

# Theoretical data in the VO

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# What is the VO?

- An international effort in astrophysics for:
  - **Standardization**
    - common data formats (VOTable, Data Models,...)  
(how the data are represented, written...)
  - **Interoperability**
    - common protocols (SIAP, SSAP, TSAP...)  
(how to make questions and how to answer them)

# Theoretical Models in VO

- **Final aim:** Full interoperability between observational and theoretical data.
- Efficiency
  - easier and faster to **compare models** with observations and with other models.
  - easier characterization
- Visibility
  - More people will have an **easier access** to the models.
  - The models will, eventually, be **more used** and referenced.

# A case study: Kurucz and Nextgen models

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## ATLAS VERSUS NEXTGEN MODEL ATMOSPHERES: A COMBINED ANALYSIS OF SYNTHETIC SPECTRAL ENERGY DISTRIBUTIONS

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<sup>2</sup> See <http://kurucz.harvard.edu>.

<sup>3</sup> See <ftp://calvin.physast.uga.edu/pub/> and <http://dilbert.physast.uga.edu/~yeti>. Note that the libraries of dwarf and giant stars available at these sites have lower  $T_{\text{eff}}$  limits than the published ones.

# Obtaining Kurucz models

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Fax 617-495-7049

Email [RKURUCZ@CFA.HARVARD.EDU](mailto:RKURUCZ@CFA.HARVARD.EDU)

This is a combined Web/outgoing-FTP site, [KURUCZ.HARVARD.EDU](http://KURUCZ.HARVARD.EDU) or [CFAKUS.CFA.HARVARD.EDU](http://CFAKUS.CFA.HARVARD.EDU). It provides up-to-date public access to my data and programs. These are the same programs and files that I use in my research. Many bugs and problems have been corrected but there are still many more errors remaining to be found. Programs and data that I would not use myself because they are still under development are not on this computer. Many of the files are large and are also available on CDs or DVDs, and I am willing to write DVDs on demand. Some files taken from Kurucz CD-ROMs 1-26 are given for historical checks although many have been replaced by new versions. Binary versions will eventually be replaced by (much larger) ASCII versions. I am willing to rewrite them in ASCII on demand. Neither the programs nor data are "black boxes". You should not be using them if you do not have some understanding of the physics and of the programming in the source code.

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# Obtaining Kurucz models

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Logical name  
[GRIDM01](#)  
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[GRIDM050DFNEW](#)  
[GRIDM05AODFNEW](#)  
[GRIDM05NOVER](#)  
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[GRIDM10AODFNEW](#)  
[GRIDM10HE50](#)  
[GRIDM10NOVER](#)  
[GRIDM10ODFNEW](#)  
[GRIDM15](#)  
[GRIDM15NOVER](#)  
[GRIDM15ODFNEW](#)  
[GRIDM15ANOVER](#)  
[GRIDM15AODFNEW](#)  
[GRIDM20](#)  
[GRIDM20NOVER](#)  
[GRIDM20ODFNEW](#)  
[GRIDM20ANOVER](#)  
[GRIDM20AODFNEW](#)  
[GRIDM25](#)  
[GRIDM25NOVER](#)  
[GRIDM25ODFNEW](#)  
[GRIDM25ANOVER](#)  
[GRIDM25AODFNEW](#)  
[GRIDM30](#)  
[GRIDM35](#)  
[GRIDM40](#)

