MGB

A code that attacks
spectral classification

v2.0

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1   A quick summary

MGB is an interactive spectral classification code that compares spectra with a grid of standards. It allows the user to move along the two traditional dimensions of spectral classification (spectral subtype and luminosity classification) plus the two additional ones of rotation index and spectral peculiarities. Double-lined spectroscopic binaries can also be fitted using a combination of two standards. The code includes OB2500 v2.0, a standard grid of blue-violet $R \sim 2500$ spectra of O stars from the Galactic O-Star Spectroscopic Survey (GOSSS, Maíz Apellániz et al. 2011), but other grids can be added to MGB.

2   Installing MGB

What do you need to run MGB? Four (or five) things:

- (a) The code itself and (b) its auxiliary files. (a) is distributed as an IDL `.sav` file (`mgb.sav`) and can be placed in any directory included in your `IDL_PATH`. The two auxiliary files are `mgbinit.pro` and `colorjma.tbl`.

- An atlas of standards. This is also an IDL `.sav` file and can be placed in any directory included in your `IDL_PATH` but it is recommended that a special directory within the path is created to avoid confusion. The public GOSSS atlas is called `gosss_atlas_public.sav`.

- A collection of spectra in either FITS or ASCII format. The public GOSSS data are located by default in a subdirectory called `B2500_public` of the directory where the public GOSSS atlas is located.

- A spectral classification file in either FITS or ASCII format to be used as a guess. This is optional but helpful if one wants to go over the same stars on different sessions. For GOSSS, the file can be generated from http://gosc.iaa.es. By default, this file should be located in the directory where IDL is being executed.

- If using the `/PRIVATE` option and a spectral classification file, a selection file is also required (see explanation below). By default, this file should be located in the directory where IDL is being executed.

Too complicated? OK, let's do it in an easier way:

- Create a directory and include it in your `IDL_PATH`.

- Download http://jmaiz.iaa.es/software/mgb/mgb_public.tar.gz, unzip it and expand it in the directory above.

And you should be ready to execute MGB (a) from that directory (b) using the GOSSS public atlas of standards (c) applied to the GOSSS public spectra. All you have to do is follow the instructions in the next section. Once you get the handle of that, you can try adding your own spectra.

3   Executing MGB

A typical MGB execution can be the following:

```
unix shell > idl
IDL Version 7.0, Mac OS X (darwin i386 m32). (c) 2006, Research Systems, Inc.
Installation number: 501126.
Licensed for use by: The Multiverse and other Fantasy Stories Institute of
                     Matalosburros del Monte
```

```
IDL> MGBINIT ; Required before any MGB session!
IDL> MGB ; Default use
IDL> MGB, '10 Lac' ; Classify one star
IDL> MGB, K0=20, WAV_RANGE=[3900,4600] ; Start with 21st star and plot a different range
IDL> MGB, CLAS_FILE='none', FITS_DIR='./input/' ; Classify all files in ./input/
IDL> MGB, COND='st EQ "O9"' ; Stars with (exact) spectral subtype O9
IDL> MGB, COND='STRPOS(st,"O9") NE -1' ; Stars with spectral subtype O9X
IDL> MGB, COND='lc EQ "V"' ; Stars with (exact) luminosity class V
IDL> MGB, COND='STRPOS(qual,"z") NE -1' ; z stars
IDL> MGB, COND='sec NE ""' ; SB2 stars
```

The arguments are the following:

- The first (and only) direct argument is the name of the star to be classified. See below for naming conventions. Wildcards are allowed e.g. 'HD 93*'. Indeed, if no argument is given (e.g., typing just MGB), all files are selected, which is equivalent to typing MGB, '*'. The underscore character (_) is always converted to a blank space.

- PRIVATE (default: 0): This flag should only be used with non-public GOSSS data. See Figure 1 and below for some of the implications.

- ATLAS_FILE (default: gosss_atlas_public.sav; if /PRIVATE is set, gosss_atlas.sav): IDL .sav file with the spectral standard atlas information. It is located in ATLAS_DIR. See below for an example of how to generate it.

