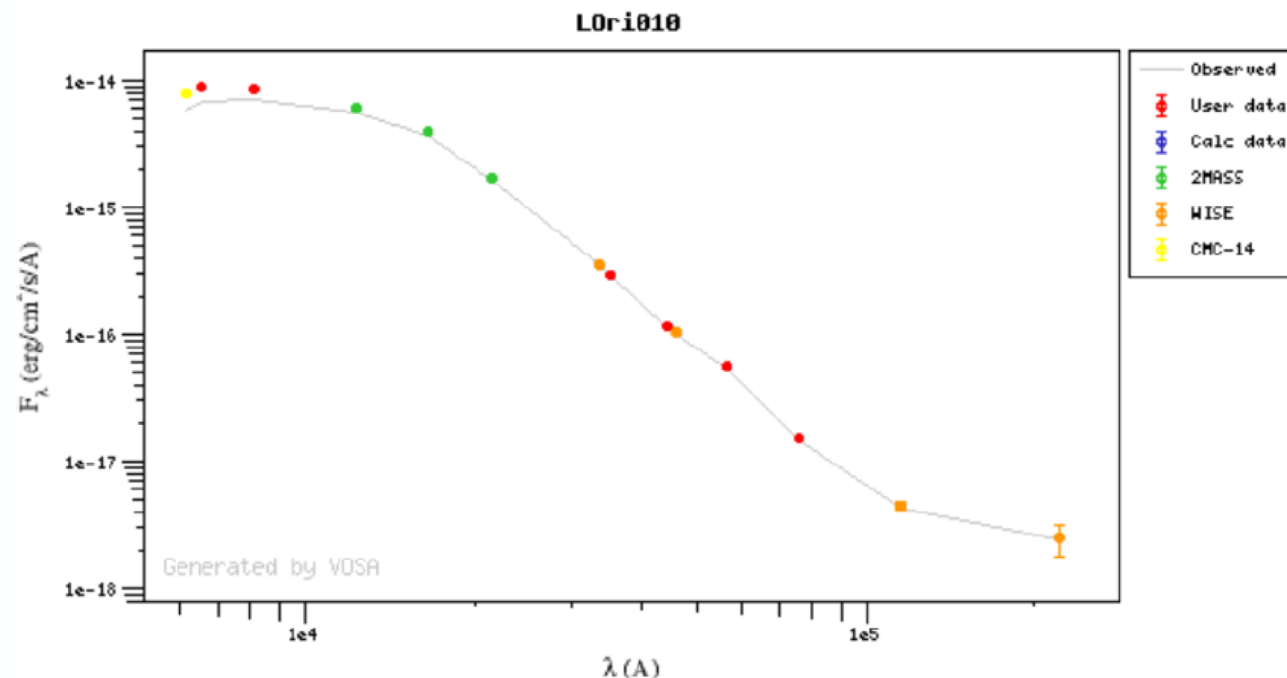


VOSA: A SHORT INTRODUCTION

SEDs IN THE VIRTUAL OBSERVATORY

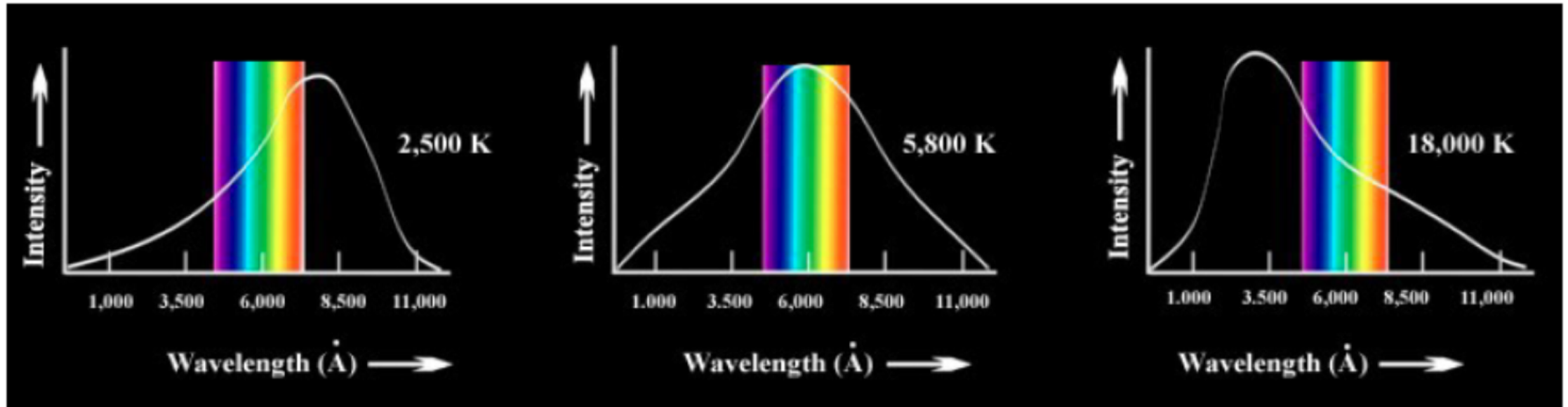
PATRICIA CRUZ
(ON BEHALF OF THE SVO TEAM)
CENTRO DE ASTROBIOLOGÍA (CSIC-INTA)