<a href="#">ddop00k2.red13</a>	13-Aug-2009	11:40	623K
<a href="#">ddop00k4.dat19</a>	13-Aug-2009	11:40	55K
<a href="#">ddop00k4.red</a>	13-Aug-2009	11:40	709K
<a href="#">ddop00k8.dat19</a>	13-Aug-2009	11:40	54K
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<a href="#">ddosun.dat13</a>	13-Aug-2009	11:40	240
<a href="#">ddosun.red13</a>	13-Aug-2009	11:40	1.6K
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<a href="#">fp00k1.pck</a>	13-Aug-2009	11:40	12M
<a href="#">fp00k1.pck19</a>	13-Aug-2009	11:40	11M
<a href="#">fp00k2.pck</a>	13-Aug-2009	11:40	9.8M
<a href="#">fp00k2.pck13</a>	13-Aug-2009	11:40	9.7M
<a href="#">fp00k2.pck19</a>	13-Aug-2009	11:40	11M
<a href="#">fp00k4.pck</a>	13-Aug-2009	11:40	11M
<a href="#">fp00k4.pck19</a>	13-Aug-2009	11:40	11M
<a href="#">fp00k8.pck</a>	13-Aug-2009	11:40	11M
<a href="#">fp00k8.pck19</a>	13-Aug-2009	11:40	11M
<a href="#">fsun.pck13</a>	13-Aug-2009	11:40	37K
<a href="#">fsun.pck19</a>	13-Aug-2009	11:40	37K

<sup>1</sup> Available via anonymous FTP from <ftp://calvin.physast.uga.edu/pub/> NextGen or via the WWW URL <http://dilbert.physast.uga.edu/~yeti>.



## Servidor no encontrado

Firefox no puede encontrar el servidor en [dilbert.physast.uga.edu](http://dilbert.physast.uga.edu).

- Compruebe que no ha cometido errores al escribir la dirección, como **www**.example.com en lugar de **www**.example.com
- Si no puede cargar ninguna página, compruebe la conexión de red de su ordenador.
- Si su ordenador o su red están protegidos por un cortafuegos o un proxy, cerciórese de que se le permite acceder a la Web con Firefox.

Reintentar

# Kurucz: data characterization

```
SDSC GRID [+0.0] VTURB 2.0 KM/S L/H 1.25
PROGRAM READFLUX
C SAMPLE PROGRAM READS THIS FILE ON UNIT 1
  DIMENSION Hnu(1221),HnuCONT(1221),WAVE(1221)
  CHARACTER*80 TITLE
  DO 11 ISKIP=1,22
11 READ(1,1)
C   wavelength in nm
  READ(1,1)WAVE
  1 FORMAT(10F10.2)
  DO 8 MODEL=1,500
C   ergs/cm**2/s/hz/ster
  READ(1,2,END=9)TITLE
  2 FORMAT(A80)
  PRINT 3,MODEL,TITLE
  3 FORMAT(15,1X,A80)
  READ(1,4)Hnu
  READ(1,4)HnuCONT
  4 FORMAT(8E10.4)
  8 CONTINUE
  9 CALL EXIT
  END
  9.09      9.35      9.61      9.77      9.96      10.20      10.38      10.56
10.77      11.04      11.40      11.78      12.13      12.48      12.71      12.84
13.05      13.24      13.39      13.66      13.98      14.33      14.72      15.10
15.52      15.88      16.20      16.60      17.03      17.34      17.68      18.02
18.17      18.61      19.10      19.39      19.84      20.18      20.50      21.05
21.62      21.98      22.30      22.68      23.00      23.40      24.00      24.65
```



## Same problems as the observational data.

- Where are they? → [Registries](#)
- Data format (ASCII, FITS, ...) → [VOTables](#)
- Data characterisation → [Data Models](#)
- Data Access
  - VO protocols (ConeSearch, SIAP, SSAP, ...) are built around coordinates
    - <http://.../ssap.jsp?POS=336.5228,-48.43854&SIZE=0.2>
    - NOT VALID FOR THEORETICAL OBJECTS
  - A theoretical model is defined by a set of parameters and the allowed values for each of them.
  - Those parameters and values are not the same for different models.

# Theoretical spectra in the VO.

- **SSAP/TSAP**: Protocol to access theoretical spectra jointly developed by SVO & ESAVO.
  - Dialog Server-Application

# Theoretical spectra in the VO.

VOSpec

File Edit View Operations Plastic SAMP Help

Target vega Ra 79.23473500 Dec 38.78369194 Size 1 Query

Wave Unit Log  
micron

Flux Unit  
Jy

RedShift 0.00

De-reddening

$\lambda V$  0.00

Graphic Mode

Spectra List

RETRIEVE Unmark All Reset

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# Theoretical spectra in the VO.

