```
NAME:
       CNTRB

PURPOSE:
       This procedure reads contribution functions from file and places
       contribution function to intensity in cntrbi(k,ny,kr), to relative
       absorption in cntrbr(k,ny,kr) and average height of formation in
       xmeani(ny,kr) and xmeanr(ny,kr).

CATEGORY:
       Multi

CALLING SEQUENCE:

       CNTRB, File

INPUTS:
       File:   File containing contribution function data.
              Default file name is IDLCNT if def_ext='none', else
              idlcnt.def_ext

OUTPUTS:
       in common block:
       cntrbi(k,ny,kr)  contribution function to intensity
       cntrbr(k,ny,kr)  contribution function to relative intensity
       cntrbf(k,ny,kr)  contribution function to flux
      xmeani(ny,kr)    average taulg of formation for intensity
       xmeanr(ny,kr)    average taulg of formation for relative intensity
       xmeanf(ny,kr)    average taulg of formation for flux

      to screen:
      'reading contribution functions for kr=',kr

COMMON BLOCKS:
       common_multi

PROCEDURE:
       cntrbr as defined by Magain

MODIFICATION HISTORY:
       Written by:     Mats Carlsson.
```

NAME:
CONVL

PURPOSE:
This function converts vacuum wavelengths to air for wavelengths greater than 2000 Angstroms.

CATEGORY:
Multi

CALLING SEQUENCE:

Result = CONVL(Lambda)

INPUTS:
Lambda: Vacuum wavelength

OUTPUTS:
This function returns the air wavelength for wavelengths greater than 2000 Angstrom, else the vacuum wavelength

PROCEDURE:
Algorithm from Starlink program IUEDR
You might not need this section for your routine.

MODIFICATION HISTORY:
Written by: Mats Carlsson

```
NAME:
       COOL_PLOT

PURPOSE:
       This procedure plots the cooling function. If line type is given,
       overlay plot.

CATEGORY:
       Multi

CALLING SEQUENCE:

       COOL_PLOT, X, Cool [,Line]

INPUTS:
       X:      Atmospheric height/depth scale to be used for x-axis

       Cool:   Cooling function.

OPTIONAL INPUTS:
       Line:   Line type, gives overlay plot


COMMON BLOCKS:
       CCOOL_PLOT:     saving local variables for overlay plot

SIDE EFFECTS:
       Plots in current window

EXAMPLE:
       Typical call sequences:
       cool_plot,height,cool_total
      for kr=0,nrad-1 do cool_plot,height,cool(*,kr),kr+1

MODIFICATION HISTORY:
       Written by:     Mats Carlsson
```

```
NAME:
       COOL_SUM

PURPOSE:
       This procedure adds up all cooling contributions
       and puts the sum into cool_total

CATEGORY:
       Multi

CALLING SEQUENCE:

       COOL_SUM, Cool, Cool_total

INPUTS:
       Cool:           Cool(k,kr) cooling function at depth k, transition kr

OUTPUTS:
       Cool_total:     Cool_total(k) total cooling function at depth k

EXAMPLE:
       Typical call: cool_sum,cool,cool_total

MODIFICATION HISTORY:
       Written by:     Mats Carlsson
```

```
NAME:
       DEFAULT

PURPOSE:
       This procedure sets default extension for input files
       idl1
       idlcnt
       idlny
       idlopc
       dumc
       jny

       extension='none' sets original upper case file names.

CATEGORY:
       Multi

CALLING SEQUENCE:

       DEFAULT, Extension

INPUTS:
       Extension:      File extension, 'none' to set original upper case
                       file names

OUTPUTS:
       in common block:
       def_ext         file extension
      openfile=0       to signal reopening of files4

COMMON BLOCKS:
       common_multi

MODIFICATION HISTORY:
       Written by:     Mats Carlsson
```

NAME:
DLAMB

PURPOSE:
This function calculates and returns delta lambda for a given Q array.

CATEGORY:
Multi

CALLING SEQUENCE:

Result = DLAMB(QQ, Lambda)

INPUTS:
QQ: Frequency parameter in typical Doppler units

Lambda: Central wavelength in Angstrom

OUTPUTS:
Delta lambda from line center in Angstrom

COMMON BLOCKS:
common_multi

MODIFICATION HISTORY:
Written by: Mats Carlsson

NAME:
DOUBLE

PURPOSE:
This procedure makes profile symmetric around x(0). Used for fluxes and intensities. For two-sided profiles, original profile is returned.

