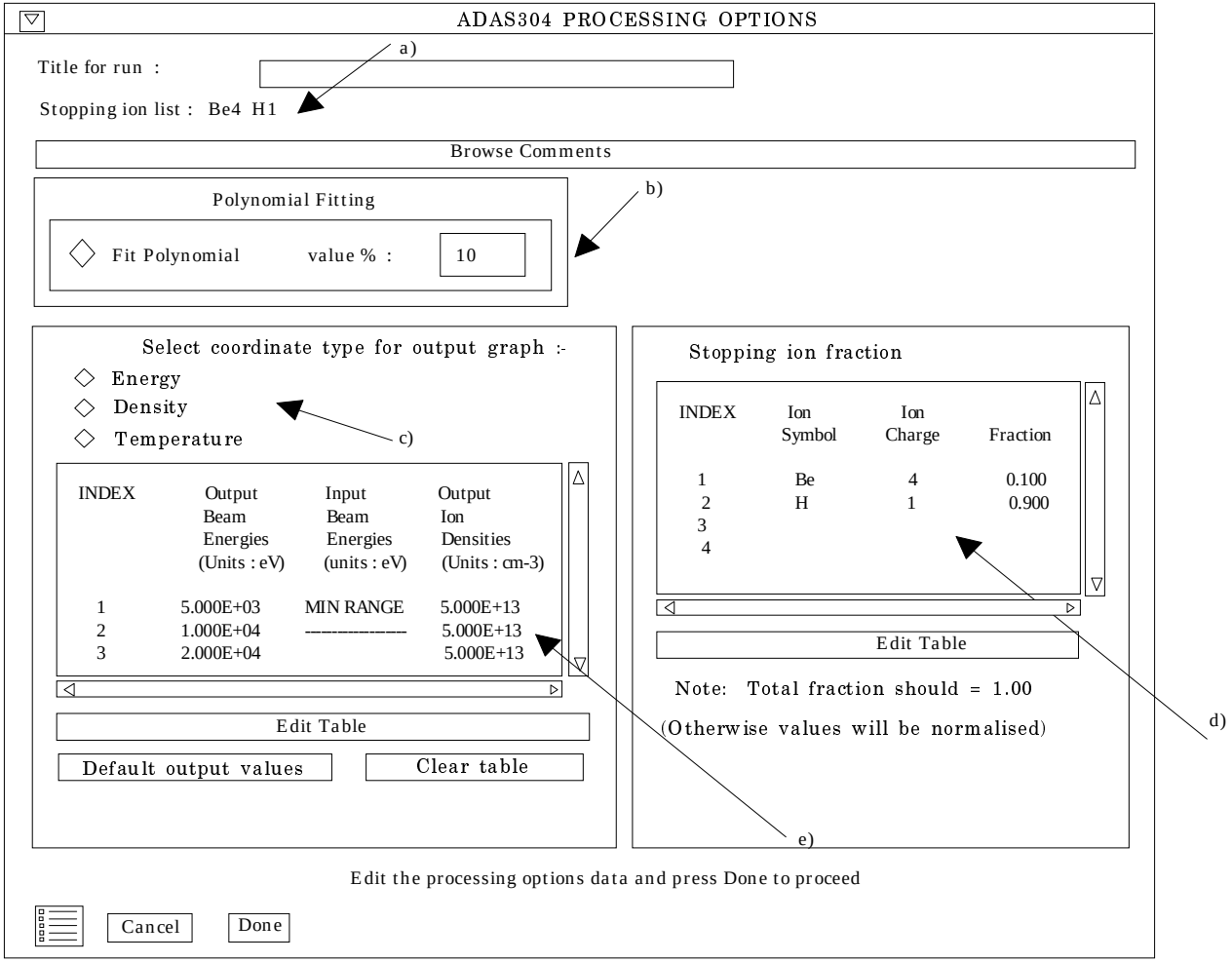
ADAS304 Input



Obtaining effective beam stopping coefficients (contd.)

