



# Callable ADAS

Martin O'Mullane  
Department of Physics  
University of Strathclyde

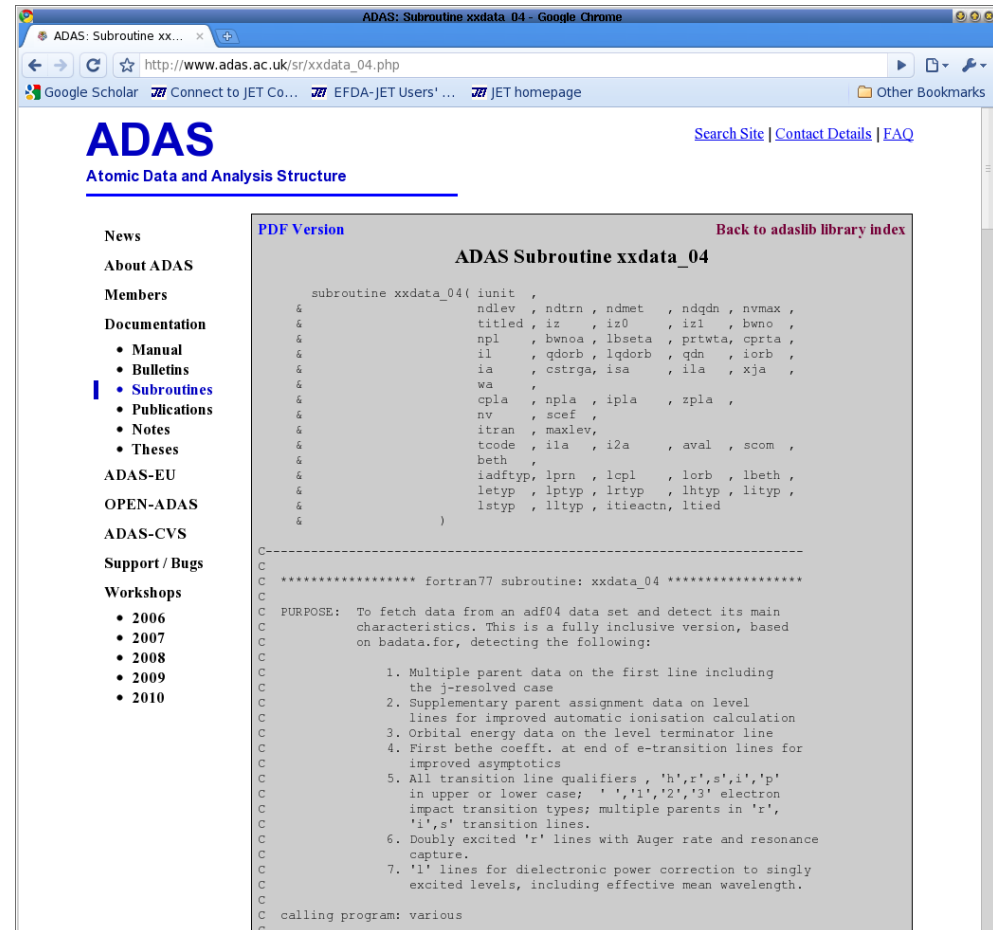
# Callable ADAS

ADAS Comes with a Fortran library of over 750 routines:

- all documented in ~1500 page appendix to the user manual,
- also documented on-line.

Also comes with extensive IDL library:

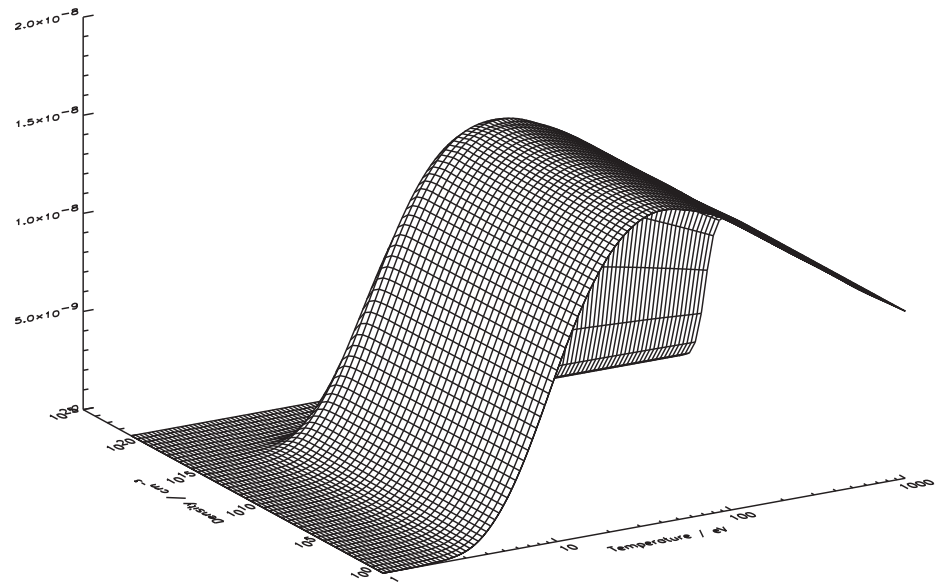
- far easier to use for interactive work at the command line,
- self documenting; almost all routines accept a '/help' keyword.



Partial/planned support for C, C++, Matlab, Perl and Python access.

# Reading ADAS data in your own programs

Reading the photon emissivity coefficient for the  $\text{Ne}^{7+}$  transition:  
 $1s^2 2p^2 P - 1s^2 2s^2 S$



```
temp = adas_vector(low=1,high=1000, num=127)
dens = adas_vector(low=1,high=1e21, num=43)
```

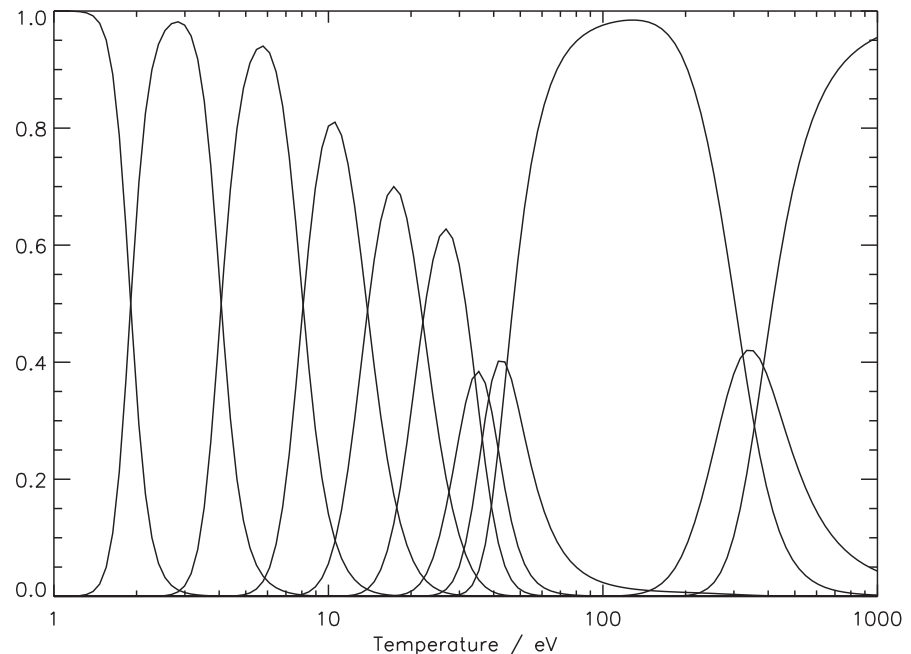
```
read_adf15,file='/home/adas/adas/adf15/pec96#ne/pec96#ne_pju#ne7.dat', $
      block=1,te=temp,dens=dens,data=data,/all
```

```
surface,data,temp,dens,/xlog,/ylog, $
      xtitle='Temperature / eV',ytitle='Density / cm!U-3'
```

# Running ADAS codes in your own programs

```
temp = adas_vector(low=1,high=1000, num=127)
dens = adas_vector(low=1,high=1e21, num=43)
```

```
run_adas405,uid = 'adas', $
              year = 96', $
              elem = 'ne', $
              te = temp, $
              dens = dens, $
              frac = frac
```



```
plot, temp, frac.ion[*], /xlog, xtitle='Temperature / eV'
```

```
for i = 1, 10 do oplot, temp, frac.ion[*],i
```

