

# CMD 2.5 input form

A web interface dealing with stellar isochrones and their derivatives

**New!** (13mar13) Several photometric systems added.

(07feb13) Format of isochrones in WFC3 wide systems changed.

(26jan13) PARSEC isochrones v1.1 released! with revised diffusion+overshooting at low masses (see [Bressan et al. \(2013\)](#)), increased range of ages at low metallicities, and finer details in the pre-MS phase.

Help

Submit

まず、このページ  
http://stev.oapd.inaf.it/cgi-bin/cmd\_2.5  
へアクセスする。

## Evolutionary tracks

New: PARSEC isochrones from [Bressan et al. \(2012\)](#), with scaled-solar composition and following the  $Y=0.2485+1.78Z$  relation. The solar metal content is  $Z_{\text{sun}}=0.0152$ . They include the pre-main sequence phase.

Note: We are still extending these isochrones. New versions will be released every few weeks.

Warning: for the moment, PARSEC isochrones do not include the TP-AGB. We are working on this.

- PARSEC version 1.1: available for  $0.0001 \leq Z \leq 0.06$  ( $-2.2 \leq [M/H] \leq +0.5$ ), in the range  $0.1 \leq M/M_{\odot} < 12$ . With revised diffusion+overshooting in low-mass stars, and improvements in interpolation scheme.
- PARSEC version 1.0: available for  $0.0005 \leq Z \leq 0.07$  ( $-1.5 \leq [M/H] \leq +0.6$ ), in the range  $0.1 \leq M/M_{\odot} < 12$ .

Mass-loss on RGB using the Reimers formula with  $\eta_{\text{Reimers}} = 0.2$

Warning: mass loss works fine as long as  $\eta_{\text{Reimers}} < 0.5$ . Check the results for higher values.

Previous sets: The following isochrones are available for all  $0.0001 \leq Z \leq 0.03$ , and ages from 0 to 17 Gyr, in the range  $0.15 \leq M/M_{\odot} < 100$ .

- [Marigo et al. \(2008\)](#) with the [Girardi et al. \(2010\)](#) Case A correction for low-mass, low-metallicity AGB tracks
- as above but for Case B
- [Marigo et al. \(2008\)](#) : [Girardi et al. \(2000\)](#) up to early-AGB + detailed TP-AGB from [Marigo & Girardi \(2007\)](#) (for  $M \leq 7M_{\odot}$ ) + [Bertelli et al. \(1994\)](#) (for  $M > 7M_{\odot}$ ) + additional  $Z=0.0001$  and  $Z=0.001$  tracks.
- Basic set of [Girardi et al. \(2002\)](#) : [Girardi et al. \(2000\)](#) + simplified TP-AGB (for  $M \leq 7M_{\odot}$ ) + [Bertelli et al. \(1994\)](#) (for  $M > 7M_{\odot}$ ) + additional  $Z=0.0001$  and  $Z=0.001$  tracks.

## Photometric system

New to CMD v2.2: The original bolometric correction tables from [Girardi et al. \(2002\)](#) are now deprecated because based on old ATLAS9 spectra. For backward compatibility, they are still available in [CMD v2.1](#).

Choose among the available photometric systems: UBVRDHK (cf. [Maiz-Apellaniz 2006](#) + [Bessell 1990](#))

They are briefly described [here](#).

For Carbon stars, you can choose bolometric corrections based either on

- [Loidl et al. \(2001\)](#) (as in [Marigo et al. \(2008\)](#) and [Girardi et al. \(2008\)](#)) OR ON
- [Aringer et al. \(2009\)](#)

## Circumstellar dust

This will only affect stars with significant mass loss, especially the red supergiants, TP-AGB, and upper-RGBs, and only in the case of [Marigo et al. \(2008\)](#) and later tracks. The following choices refer to the RT calculations, which are applied using the scaling relations described in the paper.

Available dust compositions:

	for M stars	for C stars
	<input type="radio"/> No dust	<input type="radio"/> No dust
As in <a href="#">Bressan et al. (1998)</a> :	<input type="radio"/> Silicates	<input type="radio"/> Graphites
As in <a href="#">Groenewegen (2006)</a> :	<input type="radio"/> 100% AlOx	<input type="radio"/> 100% AMC
	<input type="radio"/> 60% Silicate + 40% AlOx	<input type="radio"/> 85% AMC + 15% SiC
	<input type="radio"/> 100% Silicate	

## Interstellar extinction

If  $A_V > 0$ , extinction coefficients will be applied on a star-to-star basis. See [Girardi et al. \(2008\)](#) for details.

