PLT\_SPEC

General purpose program for comparing CMFGEN/CMF\_FLUX spectral data with observational data. Options are provided to redden the model, smooth the model, and to apply rotational broadening. Although all care has been taken, it is the user’s responsibility to check that options perform as indicated.

PLT\_SPEC contains a single buffer. Data in this buffer can be changed by PLT\_SPEC options,

and can be sent (sometimes with changes) to the plotting package (and its buffers). The buffer

in PLT\_SPEC has no connection to the buffers in the plot package. Commonly used options are

RD\_MOD (read CMFGEN model data), RD\_OBS (read observational data), and FLAM

(apply a correction for reddening and distance, and send buffer data to plot package).

Options are ordered under subject. Associated with each option are requested inputs. Some inputs are not prompted for, and can only be changed from their default values by specifying them in the call, e.g.,

RD\_MOD(OVER=T)

Such input parameters are placed in [ ] in the following documentation.

There are five types of options:

1. Options such as lx which change plotting style or units.
2. Options such as RD\_MOD(OVER=F) which pass data directly to the plot program.
3. Options such as RD\_MOD(OVER=T) which place data into the (single) buffer where it can be operated on by other commands.
4. Options such as CNVLV & ROT that operate on the data in the buffer. In some cases the data is left in the buffer -- in other cases it is sent to the plot package.
5. Options which call the plot package (default). If data is only in the PLT\_SPEC buffer, use the FLAM command to send it to the plotting buffer.

SVE file:

A text file containing options (transparent and hidden) used in the execution of a command.

Default is to write a file ‘command.sve’ (e.g., rd\_mod.sve) containing the options used when a command is executed.

Case is important for the name of the sve file but not for the option.

To execute a previous command, enter .command (e.g., .rd\_mod). Options can be changed by supplying them in () after the sve file name, e.g.,

.rd\_mod(over=t)

NB: rd\_obs, RD\_OBS and RD\_OBS1 are treated as the same option in PLT\_SPEC, but write different sve files with distinct names.

BOX file:

A text file containing an ordered sequence of commands as specfied by .sve files, e.g.,

.rd\_mod

.cnvlv

.norm

Type box=filename to write a .box file containing several .sve files, or simply use a text editor.

Type #filename to read a .box file (e.g., #mybox).

Particularly useful for reading in multiple data sets, and for comparing model sequences with observation.

Typical commands:

A typical series of commands designed to compare the model with an observational data set

is given below:

|  |  |
| --- | --- |
| **RD\_MOD(OVER=T)** | Read model data into PLT\_SPEC buffer. |
| **ROT** | Rotationally broaden buffer spectrum. |
| **CNVLV** | Adjust buffer spectrum for instrumental resolution. |
| **NORM** | Rectify buffer data if comparing with normalized data and send it to the plot package. For non-rectified data, use FLAM. |
| **RD\_OBS\_OPT** | Read in observational data set (\_OPT to create  unique sve file). |
| **RD\_OBS\_UV** | Read in observational data set (\_UV to create  unique sve file). |
|  | Hit enter/return to enter plot package. |

Observational Data Files

These are ASCII files in column format. All lines at the top of the file are ignored until the key FLUX\_UNIT= is found. Additional keywords must follow on consecutive lines, and must contain an =. Only the key FLUX\_UNIT must be present. Available keywords, and their corresponding parameters (not case sensitive) are described below. Subroutine that reads in data is $cmfdist/spec\_plt/subs/rd\_obs\_data\_v2.f.

|  |  |
| --- | --- |
| FLUX\_UNIT | ergs/cm^2/s/Ang  ergs/cm^2/s/Hz  mJy  milli-Jansky  Jansky  Norm (normalized data) |
|  |  |
| WAVE\_UNIT | Angstroms  um  micrometers  Hz |
|  |  |
| AIR\_LAM | True (default if λ > 2000A)  False |
|  |  |
| SCALE\_FACTOR | Factor to scale flux values. |
|  |  |
| DATA\_FORM | HR\_IUE (IUE data format). Single column format. |
|  |  |
| LAM\_ST | Start wavelength (IUE data format only) |
|  |  |
| DEL\_LAM | Increment (IUE data format only). |

Multiple data sets can be included in a single file. These MUST be separated by at least one row

of ‘\*\*\*\*\*\*\*\*\*’. Each data set must also have its own set of keywords that MUST begin with

FLUX\_UNIT=.