# Line ratios without all that clicking!

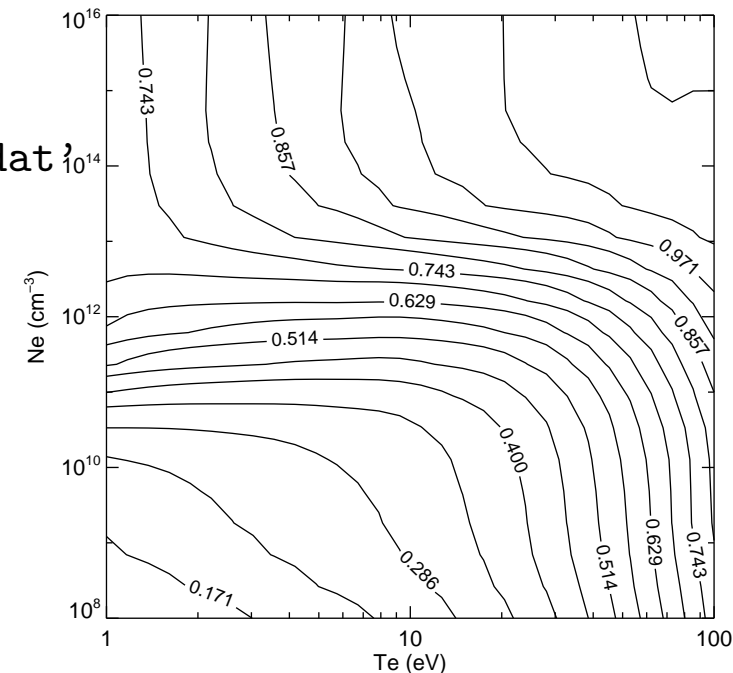
The spectrum line emissivity is:

$$\begin{aligned}\varepsilon_{j \rightarrow i} &= N_e N_\sigma A_{j \rightarrow i} F_{j \rightarrow i}^{exc} \\ &= N_e N_\sigma \mathcal{P} \mathcal{E} \mathcal{C}_{j \rightarrow i}^{exc}\end{aligned}$$

So a line ratio is the ratio of the photon emissivity coefficients.

```
temp = adas_vector(low=1, high=100, num=30)
dens = adas_vector(low=1e8, high=1e16, num=20)
file = '/home/adas/adas/adf15/pec96#c/pec96#c_vsu#c0.dat'
read_adf15, file=file, block=1, te=temp, dens=dens, $
    data=e1, /all
read_adf15, file=file, block=2, te=temp, dens=dens, $
    data=e2, /all

contour, e1/e2, temp, dens, nlevels=20, /follow, $
    /xlog, /ylog, $
    xtitle = 'Te (eV)', ytitle='Ne (cm!u-3!n)'
```



# Example: midplane emission through a fusion device

Set up grid of radial points on the midplane:

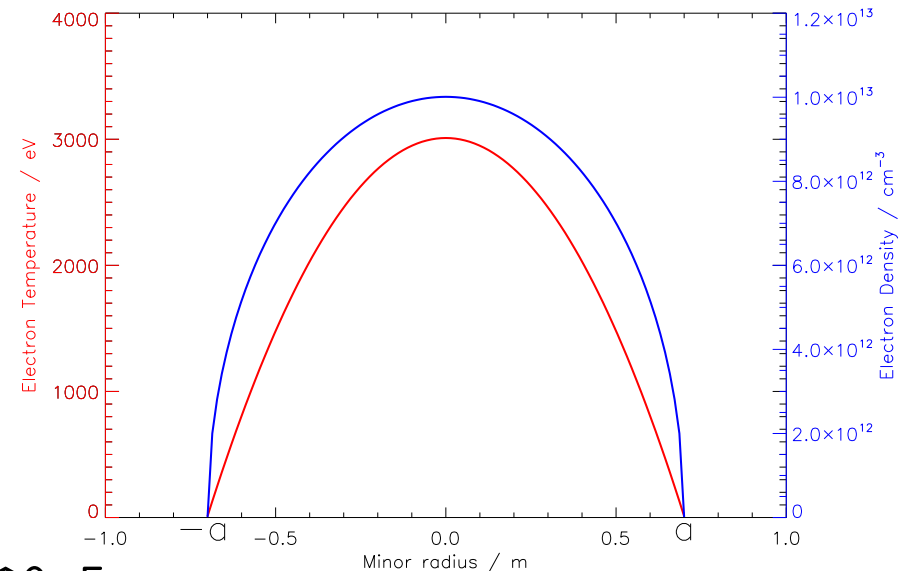
$$a = 0.7$$

$$r = a * (\text{findgen}(101) / 50.0 - 1.0)$$

Create simplified **temperature** and **density** profiles along the midplane:

$$\text{temp} = 10.0 + 3e3 * (1 - (r/a)^2)$$

$$\text{dens} = 1e10 + 1e13 * (1 - (r/a)^2)^{0.5}$$



Use ADAS to work out fractional ionisation balance along midplane:

```
run_adas405, uid='adas', year=96, elem='ne', $  
           te=temp, dens=dens, frac=frac
```

Read emissivity coefficient for  $1s^2 2p \ ^2P - 1s^2 2s \ ^2S$  transition

```
read_adf15,file='/home/adas/adas/adf15/pec96#ne/pec96#ne_pju#ne7.dat'  
      te=temp,dens=dens,block=1,data=coeff
```

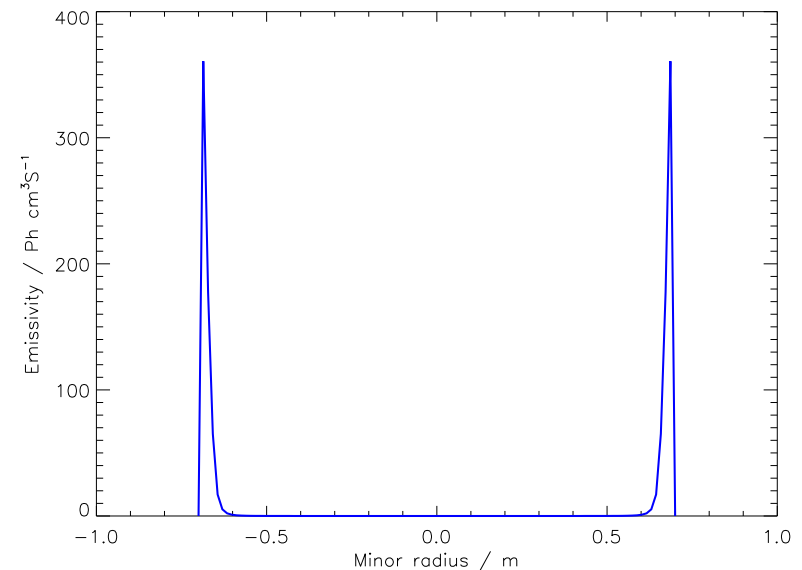
Calculate the **emissivity**

```
emissivity = frac.ion[* ,7] * $  
            coeff * dens
```

Calculate emission by integration

```
emission = int_tabulated(r,emissivity)
```

This example assumes ionisation balance equilibrium. We also need to adjust for lots of things to do real confrontation, such codes are necessarily complex...



# Reading beam attenuation coefficients

```
files = [ '/home/adas/adas/adf21/bms98#h/bms98#h_h1.dat' , $  
          '/home/adas/adas/adf21/bms97#h/bms97#h_c6.dat' , $  
          '/home/adas/adas/adf21/bms97#h/bms97#h_be4.dat' ]
```

```
fraction = [0.96, 0.03, 0.01]
```

```
temp = fltarr(80) + 2000
```