CENTRO DE ASTROBIOLOGÍA · CAB
ASOCIADO AL NASA ASTROBIOLOGY PROGRAM



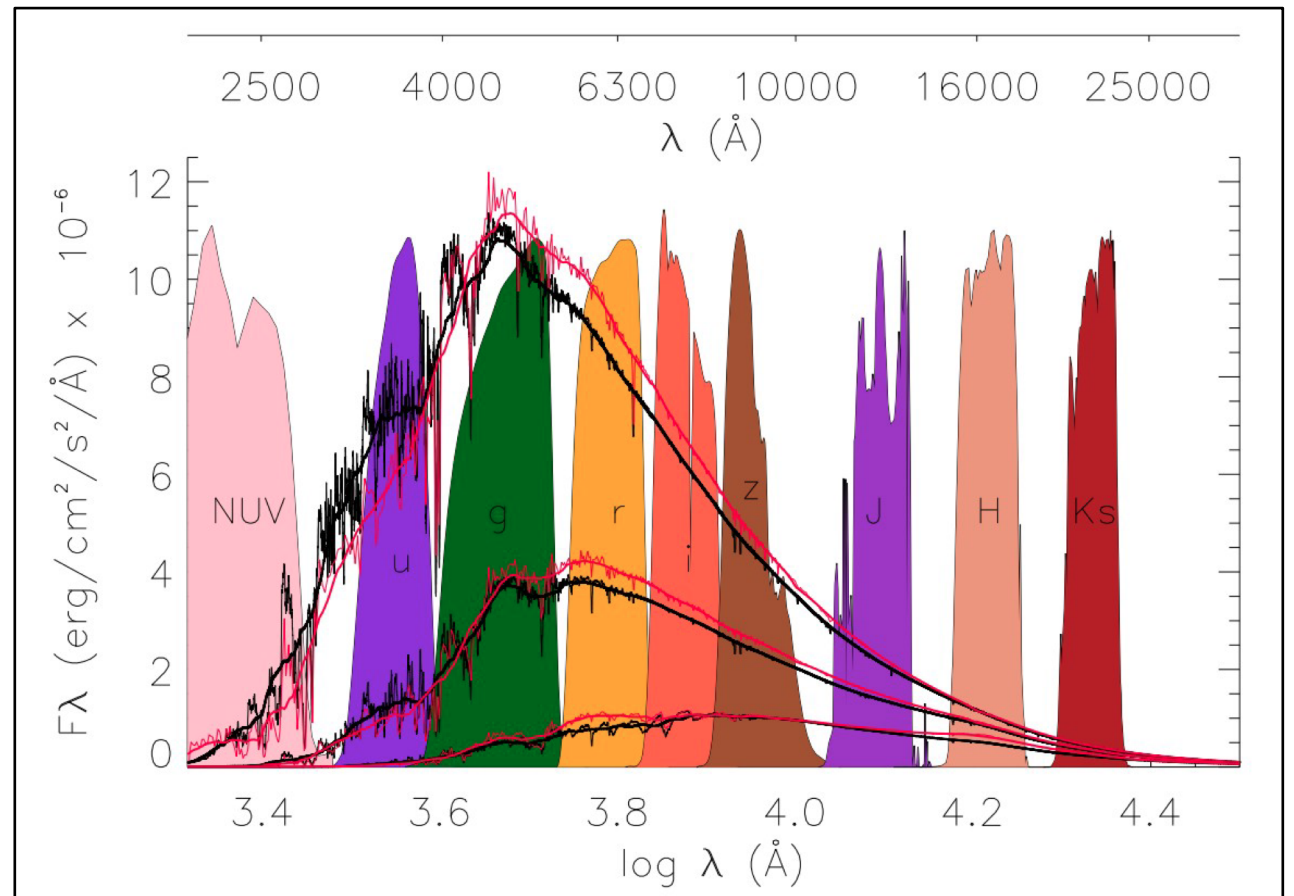
WHY USING SEDs?



The spectral distribution of the thermal energy radiated by a blackbody depends only on its **temperature**.

Stars behave approximately **like blackbodies**

WHY USING SEDs?



VOSA: THE VO SED ANALYZER

SVO theoretical services VOSA Filters Models Documents Other Services Email: Pass: Login (?) Register

VOSA VO SED Analyzer This is VOSA 7.5

This project has received funding from the European Union's Seventh Framework Programme (FP7-SPACE-2013-1) for research, technological development and demonstration under grant agreement no. 606740

Email:
Pass:

If you are a new user, please, [register](#).
If you don't remember your password, [click here](#).

VOSA (VO Sed Analyzer) is a tool designed to perform the following tasks in an automatic manner:

- Read user photometry-tables.
- Query several photometrical catalogs accessible through VO services (increases the wavelength coverage of the data to be analyzed).
- Query VO-compliant theoretical models (spectra) and calculate their synthetic photometry.
- Perform a statistical test to determine which model reproduces best the observed data.
- Use the best-fit model as the source of a bolometric correction.
- Provide the estimated bolometric luminosity for each source.
- Generate a Hertzsprung-Russel diagram with the estimated parameters.
- Provide an estimation of the mass and age of each source

[\(Take a look to the VOSA Help\)](#)

You need a username and password to use the application because it keeps a number of files and database entries with your results and we need to be able to identify which results belong to each user so that you can recover them in future sessions. If you don't have a username and password yet, please feel free to register.

