

SVO-tools for handling photometry

Enrique Solano



CENTRO DE ASTROBIOLOGÍA · CAB
ASOCIADO AL NASA ASTROBIOLOGY PROGRAM



CSIC

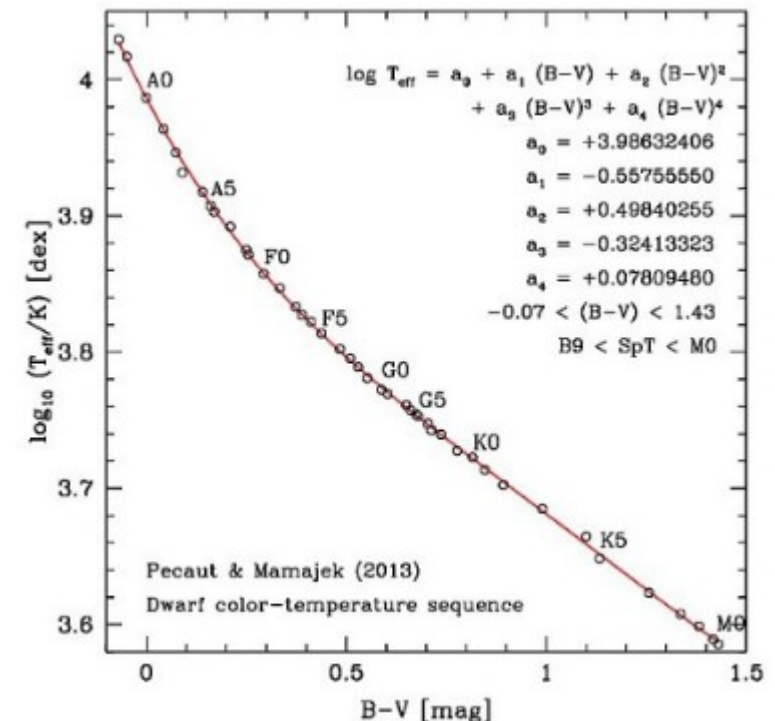


Some basics

- **Astronomical photometry** refers to measuring the apparent brightness of an astrophysical object.
- **A photometric system** can be defined as a set of filters at different wavelengths with a well-characterised response to the incident radiation.

A colour is related to the difference in brightness at two different wavelength.

By comparing information at different wavelengths using colours, it is possible to **estimate physical parameters**.



Some basics

- Since the beginning of the 21st century, large-area, multi-filter surveys have provided photometric information for millions of astronomical objects. → **photometric information for many objects in many filters**



Some basics

- The first big compilation



The Asiago Database on Photometric Systems (ADPS) I. Census parameters for 167 photometric systems

2000, A&AS 147, 361

Dina Moro^{1,2} and Ulisse Munari^{1,3}

- **Problem:** The information provided by the different photometric systems was quite heterogeneous.

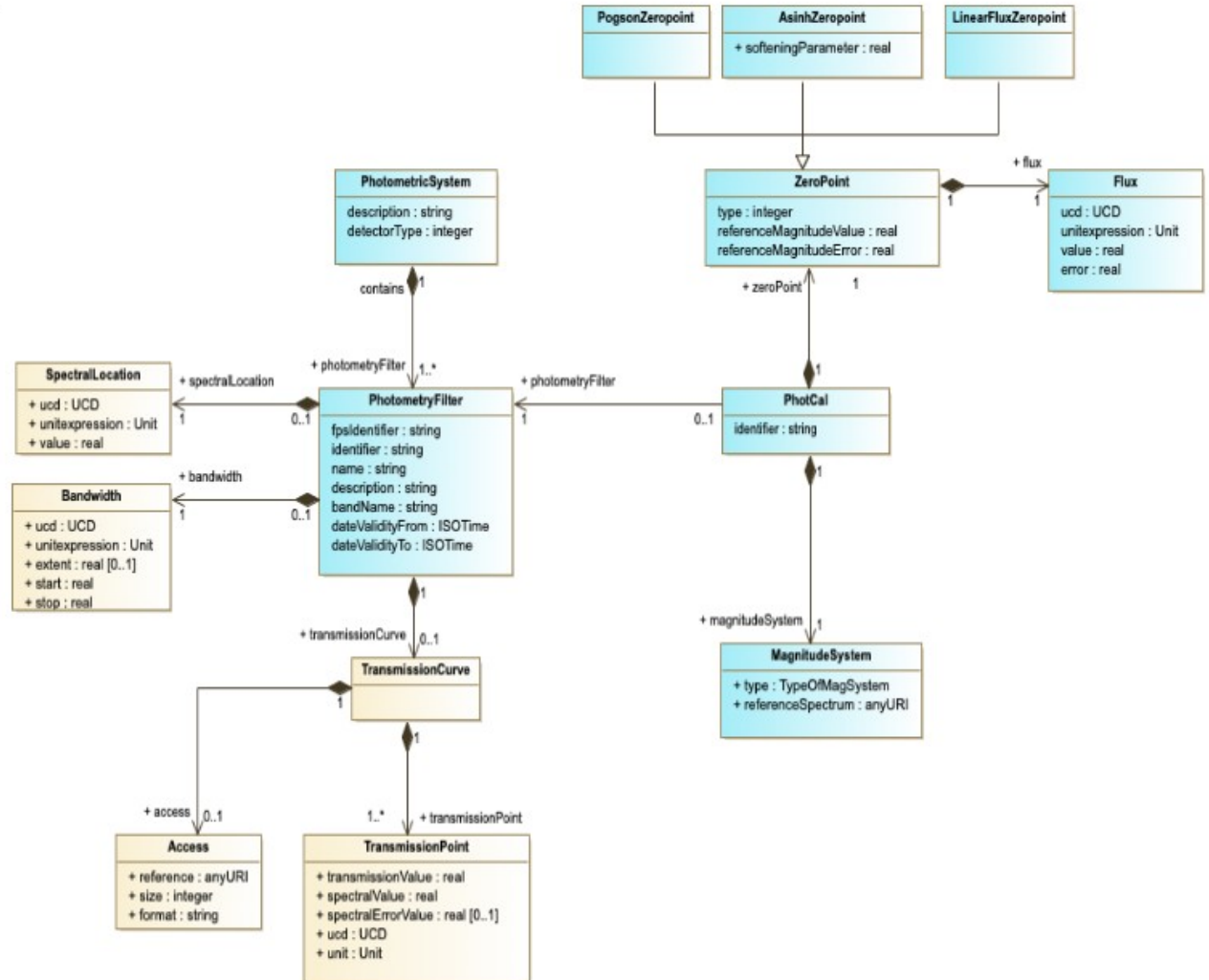
Some basics



International
Virtual
Observatory
Alliance


IVOA Photometry Data Model Version 1.1

IVOA Recommendation 2022-11-01



The SVO Filter Profile Service


- In operation since 2008




Filter Profile Service

Carlos Rodrigo


A repository of Filter information for the VO.