- Processing options
  - » *First select proportions of each impurity in the plasma (by number).*
  - » *Then specify the beam energy, plasma temperature and density model you wish for the output graph, using Table Editor.*
  - » *Finally choose the graph coordinate.*

ADAS304 Processing



Obtaining effective beam stopping or emission coefficients (contd.)

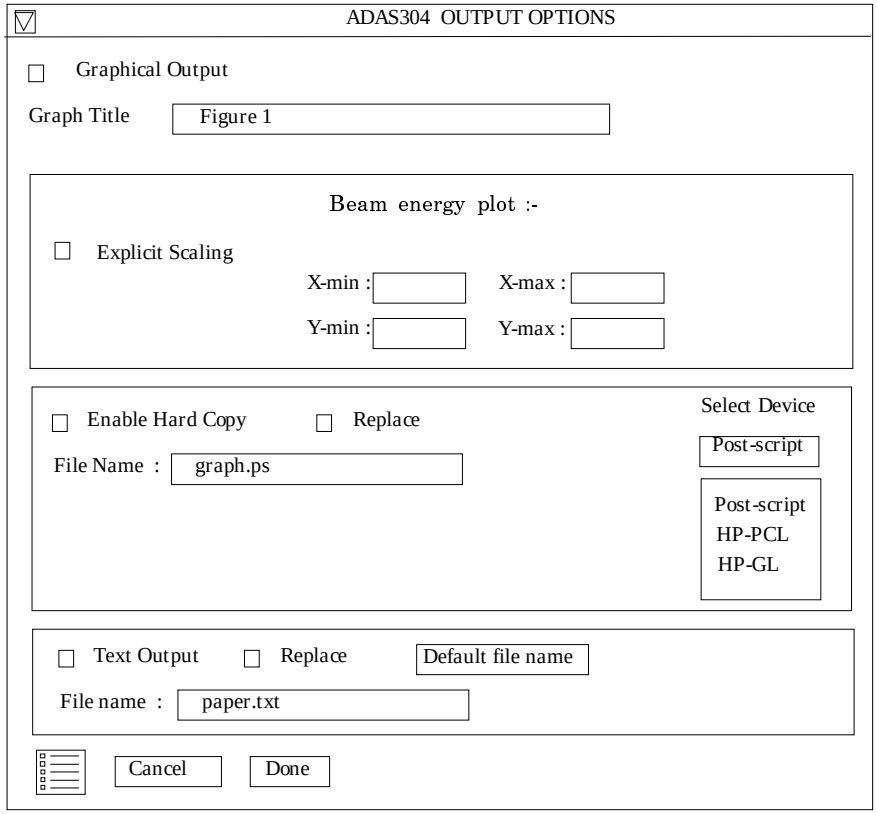
- The composite stopping for a mixed composition plasma is assembled as

$$N_e S_{CR}^{(A)}(E_B, N_I, T_I) \approx \sum_{i=1}^{I} N_{e,i} [S_{CR}^{(A,e)}(E_B, N_I, T_I) + (1/z_{0i}) S_{CR}^{(A,z_{0i})}(E_B, N_I, T_I)]$$

Obtaining effective beam stopping or emission coefficients (contd.)

- Output options
  - » *Graphical display is of the stopping coefficient usually 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.*