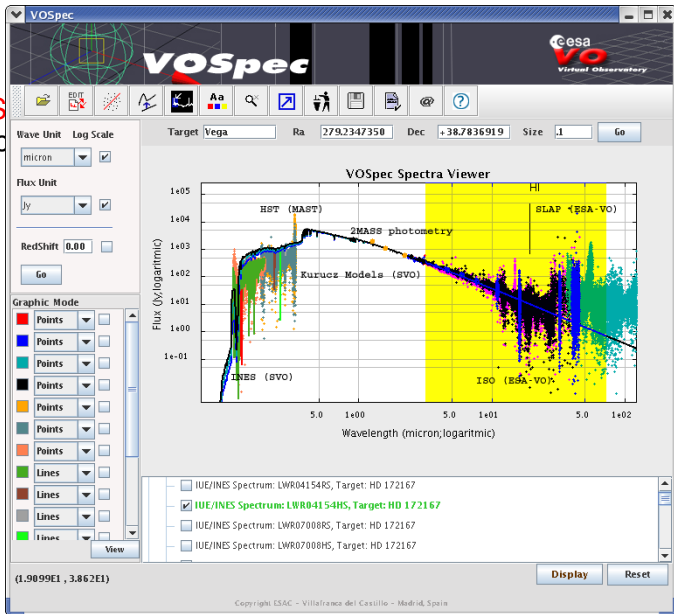
The screenshot displays the VOSpec interface with two main windows open:

- Server Selector:** A tree view under "SSA Services" with "Theoretical Spectra Services" expanded. The "Kurucz ODFNEW /NOVER models" checkbox is checked. Below the tree is a "Query Outlook" section with "Refresh", "Add SSA/TSA", and "Select All SSA" buttons, and a URL field containing <http://www.iaeff.inta.es/projects/virtualobservatory@2vo2.htm>.
- Query by params:** A tree view showing a query structure:
  - QUERY
    - Simple Query
      - TARGET\_NAME vege
      - PDS 279.234735,38.78369194
      - SIZE 1
    - Advanced Query
      - Service Specific Query
        - Kurucz ODFNEW /NOVER models
          - teff\_min 3500
          - teff\_max 3500
          - logg\_min 0.00
          - logg\_max 0.00
          - meta\_min -2.50
          - meta\_max -2.50

Below the query tree is an "Insert Param Value" section with a "Text Param" input field and an "Add" button. At the bottom of this window are "Query" and "Reset" buttons.


The main interface includes a "Query" button, a "Spectra List" section with a "View" button, and "RETRIEVE", "Unmark All", and "Reset" buttons at the bottom. The footer contains the text: "Copyright ESAC - Villafraanca del Castillo - Madrid, Spain".



# Theoretical spectra in the VO.



# Theoretical spectra in the VO.

Theoretical model services Documents **Models** Services

 **Theoretical spectra**  
Available theoretical spectra models

Funded by  

Models: **Spectra** Isochrones Astroseismology Email:  Pass:  Login Register

## Theoretical Models Web Server

- ▶ **Dalessio disk models:**  
Models of irradiated accretion disks around pre-main sequence stars by D'Alessio et al. (1998,1999,2001).
- ▶ **Coelho Synthetic stellar library:**  
Synthetic stellar library by P. Coelho, fully described in Coelho et al. (2005) (*Astron.and.Astroph., in press*)
- ▶ **Allard, NextGen:**  
The NextGen Model grid of theoretical spectra; Hauschildt, P.H., Allard, F., Baron, E., Schweitzer, A., ApJ 312, 377, 1999
- ▶ **Allard, COND 2000:**  
The COND00 Model grid of theoretical spectra. (*Chabrier et al. 2000, ApJ, 542,464*)
- ▶ **Allard, DUSTY 2000:**  
The DUSTY00 Model grid of theoretical spectra (*Allard et al. 2001, ApJ, 556, 357*)
- ▶ **Kurucz ODFNEW /NOVER models:**  
ODFNEW /NOVER models. Newly computed ODFs with better opacities and better abundances have been used. (*The convective treatment is described in Castelli et al. 1997, AA 318, 841*)