Grant PID2020-112949GB-I00 funded by



MINISTERIO DE CIENCIA E INNOVACIÓN



VO Service Browse Search News Help-Desk

Search text ~ Search (?)

[Astronomy \(7905\)](#) [Planetary science \(616\)](#) [Earth Obs. \(2452\)](#)

2MASS	AAO	ADEOS	AKARI	Akatsuki	AI/Sat1	APEX	APO	Aqua	ARCHEOPS	ARGO	Astrosat	Beijing1	Bepi-Colombo	BICEP
BLAST	BOK	BOOMERANG	CAHA	Cameras	Cassini	CASTOR	CFHT	CHEOPS	Clementine	CMO-SAI	COBE	COMS	Contour	Corot
COSMOSOMAS	CSST	CSTAR	CTIO	Dawn	DeepImpact	DENIS	DOT	DSOVR	Envisat	ERBS	EROS	ERS	ESO	Euclid
ExoMars	FengYun	Flock	FLWO	GAIA	GALEX	Galileo	GCOM-C	GCPD	Gemini	Generic	Geneva	GeoEye	Giotto	GOES
GOTO	GTC	Hayabusa2	HCT	Herschel	Himawari	Hipparcos	HST	IAC80	IKONOS	ING	INSAT	InSight	INT	Integral
IRAM	IRAS	IRS	IRSF	IRTF	ISO	IUE	JCMT	JPSS	JWST	Keck	Kepler	KOMPSTAT	KPNO	Landsat
LasCumbres	LaSilla	LBT	LCO	LICK	Liverpool	LMT	LRO	LSST	LYRA	Mariner10	Mars2020	MAXIMA	McD	MER
Mercator	Messenger	Meteosat	METOP	MEX	Misc	MKO	MMT	MOA	MOM	MOST	MRO	MSX	MT	NAOC
NEAR	NewHorizons	NigeriaSat1	NIMBUS	NIRT	NOAA	NOAO	NOT	OAF	OAJ	OAN-SPM	OAQ	Odyssey	OHP	OLIMPO
OSIRIS-REX	OSN	OVRO	P200	Palomar	PAN-STARRS	Paranal	Parasol	Pathfinder	PLANCK	Pleiades	PRIRODA	QuickBird	QUIET	QUIJOTE
RapidEye	Roman	Rosetta	SALT	SAO	Scorpio	SeaStar	Selene	Sentinel	SEOSAT	SkyMapper	SkySat	SLOAN	SMART1	SOFIA
SOHO	SolarOrbiter	Special	SPECULOOS	SPIDER	Spitzer	SPOT	SPT	SSOT	Stardust	STELLA	Subaru	Swift	TAUVEX	TCS
TD1	Terra	TESS	TIROS-N	TJO	TNG	TNO	TNT	TopHat	TRMM	TYCHO	UK-DMC	UKIRT	VATT	VenusExpress
Viking	Voyager	WASP	WFIRST	WHT	WISE	WIYN	WMAP	WorldView	XMM	ZiYuan				

© SVO, (SVO Privacy Policy), 10970 filters available, Last update: 2023-06-19

If your research benefits from the use of the SVO Filter Profile Service, we would appreciate if you could include the following acknowledgement in your publication:

This research has made use of the SVO Filter Profile Service "Carlos Rodrigo", funded by MCIN/AEI/10.13039/501100011033/ through grant PID2020-112949GB-I00

and we would appreciate if you could include the following references in your publication:

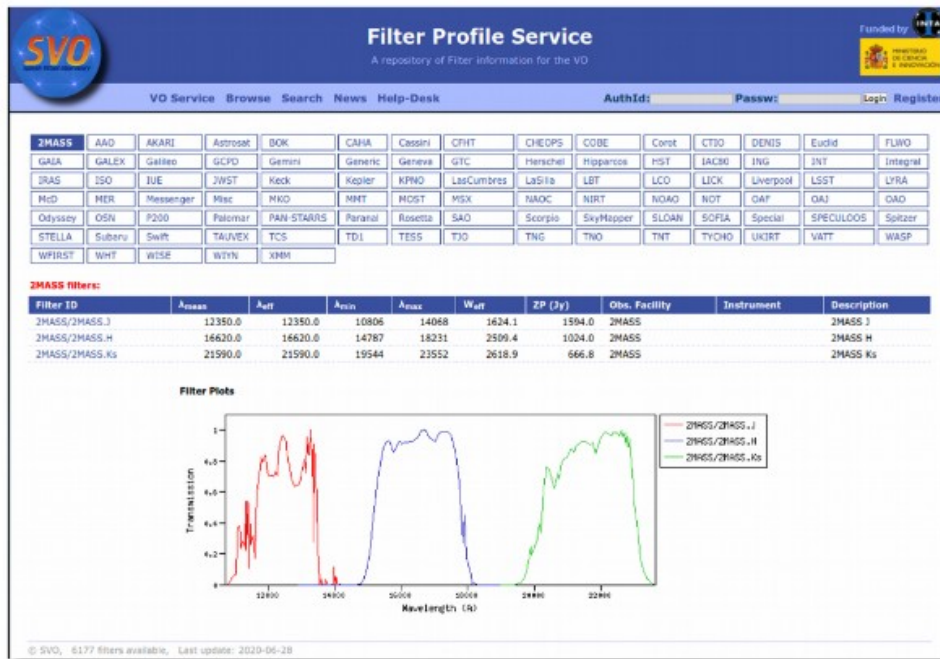
- The SVO Filter Profile Service. Rodrigo, C., Solano, E., Bayo, A., 2012; <https://ui.adsabs.harvard.edu/abs/2012ivoa.rept.1015R/abstract>
- The SVO Filter Profile Service. Rodrigo, C., Solano, E., 2020; <https://ui.adsabs.harvard.edu/abs/2020sea.confE.182R/abstract>