CATEGORY:
Multi

CALLING SEQUENCE:

DOUBLE, KR, Y, XX,YY

INPUTS:
KR: transition number

Y: array to be made symmetric, either OUTINT or FLUX

OUTPUTS:
XX: delta lambda in Angstrom

YY: symmetric Y values as function of wavelength

COMMON BLOCKS:
common_multi

EXAMPLE:
Typical call sequence:
double,0,flux,xx,yy
plot,xx,yy

MODIFICATION HISTORY:
Written by: Mats Carlsson

NAME:
GACALC

PURPOSE:
This procedure calculates ga values from line list

CATEGORY:
Multi

CALLING SEQUENCE:

GACALC

INPUTS:
From common

OUTPUTS:
In common:
GA: GA(kr) Summed A values for all transitions from upper level and lower level of transition kr

COMMON BLOCKS:
common_multi

MODIFICATION HISTORY:
Written by: Mats Carlsson.

NAME:
INTEP

PURPOSE:
This procedure is used for interpolation
uses a Hermite spline interpolation that often avoids over-shoot
found with cubic splines

CATEGORY:
Multi

CALLING SEQUENCE:

INTEP,X,Y,Xpin,Ypout [, Nowarning=Nowarning]

INPUTS:
X: X-array to interpolate in

Y: Y-array to interpolate in

Xpin: X-array where Y-values are wanted

KEYWORD PARAMETERS:
NOWARNING: If /NOWARNING there will be no warning messages
if extrapolation occurs

OUTPUTS:
Ypout: Y-array with returned interpolated values

OPTIONAL OUTPUTS:
If extrapolation is attempted, there is a warning message

RESTRICTIONS:
Instead of extrapolation, the nearest end value is used

PROCEDURE:
ref: publications of the dominion astrophysical observatory,
xvi,6,67 graham hill: intep, an effective interpolation subroutine

MODIFICATION HISTORY:
Written by: Mats Carlsson

NAME:
INTFLUX

PURPOSE:
This function calculates the integrated flux or intensity.

CATEGORY:
Multi

CALLING SEQUENCE:

Result = INTFLUX(Kr [,Mu=Mu,/Nocont])

INPUTS:
Kr: The transition for which the integrated flux/intensity is calculated.

KEYWORD PARAMETERS:
MU: If mu-index is given, integrated intensity is returned.

NOCONT: If /nocont is given, continuum flux/intensity is not subtracted.

OUTPUTS:
Integrated flux or intensity

COMMON BLOCKS:
common_multi

PROCEDURE:
Uses Trapez integration

MODIFICATION HISTORY:
Written by: Mats Carlsson.

NAME:
MULRD

PURPOSE:
This procedure reads data from file. If no file name is given, the default name IDL1 is assumed. After execution of this procedure, most common block variables are accessible.

CATEGORY:
Multi.

CALLING SEQUENCE:

MULRD, File

INPUTS:
File: Input file containing all the multi-data. Default file name is IDL1 if def_ext='none', else idl1.def_ext

OUTPUTS:
Fills most common blocks

COMMON BLOCKS:
common_multi

MODIFICATION HISTORY:
Written by: Mats Carlsson, March 1988.

NAME:
       NYCLOSE

PURPOSE:
       This procedure closes the idlny and jny files.

CATEGORY:
       Multi

CALLING SEQUENCE:

       NYCLOSE

INPUTS:
       None

OUTPUTS:
       In common:
       openfile=0   signals closed files
       lu2=0   signals closed files
       ljny=0   signals closed files

COMMON BLOCKS:
       common_multi

MODIFICATION HISTORY:
       Written by: Mats Carlsson

NAME:

NYRD

PURPOSE:

This procedure reads ny dependent variables from files file_idlny and file_jny for line kr, frequency ny. if no filename is given, the defaults IDLNY and JNY are used. Variables are: pms, iplus, iminus, p, s, tauq, dtauq, xcont, sc, scat, x, jny, sbck, rny.

