VOSA

A VO Spectral Energy Distribution Analyzer

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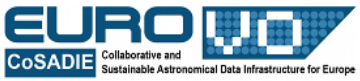
IVOA interoperability meeting
Waikoloa, September 2013



VOSA (VO Sed Analyzer)

- a web tool: http://svo2.cab.inta-csic.es/theory/vosa/
- designed to automatically determine physical parameters from comparison of observed photometry with collections of theoretical models.
- for several objects at the same time. *(∼ 2000 objects)*
- Using VO services.
- More than 200 users analysing data (last year).
- More than 165.000 objects studied (last year).
- More than 33 papers published using VOSA.

Workflow

1. **Build object SEDs.**
   - Object properties: name resolution, distance, extinction.
   - User photometry tables + VO catalogs.

2. **Analyze object SEDs.**
   - Fit observed data with theoretical spectra models and/or templates from the VO and estimate physical properties for the objects. (Chi-square test + Bayes analysis)
   - Generate a Hertzsprung-Russel diagram using the estimated parameters, obtaining isochrones and evolutionary tracks from the VO (only stars).

3. **Save results** as VOTable, ASCII, png, eps...

Two different workflows

VO SED Analyzer

VOSA allows to analyze both stellar and galactic data but, given that the physics involved is not the same, there are some important differences between both cases.

Please, select first what type of objects you want to work with in this session.

Stars and brown dwarfs

Galaxies

Acknowledging VOSA in publications:
Please include the following in any published material that makes use of VOSA:

This publication makes use of VOSA, developed under the Spanish Virtual Observatory project supported from the Spanish MICINN through grant AyA2008-02156.

Referencing VOSA in publications:
If your research benefits from the use of VOSA, we would appreciate if you could include the following reference in your publication:

Bayo, A., Rodrigo, C., Barrado y Navascués, D., Solano, E., Gutiérrez, R., Morales-Calderón, M., Allard, F. 2008, A&A 492,277B.

Other services used in VOSA
VOSA uses some external services and theoretical models that you might want to cite or acknowledge if your science benefits from the use of this tool

See the complete credits page

VOSA, version 3.0.0, May 15th, 2012

Build SED's

User data

VO data

Build object SED's

+ User SED options

- Delete or combine points.
- Upper limits.
- Quality, date of observation, etc
- Infrared and UV excess

+ Objects properties

+ VO photometry

+ Filter Profile Service

Build SED's: User Data

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Build SED's: User Data

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars and brown dwarfs (Change) — No file selected (Select/upload a file)

Upload your own data file (max size=500Kb)

It must comply with the required data format
(A small utility is available to help you to convert an original file in ascii (csv) or votable to VOSA input format)

File to upload:	Examinar... No se ha seleccionado ningún archivo.
Description:	
File type:	(•) Fluxes (erg/cm2/s/A) ( ) Fluxes (Jy) ( ) Magnitudes

Upload

Create a single object data file

Just write the coordinates (in decimal degrees) of one object that you want to study and we will create a single object data file with the adequate format.
RA and DEC are compulsory.

RA:	(deg)
DEC:	(deg)
Obj.Name:	
Description:	

Create

Your files

Folder
- Photometry tests
- Other tests
- Galaxies
- Default folder

Required input file format

The uploaded file must be an ascii document with a line for each photometric point.

Each line should contain 10 columns:

object	RA	DEC	dis	Av	filter	flux	error	pntopts	objopts
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...

- 1: a one word text label, without s
- 2: the RA, in deg, corresponding t
- 3: the DEC, in deg, corresponding
- 4: the distance to the object in pa
- 5: the A_V parameter defining the e
- 6: a label corresponding to the na
- 7: the flux in erg/cm^2/s/A, Jy or magnitude. See (7).
- 8: the observed error in the flux (in erg/cm^2/s/A) or magnitude. See (8).
- 9: options specific for this photometric point. See (9).
- 10: options specific for this object (they must be repeated in each line corresponding to the same object). See (10).

```
Obj1 19.5 23.2 80 1.2 DENIS_I 5.374863e-16 4.950433e-19 --- Av:0.5/5.5
Obj1 19.5 23.2 80 1.2 Omega2000_Ks 2.121015e-16 1.953527e-19  --- Av:0.5/5.5
Obj1 19.5 23.2 80 1.2 MIPS_M1 6.861148e-15 1.390352e-16 nofit Av:0.5/5.5
Obj2 18.1 -13.2 80 1.2 INGRID_H 1.082924e-14 2.194453e-16 --- ---
Obj2 18.1 -13.2 80 1.2 2MASS_J 2.483698e-17 2.287603e-19 --- ---
```

2957.vosa.dat	largo	2013-09-13 12:18:06	star2	1	Select
obj8.dat	obj8	2013-06-13 17:43:07	star	1	Select

Build SED's: Objects

User data

VO data

Build object SED's

+ User SED options
  - Delete or combine points.
  - Upper limits.
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  - Infrared and UV excess

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Build SED's: Objects: Coordinates

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars and brown dwarfs (Change) — File: dis edis (info) (Change)

Coordinates | Distances | Extinction

Object coordinates

This option allows you to query Sesame VO service to search for object coordinates using the object name.

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

Search for Obj. Coordinates

Mark all: User Sesame

Unmark all: User Sesame

Save Obj. Coordinates

	Final		User Data			Sesame			
Object	RA (deg)	DEC (deg)	RA (deg)	DEC (deg)		RA (deg)	DEC (deg)		Δ (")
HD000693	2.8160	-15.46797939	2.8160	-15.46797939	☑	2.81607340	-15.46797939	☐	0.255
HD001835	5.72	-12.20943607	5.72	-12.20943607	☑	5.71578527	-12.20943607	☐	14.830
HD002665	7.68935948	+57.065	7.68935948	+57.065	☑	7.68935948	+57.06489688	☐	0.371
HD002796	7.82047741	-16.79466529	7.82047741	-16.79466529	☑	7.82047741	-16.79466529	☑	0.000
HD003567	9.63311447	-8.30927645	9.63311447	-8.30927645	☑	9.63311447	-8.30927645	☑	0.003
HD003628	9.80	+3.1339	9.80	+3.1339	☑	9.80526732	+3.13392530	☐	18.934
HD004306	11.36317975	-9.54438717	11.36317975	-9.54438717	☑	11.36317975	-9.54438717	☑	0.000
HD004307	11.369	-12.88	11.369	-12.88	☑	11.36953271	-12.88080956	☐	3.462
HD004614	12.27621124	+57.81518773	12.27621124	+57.81518773	☑	12.27621124	+57.81518773	☑	0.000
HD006582	17.068	+54.7	17.068	+54.7	☑	17.06831127	+54.92034067	☐	793.227
HD006755	17.42943586	+61.54727506	17.42943586	+61.54727506	☑	17.42943586	+61.54727506	☑	0.000
HD006833	17.46777005	+54.73896613	17.46777005	+54.73896613	☑	17.46777005	+54.73896613	☑	0.000