The SVO Filter Profile Service

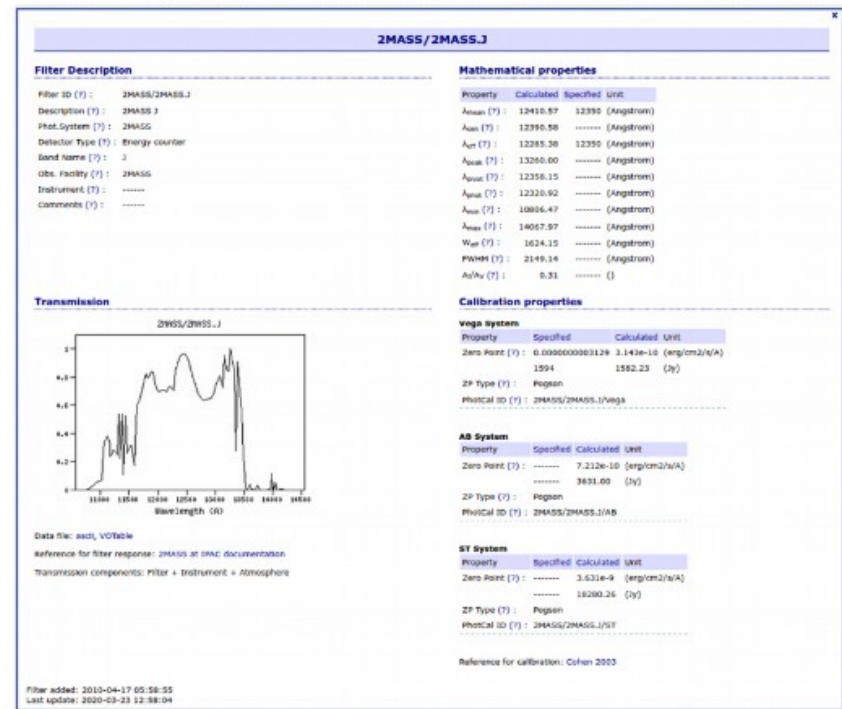
Web access



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



- Transmission curves,
- Mathematical properties,
- Reference wavelengths,
- Zero points, etc.

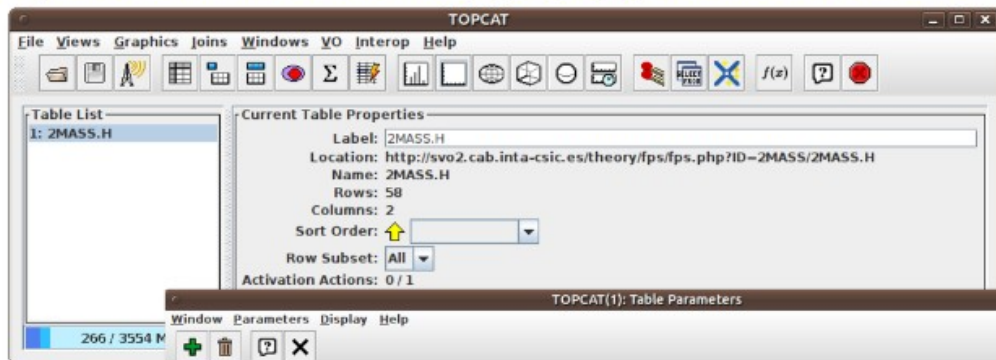


The SVO Filter Profile Service

VO access



<http://svo2.cab.inta-csic.es/theory/fps/fps.php?ID=2MASS/2MASS.H>



TOPCAT(1): Table Parameters

Table Parameters for 1: 2MASS.H

Δ Name	Value	Units	Description	UCD	Utype
Band	H				photdm:PhotometryFilter.band
CalibrationReference	http://ladsabs.harvard.edu/abs/2003A...				
Column Count	2		Number of columns		
Description	2MASS H			meta.note	photdm:PhotometryFilter.descr
Description	2MASS.H			meta.note	photdm:PhotometryFilter.descr
FWHM	2609.6475	Angstrom	Full width at half maximum. Defined as...	instr.bandwidth	
Facility	2MASS		Observational facility	meta.ref.vorn	PhotometryFilter.fpsidentfier
FilterProfileService	http://svo2.cab.inta-csic.es/theory/fps/fps.php?ID=2MASS/2MASS.H			meta.code	photdm:PhotometryFilter.SpectralAxis.c
MagSys	Vega			meta.code	photdm:PhotometryFilter.SpectralAxis.c
Name	2MASS.H		Table name		
PhotCalID	2MASS/2MASS.H/Vega			meta.id	photdm:PhotCal.identifier
PhotSystem	2MASS		Photometric system		photdm:PhotometricSystem.description
ProfileReference	http://www.ipac.caltech.edu/2mass/re...				
QUERY STATUS	OK				
Row Count	58		Number of rows		
WavelengthCen	16487.193	Angstrom	Central wavelength. Defined as the c...	em.wl	
WavelengthEff	16620.0	Angstrom	Manually specified. See reference	em.wl.effective	
WavelengthMax	18231.02	Angstrom	Maximum filter wavelength. Defined as...	em.wl.stat.max	photdm:PhotometryFilter.SpectralAxis.c
WavelengthMean	16620.0	Angstrom	Manually specified. See reference	em.wl	photdm:PhotometryFilter.SpectralAxis.c
WavelengthMin	14787.379	Angstrom	Minimum filter wavelength. Defined as...	em.wl.stat.min	photdm:PhotometryFilter.SpectralAxis.c
WavelengthPeak	16710.0	Angstrom	Peak wavelength. Defined as the lam...	em.wl	
WavelengthPhot	16423.764	Angstrom	Photon distribution based effective w...	em.wl	
WavelengthPivot	16457.506	Angstrom	Peak wavelength. Defined as sqrt(int...	em.wl	
WavelengthUCD	em.wl			meta.ucd	PhotometryFilter.SpectralAxis.UCD
WavelengthUnit	Angstrom			meta.unit	PhotometryFilter.SpectralAxis.unit
WidthEff	2509.4023	Angstrom	Effective width. Defined as integrl...	instr.bandwidth	photdm:PhotometryFilter.SpectralAxis.c
ZeroPoint	1024.0			phot.flux.density	photdm:PhotCal.ZeroPoint.Flux.value
ZeroPointType	Poisson			meta.code	photdm:PhotCal.ZeroPoint.type

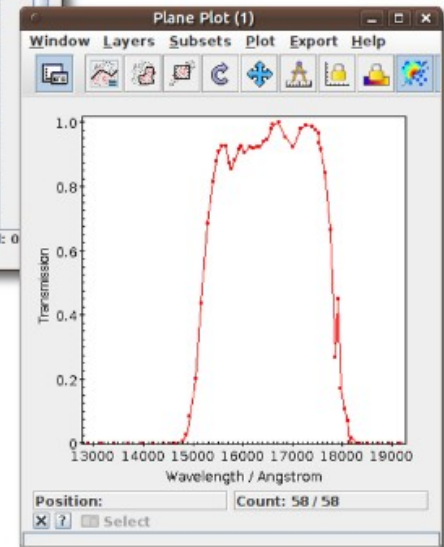
TOPCAT(1): Table Browser

Window Rows Help

Table Browser for 1: 2MASS.H

	Wavelength	Transmission
6	14180	0.
7	14400	0.0005
8	14620	0.0028
9	14780	0.0081
10	14860	0.0287
11	14930	0.0871
12	15040	0.2014
13	15150	0.4382
14	15280	0.6864
15	15390	0.8181
16	15460	0.8821
17	15510	0.9118
18	15560	0.9269
19	15650	0.9293
20	15720	0.8727
21	15770	0.8566
22	15830	0.8826
23	15920	0.9181
24	15970	0.9267
25	16020	0.9076

