Advanced VOSA
Miriam Cortés
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Spanish Virtual Observatory, Madrid, Spain.
<table>
<thead>
<tr>
<th>object</th>
<th>RA</th>
<th>DEC</th>
<th>dis</th>
<th>Av</th>
<th>filter</th>
<th>flux</th>
<th>error</th>
<th>pntopts</th>
<th>objopts</th>
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<th>dis</th>
<th>Av</th>
<th>filter</th>
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<th>error</th>
<th>pntopts</th>
<th>objopts</th>
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</table>
The role of extinction

<table>
<thead>
<tr>
<th>Object</th>
<th>RA</th>
<th>DEC</th>
<th>D (pc)</th>
<th>Model</th>
<th>$A_V$</th>
<th>$\Delta A_V$</th>
<th>$T_{\text{eff}}$</th>
<th>$\Delta T_{\text{eff}}$</th>
<th>logg</th>
<th>$\Delta \text{logg}$</th>
<th>Meta.</th>
<th>$\Delta \text{Meta.}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD302505</td>
<td>151.33561042</td>
<td>-58.73908361</td>
<td>10</td>
<td>Kurucz</td>
<td>---</td>
<td>---</td>
<td>6250</td>
<td>125</td>
<td>4.00</td>
<td>0.25</td>
<td>-0.50</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Basic data:

**HD 302505 -- Star**

Other object types: * (HD, ALS, ...), I

ICRS coord. ($ep=J2000$):

$151.3356104 -58.$

FK5 coord. ($ep=J2000$ eq=2000):

$10.05 20.547 -58$

FK4 coord. ($ep=B1950$ eq=1950):

$10.03 39.75 -58$

Gal coord. ($ep=J2000$):

$282.7896 -02.5222$

Proper motions mas/yr:

$-6.6 \ 3.6 \ [2.4 \ 2.]$

Spectral type:

B2I 1995A&AS..1

Fluxes (6):

U 9.41 [~] D 200
B 9.90 [~] C ~
V 9.60 [~] C ~
J 8.537 [0.020]
H 8.438 [0.051]
K 8.349 [0.021]

$Av=3$
The role of extinction

I: Av provided by the user

II: Av found in VO services

The main goal here is to set final values both for

- Av (that will be used to deredden the SED)
- the Av range (that, if set, will be used in the model fit as a free parameter).

In order to do this, among other options, this panel allows to query VO services in order to search for estimated extinction properties in the line of sight of the objects coordinates.

Take a look to the corresponding Help Section and Credits Page for more information. See a brief inline help about how using the form.

You can search for extinction properties in VO catalogues if you want.
The role of extinction

First select what VO services you want to search for extinction properties.

- **UBV Photometry of O & B Stars in Vela (Denoyelle 1977)**
  - The Spatial Distribution of Young Stars in Vela
  - Info in catalogue: E(B-V)
  - More info
  - Search radius: [ ] arcsec

- **Optically visible open clusters and Candidates (Dias+ 2002-2010)**
  - New catalog of optically visible open clusters and candidates (V3.0)
  - Info in catalogue: E(B-V)
  - More info
  - Search radius: [ ] arcsec

- **SAI Open Clusters Catalog (Glushikova+, 2009)**
  - Automated search for star clusters in large multiband surveys. II. Discovery and investigation of open clusters in the Galactic plane
  - Info in catalogue: E(B-V)
  - More info
  - Search radius: [ ] arcsec

- **Guarinos, 1992**
  - Interstellar matter in the Galactic Disk (Guarinos, 1992)
  - Info in catalogue: A_v
  - More info
  - Search radius: [ ] arcsec

- **Stellar Spectrophotometric Atlas**
  - Stellar Spectrophotometric Atlas
  - Info in catalogue: A_v
  - More info
  - Search radius: [ ] arcsec

- **Photometric Catalog of Northern Bright Galaxies (Kodaira+ 1992)**
  - Photometric Catalog of Northern Bright Galaxies
  - Info in catalogue: A_v
  - More info
  - Search radius: [ ] arcsec

- **6dF galaxy survey final redshift release (Jones+, 2009)**
  - 6dF galaxy survey final redshift release (Jones+, 2009)
  - Info in catalogue: A_v
  - More info
  - Search radius: [ ] arcsec

- **Reddening and extinction at high galactic latitude (Larson+, 2005)**
  - Reddening and the extinction law at high galactic latitude
  - Info in catalogue: E(B-V)
  - More info
  - Search radius: [ ] arcsec

- **RR Lyrae Metallicities (Layden 1994)**
  - RR Lyrae data II. The Metallicities and Kinematics of Local RR Lyrae
  - Info in catalogue: A_v
  - More info
  - Search radius: [ ] arcsec

- **STELIB: A library of stellar spectra at R~2000 (Le Borgne+, 2003)**
  - STELIB: A library of stellar spectra at R~2000
  - Info in catalogue: A_v
  - More info
  - Search radius: [ ] arcsec
The role of extinction

Add default user values
Here you can give "User" values for those objects where there is not a previous value defined. When you click the 'Add user values' button these values will be saved as user values (Final Av values will not be affected).