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Other services used in VOSA

Build SED's: VO Photometry

User data

VO data

Build object SED's

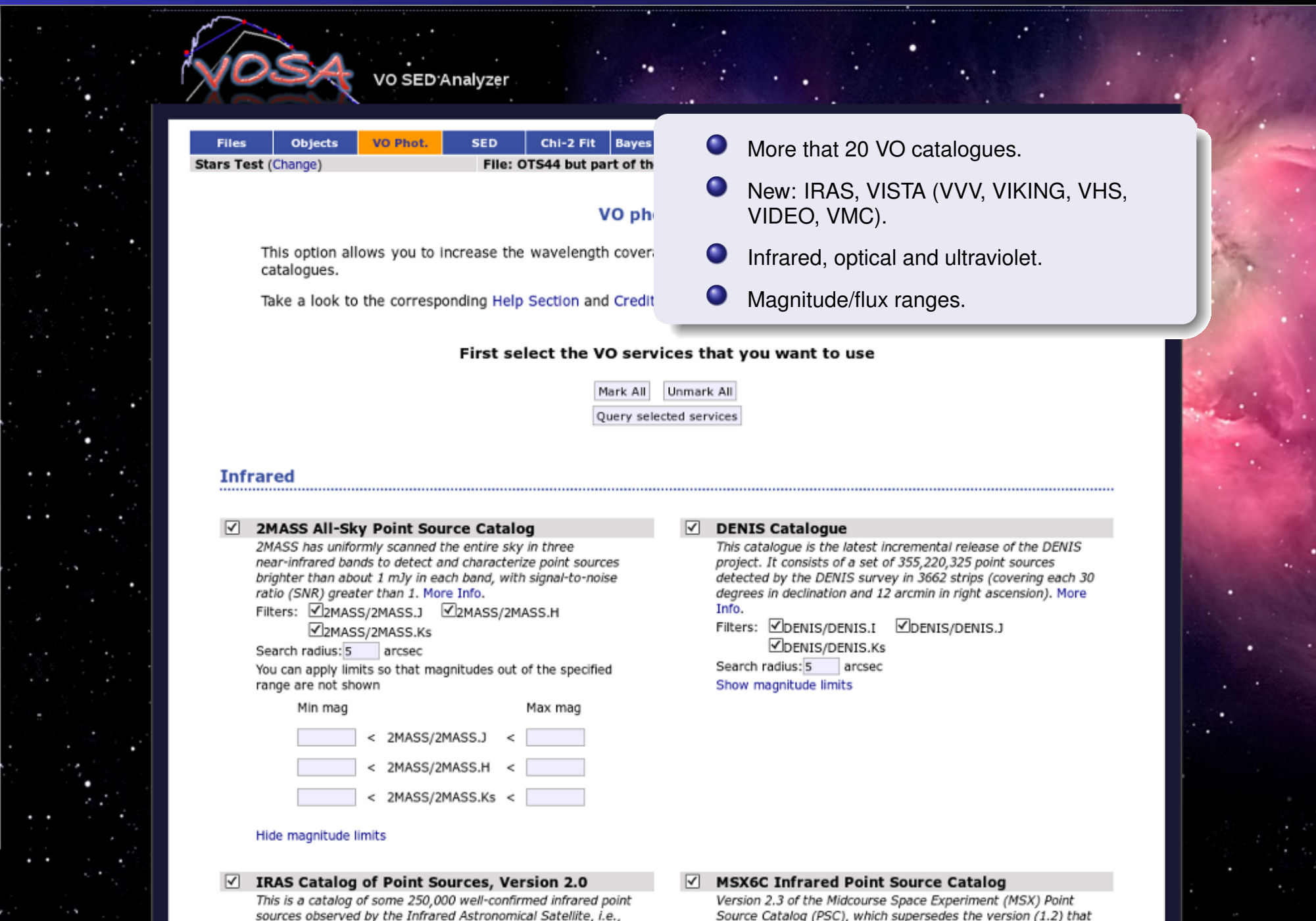
+ User SED options
  - Delete or combine points.
  - Upper limits.
  - Quality, date of observation, etc
  - Infrared and UV excess

+ Objects properties

+ VO photometry

+ Filter Profile Service

Build SED's: VO Photometry



- More that 20 VO catalogues.
- New: IRAS, VISTA (VVV, VIKING, VHS, VIDEO, VMC).
- Infrared, optical and ultraviolet.
- Magnitude/flux ranges.

Build SED's: Filter Profile Service

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Filter Profile Service

An experiment about filter standardization in the VO

Funded by

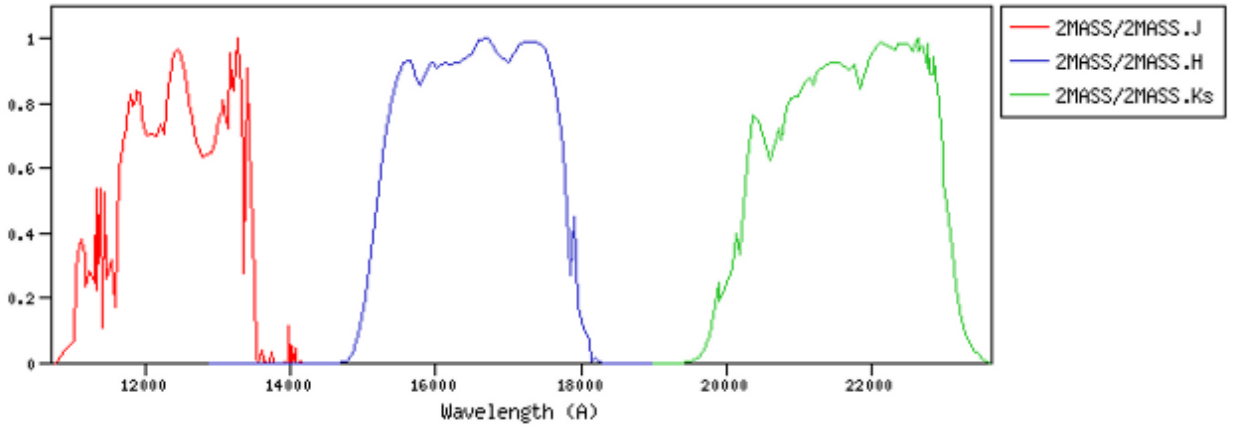
VO Service Browse Search AuthId: Passw: Login Register

2MASS	AAO	AKARI	CAHA	CFHT	CTIO	DENIS	GALEX	Gemini	Generic	Geneva	GTC	Herschel	Hipparcos	HST
IAC80	INT	IRAS	ISO	IUE	Keck	Kepler	KPNO	LaSilla	Misc	MSX	NIRT	NOT	OAF	OSN
Paranal	SAO	SLOAN	Spitzer	Subaru	TCS	TNG	TYCHO	UKIRT	WHT	WISE				

2MASS filters:

Filter ID	λ_{mean}	λ_{eff}	λ_{min}	λ_{max}	W_{eff}	ZP (Jy)	Obs. Facility	Instrument	Description
2MASS/2MASS.J	12350.0	12350.0	10806	14068	1624.1	1594.0	2MASS		2MASS J
2MASS/2MASS.H	16620.0	16620.0	14787	18231	2509.4	1024.0	2MASS		2MASS H
2MASS/2MASS.Ks	21590.0	21590.0	19544	23552	2618.9	666.8	2MASS		2MASS Ks

Filter Plots



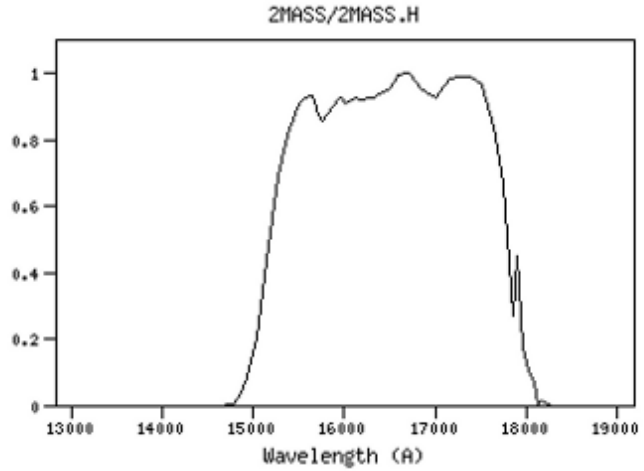
Most of the filters from the SVO Filter Profile Service are available to be used in VOSA using the FilterID as name.

Some of them are not in the list below, in some cases to make the list more easy to browse (because they seem to be less popular filters) and in other cases because not all the synthetic photometry is ready yet. In any case, you can try to use them too.

If you want to upload your own photometry into VOSA as magnitudes, make sure that VOSA will transform those magnitudes to fluxes as you expect (click on the filter name in this list to see the details of the transformation for that case). If not, please, transform your photometry to fluxes before uploading it.