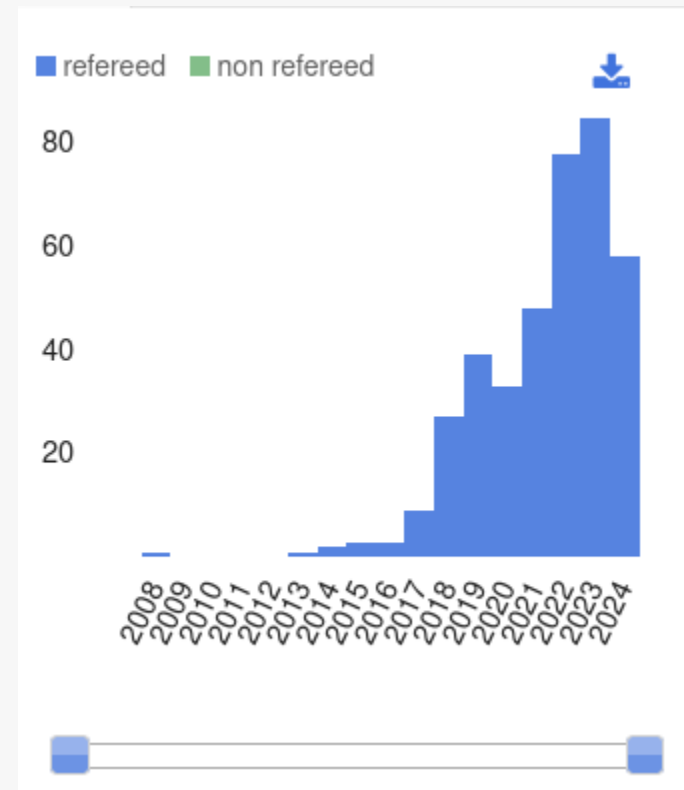
Total: 58 Visible: 58 Selected: 0



The SVO Filter Profile Service

- FPS contains the largest public collection of filters available to the community.

- [Astronomy \(7905\)](#)
- [Planetary science \(616\)](#)
- [Earth Obs. \(2452\)](#)



SVO applications making use of FPS

SVO theoretical servicesVOSAFiltersModelsDocumentsOther ServicesMy dataUploadsLogOut

20YearsSVOStellar Virtual Observatory2004 - 2024

Stellar Spectral Libraries

CaT. Empirical Calibration of the Near-IR Ca II Triplet

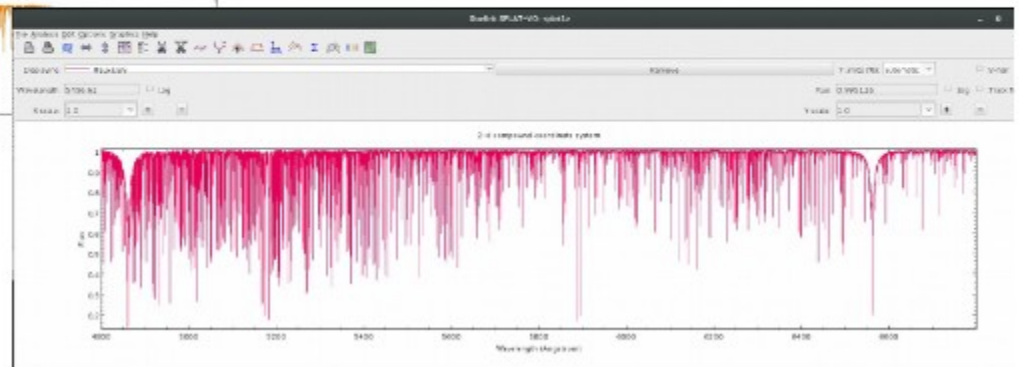
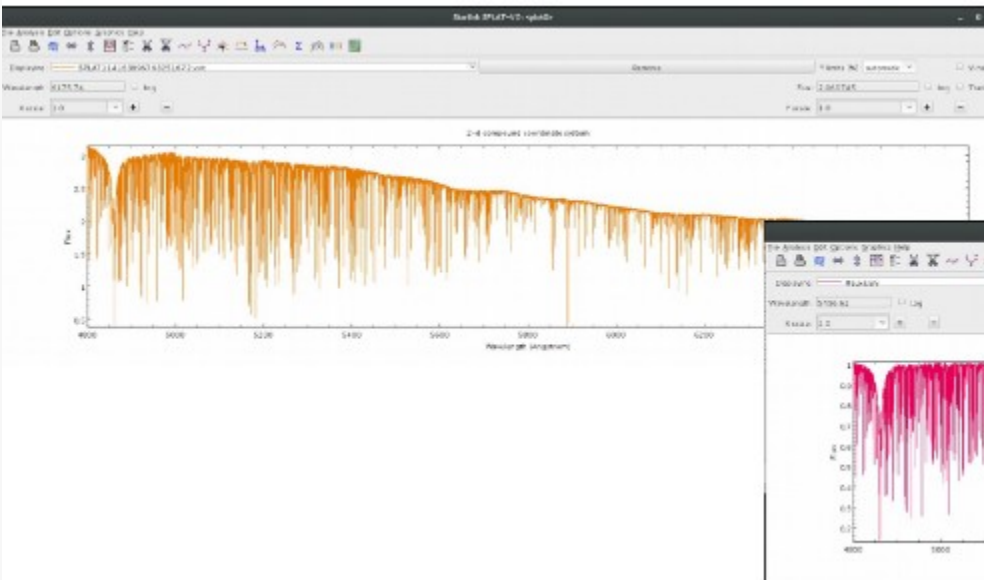
The project is dedicated to the empirical calibration of the Ca II triplet and stellar population synthesis modelling. For this purpose, we make use of a new stellar library of 706 stars in the near-IR spectral range (from 8348 to 9020 with a FWHM of 1.5) which spans a wide range of updated atmospheric parameters.