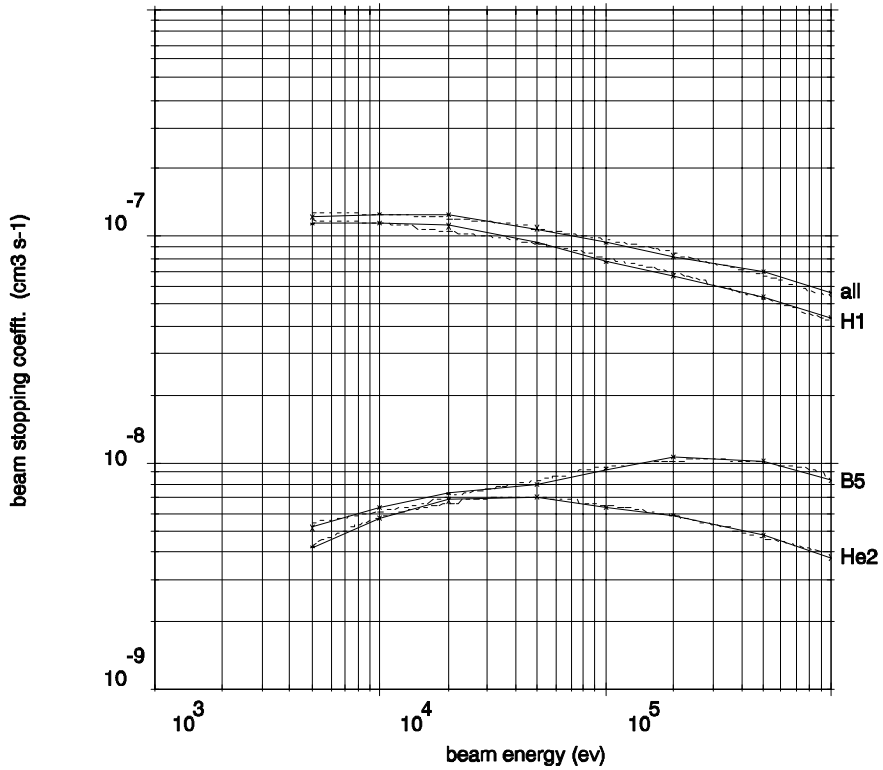
ADAS304 Output



ADAS304 graph

BEAM STOPPING COEFFT. VERSUS BEAM ENERGY : H, HE, B COMPOSITIE STOPPING DATE: 09/03/94

ADAS : ADAS RELEASE: ADAS91 V1.10 PROGRAM: ADAS304 V1.0 DATE: 09/03/94 TIME: 17.17
FILE : JETSHP.BMS93#H.DATA
IONS : H1 HE2 B5
KEY : (CROSSES/FULL LINE - SPLINE) (DAS LINE - MINIMAX)



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

-------- STOPPING ION FRACTIONS --------

INDEX	ION	CHARGE	FRACTION
1	H	1	0.900
2	HE	2	0.050
3	B	5	0.050

-- ENERGY/DENSITY/TEMP TRIPLETS --

INDEX	BEAM ENERGY (EV)	TARGET DENSITY (CM-3)	TARGET DENSITY (CM-3)
1	5.00D+03	5.00D+13	5.00D+03
2	1.00D+04	5.00D+13	5.00D+03
3	2.00D+04	5.00D+13	5.00D+03
4	5.00D+04	5.00D+13	5.00D+03
5	1.00D+05	5.00D+13	5.00D+03
6	2.00D+05	5.00D+13	5.00D+03
7	5.00D+05	5.00D+13	5.00D+03
8	1.00D+06	5.00D+13	5.00D+03

----------FITTING INFORMATION ---------

ION	TYPE	DEG	ACCRCY (%)	END GRADIENT LOWER	END GRADIENT UPPER
H1	LOGFIT	2	4.63	-0.03	-0.35
HE2	LOGFIT	3	2.55	0.49	-0.26
B5	LOGFIT	3	4.59	0.13	-0.27
ALL	LOGFIT	2	4.07	0.00	-0.32

Computing effective beam coefficients

- The first step is the calculation of the full collisional-radiative population structure of the hydrogen beam atoms.
- Code ADAS310 performs these calculations in the bundle-n model.
- It executes these repeatedly for the sets of plasma parameters required to construct tables containing the excited population structure and beam stopping.