You can click on the table headers to sort the list by that field

Filter ID	λ_{eff}	W_{eff}	A_f/A_V	ZP (Jy)	Mag.Sys.	ZP Type	Description
2MASS/2MASS.H	16620.00	2509.40	0.19	1024.00	Vega	Pogson	2MASS H



2MASS/2MASS.H

a.k.a. **2MASS_H** (you can still use the old vosa name for this filter in your input files)

VOSA will assume that, if you include in your input file magnitudes corresponding to this filter, these magnitudes must be transformed to fluxes using the following relation:

$F = F_0 * 10^{-mag/2.5}$

where

- F_0 = 1024.00 Jy *(1.13e-10 erg/cm2/s/A)*

If this is not right for your case, please, transform your magnitudes to fluxes before uploading them to VOSA

More info about this filter in the Filter Profile Service

2MASS/2MASS.J	12350.00	1624.15	0.31	1594.00	Vega	Pogson	2MASS J
2MASS/2MASS.Ks	21590.00	2618.86	0.13	666.80	Vega	Pogson	2MASS Ks
AAO/AAO.aao1	4351.69	1035.57	1.31	3926.34	Vega	Pogson	AAO #1, aao glass b, B
AAO/AAO.aao14	6418.54	1601.36	0.83	2962.97	Vega	Pogson	AAO #14, aao glass os, O*
AAO/AAO.aao2	5349.43	909.82	1.04	3636.87	Vega	Pogson	AAO #2, aao glass v, V
AAO/AAO.aao21	3634.27	642.64	1.57	1717.18	Vega	Pogson	AAO #21, aao cus04, U

Build SED's: Options

User data

VO data

Build object SED's

+ User SED options
  - Delete or combine points.
  - Upper limits.
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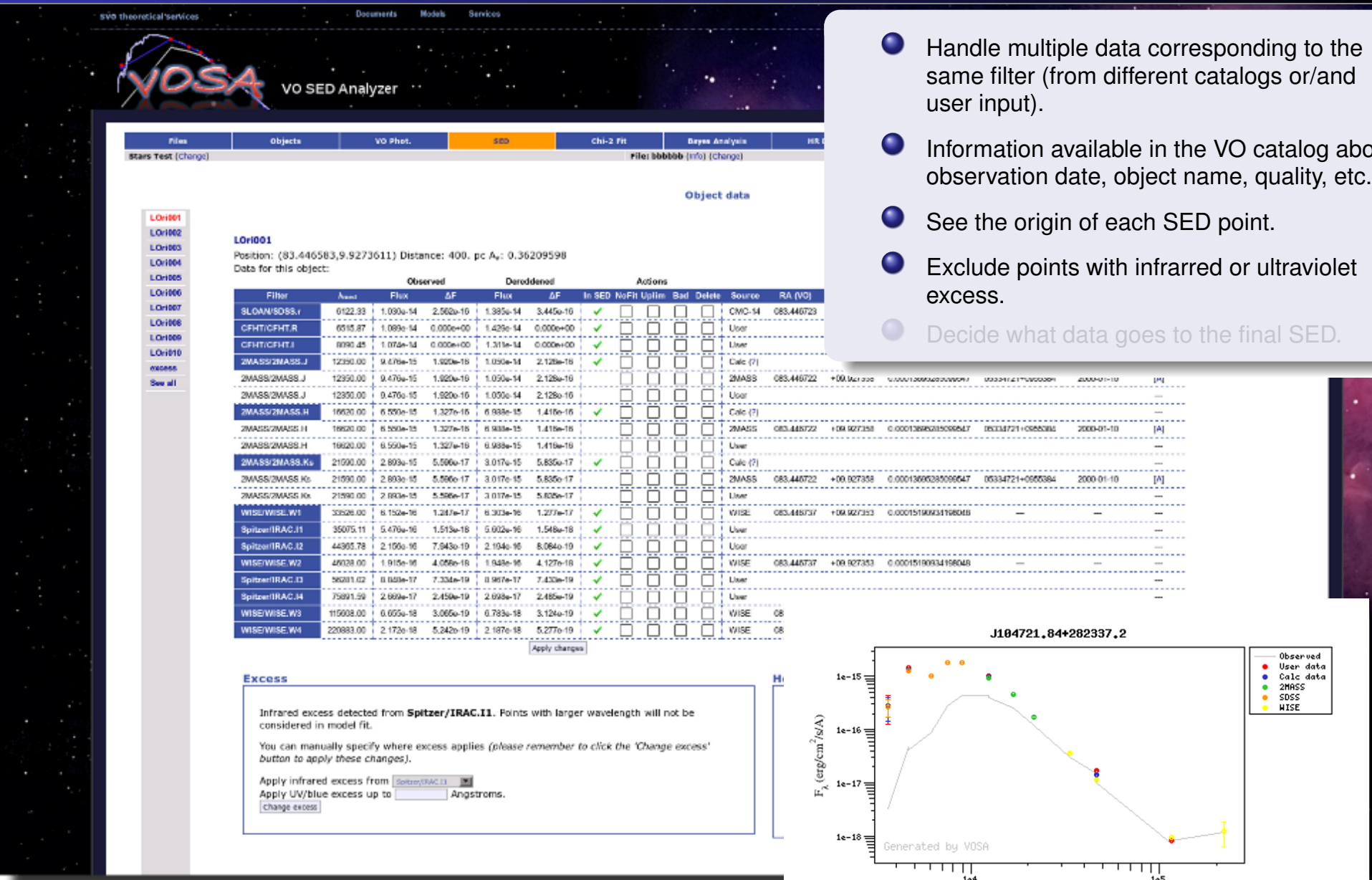
Build SED's: VO Photometry



- Handle multiple data corresponding to the same filter (from different catalogs or/and user input).
- Information available in the VO catalog about observation date, object name, quality, etc.
- See the origin of each SED point.
- Exclude points with infrarred or ultraviolet excess.
- Decide what data goes to the final SED.