FGKM stellar Library, Yee et al. 2017

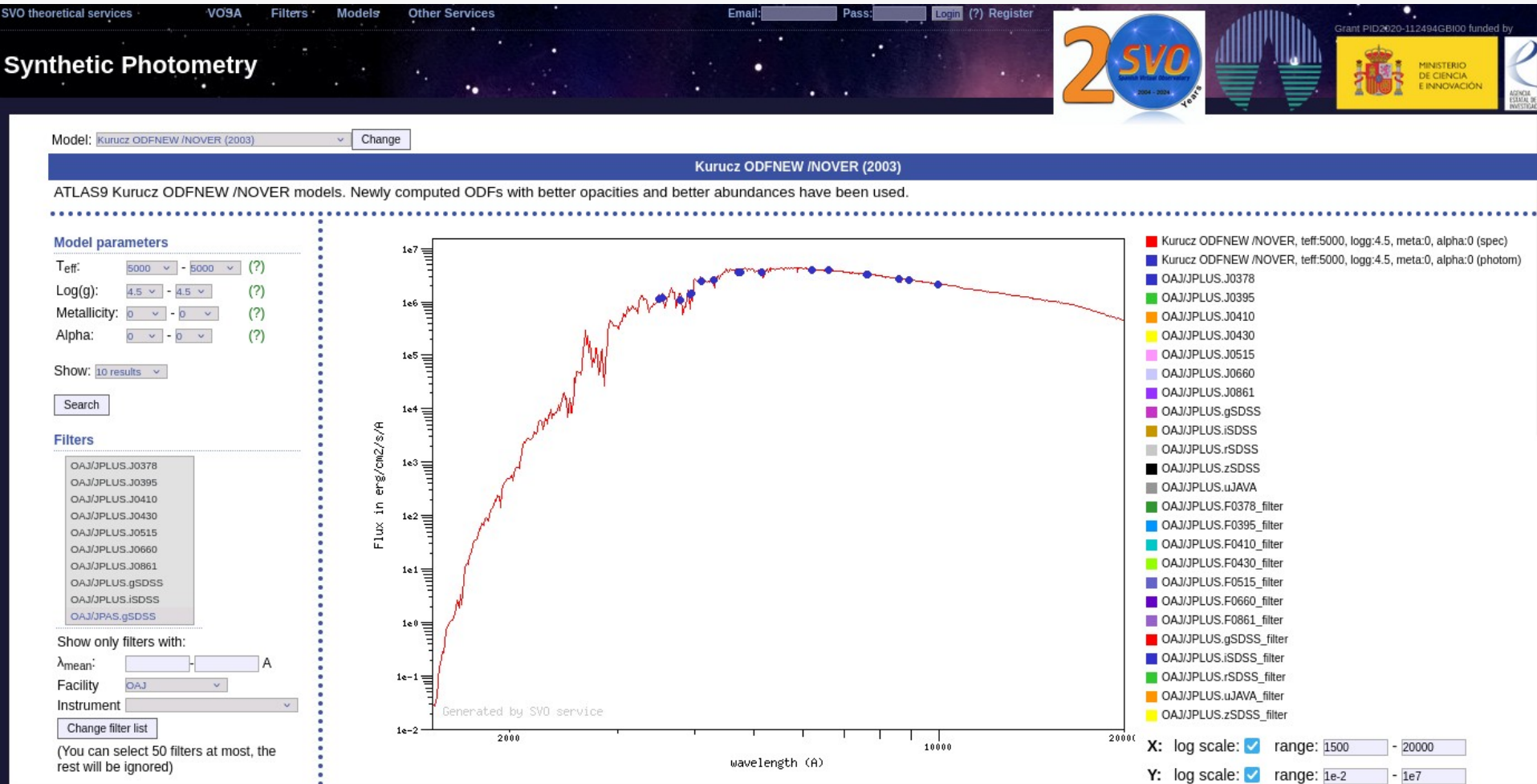
Precision Stellar Characterization of FGKM Stars using an Empirical Spectral Library.

Gaia FGK Benchmark Stars

The Gaia FGK Benchmark Stars are a common set of calibration stars, covering different regions of the HR diagram and spanning a wide range in metallicity. It is a homogeneous library in the visual range (480-680 nm) of high resolution and signal to noise ratio (S/N) spectra corresponding to the 34 Benchmark Stars and 5 metal-poor candidates.



SVO applications making use of FPS



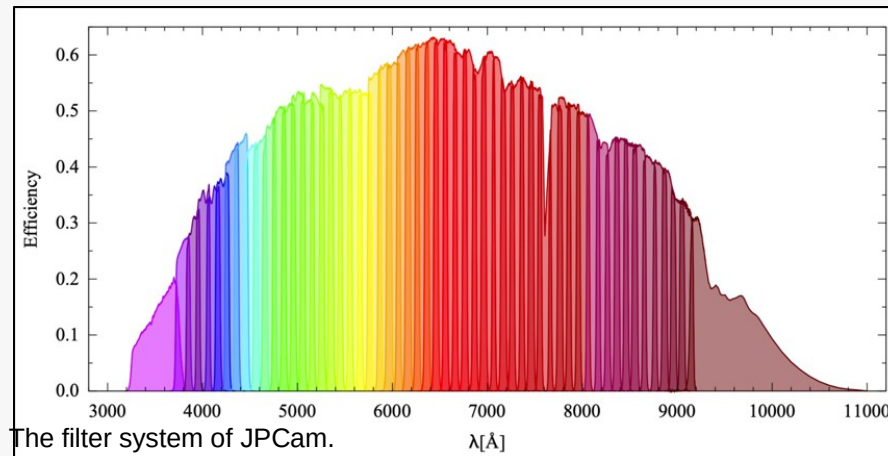
SVO applications making use of FPS

A&A, 689, A93 (2024)
<https://doi.org/10.1051/0004-6361/202449998>
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**Astronomy
&
Astrophysics**

Photometric segregation of dwarf and giant FGK stars using the SVO Filter Profile Service and photometric tools

Carlos Rodrigo^{1,*}, Patricia Cruz¹, John F. Aguilar^{2,3}, Alba Aller⁴, Enrique Solano¹,
Maria Cruz Gálvez-Ortiz¹, Francisco Jiménez-Esteban¹, Pedro Mas-Buitrago¹, Amelia Bayo⁵,
Miriam Cortés-Contreras⁶, Raquel Murillo-Ojeda¹, Silvia Bonoli^{7,8}, Javier Cenarro⁸, Renato Dupke⁹,



< 50 filter → 15 filters → 105 colours → 5460 colour combinations.

SVO applications making use of FPS

Theoretical spectra web server

Calculate colors

Model

BT-Settl (CIFIST) ▼

T_{eff}: 1200 ▼ - 7000 ▼ (?)

Logg: 2.5 ▼ - 5.5 ▼ (?)

Metallicity: 0 ▼ - 0 ▼ (?)