<http://svo2.cab.inta-csic.es/theory/vosa/>

VOSA: THE VO SED ANALYZER



<http://svo2.cab.inta-csic.es/theory/vosa/>

> 3600 users

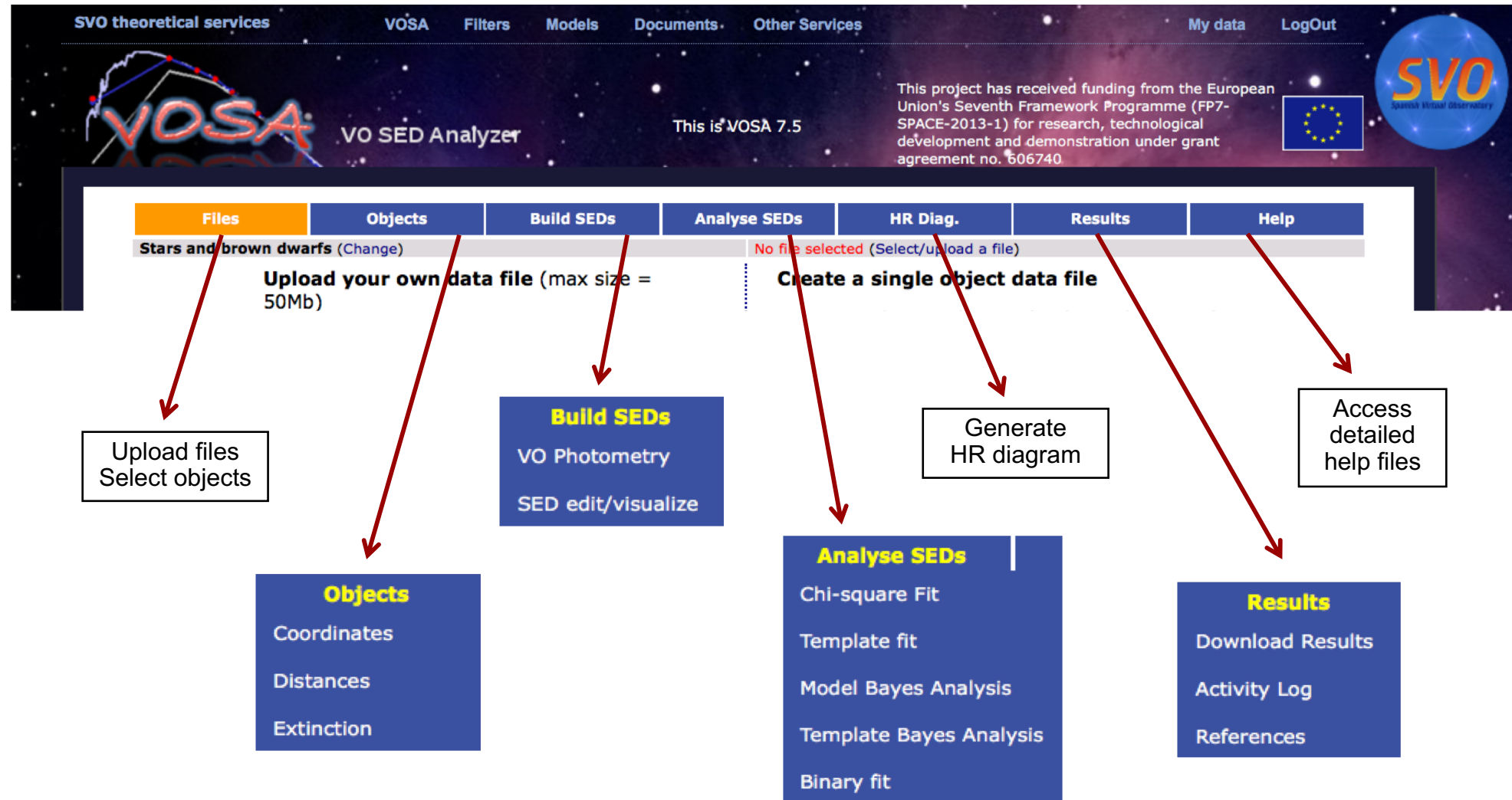
> 13 300 000 objects

> 330 refereed papers including
VOSA in the text

Bayo et al. (2008) includes 355 cites.



VOSA: THE VO SED ANALYZER



VOSA: THE VO SED ANALYZER

[SVO theoretical services](#) [VOSA](#) [Filters](#) [Models](#) [Documents](#) [Other Services](#) [My data](#) [LogOut](#)

 **VO SED Analyzer** This is VOSA 7.5

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Files	Objects	Build SEDs	Analyse SEDs	HR Diag.	Results	Help
Stars and brown dwarfs (Change)			No file selected (Select/upload a file)			
Upload your own data file (max size = 50Mb) It must comply with the required format (you can download some examples of input files). A small utility is also available to help you to convert an original file in ascii (csv) or votable to VOSA input format. You can also use SpecPhot to get photometric information in VOSA input format from a spectrum / list of spectra. File to upload: Choose File no file selected Description: File type: ☒ Fluxes (erg/cm2/s/A) ☐ Fluxes (Jy) ☐ Magnitudes SED plots: Flux vs λ (?) 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: SED plots: Flux vs λ (?) Create			