Build SED's: VO Photometry

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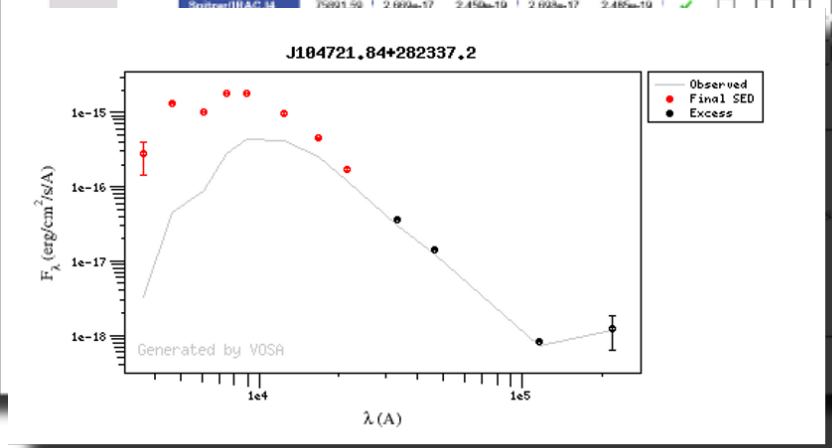
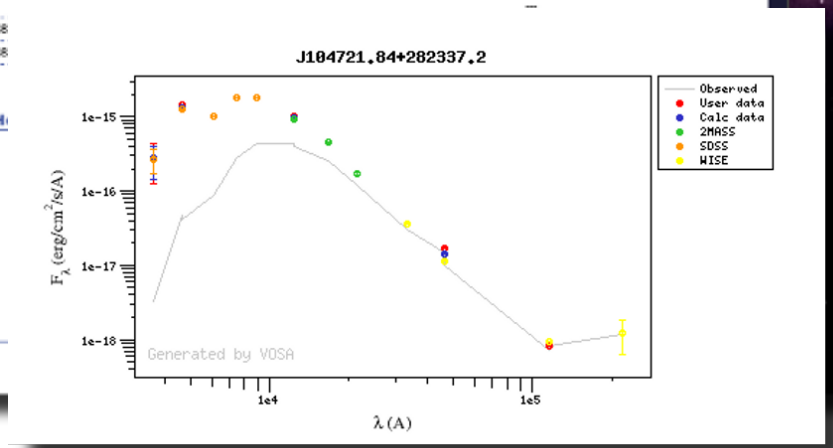
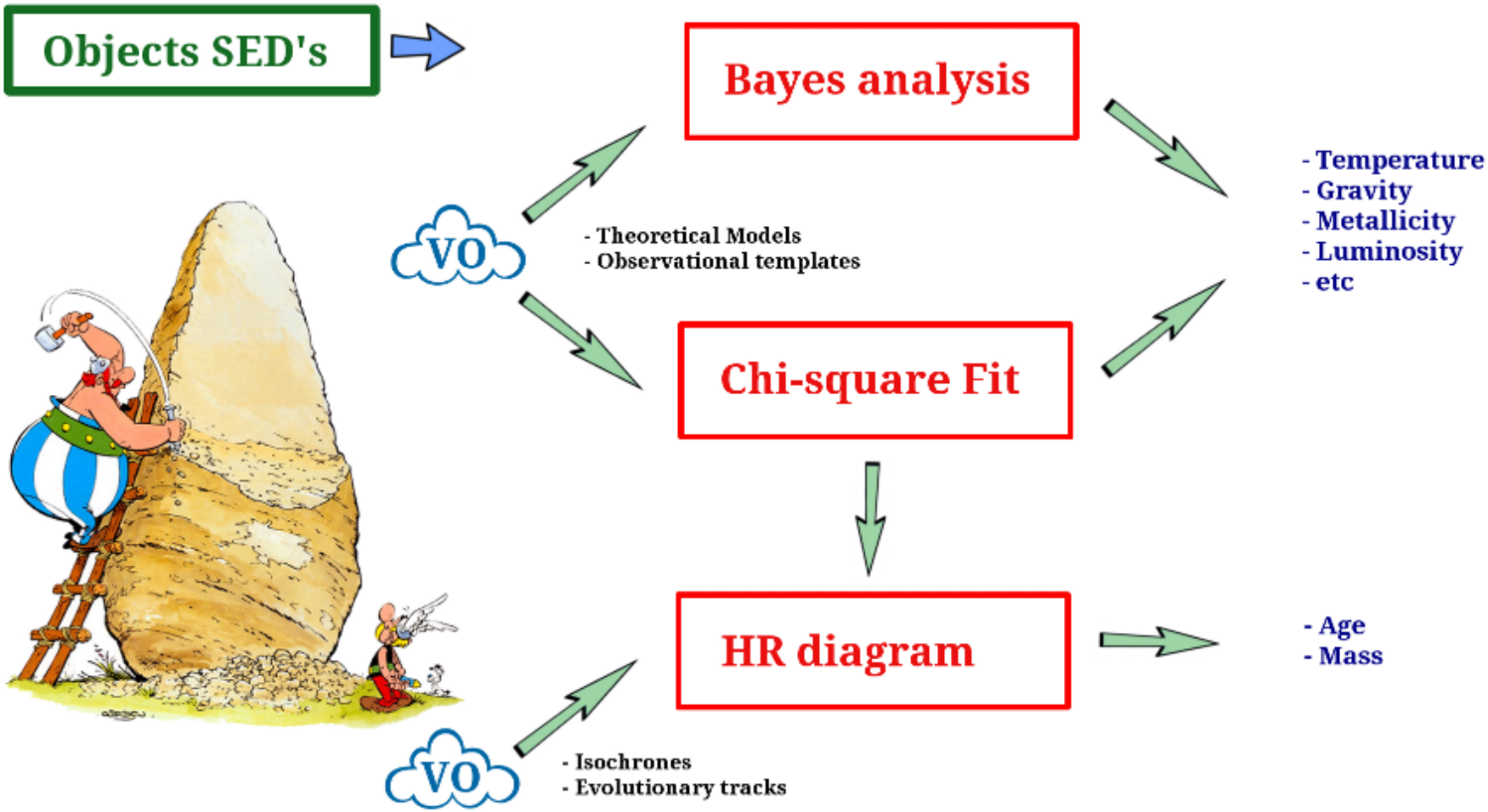
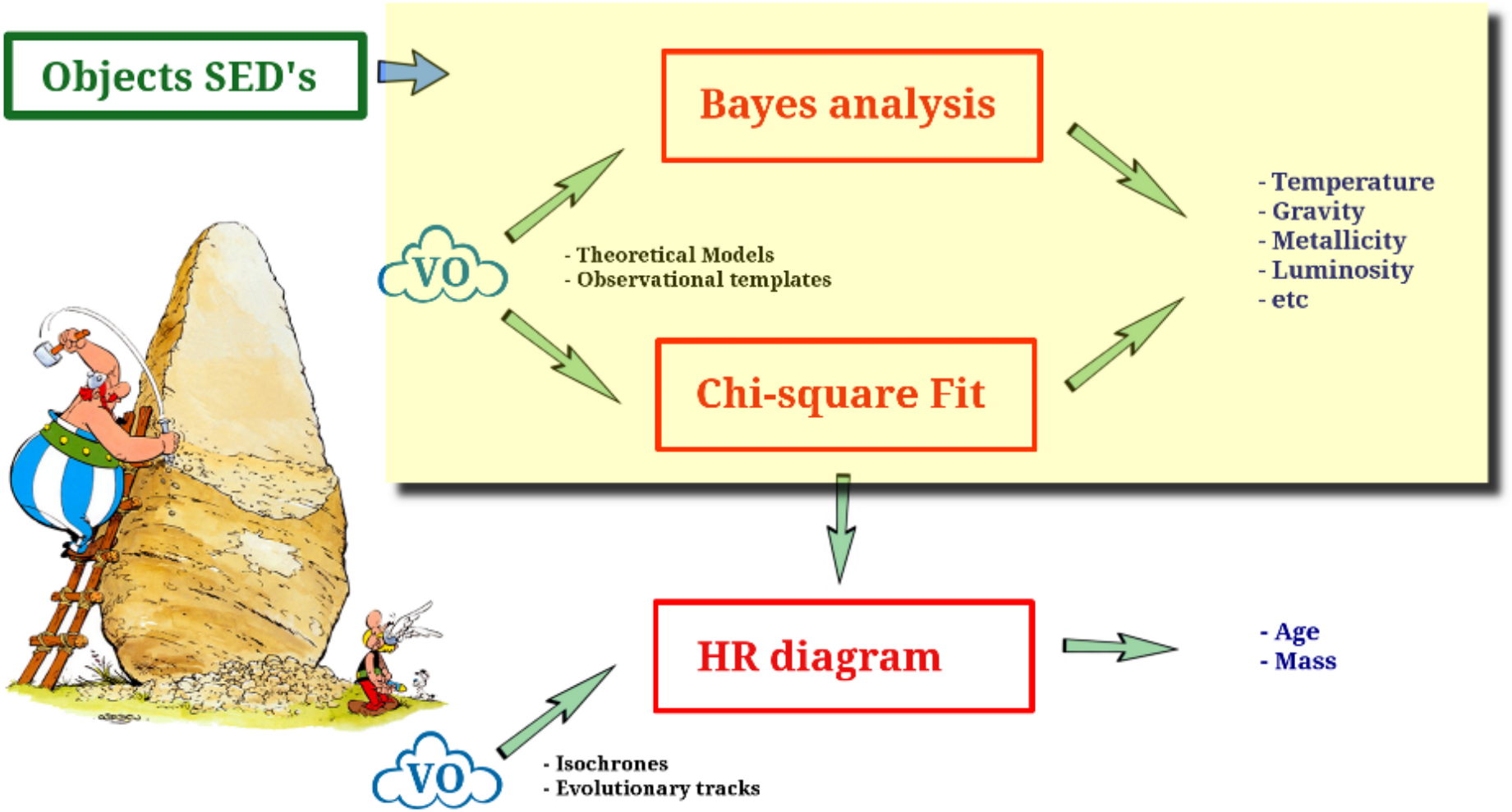




Analyze SED's



Analyze SED's: Chi-square fit.