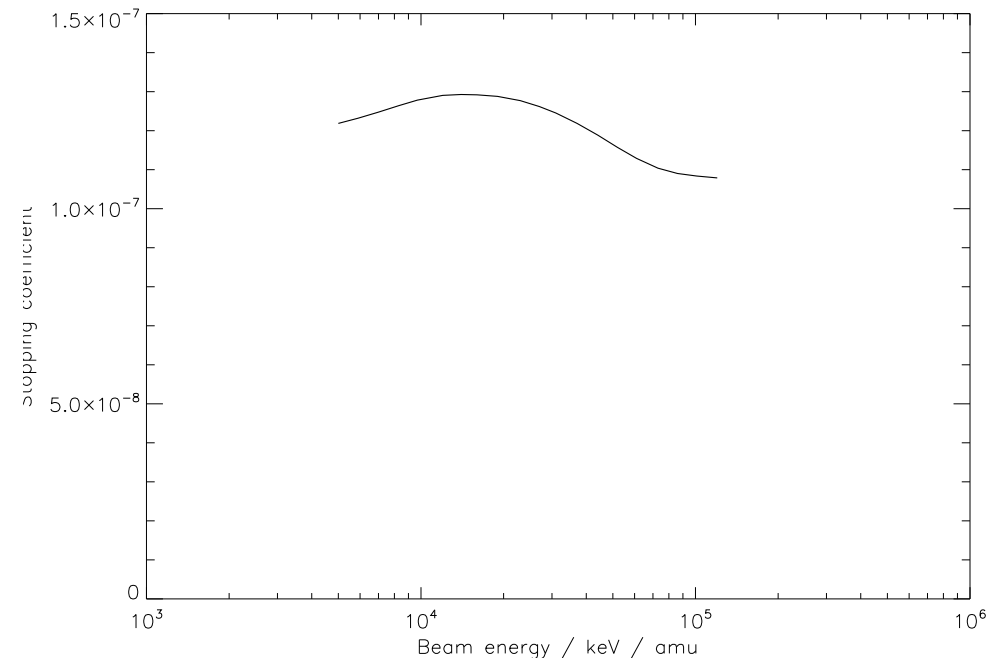
```
dens = fltarr(80) + 1e13
```

```
ener = [ 5000,  5900,  7000,  8300, $  
        9700, 12000, 14000, 16000, $  
        19000, 23000, 27000, 31000, $  
        37000, 44000, 52000, 61000, $  
        73000, 86000, 101000, 120000 ]
```

```
read_adf21, files=files, data=data, $
```

```
fraction=fraction, te=temp, dens=dens, energy=ener
```

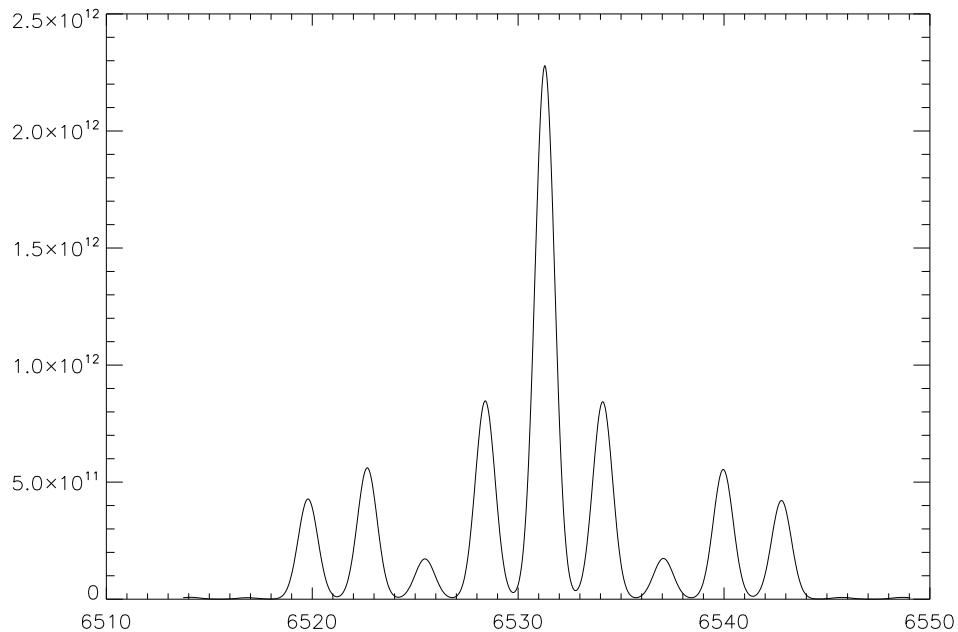
```
plot, ener, data, /xlog, ytitle='Stopping coefficient', $  
      xtitle='Beam energy (keV/amu)'
```





# Producing a stark feature

```
pars = afg('stark',/parameters)
pars.broaden = 1
res = afg('stark',calculate=pars)
plot, res.wv, res.intensity
```