VOSA: THE VO SED ANALYZER

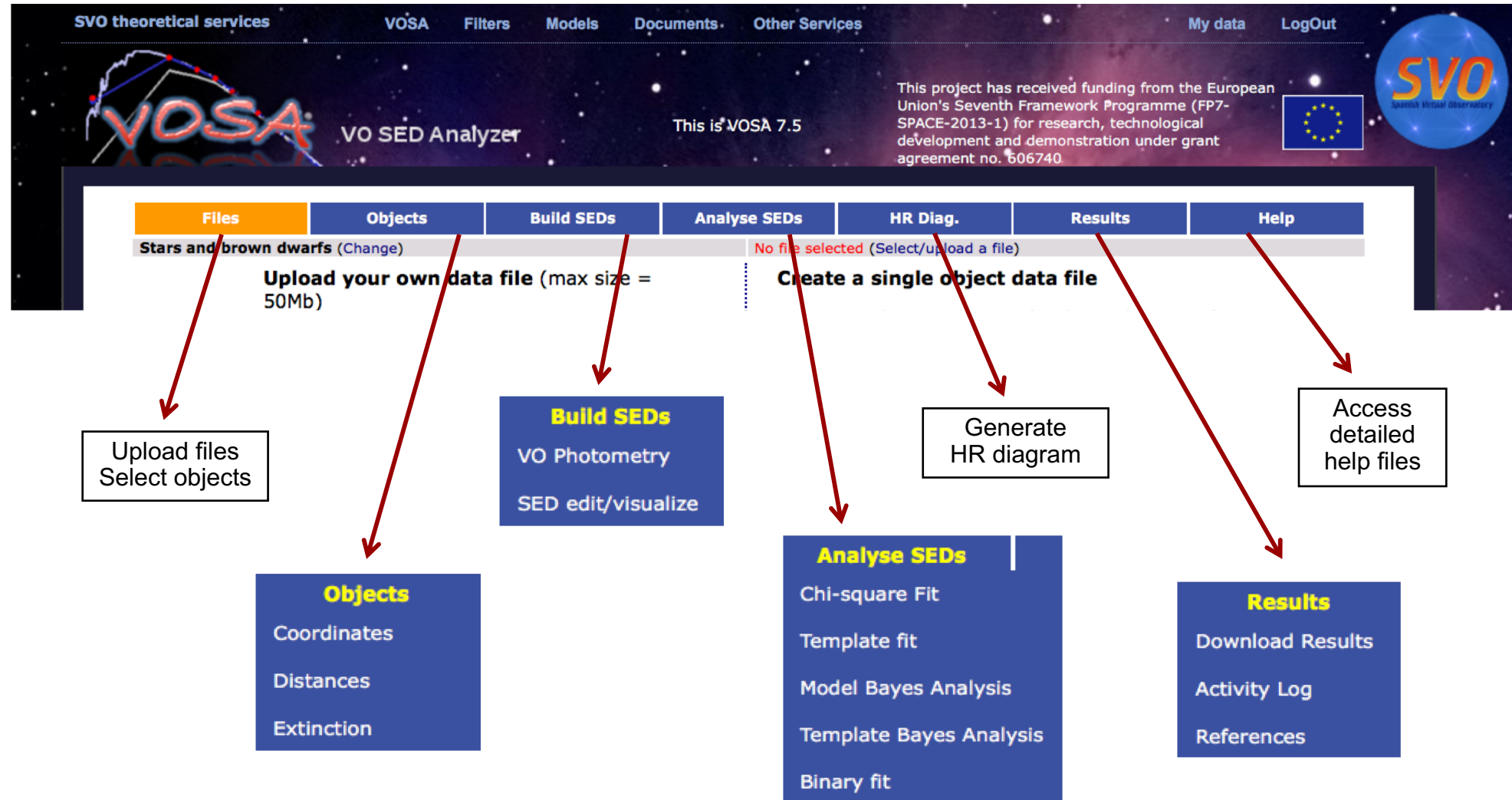
Required input file format:

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

```
TYC_5273-16-1 --- --- 52|
TYC_9023-815-1 --- ---
TYC_9083-198-1 --- ---
TYC_9241-249-1 --- ---
TYC_50_1383_1 --- ---
```

```
TYC_5273-16-1 --- --- 52+-4
TYC_9023-815-1 --- ---
TYC_9083-198-1 --- ---
TYC_9241-249-1 --- ---
TYC_50_1383_1 --- ---
```


VOSA: THE VO SED ANALYZER



VOSA: BUILDING SEDs

Observational photometry

☒ 2MASS All-Sky Point Source Catalog

2MASS has uniformly scanned the entire sky in three near-infrared bands to detect and characterize point sources brighter than about 1 mJy in each band, with signal-to-noise ratio (SNR) greater than 1

[More Info.](#)

Filters: ☒ 2MASS/2MASS.J ☒ 2MASS/2MASS.H

☒ 2MASS/2MASS.Ks

Search radius: 5 arcsec

[Show magnitude limits](#)

☒ IRAS Catalog of Point Sources, Version 2.0

This is a catalog of some 250,000 well-confirmed infrared point sources observed by the Infrared Astronomical Satellite, i.e., sources with angular extents less than approximately 0.5, 0.5, 1.0, and 2.0 arcmin in the in-scan direction at 12, 25, 60, and 1

[More Info.](#)

Filters: ☒ IRAS/IRAS.12mu ☒ IRAS/IRAS.25mu

☒ IRAS/IRAS.60mu ☒ IRAS/IRAS.100mu

Search radius: 20 arcsec

[Show flux limits](#)

☒ MSX6C Infrared Point Source Catalog

Version 2.3 of the Midcourse Space Experiment (MSX) Point Source Catalog (PSC), which supersedes the version (1.2) that was released in 1999 (Cat. V/107), contains over 100,000 more sources than the previous version.