Input/output:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NORM | Reads in a spectrum, and divides the present PLOT\_SPEC buffer spectrum by it. The existing model spectrum is not corrupted. Wavelength scales need not be identical.   |  |  | | --- | --- | | FILE | Name of continuum file output by CMF\_FLUX (e.g., obs\_cont). | | [RD\_OBS] | Reads in continuum from file in column format. | | [LIN] | When TRUE, linear interpolation is used. The default is to use monotonic cubic interpolation. | | [WR] | Write data to file. | | [OVER] | When set to T, the normalized spectrum is placed in the buffer (instead of sending to plot package). | | [ADD] | Adds poissonian noise to spectrum. If TRUE, mean continuum counts and wavelength range are requested. | |
| RD\_CONT | Reads in a model continuum spectrum. The data is sent directly to the plotting package unless OVER=.TRUE. This option can be used to read in a continuum. (Similar to option RD\_MOD, but becoming obsolete.)  FILE Name of ascii data file  [WR] Write data to file (logical). Default is FALSE.  [SCALE] Value to multiply data by. |
| RD\_EW | Reads in an EW file. To plot EW as a function of Lambda.   |  |  | | --- | --- | | FILE | Name of ASCII data file created by CMFGEN or CMF\_FLUX. | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| RD\_MOD | Reads in a different model spectrum (as contained in OBSFLUX). The data is sent directly to the plotting package unless OVER=TRUE.   |  |  | | --- | --- | | FILE | Name of model file output by CMFGEN (e.g., OBSFLUX) or. CMF\_FLUX (e.g., obs\_fin). | | [OVER]=T | Reads in a new model spectrum replacing the existing buffer spectrum. No plots are done. | | [SCALE] | Value to normalize the model data by [Logical].(not done if OVER=T) | |
| RD\_OBS | Reads an observation data file, sending it (generally) to the plot buffer. Options can be set to perform simple standard operations   |  |  |  | | --- | --- | --- | | FILE | Name of ASCII data file with observational data. | | | [SCALE] | Value to scale the data. | | | [CLEAN] | When set, data points with zero flux are removed [Logical]. Useful for operating on UV data. Simply averages the neighboring data points. Option could easily be improved. | | [SMOOTH] | Indicates whether data is to be smoothed. Only option  presently available is HAN. If the data is not monotonic (e.g., for overlapping echelle orders) each section is smoothed separately. | | | [CLN\_CR] | When set, cosmic ray spikes are removed. | | | [COLS] | Specify [e.g., (COLS=2,3)] columns containing data. Default is columns 1 & 2. | | | [RAD\_VEL] | Specifies a radial velocity. +ve refers to object moving away. After correction, wavelengths will be smaller. | | | [OVER] | Writes observations into buffer. The observations can then, for example, be reddened, or dereddened (option was formerly TREAT\_AS\_MOD). | | | [WR] | Writes data to file (unit 50). | | |
| RXY | Reads in a simple ASCII file – two column format (X,Y). |

Axis/Unit Options

|  |  |
| --- | --- |
| LX or  LOGX or  LINX | Switches between logarithmic and linear X-AXIS (i.e., do the opposite to current setting. |
| XU  XUNITS | Choices: Hz, um, Ang, AA (air Ang), eV, keV, km/s, mm/s (case not important). |
| LY or  LOGY or  LINY | Switches between logarithmic and linear Y-AXIS (i.e., do the opposite to current setting) |
| YU  YUNITS | Choices:  FLAM <=> ergs/cm^2/s/Ang  FNU <=> Jy  NU\_FNU <=> ergs/cm^2/s |
| HZ\_IN | Switches frequency input units to 1015 Hz (def). |
| KEV\_IN | Switches frequency input units to keV. |
| ANG\_IN | Switches frequency input units to Angstroms. |
|  |  |
| GR | Enter plot package. |
| GRNL | Enter plot package -- no labels are passed. |
| EX | Exit program. |