Colors

2MASS/2MASS.J ▼	-	2MASS/2MASS.H ▼
--- ▼	-	--- ▼
--- ▼	-	--- ▼

Get results

Download VOTable

Download CSV

Direct URL for VOTable:

[http://svo2.cab.inta-csic.es/theory/newov2/colors.php?model=bt-settl-cifist &color\[1\]=2MASS/2MASS.J,2MASS/2MASS.H &restri\[teff\]=1200/7000 &restri\[logg\]=2.5/5.5 &restri\[meta\]=0/0](http://svo2.cab.inta-csic.es/theory/newov2/colors.php?model=bt-settl-cifist &color[1]=2MASS/2MASS.J,2MASS/2MASS.H &restri[teff]=1200/7000 &restri[logg]=2.5/5.5 &restri[meta]=0/0)

Direct URL for CSV:

[http://svo2.cab.inta-csic.es/theory/newov2/colors.php?model=bt-settl-cifist &color\[1\]=2MASS/2MASS.J,2MASS/2MASS.H &restri\[teff\]=1200/7000 &restri\[logg\]=2.5/5.5 &restri\[meta\]=0/0 &format=csv](http://svo2.cab.inta-csic.es/theory/newov2/colors.php?model=bt-settl-cifist &color[1]=2MASS/2MASS.J,2MASS/2MASS.H &restri[teff]=1200/7000 &restri[logg]=2.5/5.5 &restri[meta]=0/0 &format=csv)

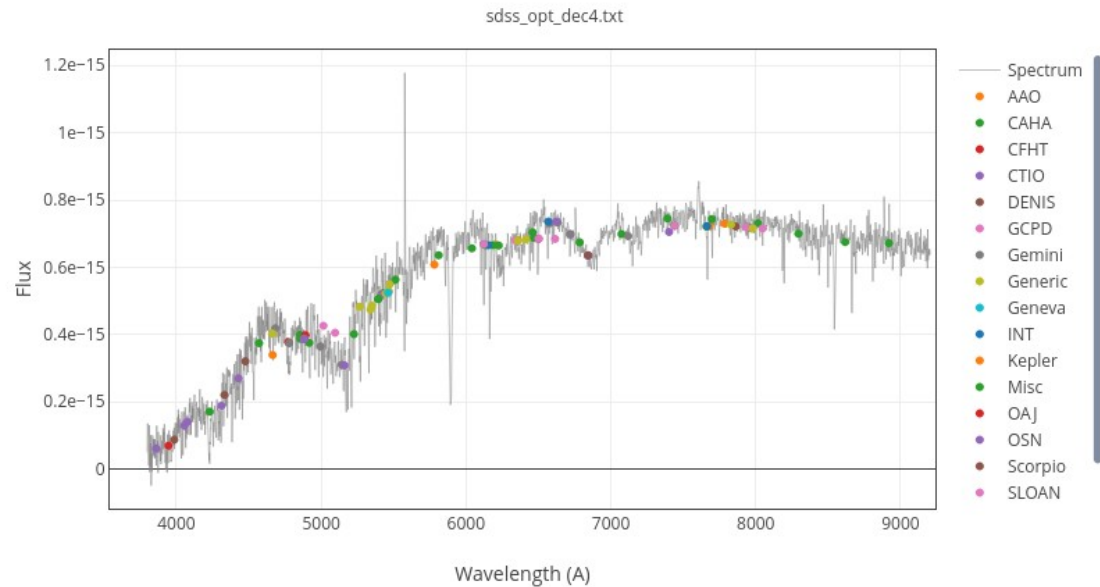
SVO applications making use of FPS



Your collections Upload new collection Help

Collection: Spectrum:

Filter	λ	Flux
AAO/AAO.aao90	4664.98	3.394248e-16
AAO/AAO.aao23	5416.22	5.191478e-16
AAO/AAO.aao91	6208.99	6.669996e-16
AAO/AAO.aao46	6358.40	6.806724e-16
AAO/AAO.aao24	6499.55	6.845242e-16
AAO/AAO.aao92	7680.78	7.226463e-16
AAO/AAO.aao47	7784.64	7.300226e-16
CAHA/ALHAMBRA.F427W	4230.27	1.711250e-16
CAHA/ALHAMBRA.F458W	4571.24	3.748070e-16
CAHA/BUSCA.Hbn	4853.41	3.990099e-16
CAHA/LAICA.SDSS_g	4855.59	3.882855e-16
CAHA/ALHAMBRA.F489W	4917.34	3.758881e-16
CAHA/ALHAMBRA.F520W	5226.09	4.009534e-16
CAHA/LAICA.Johnson_V	5428.81	5.231630e-16
CAHA/ALHAMBRA.F551W	5512.77	5.636919e-16
CAHA/ALHAMBRA.F582W	5811.48	6.355001e-16
CAHA/ALHAMBRA.F613W	6133.31	6.653991e-16
CAHA/LAICA.SDSS_r	6186.46	6.659410e-16
CAHA/BUSCA.Red	6225.67	6.644391e-16
CAHA/ALHAMBRA.F644W	6460.00	7.042320e-16
CAHA/LAICA.Johnson_R	6467.52	6.869977e-16
CAHA/ALHAMBRA.F675W	6794.44	6.720290e-16



SVO applications making use of FPS



[Your collections](#) [Upload new collection](#) [Help](#)

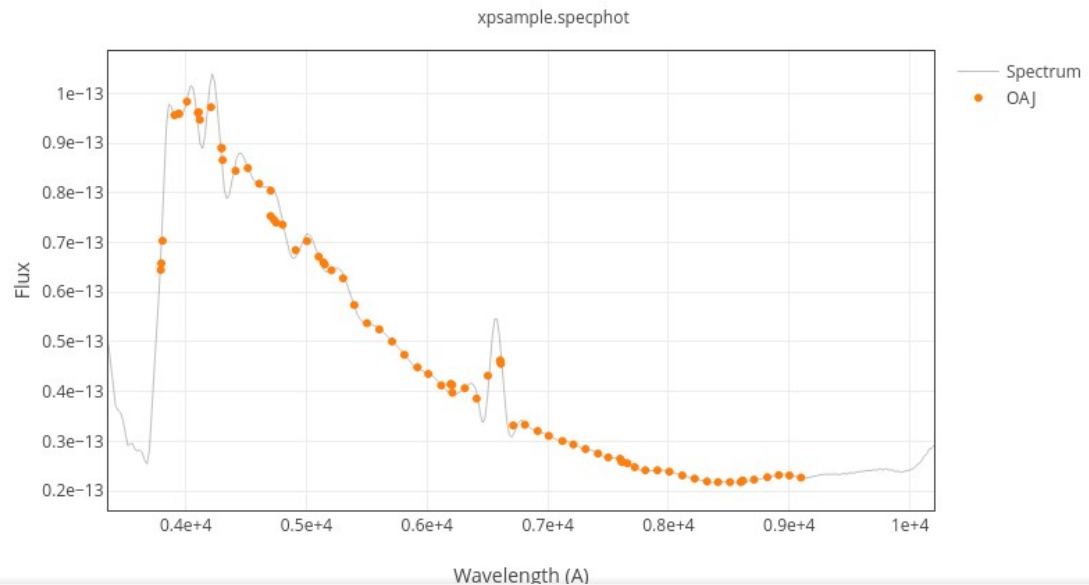
Collection: Spectrum:

This is the photometry calculated for this spectrum.

If you want to recalculate it for this spectrum and these or different filters, just [Recalculate it](#).