[More Info.](#)

Filters: ☒ MSX/MSX.B1 ☒ MSX/MSX.B2

☒ MSX/MSX.A ☒ MSX/MSX.C

☒ MSX/MSX.D ☒ MSX/MSX.E

Search radius: 5 arcsec

[Show flux limits](#)

☒ AKARI/FIS All-Sky Survey Point Source Catalogues (ISAS/JAXA, 2010)

The AKARI/FIS All-Sky Survey Bright Source Catalog Version 1.0 provides positions and fluxes for 427071 point sources in the 4 far-infrared wavelengths centered at 65, 90, 140 and 160μm

[More Info.](#)

☒ DENIS Catalogue

This catalogue is the latest incremental release of the DENIS project. It consists of a set of 355,220,325 point sources detected by the DENIS survey in 3662 strips (covering each 30 degrees in declination and 12 arcmin in right ascension)

[More Info.](#)

Filters: ☒ DENIS/DENIS.I ☒ DENIS/DENIS.J

☒ DENIS/DENIS.Ks

Search radius: 5 arcsec

[Show magnitude limits](#)

☒ IRAS Faint Source Catalog

The Faint Source Survey (FSS) is the definitive Infrared Astronomical Satellite data set for faint point sources.

[More Info.](#)

Filters: ☒ IRAS/IRAS.12mu ☒ IRAS/IRAS.25mu

☒ IRAS/IRAS.60mu ☒ IRAS/IRAS.100mu

Search radius: 20 arcsec

[Show flux limits](#)

☒ AKARI/IRC mid-IR all-sky Survey (ISAS/JAXA, 2010)

The AKARI/IRC Point Source Catalogue Version 1.0 provides positions and fluxes for 870,973 sources observed with the InfraRed Camera (IRC)

[More Info.](#)

Filters: ☒ AKARI/IRC.S9W ☒ AKARI/IRC.L18W

Search radius: 5 arcsec

[Show flux limits](#)

☒ C2D Spitzer and Ancillary Data

C2D Fall '07 Full CLOUDS Catalog (CHA, II, LUP, OPH, PER, SER)

Filters: ☒ Spitzer/IRAC.I1

☒ Spitzer/IRAC.I2

☒ Spitzer/IRAC.I3

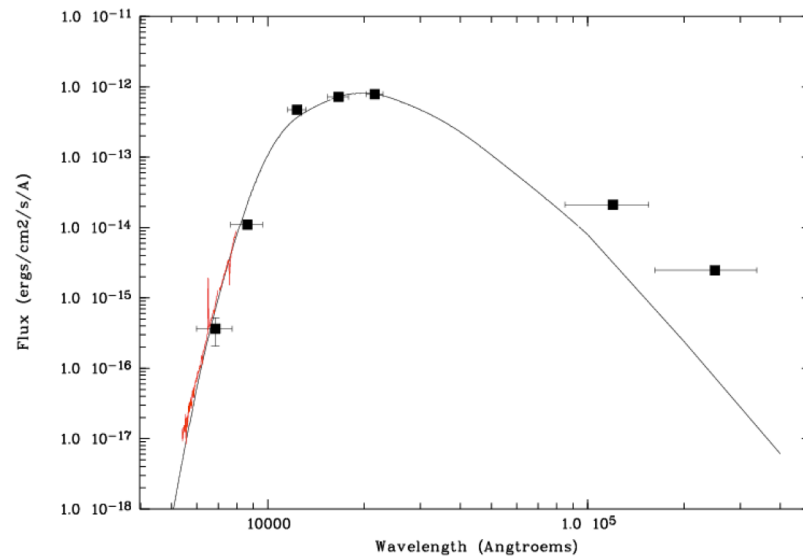
☒ Spitzer/IRAC.I4

☒ Spitzer/MIPS.24mu

☒ Spitzer/MIPS.70mu

VOSA: BUILDING SEDs

Data: from magnitudes to fluxes



[I/337/gaia](#) [Gaia DR1 \(Gaia Collaboration, 2016\)](#)
[Post annotation](#) [GaiaSource data \(Download Gaia Source Catalogue\)](#)

 [start AladinLite](#)

<i>Full</i>	<u>RA ICRS</u>	<u>DE ICRS</u>	<u><Gmag></u>
<i>deg</i>	<i>deg</i>	<i>mag</i>	
<u>1</u>	063.4107528711	-89.9888879972	17.965
<u>2</u>	037.5117084305	-89.9858176527	16.664
<u>3</u>	084.7593492719	-89.9781776713	18.553
<u>4</u>	081.5942616579	-89.9832765720	20.472
<u>5</u>	070.9024070024	-89.9715663343	19.829
<u>6</u>	060.8702751299	-89.9781334323	19.492
<u>7</u>	073.1733654732	-89.9817426647	20.019
<u>8</u>	027.3236159503	-89.9767950251	17.006
<u>9</u>	029.9573489468	-89.9759664621	18.649
<u>10</u>	020.0044580076	-89.9836077196	19.202

[EUROPEAN SPACE AGENCY](#) [SCIENCE & TECHNOLOGY](#)