Spectral options

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| --- | --- |
| BB | Sends a Blackbody spectrum, normalized by the radius or the flux at a particular wavelength, to the plotting package.  OVER: When TRUE, places spectrum in buffer. |
| CUM | Creates the cumulative luminosity as a function of λ, and passes the data to the plot package. |
| CNVLV | Smooths the spectrum using a Gaussian. It is used to apply macroturbulance and instrumental broadening to model data. The smoothing may be carried out either in wavelength space (i.e., with fixed dλ ) or in velocity space (fixed dV). Only one of INST\_RES or RES can be non zero.   |  |  | | --- | --- | | INST\_RES | Resolution in A (dλ). | | RES | Resolution (FWHM): λ/dλ or dV(km/s). | | MIN\_RES | Minimum resolution of model spectrum (km/s) | | FFT | Use FFT for convolution | | WAVE\_MIN | Specify wavelength region | | WAVE\_MAX | Upper wavelength bound | |
| EBMV | Plots A(λ) as a function of X unit.  R\_EXT = A(V)/E(B-V)]  There are 4 interstellar extinction laws available:  Galactic: Clayton, Cardelli, and Mathis (λ > 1000Å)  Galactic: Howarth (1983, MNRAS, 203, 301) (λ > 912Å)  LMC: Howarth (1983, MNRAS, 203, 301)(λ > 912Å)  SMC: Gordon et al. (2003, ApJ, 594, 279) |
| EXT | Extracts a spectrum (from the buffer spectrum) at fixed resolution (RES= λ/dλ). Buffer spectrum is overwritten. Prior to this command it may be necessary to smooth the buffer spectrum to ensure Nyquist sampling theorem is satisfied. |

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| FLAM | Passes data in the buffer to plot program; command control is then passed to the plot package. The type-of-axes are determined by the X and Y-axis options. More than one E(B-V) may be non-zero.   |  |  | | --- | --- | | EBMV\_CCM[0.0] | CCM E(B-V) | | EBMV\_GAL[0.0] | Galactic E(B-V) (Howarth’s law) | | EBMV\_LMC[0.0] | LMC E(B-V | | EBMV\_SMC [0.0 | SMC E(B-V) | | DIST[1.0] | Distance in kpc | | OVER[F] | Over write PLOT\_SPEC buffer. | |
| FNU | Same as FLAM |
| GEN | Combination of RD\_MOD. ROT, ISABS & NORM |
| ISABS | Applies interstellar line absorption (primarily HI and H2) to buffer spectrum. The following parameters are requested:   |  |  | | --- | --- | | T\_IN\_K | Excitation temperature (K). | | V\_TURB | Turbulent velocity (km./s). Used with T\_IN\_K to compute absorption profile. | | LOG\_NTOT | HI column density (cm-2) | | LOG\_H2\_NTOT | H2 column density (cm-2) | | HI\_ABS | Allow for HI absorption (logical) | | H2\_ABS | Allow for H2 absorption (logical) | | V\_R | Radial velocity offset (km/s) | | WAVE\_MIN | Specifies region to be changed | | WAVE\_MAX | “ | | MIN\_ | Minimum model resolution in km/s. | |
| ROT | Rotationally broadens the spectrum. A simple convolution is performed.  Required:   |  |  | | --- | --- | | Vsini | In km/s. | | Eps | Limb-darkening parameter (default is 0.5)  I(μ) = 1 - ε + με | | WAVE\_MIN | Specifies region to be changed | | WAVE\_MAX | “ | | MIN\_RES[1.0] | Minimum model resolution in km/s | | NUM\_RES[5.0] | Number of resolution elements | |
| WRFL | Same as FLAM except data is written to unit 50. |

Miscellaneous Options

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| --- | --- |
| DV | Plots the coefficients for the cubic polynomial used to interpolate the buffer spectrum. |
| FILT | Not working |
| MAG | Outputs approximate magnitudes in various filter systems. |
| ZAN | Outputs Zanstra parameters. For example, the number of photons emitted shortward of the Lyman limit. |