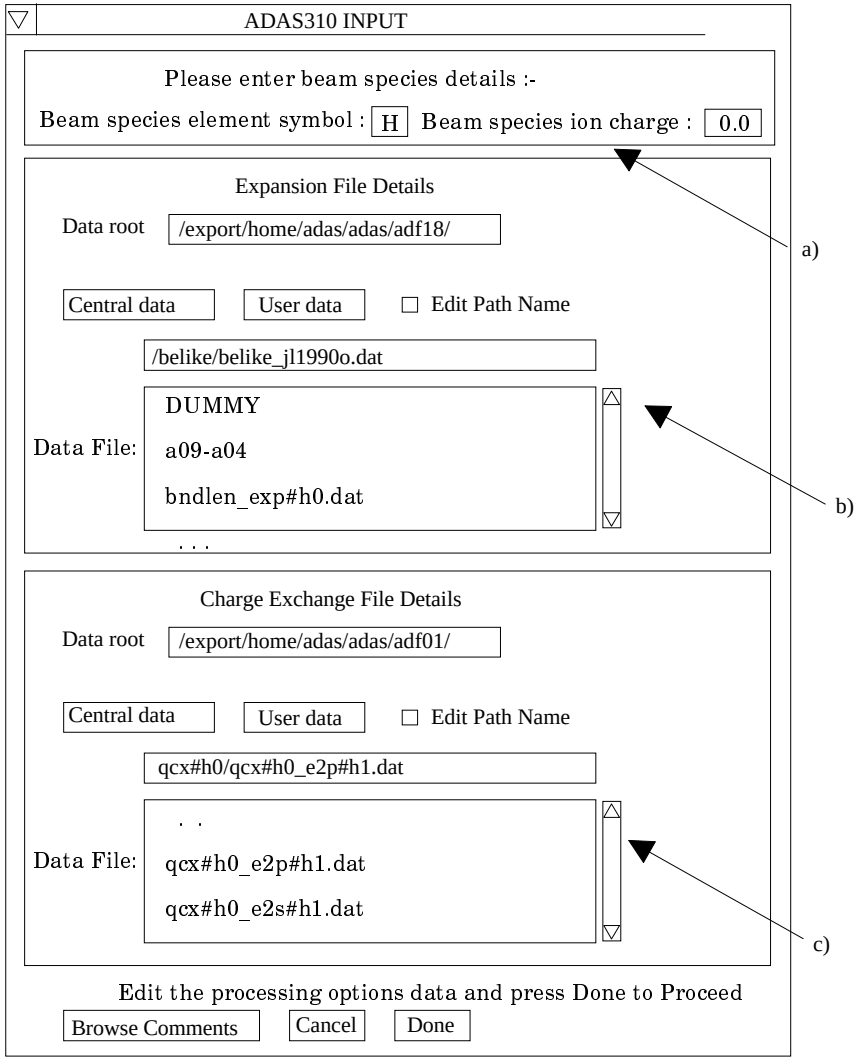
Computing effective beam coefficients (contd.)

- The full population structures are archived in ADF26 according to (single) impurity.
- Code ADAS312 post-processes the ADF25 files to extract the beam stooping and beam emission coefficients of choice.
- The output is structured according to the ADF21 (beam stopping) and ADF22 (beam emission) specifications.

Computing effective beam coefficients (contd.)

- File selection
  - » *Two input files may be selected.*
  - » *The first, called the expansion file, gives the pathway for storing condensed collisional-radiative matrices.*
  - » *The second, charge exchange file, is not important for the beam case. ADAS310 can compute hydrogen populations in the plasma (including CX) as well as beams*