- \( R_V \): 
- \( E(B-V) \): 
- \( A_V \): 
- \( A_v \) range: 

Only apply where there is not a previous user value

Add user values

Which values do you trust better?
Here you can set the "Final" value of \( A_v \) for all the objects at the same time. Depending on the choices that you make, the changes will be done for all the objects in the file when you click the "Save values" button.

- Select values by ranking:
  - 1: Morales
  - 2: 

  (Your first option will be chosen for every object if there is a value available. For those objects with no value in the first option, the second option will be chosen, and so on. If you don't mark this, \( A_v \) values will be selected first, then VO values in the same order that they are found, till a value for \( A_v \) can be built).

- Select only \( A_v \) values in catalogues. Do not use \( R_V, E(B-V) \) to build a value for \( A_v \)

- Select \( A_v \) values first if available. Then, if not, \( R_V, E(B-V) \) values to build a value for \( A_v \)

- Select any combination of values that permits that a value for \( A_v \) can be built

Save values

Combine final value/range for \( A_v \)
The main goal here is to set "Final" values both to \( A_v \) and the \( A_v \) range.
If, for some objects, you have set a value for one of the variables but not both, you can use this form to go further.

- Set the final \( A_v \) value based on the final \( A_v \) range (when the range is already set)
  \( A_v = \) [Minimum] * \( A_v \) range

- Set the final \( A_v \) range based on the \( A_v \) final value (when the value is set)
  \( A_v \) range min = [Minimum] * \( A_v \)
  \( A_v \) range max = [Maximum] * \( A_v \)

- Apply even if there is a previous value

Set final values

Object

<table>
<thead>
<tr>
<th>Name</th>
<th>RA (deg)</th>
<th>DEC (deg)</th>
<th>Final Av range</th>
<th>User Av range</th>
<th>VO Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD302505</td>
<td>151.33561042</td>
<td>-58.73908861</td>
<td>2.32</td>
<td>3.0</td>
<td>2.32</td>
</tr>
</tbody>
</table>

- \( \Delta \) (arcsec): 0
- \( R_V \): 151.33561042
- \( E(B-V) \): -58.739089111
- \( A_v \): 2.32
- \( E(B-V) \): 0.7226
- \( A_v \): 2.32

Source
- Extinction map, Morales+, 2006
- The Rv extinction factor, Morales+, 2005
The role of extinction

III: $A_v$ as a free parameter

$HD302505 \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad \cdots \quad A_v:0.0/3.0$

**WARNING**

$A_v / \text{Teff}$ degeneracy.
we find that diskless stars (i.e., stellar photospheres) can be characterized by < 2.56". 
Reddening: Refinement

\[
\frac{F_{obs} - F_{mod}}{\Delta F_{obs}} > 3
\]

\[
\frac{F_{obs} - F_{mod}}{F_{mod}} > 0.2
\]
# Reddening: Refinement

## Model fit

**Best fit results**

Click in the object name to see the best fits for that object.

Showing objects 1 to 20. Use pagination options if you wish.

### Find object: obj1  Show: 20  objects per page

<table>
<thead>
<tr>
<th>Object</th>
<th>RA</th>
<th>DEC</th>
<th>D (pc)</th>
<th>Model</th>
<th>(A_v)</th>
<th>(T_{\text{eff}})</th>
<th>logg</th>
<th>Meta.</th>
<th>more</th>
<th>(\chi^2)</th>
<th>(M_d)</th>
<th>(F_{\text{obs}}/F_{\text{tot}})</th>
<th>(L_{\text{bol}}/L_{\text{sun}})</th>
<th>(\Delta L_{\text{bol}}/L_{\text{sun}})</th>
<th>(N_{\text{fit}}/N_{\text{tot}})</th>
<th>Data VOTables</th>
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<tbody>
<tr>
<td>obj1</td>
<td>117.590198605</td>
<td>41.5662259062</td>
<td>10</td>
<td>BT-Settl CIFIST</td>
<td>2900</td>
<td>5.5</td>
<td>0</td>
<td>---</td>
<td>---</td>
<td>1.521e+1</td>
<td>1.029e-21</td>
<td>0.49</td>
<td>1.311e-5</td>
<td>1.353e-6</td>
<td>8/13</td>
<td>Syn.Spec.</td>
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<tr>
<td>obj10</td>
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<td>BT-Settl CIFIST</td>
<td>3100</td>
<td>5.5</td>
<td>0</td>
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<td>---</td>
<td>2.217e+1</td>
<td>2.498e-22</td>
<td>0.53</td>
<td>4.082e-6</td>
<td>6.100e-7</td>
<td>9/13</td>
<td>Syn.Spec.</td>
</tr>
</tbody>
</table>