GAIA DATA RELEASE DOCUMENTATION



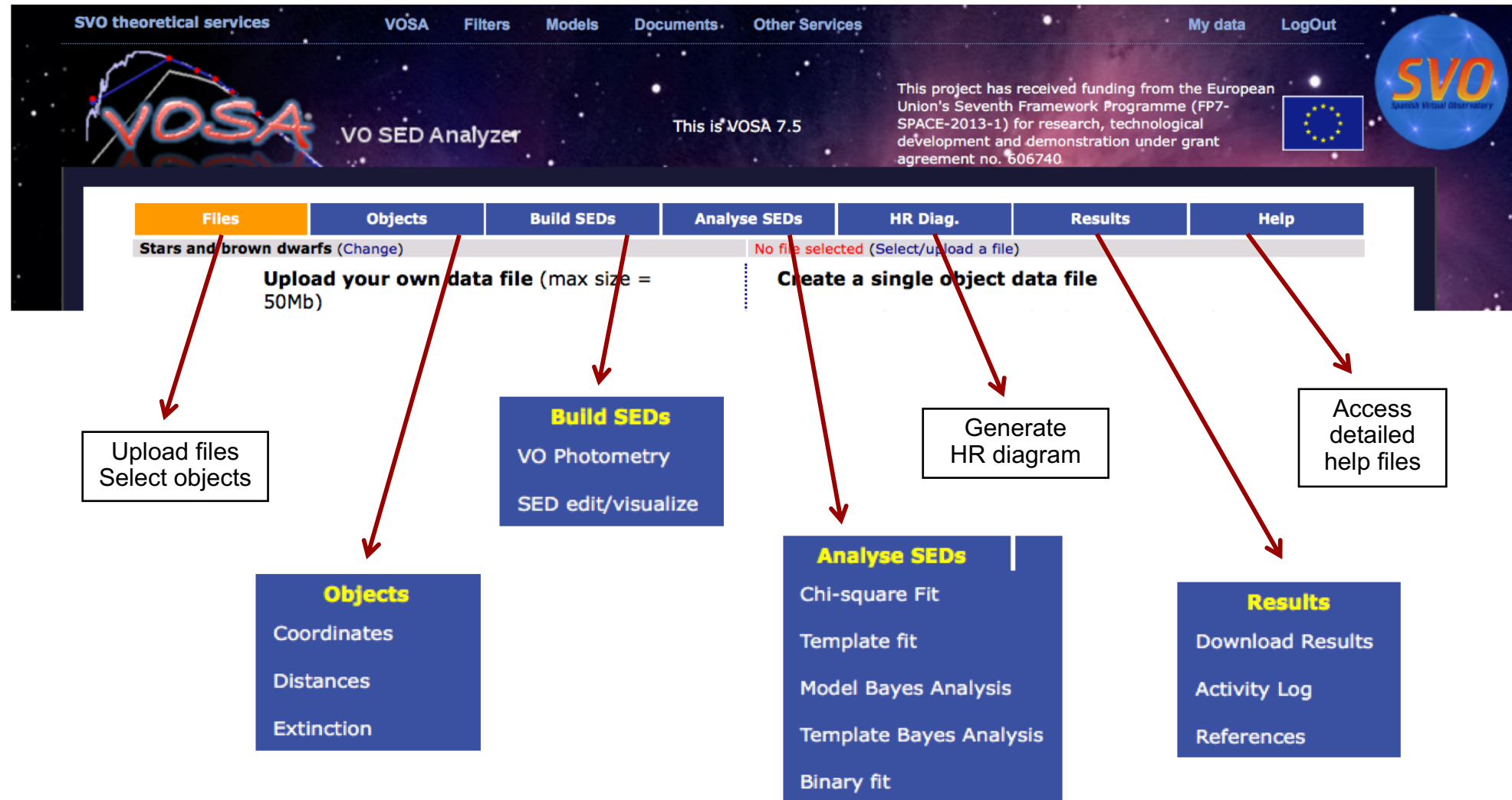
[Gaia Data Release 1 Documentation release D.0](#)

- [\[-\] Gaia Data Release 1 Documentation release D.0](#)
 - [\[+\] Introduction to Gaia DR1](#)
 - [\[+\] Gaia Data Processing](#)

[5.2 Properties of the input data](#)[5.3 Calibration models](#)[5.4 Processing steps](#)

$$m_x = -2.5 \log_{10} \left(\frac{F_x}{F_{x,0}} \right),$$

VOSA: THE VO SED ANALYZER



VOSA: BUILDING SEDs

Theoretical models

☐ BT-Settl (AGSS2009)

The BT-Settl Model grid of theoretical spectra; With a cloud model, valid across the entire parameter range. Using AGSS2009 abundances. Wavelengths have been converted to air wavelengths.

[More info](#)

☐ Coelho Synthetic stellar library (SEDs)

Low resolution theoretical fluxes covering 130nm to 100micron, fully described in Coelho (2014).

[More info](#)

☐ GRAMS, C-rich grid

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.

[More info](#)

☐ Koester WD models

These models are for white dwarfs of spectral type DA with pure hydrogen atmospheres. They use LTE (local thermodynamic equilibrium), hydrostatic equilibrium and plane-parallel, one-dimensional structure. Basic methods and data are described in Koester (2010, Mem.S.A.It. Vol. 81, 921). Since then many improvements were implemented, most notably the hydrogen Stark profiles by Tremblay & Bergeron (2009, ApJ 696,1755), and Tremblay (2015, priv. comm).

Original models have been transformed to air wavelengths and rescaled to $4\pi F_{\text{Eddington}}$ flux in erg/cm²/s/Å

[More info](#)

☐ Kurucz ODFNEW /NOVER, alpha: 0.4 (2003)

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

[More info](#)

☐ BT-Settl (CIST)

The BT-Settl Model grid of theoretical spectra. With a cloud model, valid across the entire parameter range and using the Caffau et al. (2011) solar abundances. Wavelengths have been converted to air wavelengths.

[More info](#)

☐ DRIFT-PHOENIX

Drift-Phoenix is a computer code that simulates the structure of an atmosphere including the formation of clouds. The code is part of the Phoenix-code family. Drift describes the formation of mineral clouds and allows to predict cloud details, like the size of the cloud particles and their composition

[More info](#)

☐ GRAMS, O-rich original grid

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 Oxygen-rich stars

Note that no IR excess is considered when fitting with these models.

