Population processing

A schematic of the programs and datasets of ADAS2 series is shown in figure 3.0 The programs are associated with two streams of population modelling. The first stream is concerned with modelling and prediction of detailed spectral line emission from plasmas and commences with a collection of 'complete' reaction data for an identified group of levels of an individual ion, called a *specific ion file* (type ADF04). Such a dataset can include state selective recombination, charge exchange recombination, electron impact ionisation and ion impact excitation coefficient data. Special codes ADAS211, ADAS212 and ADAS213 add such data to the ADF04 dataset. However the primary content is electron impact excitation data. The electron impact excitation data in such files are individually prepared for the highest precision but can also be produced semi-automatically by direct calculation or, for members of prepared isoelectronic sequences, through extraction from *general z excitation files* (type ADF05) by the program ADAS203. The practicalities of preparing ADF04 datasets are aided by a number of codes which include level bundling (ADAS209), level un-bundling (ADAS210) and temperature re-gridding (ADAS215). ADAS201 allows interrogation and display of the electron collisional data in an ADF04 file.

The excited level populations are calculated at an array of temperatures and densities in the quasi-equilibrium approximation with respect to identified metastables of the ion. The basic program is ADAS205 and it produces plots of and tables of populations and prepares files of metastable fractions (MET), metastable cross-coupling coefficients (QCD) for a generalised collisional-radiative picture. Also a temporary passing file of the complete population set is generated for use by program ADAS207. This program supports diagnostic line studies by plotting line emissivities and emissivity ratios as functions of temperature, density or as contours in the temperature/density plane. ADAS206 is functionally very similar to ADAS205 but specifically prepares files of total line power (PLT) and one arbitrarily chosen specific line power (PLS).

The second stream is concerned with the modelling and prediction of effective recombination and ionisation coefficients in finite density thermal plasma. The main program is ADAS204 which carries out a *bundle-nS* population and generalised collisional-radiative calculations. It feeds directly to collisional-radiative recombination (ACD), ionisation (SCD), parent cross-coupling (XCD) and recombination-cascade power (PRB) coefficient files of type ADF10. Also it produces a low level *projection file* of type ADF17 for advanced studies. ADAS202 is designed to assist setting up of the ADAS204 calculations by extracting necessary recombination and ionisation parameters from a prepared general z ionisation/ recombination file (type ADF06). This code is not retained in IDL-ADAS. Its functionality is provided by a by the ADAS series 4 code, ADAS407.