# S3: a more general approach for theoretical data.

- Servers for isochrones and evolutionary tracks.
  - NextGen, COND, DUSTY, Siess (SVO)
  - BaSTI (IVO)

# S3: a more general approach for theoretical data.

Sessions	Files	Coordinates	VO Phot.	Objects	Model Fit	Template fit	HR Diag.	Save Results	Help	Logout
Stars and brown dwarfs			Session: (info) (Change)				File: Lori (info) (Change)			

## HR Diagram

This option allows you to estimate values for the age and the mass of the objects. In order to do that, the ( $T_{\text{eff}}, \log(L)$ ) values obtained from the fitting are used as starting points for interpolating collections of theoretical isochrones and evolutionary tracks obtained from the VO. Then, a HR diagram is displayed showing the data points, isochrones and evolutionary tracks.

Take a look to the corresponding [Help Section](#) and [Credits Page](#) for more information.

### Choose the parameter ranges that you want to use for the diagram

#### NextGen Isochrones

*Theoretical Evolutionary Tracks from Baraffe, Chabrier, Allard, Hauschildt, 1998, A&A, 337, 403 "Evolutionary models for solar metallicity low-mass stars: mass-magnitude relationships and color-magnitude diagrams" and Baraffe, Chabrier, Allard, Hauschildt, 2001, A&A, accepted "Evolutionary models for low-mass stars and brown dwarfs: uncertainties and limits at very young ages"*

**t:**  -  (Min/Max value for the age of the star. Ages are given in Gyr)

#### NextGen Evolutionary Tracks

*Theoretical Evolutionary Tracks from Baraffe, Chabrier, Allard, Hauschildt, 1998, A&A, 337, 403 "Evolutionary models for solar metallicity low-mass stars: mass-magnitude relationships and color-magnitude diagrams" and Baraffe, Chabrier, Allard, Hauschildt, 2001, A&A, accepted "Evolutionary models for low-mass stars and brown dwarfs: uncertainties and limits at very young ages"*

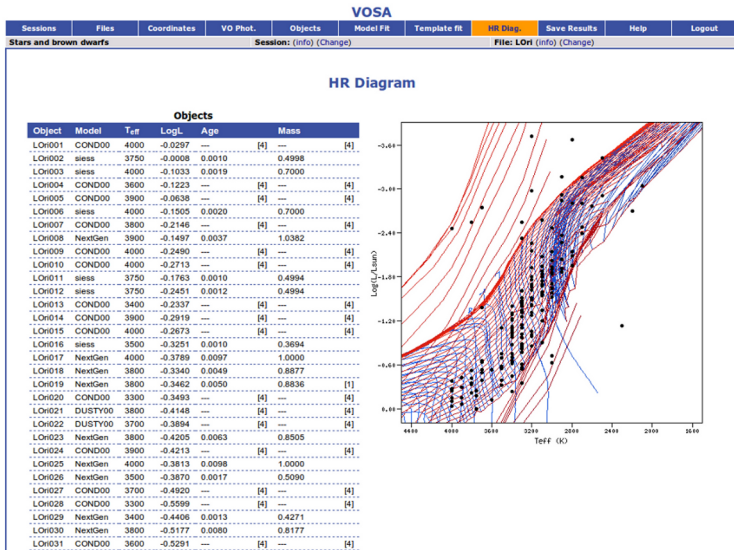
**m:**  -  (Min/Max value for the mass of the star. Masses are given in  $M_{\text{sun}}$ )

#### DUSTY99 Isochrones

*Theoretical Evolutionary Tracks from Chabrier, Baraffe, Allard, Hauschildt, 2000, ApJ, 542, 464 "Evolutionary models for very-low-mass stars and brown dwarfs with dusty atmospheres" and Baraffe, Chabrier, Allard, Hauschildt, 2002, A&A, 382, 563 "Evolutionary*



# S3: a more general approach for theoretical data.

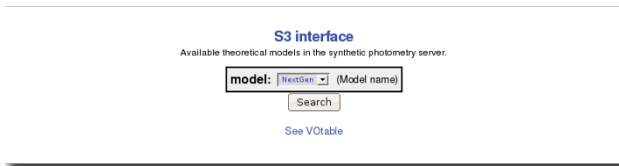


# S3: a more general approach for theoretical data.

- Synthetic photometry for different models:
  - NextGen, COND, DUSTY, Kurucz...