[More info](#)

☐ Kurucz ODFNEW /NOVER, alpha: 0.0 (2003)

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

[More info](#)

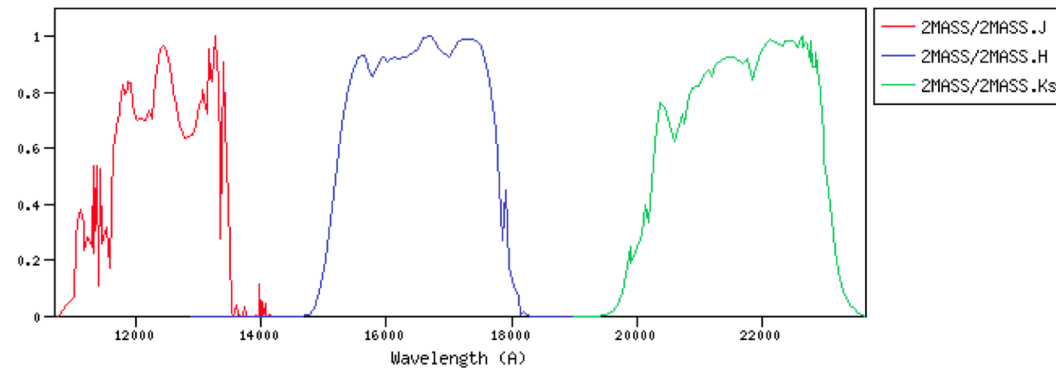
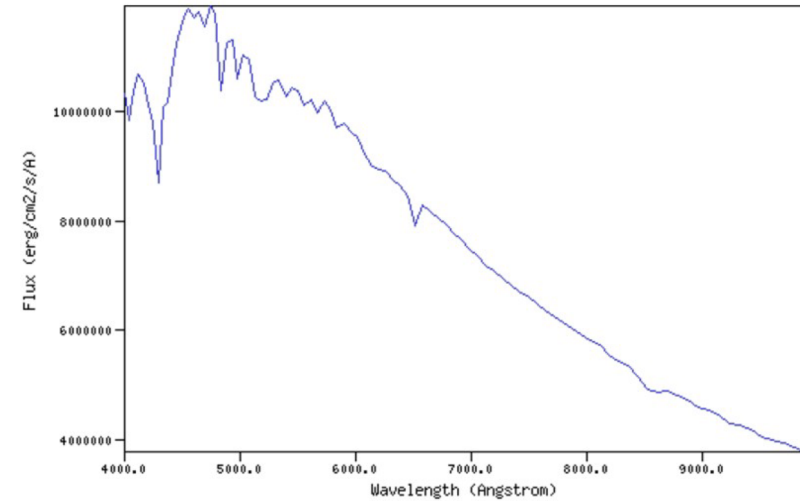
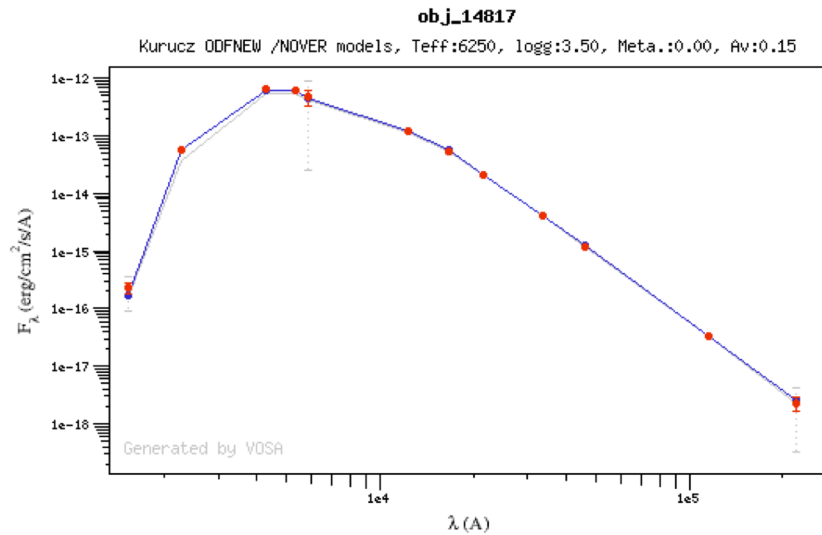
☐ Levenhagen 2017

A grid of LTE and non-LTE synthetic spectra of hot DA white dwarfs. It covers T_{eff} from 17,000 K to 100,000 K and $\log(g)$ from 7.0 to 9.5. The stellar models are built for pure hydrogen and the spectra cover a wavelength range from 90 nm to 2.5 micron.