- CLAS_FILE (default: spectral_clas_public.fits; if /PRIVATE is set, spectral_clas.fits): File with names and initial spectral classifications. It is located in DATA_DIR. It can be either a FITS or an ASCII table. If it is a FITS table, the columns must be 'stars', 'stv3', 'lcv3', 'qualv3', and 'secv3' for the star names, spectral subtypes, luminosity classes, qualifiers, and secondary spectral types, respectively. If it is an ASCII table, the same five columns must be present in that order separated by vertical bars (|). Additional columns must be present if PRIVATE is set. If it set to none, no file is read and all the files with .fits and .dat extensions are used. See Figure 1.

- ATLAS_DIR (default: not set). By default the ATLAS_FILE file is searched for in the IDL_PATH. Use this argument to force it to be elsewhere.

- FITS_DIR (default: Set by the fits_dird variable found in ATLAS; B2500_public for GOSSS without /PRIVATE, B2500 with it): Directory where the spectra to be analyzed are located.

- DATA_DIR (default: ./): Directory where CLAS_FILE and of SEL_FILE are located. Also, location of the possible outputs.

- K0 (default: 0): Index of star (from 0 to n-1, where n is the number of stars to be classified) to start MGB with.

- COND (default: not used): Alternative way of selecting stars with conditions. The expressions used must follow IDL language rules. see above for examples.

- WAV_RANGE (default: Set by the wav_ranged variable found in ATLAS_FILE; 3975-4940 for GOSSS): Wavelength range (in Å) to plot.

- Y_RANGE (default: Set by the y_ranged variable found in ATLAS_FILE; 0.5-1.5 for GOSSS): Vertical range to plot.

- PLOT_SIZE (default: Set from the screen size): Plot size (in horizontal pixels).

- THICK (default: 1): Plot thickness.

- COLOR (default: 1 ≡ red): Color for standard stars.

- SEL_FILE (default: selected.dat): ASCII table with names, dates, observatories, and resolutions (separated by |). Only used with /PRIVATE. See Figure 1.

- `SIMPLE` (default: not set): Flag to activate simple names (see below).

MGB requires the user to follow certain naming conventions for the files with the spectra, which depend on the type of execution. There are three possible cases:

- Default: `STAR_MODE.fits` or `STAR_MODE.dat`
- `/PRIVATE`: `STAR_DATE_OBS_MODE.fits` or `STAR_DATE_OBS_MODE.dat`
- `/PRIVATE` and `/SIMPLE`: `STAR.fits` or `STAR.dat`

Each part of the name has the following properties:

- `STAR`: Star name. It can include the underscore character but all special characters such as `?`, `[`, and `]` have to be eliminated.
- `MODE`: A letter describing the band and a number with the spectral resolution. Default: `B2500`.
- `DATE`: The observing date in the format YYMMDD.
- `OBS`: An observatory code. Example: `O` for OSN.