# S3: a more general approach for theoretical data.

- Synthetic photometry for different models:
  - NextGen, COND, DUSTY, Kurucz...



**S3 interface**  
Available theoretical models in the synthetic photometry server.

model:  (Model name)

[See VOTable](#)

# S3: a more general approach for theoretical data.

- Synthetic photometry for different models:
  - NextGen, COND, DUSTY, Kurucz...

**S3 interface**  
ODFNEW /NOVER models. Newly computed ODFs with better opacities and better abundances have been used.

<b>teff:</b>	<input type="text" value="5000"/> - <input type="text" value="6000"/>	(value for the effective temperature for the model. Temperatures are given in K)
<b>logg:</b>	<input type="text" value="1.00"/> - <input type="text" value="2.00"/>	(value for Log(G) for the model.)
<b>meta:</b>	<input type="text" value="0.00"/> - <input type="text" value="0.20"/>	(value for the Metallicity for the model.)
<b>UFI:</b>	<input type="text" value="SDSS_G"/> <input type="text" value="SDSS_I"/> <input type="text" value="SDSS_R"/> <input type="text" value="SDSS_U"/>	(Available filters)

[See VOTable](#)

# S3: a more general approach for theoretical data.

- Synthetic photometry for different models:
  - NextGen, COND, DUSTY, Kurucz...

## S3 interface

Synthetic photometry for Kurucz ODFNEW /NOVER models. Newly computed ODFs with better opacities and better abundances have been used.

teff	logg	meta	UFI	phot
5000	1.00	0.00	SDSS_R	1.39734087217e-13
5000	1.50	0.00	SDSS_R	1.38714034883e-13
5000	2.00	0.00	SDSS_R	1.37719326443e-13
5250	1.00	0.00	SDSS_R	1.7696765093e-13
5250	1.50	0.00	SDSS_R	1.75586497773e-13
5250	2.00	0.00	SDSS_R	1.74290347396e-13
5500	1.00	0.00	SDSS_R	2.19029620013e-13
5500	1.50	0.00	SDSS_R	2.17163839636e-13
5500	2.00	0.00	SDSS_R	2.15413488457e-13
5750	1.00	0.00	SDSS_R	2.66023807988e-13
5750	1.50	0.00	SDSS_R	2.63624783206e-13
5750	2.00	0.00	SDSS_R	2.61345124187e-13
6000	1.00	0.00	SDSS_R	3.17930670692e-13
6000	1.50	0.00	SDSS_R	3.15149711273e-13
6000	2.00	0.00	SDSS_R	3.1237641431e-13

See VOTable

## Granada Stellar Seismic Models

Granada Stellar Seismic Models (GSSM-VO) adapts the Granada Team numerical package outputs to be used in VO in order to perform on-line stellar seismology. This package contains the evolutionary codes [CESAM](#) and [CESAM2K](#) and two oscillation codes: [GraCo](#) and [FILOU](#)

Please, select one evolution code

Evolutionary code

CESAM2k evolutionary code  
CESAM evolutionary code  
CESAM2k evolutionary code

Continue

### References:

- [CESAM evolutionary code](#)
- [CESAM2k evolutionary code](#)

## Granada Stellar Seismic Models

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### CESAM2k evolutionary code

Please, select an oscillation code or 'None' if you only want to access the structure information

Oscillation code

#### References:

- \* [CESAM2k evolutionary code](#)
- \* [GraCo oscillation code](#)

# S3: asteroseismology

- Please, select a range for each parameter that you want to use in the search and then click the "Search" button to retrieve a list of the available files.
- Take into account that some combinations of values could correspond to no result.