BEAM_MASS	FLOAT	2.00000
BEAM_ENERGY	FLOAT	40.0000
BEAM_TE	FLOAT	10.0000
BEAM_DENSITY	FLOAT	1.00000e+10
PLASMA_MASS	FLOAT	2.00000
PLASMA_TE	FLOAT	4440.00
PLASMA_DENSITY	FLOAT	2.50000e+13
PLASMA_ZEFF	FLOAT	2.00000
BEAM_DC_X	FLOAT	0.00000
BEAM_DC_Y	FLOAT	0.00000
BEAM_DC_Z	FLOAT	1.00000
BFIELD_VALUE	FLOAT	3.39150
BFIELD_DC_X	FLOAT	0.788000
BFIELD_DC_Y	FLOAT	0.00530000
BFIELD_DC_Z	FLOAT	0.615200
EFIELD_VALUE	FLOAT	0.00000
EFIELD_DC_X	FLOAT	1.00000
EFIELD_DC_Y	FLOAT	0.00000
EFIELD_DC_Z	FLOAT	0.00000
OBS_DC_X	FLOAT	0.870100
OBS_DC_Y	FLOAT	-0.0470000
OBS_DC_Z	FLOAT	0.490500
OBS_SIGMA	FLOAT	0.510000
OBS_PI	FLOAT	1.00000
BROADEN	INT	1

# Fortran Example: Bremsstrahlung emission

Evaluate bremsstrahlung emission using ADAS.

Requires specification of ion and temperature/wavelength:

- We'll use  $C^{6+}$  at 3keV and 6000Å for this example.

```
PROGRAM BREM
C-----
C   DEFINE APPROPRIATE VARIABLES
C-----
C   IMPLICIT NONE
C-----
C   INTEGER*4 IZO , IZ1
C   REAL*8    WAVE , TEV , CONTFF , CONTIN
C-----
C   SPECIFY WE'RE DEALING WITH FULLY STRIPPED CARBON
C-----
C   IZO=6
C   IZ1=7
C-----
C   SPECIFY A TEMPERATURE OF 3keV and a WAVELENGTH OF 6000A
C-----
C   TEV=3000
C   WAVE=6000
```

```

C-----
C   USE ADAS TO CALCULATE EMISSION
C-----
C   CALL CONTINUO(WAVE   , TEV   , IZ0  , IZ1  ,
&                CONTFF , CONTIN          )
C-----
C   PRINT THE FREE-FREE EMISSIVITY (Ph cm3 s-1 A-1)
C-----
C   PRINT *,CONTFF

C-----
C   PRINT THE TOTAL EMISSIVITY (Ph cm3 s-1 A-1)
C-----
C   PRINT *,CONTIN

END

```

## Compile with:

```
f77 brem.for -L/home/adas/lib -ladas3xx -ladaslib -o brem.x
```

## Run to give the result:

6.12203887E-17

6.12357634E-17

IDL version: continuo, 6000.0, 3000.0, 6, 7, contff, contin

# C Example: Bremsstrahlung emission

Direct C translation of previous Fortran example.

```
/******  
Bremsstrahlung routine is in adaslib library so include appropriate header  
*****/  
#include "adaslib.h"  
  
int main(int argc, char *argv)  
{  
  
/******  
    Declare appropriate variables  
*****/  
    int iz0, iz1;  
    double wave,tev,contff,contin;  
/******  
    Specify we're dealing with fully stripped carbon  
*****/  
    iz0=6;  
    iz1=7;  
  
/******  
    Specify a temperature of 3keV and a wavelength of 6000A  
*****/  
    wave=6000;  
    tev=3000;
```

```

/*****
    Use ADAS to calculate emission
*****/
    continuo_(&wave    , &tev    , &iz0  , &iz1  ,&contff , &contin);

/*****
    Print off free-free emissivity (Ph cm3 s-1 A-1)
*****/
    printf("%e\n",contff);

/*****
    Print off total emissivity (Ph cm3 s-1 A-1)
*****/
    printf("%e\n",contin);

    return 0;
}

```

## Compile with:

```
g77 -I/home/adas/include brem.c -L/home/adas/lib -ladas3xx -ladaslib brem.c -o brem.x
```

Note that g77 is used for compilation even though this program is written in C.