CATEGORY:

Multi

CALLING SEQUENCE:

NYRD, Kr, Ny [, File_idlny, File_jny, MDEP=MDEP, /DP, /JNYDP]

INPUTS:

Kr:	The transition number for which variables are read
Ny:	Frequency number for which variables are read
File_idlny:	idlny file name. Default file name is IDLNY if def_ext='none', else idlny.def_ext
File_jny:	jny file name Default file name is JNY if def_ext='none', else jny.def_ext

KEYWORD PARAMETERS:

MDEP:	Dimension MDEP. Defaults to NDEP. If dimension is different from NDEP this keyword has to be given in order to get correct JNY
DP:	signals that program was compiled in double precision this means that the record length for odd values of NDEP is different than in SP which this keyword takes care of. Note that the file JNY is still assumed to be in single precision (see JNYDP keyword)
JNYDP:	JNY file is assumed to be in double precision. sets /DP as well

OUTPUTS:

In common:

pms	P-S
iplus	IPLUS
iminus	IMINUS
p	Feautrier mean intensity
s	Source function
tauq	Monochromatic optical depth
dtauq	dtauq(k)=tauq(k)-tauq(k-1)
xcont	continuum opacity relative to standard opacity
sc	absorption part of source function
scat	scattering part of source function
x	total opacity relative to standard opacity
jny	mean intensity
sbck	background source function, SBCK=SC+SCAT*JNY
rny	xcont/x

COMMON BLOCKS:

common_multi

RESTRICTIONS:
The jny file has to be converted to single precision - this is
NOT taken care of by the keyword /DP - or you have to use /JNYDP

MODIFICATION HISTORY:
Written by: Mats Carlsson
95-11-30 JNYDP keyword added

NAME:
OPCPLOT

PURPOSE:
This procedure plots opacity contributions as function of depth.

CATEGORY:
Multi

CALLING SEQUENCE:

OPCPLOT, Xscale, Il, Min_cont [, /TOTAL]

INPUTS:
Xscale: X scale on plot (i.e. taulg).

Il: Wavelength index.

Min_cont: Minimum contribution to be plotted (default 0.02)

KEYWORD PARAMETERS:
TOTAL: Contributions relative to total opacity and not relative
to background opacity.

COMMON BLOCKS:
common_multi
blocks, just delete this entry.

SIDE EFFECTS:
Plots in current window

EXAMPLE:
```
opcrd           reads opacity file
print,xla       find wavelength number of interest
opcplot,taulg,4,/total
```

MODIFICATION HISTORY:
Written by: Mats Carlsson

```
NAME:
       OPCRD

PURPOSE:
       This procedure reads opacity data from file.

CATEGORY:
       Multi

CALLING SEQUENCE:

       OPCRD, File

INPUTS:
       File:   Name of file containing opacity data.
               Default file name is IDLOPC if def_ext='none', else
               idlopc.def_ext

      Iwopac:  The procedure asks for iwopac

OUTPUTS:
       In common block

COMMON BLOCKS:
       common_multi

MODIFICATION HISTORY:
       Written by:     Mats Carlsson
```

NAME:
PLANCK

PURPOSE:
This function calculates the Planck function, B_ny(lambda,t).

CATEGORY:
Multi

CALLING SEQUENCE:

Result = PLANCK(Lambda, T)

INPUTS:
Lambda: Wavelength in Angstroms.

T: Temperature in Kelvins.

either input (but not both) can be an array

OUTPUTS:
Returns B_ny in cgs units

MODIFICATION HISTORY:
Written by: Mats Carlsson, April 1988.

NAME:
PLOTCNTRB

PURPOSE:
This procedure plots contribution function

CATEGORY:
Multi

CALLING SEQUENCE:

PLOTCNTRB, Kr, Xscale, Cntrb

INPUTS:
Kr: Transition number.

Xscale: X scale on plot (i.e. taulg).

Cntrb: Contribution function to be plotted.

COMMON BLOCKS:
common_multi

SIDE EFFECTS:
Plots in current window

EXAMPLE:
Typical calls are: plotcntrb,0,alog10(tau),cntrbi
plotcntrb,0,alog10(tau),cntrbr

MODIFICATION HISTORY:
Written by: Mats Carlsson, March 1988.

NAME:
TRADB

PURPOSE:
This function calculates trad from given (i,lambda) array. Trad is the radiation temperature.

CATEGORY:
Multi

CALLING SEQUENCE:

Result = trad(I, Lambda)

INPUTS:
I: Intensity I_nu in cgs units

Lambda: Wavelength in Angstrom

OUTPUTS:
This function returns trad

MODIFICATION HISTORY:
Written by: Mats Carlsson, April 1988.

NAME:
TRAPEZ

PURPOSE:
This function performs trapezoidal integration.

CATEGORY:
Multi

CALLING SEQUENCE:

Result = TRAPEZ(X, Y)

INPUTS:
X: X-array

Y: Y-array

OUTPUTS:
This function returns the integral Y*dx

MODIFICATION HISTORY:
Written by: Mats Carlsson