Otherwise, you can also download these data as an [ASCII file](#), a [VOTable file](#), or generate a [VOSA file](#) with these data

Filter	λ	Flux
OAJ/JPLUS.J0378	3793.43	6.450167e-14
OAJ/JPLUS.F0378_filter	3797.78	6.579922e-14
OAJ/JPAS.J0378	3808.73	7.037102e-14
OAJ/JPAS.J0390	3906.57	9.560405e-14
OAJ/JPLUS.J0395	3938.56	9.587757e-14
OAJ/JPLUS.F0395_filter	3946.00	9.591309e-14
OAJ/JPAS.J0400	4010.69	9.831019e-14
OAJ/JPLUS.F0410_filter	4101.72	9.608740e-14
OAJ/JPLUS.J0410	4108.03	9.623272e-14
OAJ/JPAS.J0410	4117.40	9.471964e-14
OAJ/JPAS.J0420	4209.55	9.720905e-14
OAJ/JPLUS.F0430_filter	4297.01	8.906084e-14
OAJ/JPLUS.J0430	4298.44	8.893230e-14
OAJ/JPAS.J0430	4306.32	8.655595e-14
OAJ/JPAS.J0440	4413.40	8.441734e-14
OAJ/JPAS.J0450	4514.44	8.500201e-14
OAJ/JPAS.J0460	4608.54	8.185387e-14
OAJ/JPLUS.gSDSS_filter	4703.39	7.530752e-14
OAJ/JPAS.J0470	4704.39	8.041419e-14



SVO applications making use of FPS

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:

Login

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:

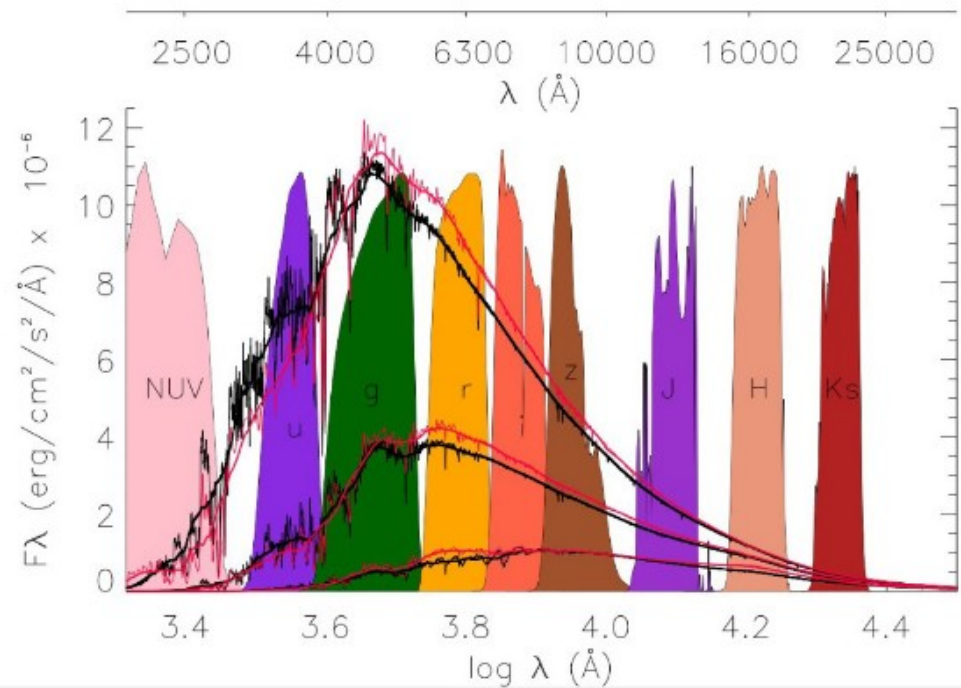
- Read user photometry-tables.
- Query several photometrical catalogs accessible through VO services (increases the wavelength coverage of the data to be analyzed).
- Query VO-compliant theoretical models (spectra) and calculate their synthetic photometry.
- Perform a statistical test to determine which 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/>

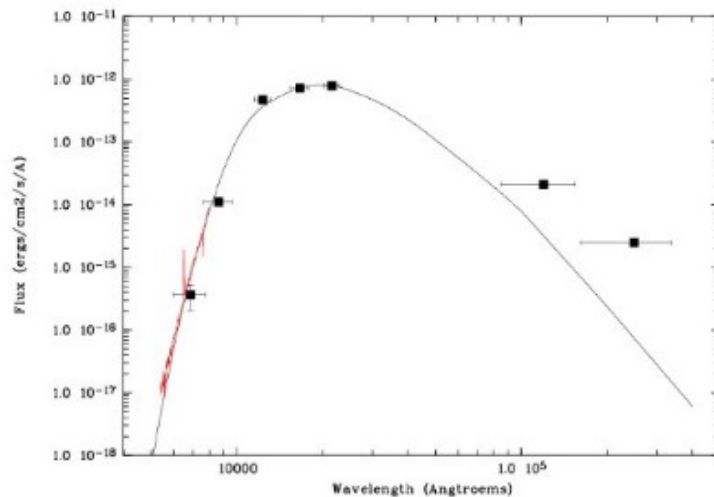
SVO applications making use of FPS



SVO applications making use of FPS

VOSA: BUILDING SEDs


- Data Manipulation: From magnitudes to fluxes




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

 [start Aladin Lite](#)

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

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Gaia Data Release Documentation