Analyze SED's: Chi-square fit.

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Baye

Stars Test (Change) File: n

Model Fit

Moc

This option allows you to estimate some physical properties (suc
object comparing its SED with those derived from theoretical sp

Take a look to the corresponding Help Section and Credits Page f

- 15 collections of theoretical models (+5 for galaxies)
- Choose ranges of parameters.
- Get best fit values: Teff, logg, metallicity, luminosity, etc.
- Extinction as an additional fit parameter.

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

Mark All | Unmark All

Next: Select model params

☑ **AMES-Dusty 2000**
The AMES-Dusty Model grid of theoretical spectra

☑ **AMES-Cond 2000**
The AMES-Cond Model grid of theoretical spectra.

☑ **Kurucz ODFNEW /NOVER models**
ATLAS9 Kurucz ODFNEW /NOVER models. Newly computed ODFs with better opacities and better abundances have been used.

☑ **Husfeld et al models for non-LTE Helium-rich stars**
Husfeld et al models for non-LTE Helium-rich stars

☑ **BT-Settl**
The BT-Settl Model grid of theoretical spectra; With a cloud model, valid across the entire parameter range.

☑ **BT-COND**
The BT-COND Model grid of theoretical spectra.

☑ **BT-DUSTY**
The BT-DUSTY Model grid of theoretical spectra.

☑ **BT-NextGen (AGSS2009)**
The NextGen Model grid of theoretical spectra; Gas phase only, valid for Teff > 2700 K. Updated opacities.

☑ **BT-NextGen (GNS93)**
The NextGen Model grid of theoretical spectra; Gas phase only, valid for Teff > 2700 K. Updated opacities.

☑ **Black Body flux**
Black Body flux as calculated in the BT-NextGen model.

☑ **GRAMS C-rich grid**

☑ **GRAMS O-rich original grid**

Analyze SED's: Chi-square fit.

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars Test (change) File: bbbbbb (info) (change)

Model Fit | Template fit

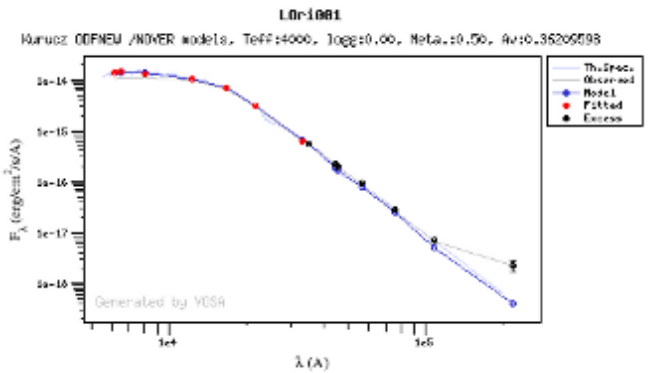
Model fit+

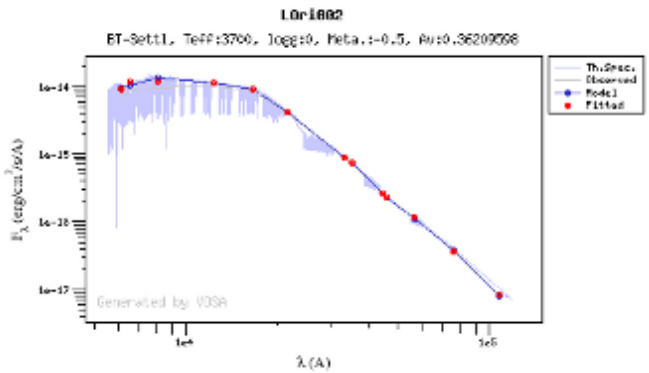
Bestfit
LOri001
LOri002
LOri003
LOri004
LOri005
LOri006
LOri007
LOri008
LOri009
LOri010

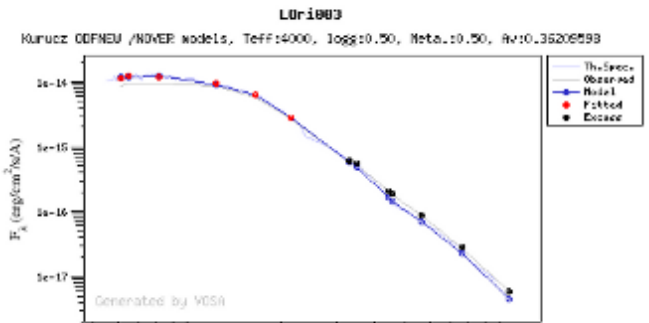
Best fit+ results

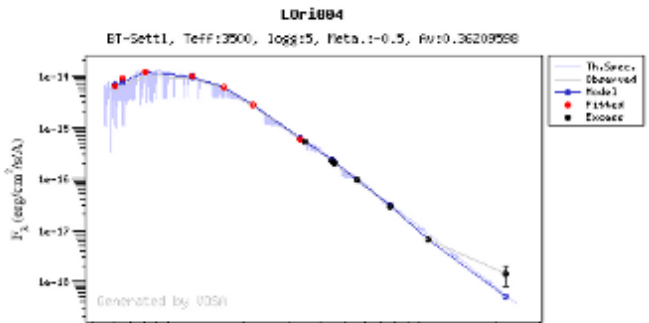
Hide graphs | Delete this fit

Object	RA	DEC	D (pc)	Model	T_{eff}	logg	Meta.	more	χ^2	M_{ini}	F_{tot}	ΔF_{tot}	F_{obs}/F_{tot}	L_{bol}/L_{sun}	$\Delta L_{bol}/L_{sun}$	λ_{max}	A_V	ΔT_{eff}	Δlogg	ΔMeta.	N_{ap}/N_{tot}	Data VOtables
LOri001	83.446583	9.9273611	400.000	Kurucz	4000	0.00	0.50	—	4.421e+0	1.238e-20	1.769e-10	1.885e-12	0.53	8.922e-1	9.306e-3	33526	0.36209598	125	0.25	0.15	7/14	Syn.Spec.
LOri002	84.043167	10.148583	400.000	BT-Settl	3700	0	-0.5	alpha:0.2	1.021e+1	2.848e-20	1.929e-10	2.488e-12	0.54	8.921e-1	1.241e-2	115608	0.36209598	50	0.25	0.25	13/13	Syn.Spec.
LOri003	83.961000	9.9420833	400.000	Kurucz	4000	0.50	0.50	—	4.489e+0	1.096e-20	1.587e-10	1.489e-12	0.50	7.915e-1	7.423e-3	21590	0.36209598	125	0.25	0.15	6/13	Syn.Spec.
LOri004	83.948125	9.7640278	400.000	BT-Settl	3500	5	-0.5	alpha:0.2	3.047e+1	1.789e-20	1.520e-10	1.445e-12	0.50	7.581e-1	7.209e-3	33526	0.36209598	50	0.25	0.25	7/14	Syn.Spec.
LOri005	83.473542	9.7188889	400.000	BT-Settl	3900	1	0	alpha:0	6.841e+0	1.576e-20	1.721e-10	2.778e-12	0.54	8.584e-1	1.385e-2	115608	0.36209598	50	0.25	0.2	13/14	Syn.Spec.
LOri006	83.817750	9.9218111	400.000	Kurucz	4000	0.50	0.50	—	2.035e+0	9.780e-21	1.417e-10	1.453e-12	0.48	7.065e-1	7.244e-3	33526	0.36209598	125	0.25	0.15	6/13	Syn.Spec.
LOri007	83.623125	9.8163056	400.000	Kurucz	3500	5.00	-1.00	—	2.750e+0	1.389e-20	1.206e-10	1.882e-12	0.50	6.027e-1	9.384e-3	21590	0.36209598	125	0.25	0.25	6/14	Syn.Spec.
LOri008	83.991542	9.9091111	400.000	BT-Settl	3500	3.5	-2	alpha:0.4	4.264e+1	1.691e-20	1.411e-10	5.587e-12	0.48	7.035e-1	2.786e-2	21590	0.36209598	50	0.25	0.25	6/13	Syn.Spec.
LOri009	83.699083	10.109889	400.000	BT-Settl	4100	-0.5	-2.5	alpha:0.4	5.970e+0	1.565e-20	1.151e-10	2.045e-12	0.55	5.740e-1	1.020e-2	115608	0.36209598	50	0.25	0.25	13/13	Syn.Spec.
LOri010	83.637333	10.144750	400.000	BT-Settl	4100	-0.5	-2.5	alpha:0.4	2.192e+1	1.461e-20	1.090e-10	1.178e-12	0.55	5.436e-1	5.873e-3	70891	0.36209598	50	0.25	0.25	12/14	Syn.Spec.