Warning: For the moment, interstellar extinction works only for isochrone tables, not for LFs or SSP integrated magnitudes.

Extinction curve: [Cardelli et al. \(1989\)](#) + [O'Donnell \(1994\)](#) with  $R_V=3.1$ .

Total extinction  $A_V = 0.0$  mag.

## Initial mass function

The IMF will be used to compute the stellar occupation along the isochrones, when computing integrated magnitudes, LFs, etc.

IMF for single stars: [Chabrier \(2001\)](#) lognormal

## Ages/metallicities

Choose your age and metallicity values using the approximation  $[M/H] = \log(Z/Z_{\odot})$ , with  $Z_{\odot}=0.019$  for [Marigo et al. \(2008\)](#) and  $Z_{\odot}=0.0152$  for PARSEC ([Bressan et al. 2012](#)) tracks,

Warning: with the latest [Girardi et al. \(2010\)](#) TP-AGB tracks, the maximum age for a reliable

- Single isochrone of  $t = 1.0e9$  yr, and  $Z = 0.019$
- Sequence of isochrones of constant metallicity,  $Z = 0.008$ , from  $\log(t/\text{yr}) = 6.6$  to  $10.13$  at steps of  $\Delta(\log t) = 0.05$
- Sequence of isochrones of constant age,  $t = 12.7e9$ , from  $Z = 0.0001$  to  $0.03$  at steps of  $\Delta Z = 0.0001$

この数値(だけ)を自分で指定する (=変える)。星団が生まれてからの時間 (=星団の年齢)で、単位は年。1.0e9は $10^9$ という意味。3.5e10だと、 $3.5 \times 10^{10}$ のこと。いくつかの年齢について色等級図を作り、観測された (=自分たちの作った)色等級図と比較して、散開星団M67の年齢を推定する。

## Output

Kind of output:

- Isochrone tables  Tag main evolutionary stages.
  - Luminosity functions in the interval from 20 to -20 with bins 0.2 mag wide
  - SSP integrated magnitudes
- gzip the output file (Files above 50 Mby will always be gzipped!)

ここを押して、実行する。

Submit Reset

次のページの画面が現れる。

## CMD 2.5 output

### Results

Your job was submitted on Sat Oct 24 07:10:27 CEST 2015  
 Your job was completed on Sat Oct 24 07:10:29 CEST 2015.  
 The results are available at [output174800402325.dat](#), and will be deleted in 2 h from now.

ここをクリックすると、データのダウンロードが始まる。

Output header:

```
# File generated by CMD 2.5 (http://stev.oapd.inaf.it/cmd) on Sat Oct 24 07:10:27 CEST 2015
# PARSEC isochrones, release v1.1
# Basic reference: Bressan et al. (2012), MNRAS, 427, 127
# Warning: the TP-AGB phase is not included! TP-AGB tracks are in preparation by Marigo et al.
# Photometric system: UBVRIZJK (cf. Maiz-Apellaniz 2006 + Bessell 1990)
# BCs of Carbon stars derive from Loidl et al. (2001, A&A 342, 531)
# O-rich circumstellar dust ignored
# C-rich circumstellar dust ignored
# IMF: Chabrier (2001) lognormal
# On RGB, assumed Reimers mass loss with efficiency eta=0.2
# Kind of output: isochrone tables
```

### Useful system parameters

Filter	U	B	V	R	I	J	H	K
$\lambda_{eff}$ (Å)	3641.89	4460.62	5501.70	6557.09	8036.57	12314.46	16369.53	21937.19
$\alpha_{eff}$ (Å)	640	920	920	1640	1260	2000	2325	3200
$A_i/A_V$	1.54892	1.29719	1.00600	0.81512	0.60329	0.29100	0.18372	0.11471

These values are for a G2V star, using Cardelli et al (1989) + O'Donnell (1994) extinction curve with  $R_V=3.1$ .

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This service is maintained by [Leo Girardi](#) at the [Observatorio Astronomico di Padova](#).  
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