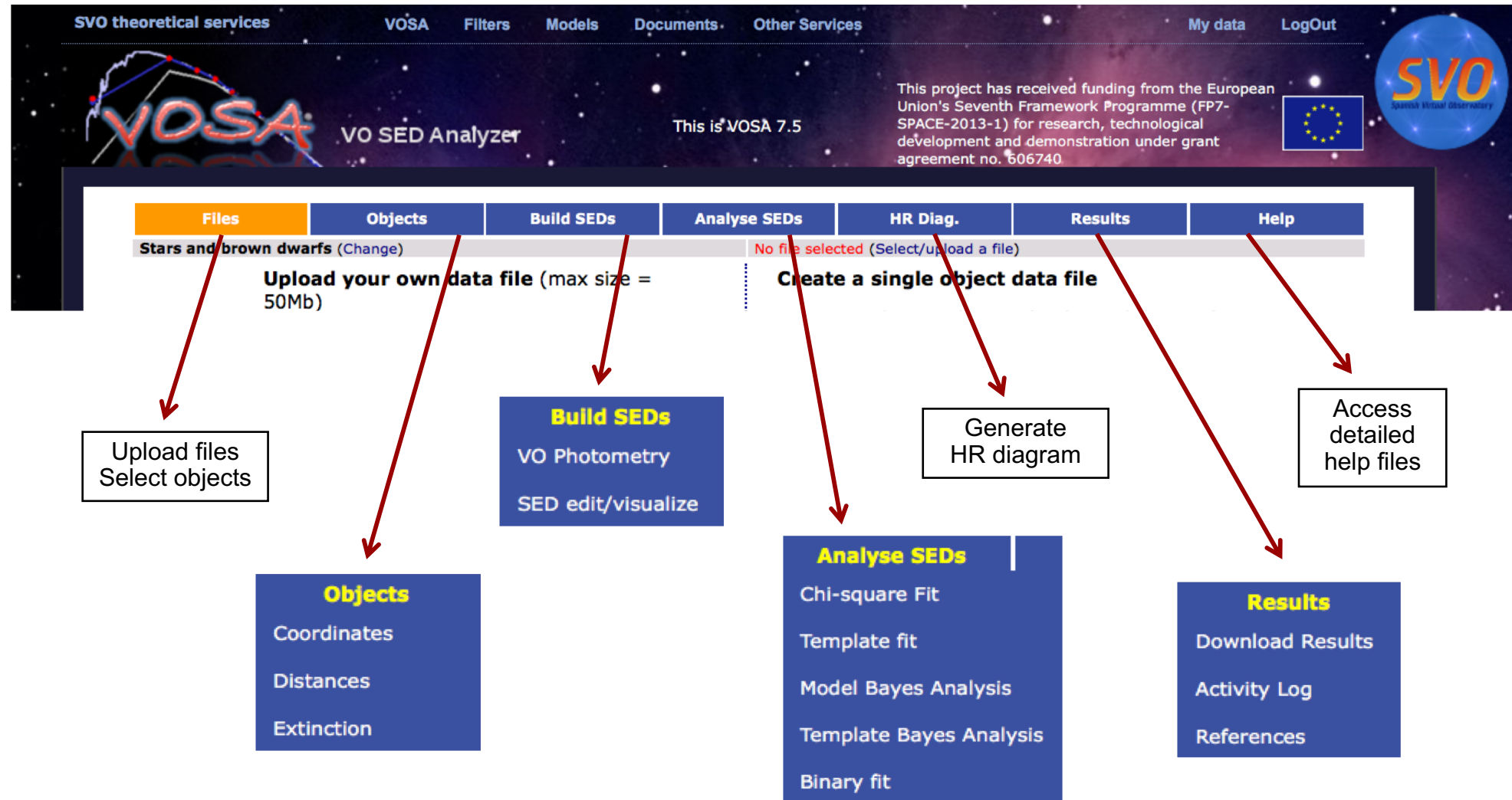
[More info](#)

VOSA: BUILDING SEDs

Data: from theoretical spectra to synthetic photometry



VOSA: THE VO SED ANALYZER



VOSA: THE VO SED ANALYZER



VOSA. Help and Documentation

Version 7.5, July 2022

[Help](#) [News](#) [FAQ](#) [Credits](#) [Help-Desk](#)

Stars and brown dwarfs

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2.6. Filters

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3.1. Coordinates

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5. Analysis

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5.5. Binary Fit

5.6. HR diagram

5.7. Upper Limits

5.8. Statistics

6. Save results

6.1. Download

6.2. SAMP

6.3. References

6.4. Log file

6.5. Plots

Introduction

VOSA (VO Sed Analyzer) is a tool designed to perform the following tasks in an automatic manner:

- Read user photometry-tables.
- Query several photometrical catalogs accessible through VO services (increases the wavelength coverage of the data to be analyzed).
- Query VO-compliant theoretical models (spectra) and calculate their synthetic photometry.
- Perform a statistical test to determine which model reproduces best the observed data (optionally fitting at the same time the optimal interstellar extinction).
- Provide the likelihood of the model parameters (and the interstellar extinction).
- Use the best-fit model as the source of a bolometric correction.
- Provide the estimated bolometric luminosity for each source.
- Generate a Hertzsprung-Russel diagram with the estimated parameters.
- Provide an estimation of the mass and age of each source.

[See this documentation in a single page.](#)

This can be useful to print or to search text, but take into account that it is a large page and can be heavy to load for your browser.

[Upload files](#) ▶

(Click here for a short link to this documentation section)

VOSA: THE VO SED ANALYZER

VOSA. Help and Documentation
Version 7.0, July 2021

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5.6. HR diagram

FAQ

[Distances](#) | [Catalogs / Photometry](#) | [Model fit](#) | [Output products](#)

Distances

Why parallax errors in TGAS are larger in VOSA than those given by the catalogue?

VOSA adds a sistematic error of 0.3 mas to the original error, as recommended in [Brown et al. 2016](#).

Catalogs / Photometry

How is the counterpart selected in the photometric catalogs?

We always take the nearest counterpart within the search radius chosen in the "VO Photometry" tag. For those catalogues containing botn point and extended sources (e.g. SDSS, UKIDSS, VISTA, DES,...), if the nearest counterpart is an extended object, then VOSA does not return any photometric information.

If a photometric point has $\Delta\text{Flux}=0$, how is this treated in the fit?

In summary, points with $\Delta\text{Flux}=0$ are treated as if they had **the largest error** in the SED. VOSA calculates the largest relative error in the SED, adds a 10% and then assigns this relative error to those points without an observational ΔFlux . See the [Fit help](#) section for details.

VOSA: THE VO SED ANALYZER