Analyze SED's: Bayes analysis

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars Test (Change) **File: bbbbbb** (info) (Change)

Model Bayes Analysis | Template Bayes Analysis

Model Bayes analysis+

Bestfit
LOri001
LOri002
LOri003
LOri004
LOri005
LOri006
LOri007
LOri008
LOri009
LOri010

| Next >

LOri001

Here you can see, for each model, the relative probability found for each parameter.
Only those with a probability higher than 1e-4 are shown.

Kurucz ODFNEW /NOVER models

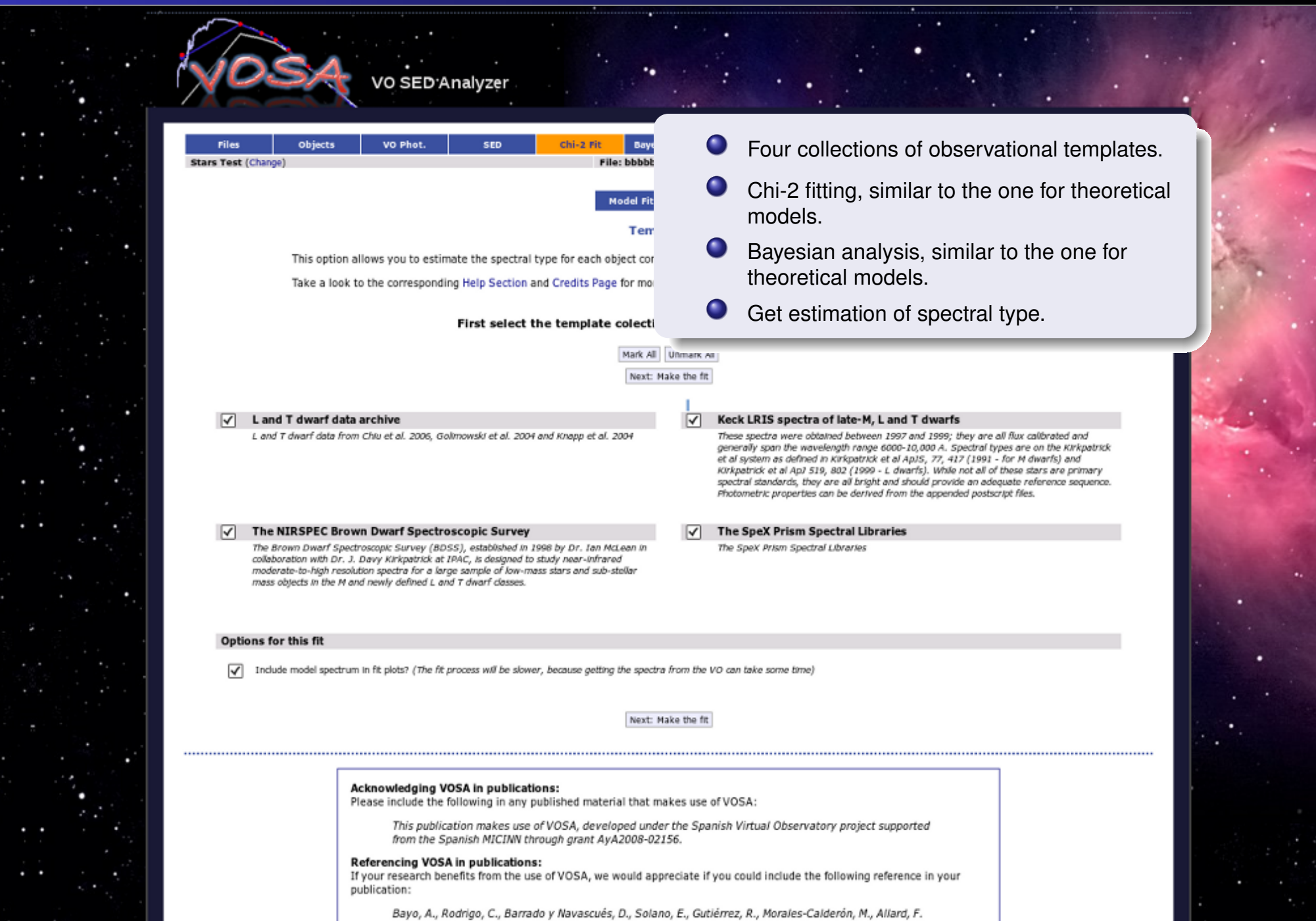
A_V	Probability
0.36209598	1.000000

logg	Probability
0.00	0.548390
0.50	0.161894
1.00	0.027613
1.50	0.008018
2.00	0.031249
2.50	0.051509
3.00	0.083071
3.50	0.073487
4.00	0.012700
4.50	0.001856
5.00	0.000212

Meta.	Probability
-2.50	0.121223
-2.00	0.097722
-1.50	0.030925
-1.00	0.005155
-0.50	0.008567
0.00	0.058373
0.20	0.312587
0.50	0.365448

T_{eff}	Probability
3500	0.000229
3750	0.156114
4000	0.843655

Analyze SED's: Template fit.



- Four collections of observational templates.
- Chi-2 fitting, similar to the one for theoretical models.
- Bayesian analysis, similar to the one for theoretical models.
- Get estimation of spectral type.

Analyze SED's: Template fit.

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars Test (Change) **File: bbbbbb** (info) (Change)

Model Fit | Template fit

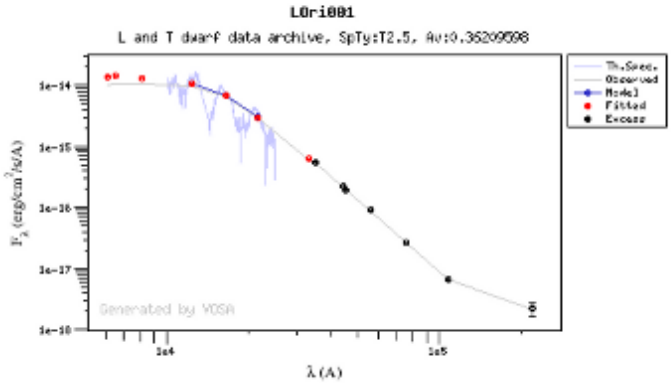
Template fit

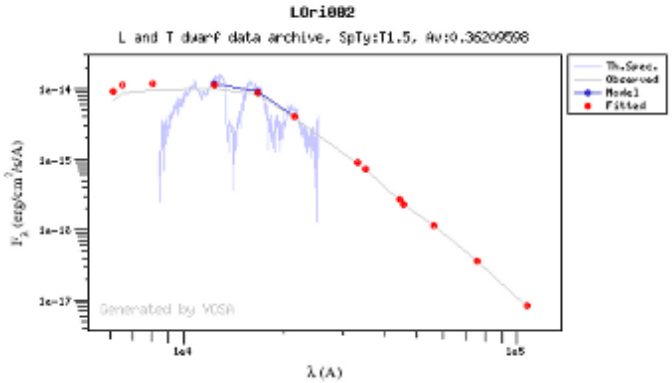
Bestfit
LOri001
LOri002
LOri003
LOri004
LOri005
LOri006
LOri007
LOri008
LOri009
LOri010