Once inside MGB, the user is asked to press a key according to the following mostly self-explaining menu.

```
left:   Decrease spectral subtype
right:  Increase spectral subtype
down:   Increase luminosity class
up:     Decrease luminosity class
Esc:    Quit (press twice)
q:      Next star
a:      Previous star
z:      Shift reference spectrum position
x:      Alternate reference spectrum
c:      Decrease n index (rotation)
v:      Increase n index (rotation)
b:      Assume smaller input R for data
n:      Assume larger input R for data
s:      Secondary spectrum
w:      Secondary spectrum (without rotation)
d:      Screen capture
p:      PostScript + FITS standard output
h:      Help (this key list)
```
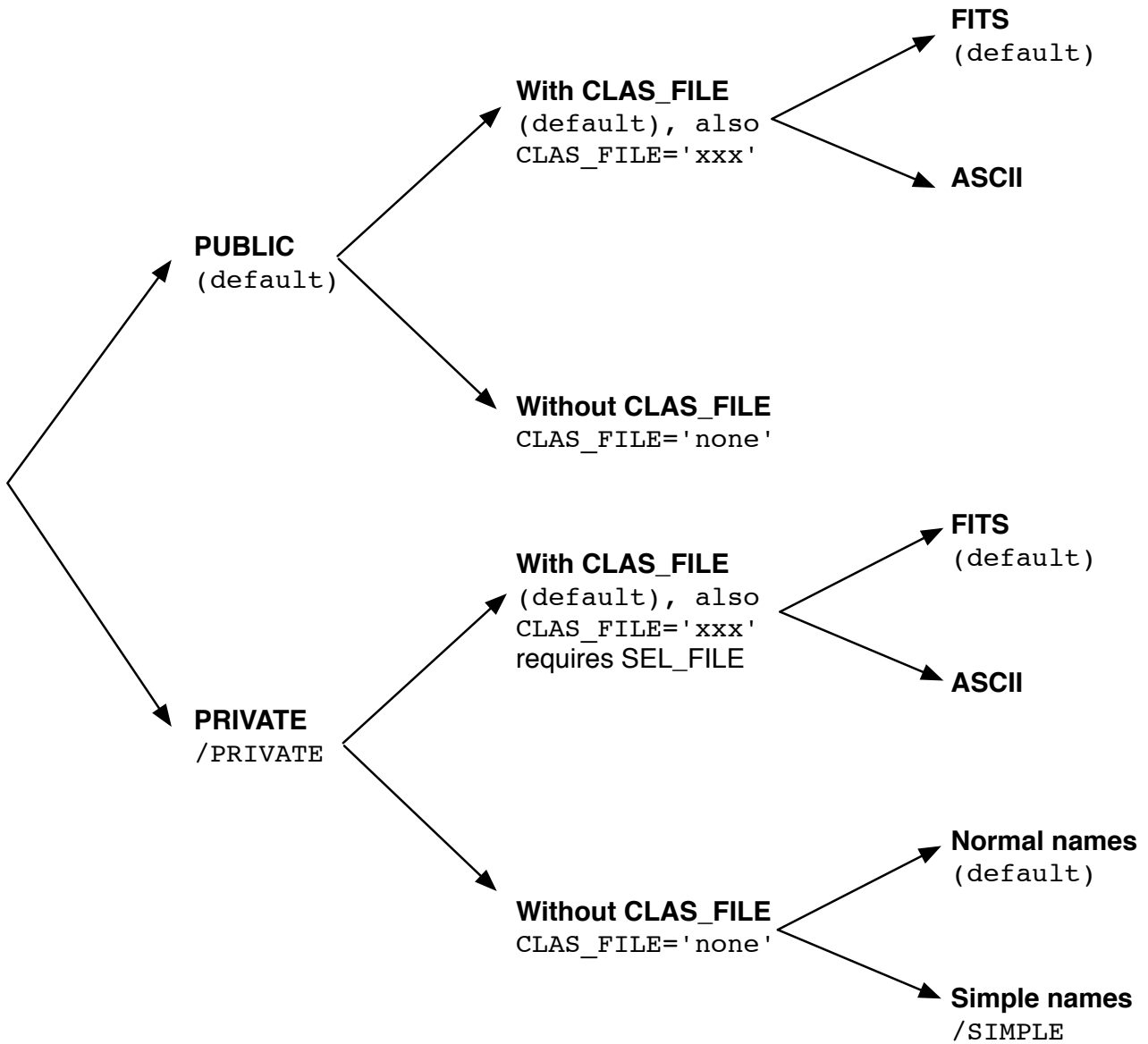
`z` can be used to move up and down the standard spectrum. `x` shifts to an alternate standard with the same spectral type. MGB assumes that the standards and the data have the same spectral resolution. If the data have a higher spectral resolution, `b` and `n` can be used to change it to adapt them to that of the standards. Pressing `s` prompts the user to input additional information: the fraction of flux contained in the secondary, the velocity shifts of the primary and secondary, and the spectral subtype and luminosity class of the secondary.

4   Building your own atlas of standards

Contact me at `jmaiz@cab.inta-csic.es`.

References

- Maíz Apellániz, J. et al. 2011, *Highlights of Spanish Astrophysics VI*, 467.

Figure 1: Decision tree for MGB.