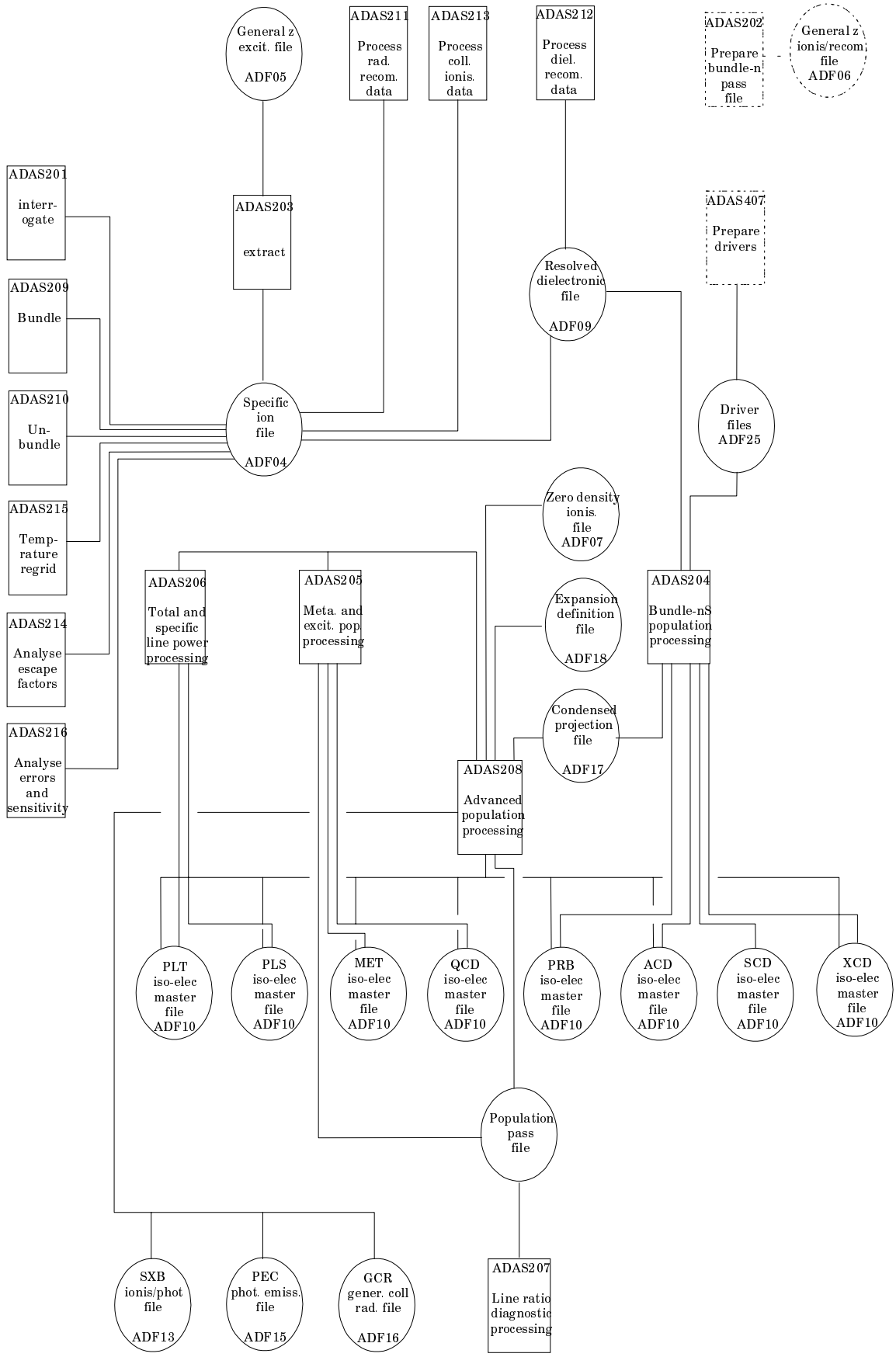
The most refined *photon emissivity* (PEC), *ionisation per photon* (SXB) and *generalised collisional-radiative* (GCR) data are produced along with a complete set of files of type ADF10 by the program ADAS208. This is an advanced version of ADAS205 which merges the key parts of the two streams. It draws necessary additional data on zero density ionisation

coefficients (type ADF07), expansion (type ADF18) and condensation (type ADF17) data if required and as available.

The archive database formats for which ADAS2 series programs prepare data are indicated also in the figure. The programs structure the datasets according to ADAS data format specifications but name them with extension .PASS for subsequent renaming into permanent archive storage by the user. The theory, user interaction information required, an illustration and special notes are provided for each program in the following sections.

There are two additional advanced codes. ADAS214 allows an opacity assessment within a number of simple plasma geometric models and line broadening mechanisms. It then modifies the ADF04 dataset with escape factors to permit re-calculation of spectral line ratios in the optically thick case. ADAS216 provides a detailed analysis of the sensitivity of population structure to errors or uncertainties in the fundamental data in the ADF04 file. This code supports both tracking of individual contributions to resultant error an statistical assessment of cumulative error.

Figure 3.0


General z excit. file ADF05
ADAS211 Process rad. recom. data
ADAS213 Process coll. ionis. data
ADAS212 Process diel. recom. data
ADAS202 Prepare bundle-n pass file
General z ionis/recom file ADF06
ADAS201 interr-ogate
ADAS203 extract
ADAS407 Prepare drivers
ADAS209 Bundle
Resolved dielectronic file ADF09
ADAS210 Un-bundle
Specific ion file ADF04
Driver files ADF25
ADAS215 Temp-rature regrid
Zero density ionis. file ADF07
ADAS206 Total and specific line power processing
ADAS205 Meta. and excit. pop processing
ADAS204 Bundle-nS population processing
ADAS214 Analyse escape factors
Expansion definition file ADF18
Condensed projection file ADF17
ADAS216 Analyse errors and sensitivity
ADAS208 Advanced population processing
PLT iso-elec master file ADF10
PLS iso-elec master file ADF10
MET iso-elec master file ADF10
QCD iso-elec master file ADF10
PRB iso-elec master file ADF10
ACD iso-elec master file ADF10
SCD iso-elec master file ADF10
XCD iso-elec master file ADF10
Population pass file
SXB ionis/phot file ADF13
PEC phot. emiss. file ADF15
GCR gener. coll rad. file ADF16
ADAS207 Line ratio diagnostic processing