Click here to configure what fields to show.
Model fit: Include upper limits

GRAMS (Grid of Red supergiant and Asymptotic giant ModelS) is a grid of radiative transfer (RT) models for dust shells around red supergiant (RSG) and asymptotic giant branch (AGB) stars. This is the model grid for Carbon-rich stars. Note that no IR excess is considered when fitting with these models.

Options for this fit
- Include model spectrum in fit plots? (The fit process will be slower, because getting the spectra from the VO can take some time)
- Estimate fit parameter uncertainties using a statistical approach, performing a 100 iteration monte carlo simulation (The fit process will be slower)
- Use chi2 instead of the reduced chi2.
- Do not use upper limits in the fit.

\[
\begin{align*}
F_{\text{lx}} &= 0 \\
\Delta F_{\text{lx}} &= F_{\text{uplim}}
\end{align*}
\]
Then we assign a relative probability for each model as:

\[ W_i = \exp(-\chi^2_i/2) \]

Using this, the probability corresponding to a given parameter value \( \alpha_j \) is given by:

\[ P(\alpha_j) = \sum_i W_i \]

where the sum is performed over all the models with that value for that parameter.

We finally normalize these probabilities, for each parameter, dividing by the total probability (the sum of the probilities obtained for each value).

\[ P'(\alpha_j) = \frac{P(\alpha_j)}{\sum_i P(\alpha_i)} \]
**Statistics**

<table>
<thead>
<tr>
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<th>Value distribution</th>
</tr>
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<tbody>
<tr>
<td>$T_{\text{eff}}$</td>
<td>$\Delta T_{\text{eff}}$</td>
</tr>
<tr>
<td>3000</td>
<td>50</td>
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<tr>
<td>3100</td>
<td>50</td>
</tr>
<tr>
<td>3200</td>
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<tr>
<td>3700</td>
<td>50</td>
</tr>
<tr>
<td>3800</td>
<td>50</td>
</tr>
</tbody>
</table>

**Values**

- Average: 3363.54
- Std. Dev (σ): 185.313
- Mode: 3400/3500
- Median: 3322.22
- Skewness: 0.0140213
- Kurtosis: 2.18994
- $\mu_2$: 34341
- $\mu_3$: 89229.3
- $\mu_4$: 2.58261e+9
- Q1: 3162.5
- Q2: 3322.22
- Q3: 3455.56
- 68%CL-Min: 3108.5
- 68%CL-Max: 3505.82
- 96%CL-Min: 3000
- 96%CL-Max: 3677
- Norm_min: 0.75
- Norm_max: 0.9
VOSA for galaxies

This option allows you to estimate some physical properties (such as effective temperature, surface gravity and luminosity) for each object comparing its SED with those derived from theoretical spectra obtained from VO services.

Take a look to the corresponding Help Section and Credits Page for more information.

First select the models that you want to use for the fit

- POPSTAR with Chabrier IMF
  PopStar Evolutionary synthesis models. Using IMF from Chabrier (2003). This grid of Single Stellar Populations covers a wide range in both, age and metallicity. The models use the most recent evolutionary tracks together with the use of new NLTE atmosphere models.

- POPSTAR with Kroupa IMF
  PopStar Evolutionary synthesis models. Using IMF from Kroupa (2002). This grid of Single Stellar Populations covers a wide range in both, age and metallicity. The models use the most recent evolutionary tracks together with the use of new NLTE atmosphere models.

- POPSTAR with Salpeter IMF (1)
  PopStar Evolutionary synthesis models. Using IMF from Salpeter (1955) with m = (0.15-100)M sun. This grid of Single Stellar Populations covers a wide range in both, age and metallicity. The models use the most recent evolutionary tracks together with the use of new NLTE atmosphere models.

- POPSTAR with Ferrini IMF
  PopStar Evolutionary synthesis models. Using IMF from Ferrini, Penco, Palla (1999). This grid of Single Stellar Populations covers a wide range in both, age and metallicity. The models use the most recent evolutionary tracks together with the use of new NLTE atmosphere models.

- POPSTAR with Salpeter IMF (2)
  PopStar Evolutionary synthesis models. Using IMF from Salpeter (1955) with m = (0.15-100) M sun. This grid of Single Stellar Populations covers a wide range in both, age and metallicity. The models use the most recent evolutionary tracks together with the use of new NLTE atmosphere models.