Structure search parameters				Sismology search parameters			
(?)	<b>T<sub>eff</sub></b>	4000	- 5000 (K)	(?)	<b>F0</b>		- (μHz)
(?)	<b>Lum</b>		- (L <sub>sun</sub> )	(?)	<b>F1</b>		- (μHz)
(?)	<b>Log(g)</b>		-	(?)	<b>F0/F1</b>		-
(?)	<b>Density</b>		- (g/cm <sup>3</sup> )	(?)	<b>Δ(v)</b>	20	- 25 (μHz)
(?)	<b>Age</b>		- (Myr)	(?)	<b>δ(v)</b>		- (μHz)
(?)	<b>[Fe/H]</b>		-	(?)	<b>ν</b>		- (μHz)
(?)	<b>Z</b>		-	(?)	<b>l</b>		-
(?)	<b>Hcent</b>		-	(?)	<b>n</b>		-
(?)	<b>R<sub>*</sub></b>		- (R <sub>sun</sub> )	(?)	<b>Sta.</b>	all modes	
(?)	<b>Mass</b>		- (M <sub>sun</sub> )	(?)	<b>VSta</b>		- (μHz)
(?)	<b>Vrot</b>		- cm/s				
(?)	<b>Wrot</b>		- rad/s				
(?)	<b>Trot</b>		- sec				
(?)	<b>α<sub>MLT</sub></b>		-				
(?)	<b>Over.</b>		-				

**Search** **Reset**

#### References:

- CESAM2k evolutionary code
- GraCo oscillation code



# S3: asteroseismology

## Granada Stellar Seismic Models

Granada Stellar Seismic Models (GSSM-VO) adapts the Granada Team numerical package outputs to be used in VO in order to perform on-line stellar seismology. This package contains the evolutionary codes [CESAM](#) and [CESAM2K](#) and two oscillation codes: [GraCo](#) and [FILOU](#)

### CESAM2k evolutionary code

1939 results have been found for your search criteria.

#### Summary table

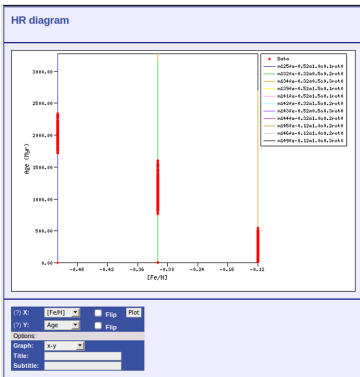
[Show Results](#) [HR diag](#) [New Search](#)

	$T_{\text{eff}}$	Lum	Log(g)	Density	Age	[Fe/H]	Z	Hcent	R $\cdot$	Mass	Vrot	Wrot	Trot	$\alpha_{\text{MLT}}$	Over.
Min	7355.0000	4.5114	4.2506	0.6605	0	-0.5200	0.0055	0.7221	1.2901	1.2502	0	0	0	0.5000	0.1000
Max	7504.9000	5.3293	4.3585	0.9057	2345.9000	-0.1200	0.0134	0.7473	1.3899	1.4902				1.5000	0.3000

#### References:

- \* [CESAM2k evolutionary code](#)

# S3: asteroseismology



## Stellar Seismic Models

Granada Team numerical package outputs to be used in VO in order to perform evolutionary codes [CESAM](#) and [CESAM2K](#) and two oscillation codes: [GraCo](#) and [FILOU](#)

## CESAM2k evolutionary code

have been found for your search criteria.

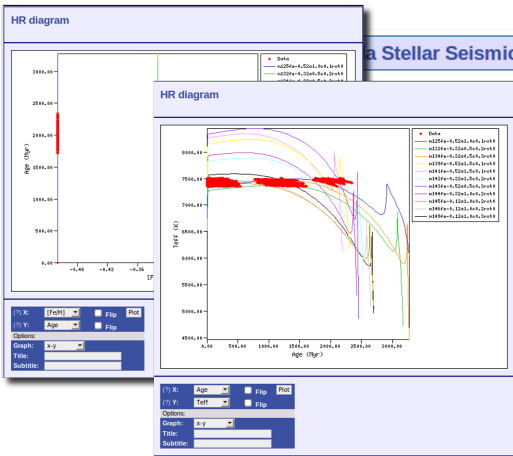
## Summary table

View Results	HR diag	New Search	[Fe/H]	Z	Hcent	R <sub>*</sub>	Mass	Vrot	Wrot	Trot	$\alpha_{MLT}$	Over.
			-0.5200	0.0055	0.7221	1.2901	1.2502	0	0	0	0.5000	0.1000
			-0.1200	0.0134	0.7473	1.3899	1.4902				1.5000	0.3000