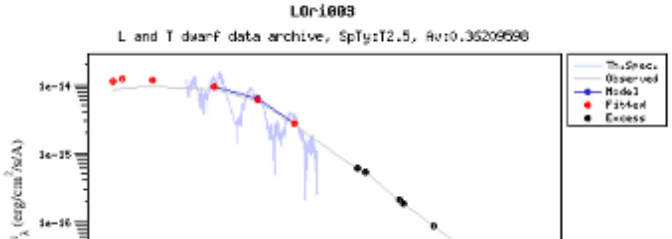
Best fit+ results

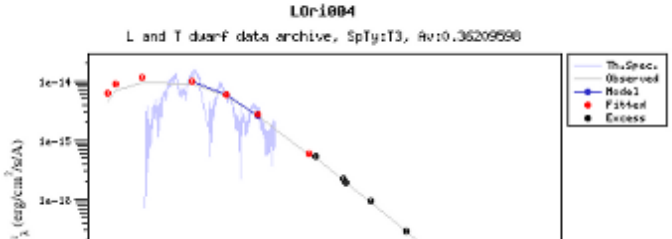
Hide graphs | Delete this fit

Object	RA	DEC	Model	SpTy	more	A_V	χ^2	M_d	λ_{max}	N_{fit}/N_{tot}	Data VOtables
LOri001	83.446583	9.9273611	Chiu et al. 2006	T2.5	---	0.36209598	5.028e-1	1.409e+2	33526	3/14	Spec.
LOri002	84.043167	10.148583	Chiu et al. 2006	T1.5	---	0.36209598	9.330e+0	2.386e+2	115608	3/13	Spec.
LOri003	83.981000	9.9420833	Chiu et al. 2006	T2.5	---	0.36209598	1.331e-1	1.267e+2	21590	3/13	Spec.
LOri004	83.948125	9.7640278	Chiu et al. 2006	T3	---	0.36209598	3.385e+0	6.330e+1	33526	3/14	Spec.
LOri005	83.473542	9.7188889	Chiu et al. 2006	T1.5	---	0.36209598	9.135e-1	1.954e+2	115608	3/14	Spec.
LOri006	83.817750	9.9216111	Chiu et al. 2006	T2.5	---	0.36209598	4.205e-1	1.128e+2	33526	3/13	Spec.
LOri007	83.623125	9.8163056	Chiu et al. 2006	T3	---	0.36209598	1.208e+0	4.637e+1	21590	3/14	Spec.
LOri008	83.991542	9.9091111	Chiu et al. 2006	T2.5	---	0.36209598	3.123e-1	1.123e+2	21590	3/13	Spec.
LOri009	83.693083	10.109889	Chiu et al. 2006	T2	---	0.36209598	1.351e+0	6.296e+1	115608	3/13	Spec.
LOri010	83.637333	10.144750	Chiu et al. 2006	T2.5	---	0.36209598	1.957e+0	8.043e+1	75891	3/14	Spec.

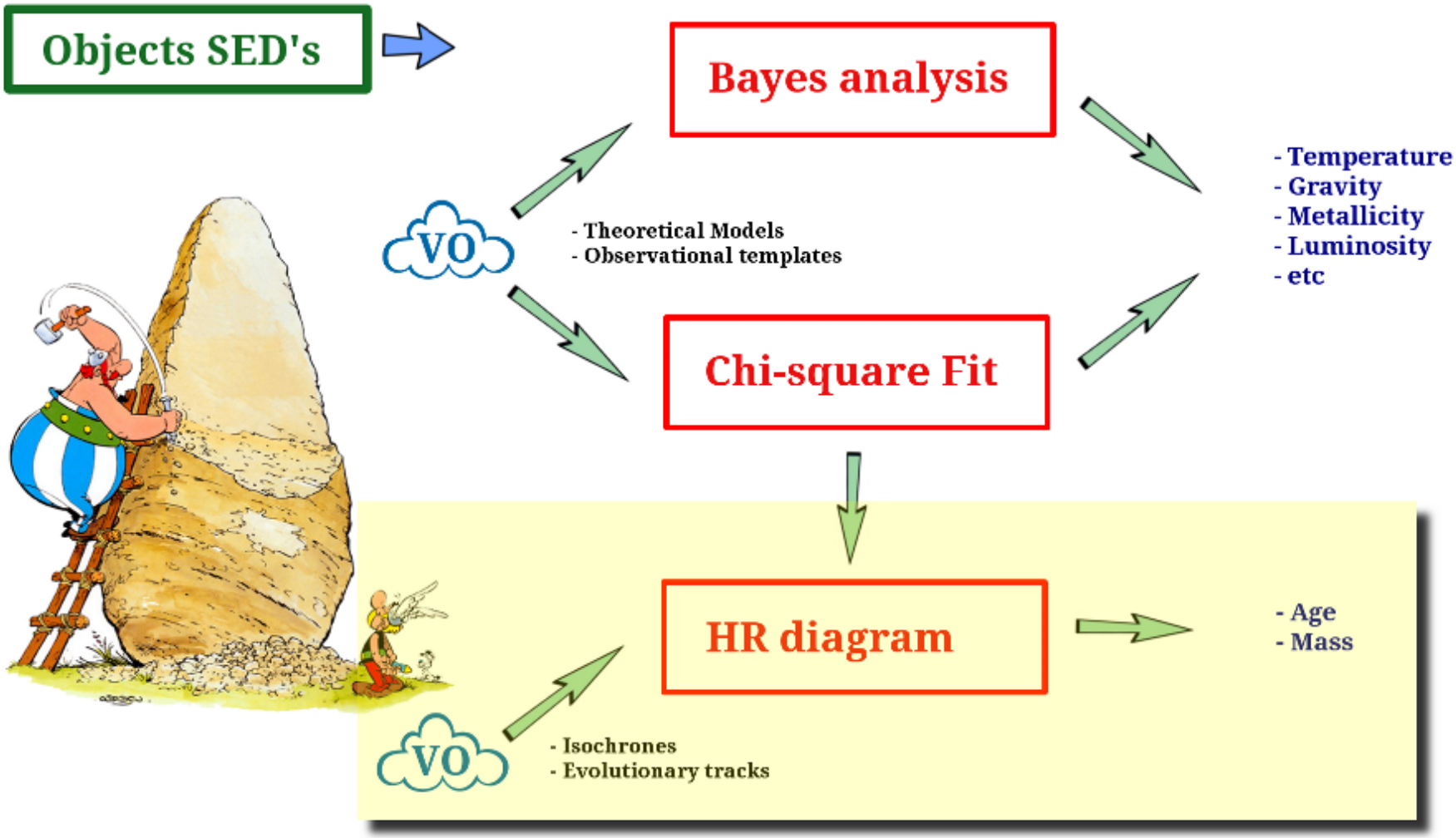








Analyze SED's: HR diagram.



Analyze SED's: HR diagram.

Analyze SED's: HR diagram.