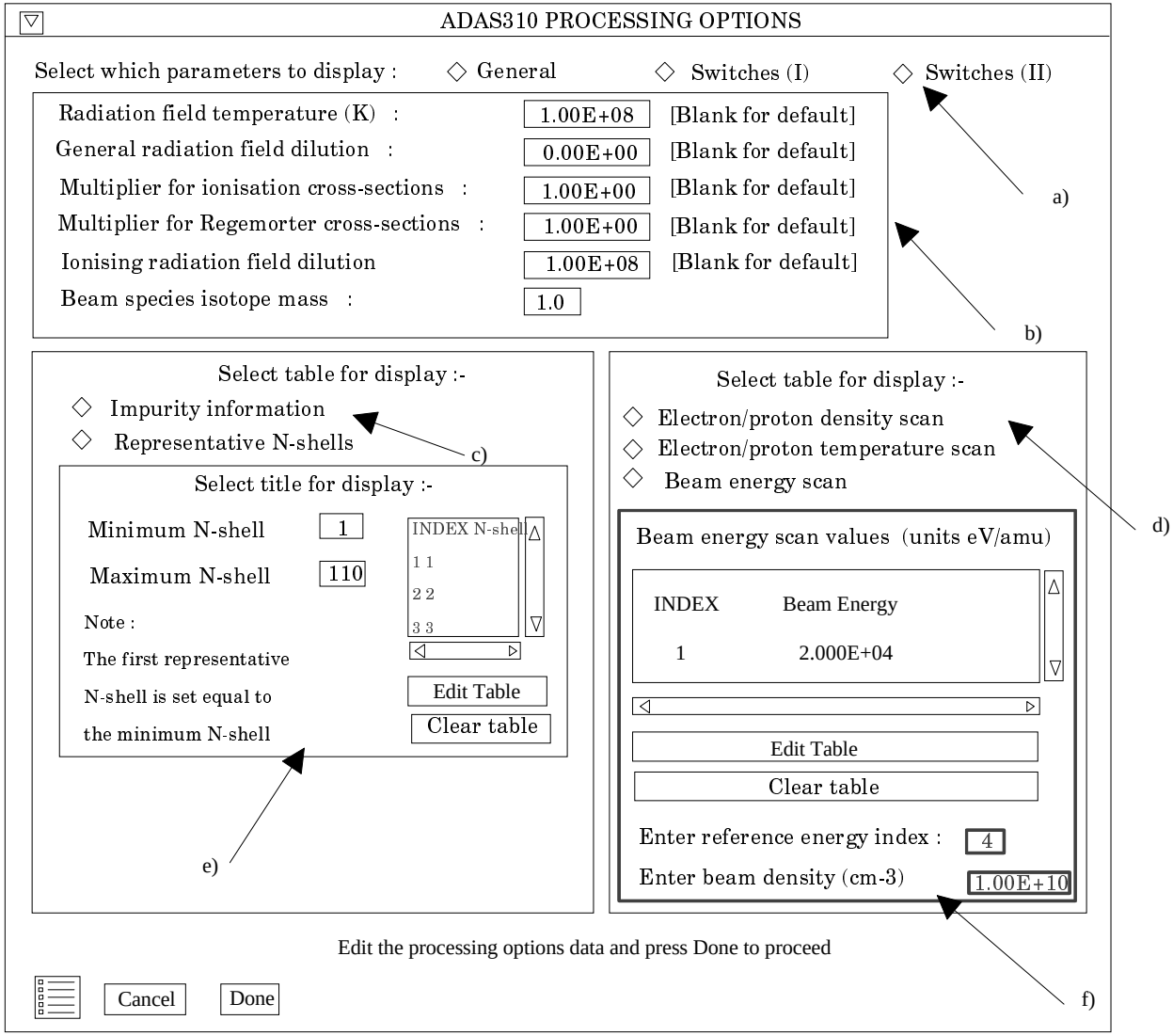
ADAS310 Input



Computing effective beam coefficients (contd.)

- Processing options
  - » *There are many parameters to specify but most are set with defaults.*
  - » *The main user data are the impurity specifications and the plasma parameter scans.*
  - » *ADAS310 can work with mixed impurities but main tabulations are for single impurities which are linearly combined for mixtures at the spectral analysis stage*

ADAS310 Processing



ADAS310 Processing (contd.)