## References:

- \* [CESAM2k evolutionary code](#)

# S3: asteroseismology



## Stellar Seismic Models

Package outputs to be used in VO in order to perform  
and CESAM2K and two oscillation codes: GraCo and FILOU

code

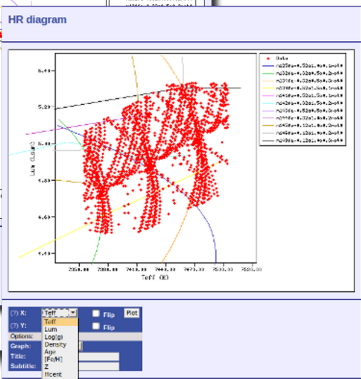
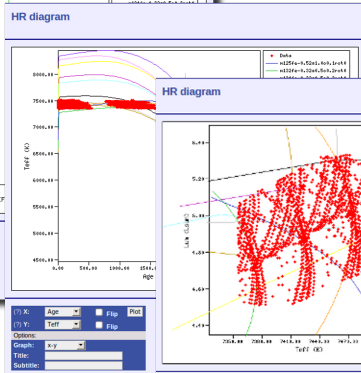
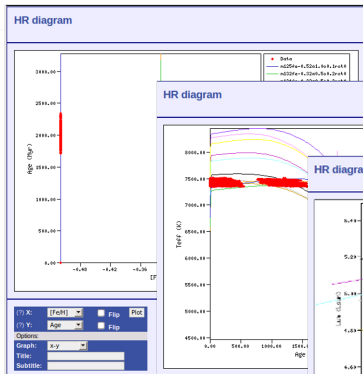
search criteria.

search

	R.	Mass	Vrot	Wrot	Trot	$\alpha_{MLT}$	Over.
1	1.2901	1.2502	0	0	0	0.5000	0.1000
3	1.3899	1.4902				1.5000	0.3000

side

# S3: asteroseismology



## Stellar Seismic Models

Package outputs to be used in VO in order to perform  
and CESAM2K and two oscillation codes: GraCo and FILOU

Wrot	Trot	$\alpha_{MLT}$	Over.
0	0	0.5000	0.1000
		1.5000	0.3000

# S3: asteroseismology

## Results table

[Summary](#) [New Search](#) [Restart](#)

### Values common to all shown results

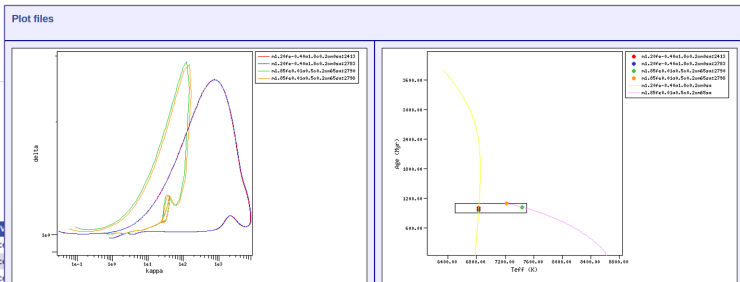
[Fe/H]	Z	Vrot	Wrot	Trot	$\rho_{MLT}$	Over.
0.0800	0.0206	0	0	0	0.5000	0.3000

Page: [1](#) [2](#) [3](#) [4](#) [Next Results](#)

