Callable ADAS — Exercise sheet

October, 2012

1 Aim

The aim is to familiarise you with callable ADAS, mainly in an IDL environment but also using Fortran. Please feel free to expand any of the tasks or change them slightly to deal with your favourite ion! The sub tasks should be considered optional and are often more difficult (marked with 🌶s) so don't spend too much time on them unless they are of particular interest — getting the main tasks done is more important.

2 Tasks

1. Use `run_adas208` to explore the population structure of boron-like neon.
   - Find the approximate density where the systems switches from coronal to CR and from CR to LTE.
   - Produce a PEC file for the system🌶.
2. Use `read_adf11` to read ionisation and recombination coefficients for carbon.
   - Plot the temperature where the ionisation and recombination rates are equal as a function of ion charge 🌶🌶.
3. Use `run_adas405` to generate an equilibrium ionisation balance for carbon.
   - Compare the temperature of peak abundance (as a function of ion charge) with the points where the rates are equal (see above) 🌶🌶🌶.
   - Contrast `run_adas405` (time independent) with `run_adas406` (time dependent)🌶🌶🌶🌶.
   - See if you can feed the results into `write_adf19` to produce a PZD file🌶🌶🌶.
4. Use `read_adf15` to read data for the $1s^2\ {}^1S - 1s2p\ {}^1P$ and $1s^2\ {}^1S - 1s2p\ {}^3S$ in He-like argon.
   - Produce a contour plot over a sensible temperature and density range🌶.
   - Hence show that the ratio is a useful density diagnostic🌶.

5. Use `read_adf15` to read the PEC for the 977Å line of C^{+2}

   - Compare the power radiated in this line with the total line power for C3+ in coronal equilibrium conditions 🌶🌶🌶.

6. Using the fortran routine `r8ah`, write a small Fortran program which prints out the A-value of the 8p - 3s transition in hydrogen.

   - Extend the program to print out the A-value of the whole $n = 8$ to $n = 3$ transition🌶.
   - Do the same in IDL.

7. Combine `run_adas405` and `read_adf15` to produce an emission profile over the device (fusion machine, star, blob of tin) of your choosing.

   - Integrate over the data to simulate a spectrometer🌶.
   - Automatically produce an adaptive grid of points where the emission is highest🌶🌶🌶.

8. Use `run_adas416` to produce partitioned data using the file `/home/sipp/gipp/masterf/ADAS/ADAS7/example.dat`.

   - Modify the partition and explore how the various ions move in and out of being bundled🌶.

9. Use `read_adf12` to read effective charge exchange emission coefficients for the $n = 8 \rightarrow n = 7$ transition of CVI.

   - Write a program which can turn a fitted line area into a carbon concentration given a known beam energy, beam density and plasma parameters🌶🌶🌶.

10. Use `read_adf22` to read beam populations (`BMP`) for a hydrogen beam, look at the relative populations of $n = 2$ to $n = 1$ as a function of energy.

    - Combine these populations with two ADF12 files (via `read_adf12`) and explore the variation with energy, compare it with just assuming $n = 1$ population🌶🌶.

11. Read beam stopping coefficients for a neutral beam passing through a hydrogen plasma with a 3% neon content.

    - Find the dependence on the stopping as a function of neon content.
    - Integrate a real beam over a sensible profile, find the penetration depth as a function of neon concentration🌶🌶🌶🌶🌶.

12. Use `run_adas306` to compare active CX emission and excitation driven emission for CVI 8-7.

    - Plot the Doppler broadened feature (see `c5dplr.pro`) along with the components which make it up🌶.
    - Write a program which finds where the two emission processes become comparable🌶🌶🌶.

3 Hints

- Many IDL routines will give you help if you type their name followed by `,/help` (e.g. `run_adas405,/help`). Source is also available.
- You can search for r8ah online.
- IDL has built-in integration routines, type 'idlhelp' to see it.
- The `adas_vector` function can provide help in producing lists of numbers, see: `/home/sipp/gipp/adas/idl/adaslib/util/adas_vector.pro`.