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars Test (Change) **File: bbbbbb** (info) (Change)

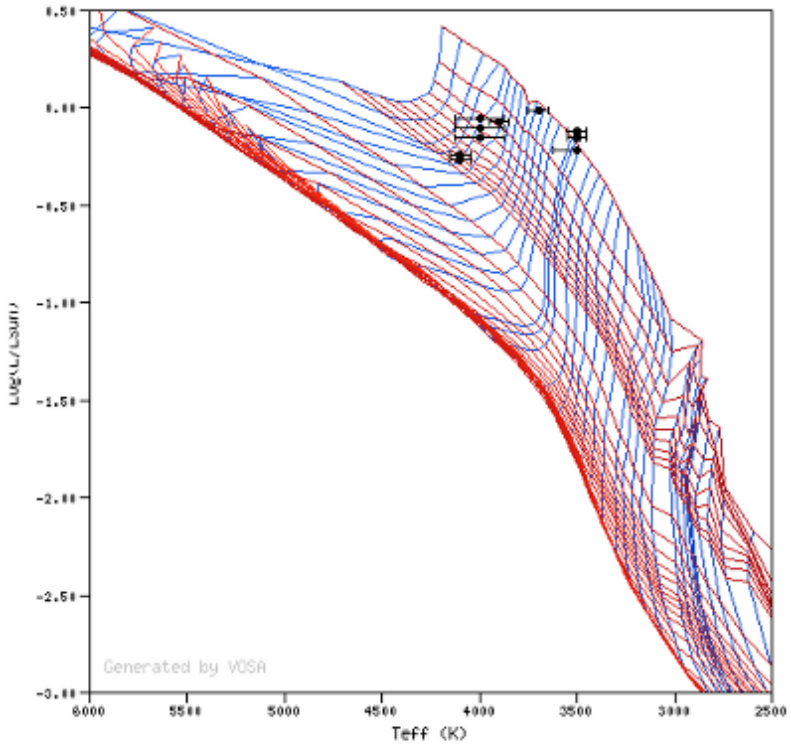
HR Diagram

Delete this HR Diagram

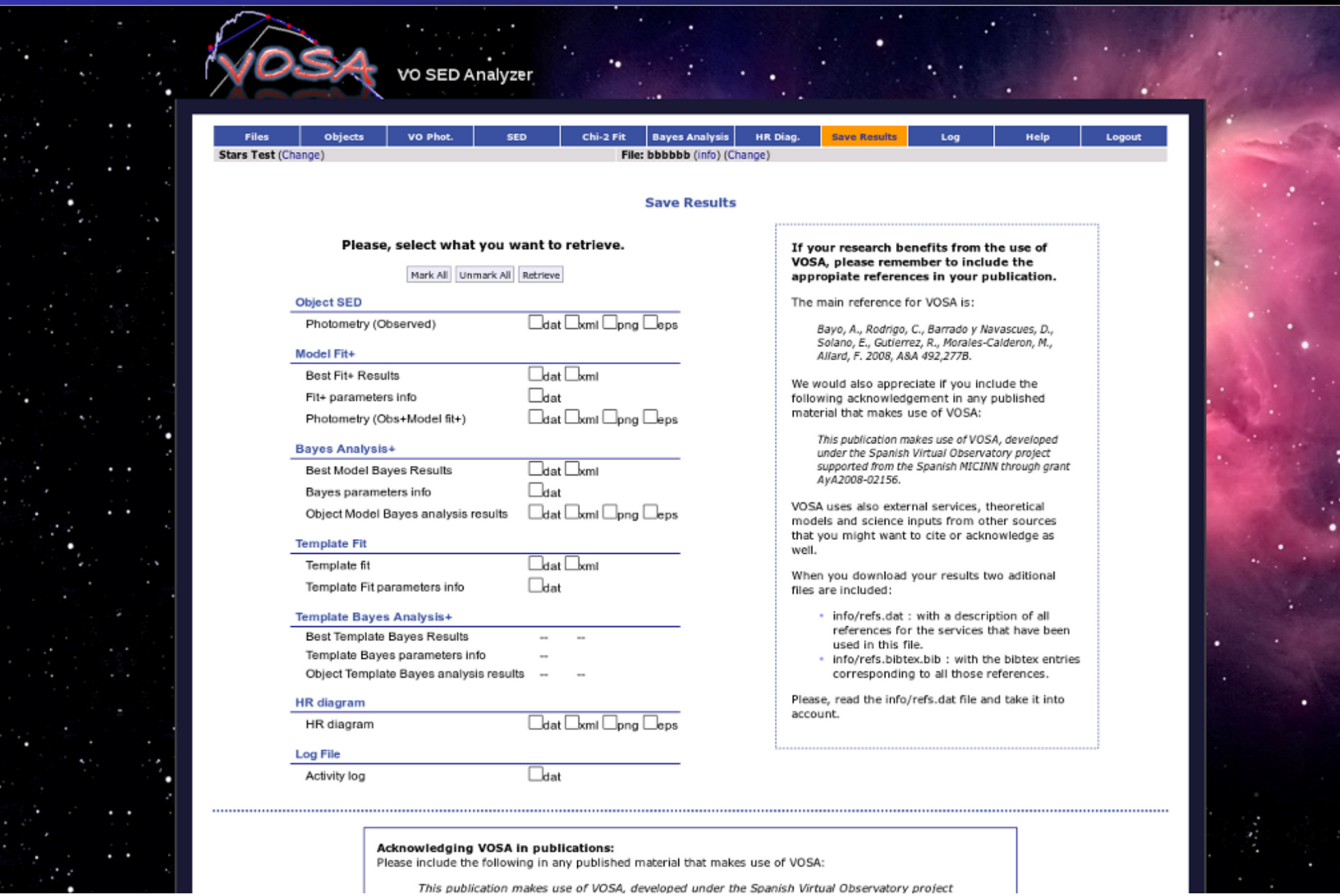
Objects

Object	Model	T_{eff}	LogL	Age		Mass	
LOri001	siess	4000	-0.0496	0.0018		0.6992	
LOri002	BT-Settl	3700	-0.0168	0.0011		0.8333	
LOri003	siess	4000	-0.1015	0.0019		0.7000	
LOri004	BT-Settl	3500	-0.1203	---	[4]	---	[4]
LOri005	BT-Settl	3900	-0.0663	0.0029		1.0515	
LOri006	siess	4000	-0.1509	0.0020		0.7000	
LOri007	siess	3500	-0.2199	0.0009		0.3700	
LOri008	BT-Settl	3500	-0.1527	---	[4]	---	[4]
LOri009	BT-Settl	4100	-0.2411	0.0079		1.1052	
LOri010	BT-Settl	4100	-0.2647	0.0081		1.1000	

[4] The point lies outside the area covered by the isochrones



Results: files.



Results: activity log.

VO SED Analyzer

Files | Objects | VO Phot. | SED | Chi-2 Fit | Bayes Analysis | HR Diag. | Save Results | Log | Help | Logout

Stars Test (Change) **File: bbbbbb** (info) (Change)

Activity Log

Here you can see a log with a summary of all the activity already performed with this file.

Last operations are shown first

2013/09/18 02:51:17 HR diagram generated

Model parameter values used for the diagram:
BT-Settl Isochrones and Evolutionary Tracks
  Isochrones
    t_min = 0.00100
    t_max = 12.00000
  Ev. tracks
    m_min = 0.001
    m_max = 1.400
Siess Isochrones and Evolutionary Tracks
  Isochrones
    t_min = 0.00007
    t_max = 30
  Ev. tracks
    m_min = 0.1
    m_max = 7.0

2013/09/18 02:49:46 Previous HR diagram results are not valid anymore. They have been deleted

2013/09/18 02:10:00 Bayes+ analysis executed

Model parameter values used for the fit:
Kurucz ODFNEW /NOVER models
  teff_min = 3500
  teff_max = 50000
  logg_min = 0.00
  logg_max = 5.00
  meta_min = -2.50
  meta_max = 0.50

2013/09/18 02:09:49 Previous Bayes+ analysis results are not valid anymore. They have been deleted

2013/09/18 02:02:06 Model fit+ executed

Parameter values used for the fit:
L and T dwarf data archive
Keck LRIS spectra of late-M, L and T dwarfs
The NIRSPEC Brown Dwarf Spectroscopic Survey
The SpeX Prism Spectral Libraries

Summary of news/future news

- Blue/UV excess.
- New VO catalogues.
  - IRAS, VISTA (VVV, VIKING, VHS, VIDEO, VMC).
- New theoretical models.
  - TMAP, sdOs.
- Better control of final SED / VO photometry.
  - Several points for the same filter.
  - More info about observation date, quality, etc.
  - Manual editing of SED.
- Better handling of extinction properties.
  - Accesing extinction maps from VO services.

THANK YOU!