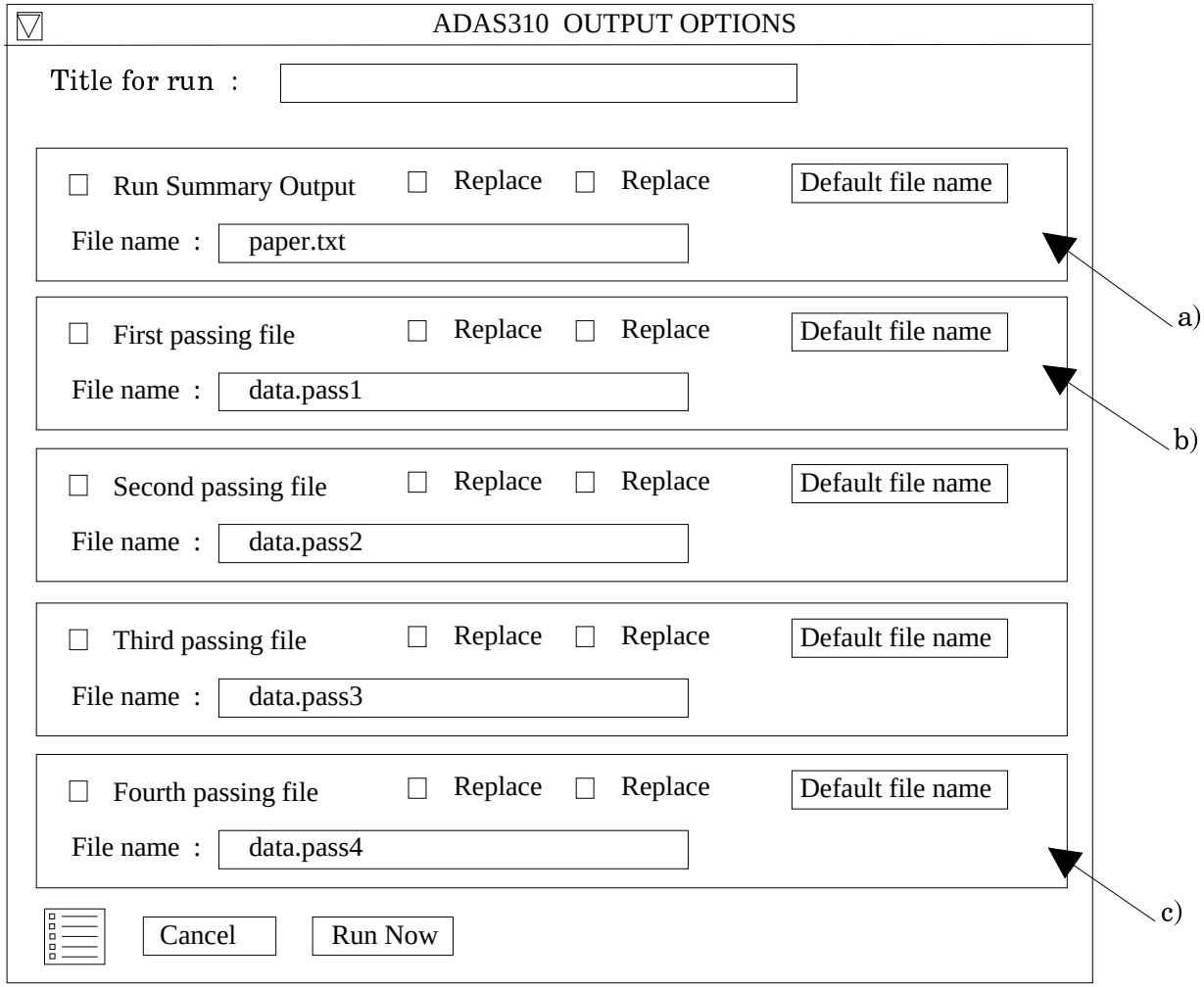
Select mode of operation | Multiple impurities

Multiple impurities (total fraction must be <= 1.0)

INDEX	Symbol	Atomic mass no.	Fraction
1	H	2.0	0.95
2	Be	9.0	0.03

Edit Table

Computing effective beam coefficients (contd.)

- Output options
  - » *There is no graphical display from ADAS310*
  - » *Several pass files are created*
  - » *.pass4 is the population structure (ADF26)*
  - » *Execution time can be ~ 10 mins.*

ADAS310 Output