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Plot	VOT	Txt	VOT	Txt	Track	Field	$T_{\text{eff}}$	Lum	Log(g)	Density	Age	Hcent	R+	Mass	F0	F1	F0/F1	$\Delta(v)$	$\delta(v)$		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0292	4986.7000	3.8788	3.6908	0.0955	5261.3000	0.0033	2.6433	1.2502	87.3310	115.2400	0.7578	22.4010	-37.1810
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0291	4957.1000	3.8078	3.6885	0.0948	5258.6000	0.0042	2.6503	1.2502	86.4820	114.4000	0.7559	22.4240	-36.1970
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0290	4937.7000	3.7608	3.6871	0.0943	5256.4000	0.0049	2.6546	1.2502	85.9140	113.9000	0.7543	22.0370	-36.9380
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0289	4924.1000	3.7276	3.6862	0.0940	5254.6000	0.0055	2.6575	1.2502	85.5050	113.5400	0.7531	22.6830	-35.8050
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0288	4914.2000	3.7033	3.6855	0.0938	5253.0000	0.0060	2.6595	1.2502	85.2120	113.3100	0.7520	23.4070	-34.5530
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0287	4906.7000	3.6849	3.6850	0.0936	5251.8000	0.0064	2.6610	1.2502	84.9840	113.1300	0.7512	22.8640	-35.5080
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0286	4901.0000	3.6708	3.6847	0.0935	5250.7000	0.0067	2.6622	1.2502	84.7990	112.9800	0.7506	23.0220	-35.3060
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0285	4896.4000	3.6597	3.6843	0.0934	5249.8000	0.0070	2.6631	1.2502	84.6550	112.8700	0.7500	23.2040	-35.1530
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0284	4892.7000	3.6509	3.6841	0.0933	5249.0000	0.0072	2.6639	1.2502	84.5410	112.7800	0.7496	23.4410	-35.0020
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0283	4889.7000	3.6435	3.6839	0.0933	5248.4000	0.0074	2.6644	1.2502	84.4550	112.7300	0.7492	23.2930	-34.9090
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0282	4887.3000	3.6372	3.6838	0.0932	5247.9000	0.0076	2.6648	1.2502	84.3850	112.6800	0.7489	23.2950	-34.8380
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0281	4885.4000	3.6319	3.6838	0.0932	5247.5000	0.0077	2.6649	1.2502	84.3290	112.6300	0.7487	22.8750	-34.7850
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0280	4883.9000	3.6275	3.6837	0.0932	5247.1000	0.0078	2.6650	1.2502	84.2900	112.6100	0.7485	23.1260	-33.0690
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0279	4882.7000	3.6240	3.6837	0.0932	5246.8000	0.0079	2.6650	1.2502	84.2700	112.6200	0.7483	23.3500	-32.7900
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0278	4881.8000	3.6213	3.6837	0.0932	5246.6000	0.0080	2.6650	1.2502	84.2440	112.5900	0.7482	23.4390	-33.0420
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0277	4881.1000	3.6193	3.6837	0.0932	5246.4000	0.0080	2.6650	1.2502	84.2330	112.6000	0.7481	23.1310	-33.0610
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0276	4880.6000	3.6179	3.6837	0.0932	5246.2000	0.0081	2.6650	1.2502	84.2140	112.5800	0.7481	22.9590	-32.8680
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	cesam2k	graco	cesam2k	graco	m125fe0.08a0.5o0.3rot0	0275	4880.3000	3.6171	3.6837	0.0932	5246.1000	0.0081	2.6651	1.2502	84.2040	112.5700	0.7480	23.6950	-32.6260

# S3: asteroseismology



## Structure variables plots

(?) X:   Flip  Plot

(?) Y:   Flip  Plot

Divide by constant value:

(?) X:   Flip  Plot

(?) Y:   Flip  Plot

Options:

Graph:

Title:

Subtitle:

X range:

Y range:

## Seismic variable plots

(?) X:   Flip  Plot

(?) Y:   Flip  Plot

Options:

Graph:

Title:

Subtitle:

X range:

Y range:

$\Delta(v)$	$\delta(v)$
22.4010	-37.1810
22.4240	-36.1970
22.0370	-36.9380
22.6830	-35.8050
23.4070	-34.5530
22.8640	-35.5080
23.0220	-35.3060
23.2040	-35.1530
23.4410	-35.0020
23.2930	-34.9090
23.2950	-34.8380
22.8750	-34.7850
23.1260	-33.0690
23.3500	-32.7900
23.4390	-33.0420
23.1310	-33.0610
22.9590	-32.8680
23.6950	-32.6260

THANK YOU!