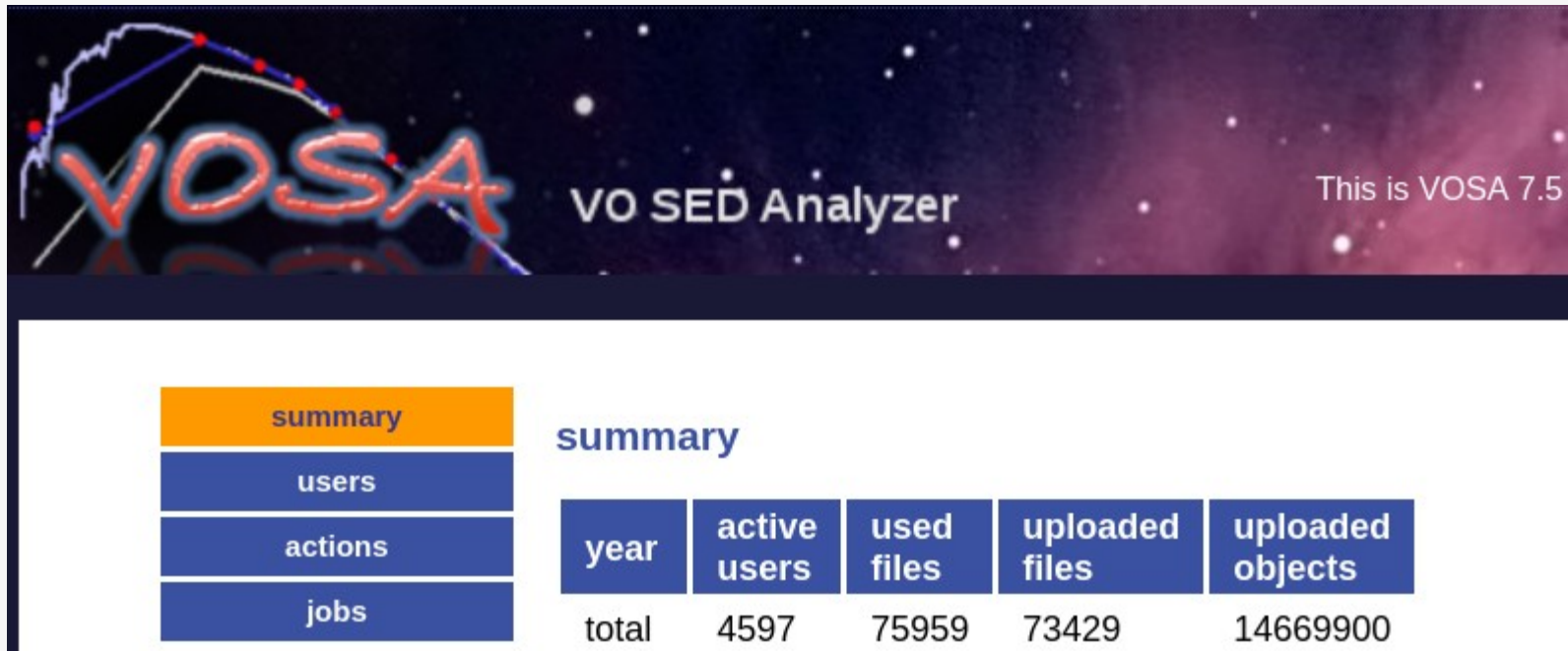
[Gaia Data Release 1 Documentation](#)
release D 0

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

[Introduction to Gaia DR1](#)

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

SVO applications making use of FPS



Others applications making use of FPS

Gemini Science Archive

This page provides access to data from the Gemini Observatory. The Observatory has deployed a new archive service [described here](#) and it can be accessed from the link in the menu to the left. All proprietary data must now be retrieved using this service.

The CADC will continue to provide access to public Gemini data through its [Advanced Search](#) service. For convenience a link to a search page for the Gemini collection is provided in the menu to the left.

Acknowledgements

Any paper that includes any data obtained with one or both of the Gemini telescopes should use the [appropriate acknowledgement](#) as a footnote on the first page of the paper.

If your research benefits from the use of the SVO Filter Profile Service, we would appreciate if you could include the following acknowledgement in your publication:

This research has made use of the [SVO Filter Profile Service](#) supported from the Spanish MINECO through grant AYA2017-84089.

Others applications making use of FPS

VizieR Photometry viewer

The VizieR photometry tool allows for easy visualization of photometry points extracted around a given position or object name from photometry-enabled catalogues in VizieR.

Alternative output: Query VizieR photometry using [API](#)

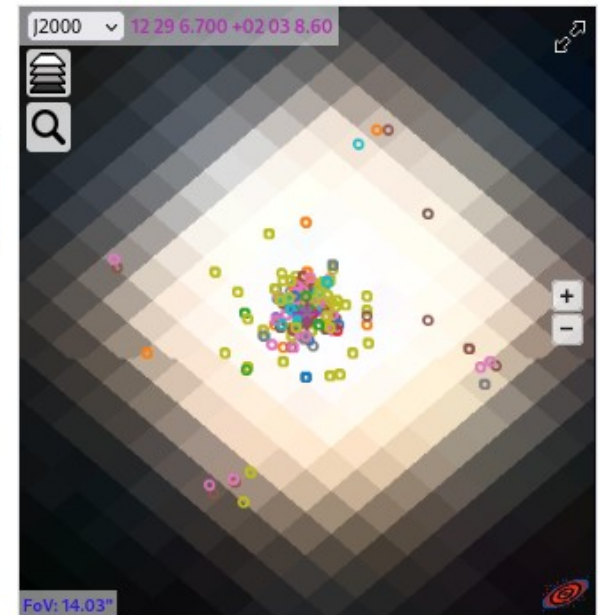
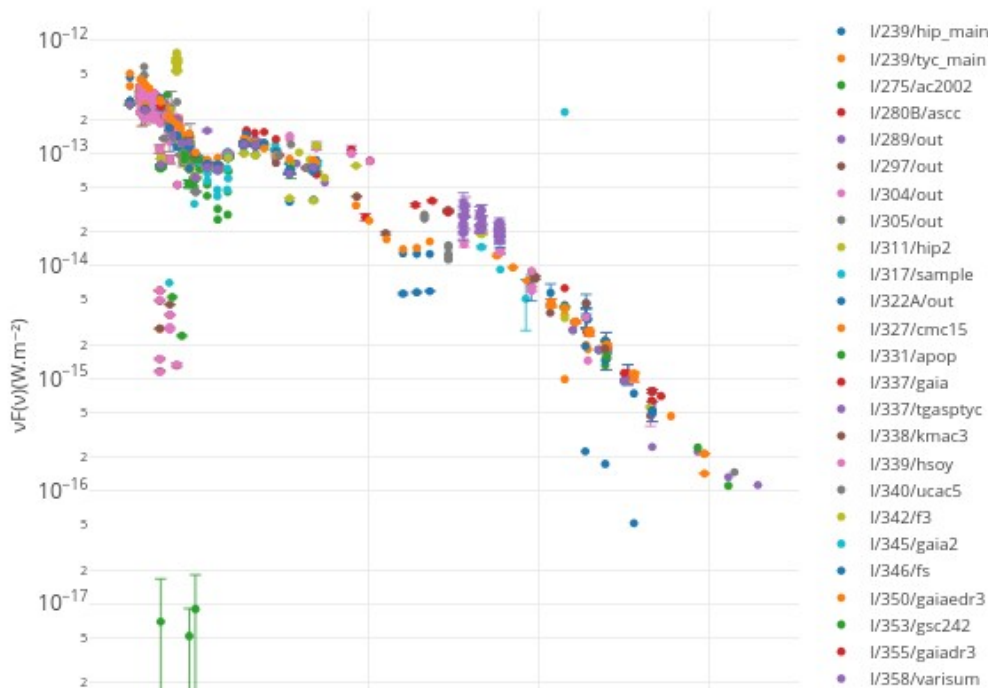
Target: 3c 273

Radius (in arcsec): 5

submit

2D 3D

Spectral energy distribution



Selected point: -1

Wavelength: Infinity μm

Frequency: 0 Ghz

Energ: 0 eV

Others applications making use of FPS

README MIT license



ska - Spectral-Kit for Asteroids

Suites of tools to compute colors from spectra or reflectance spectra using the [SVO Filter Service](#) in different photometric system: Vega, AB, ST.

Installation

Install from PyPi using `pip` :

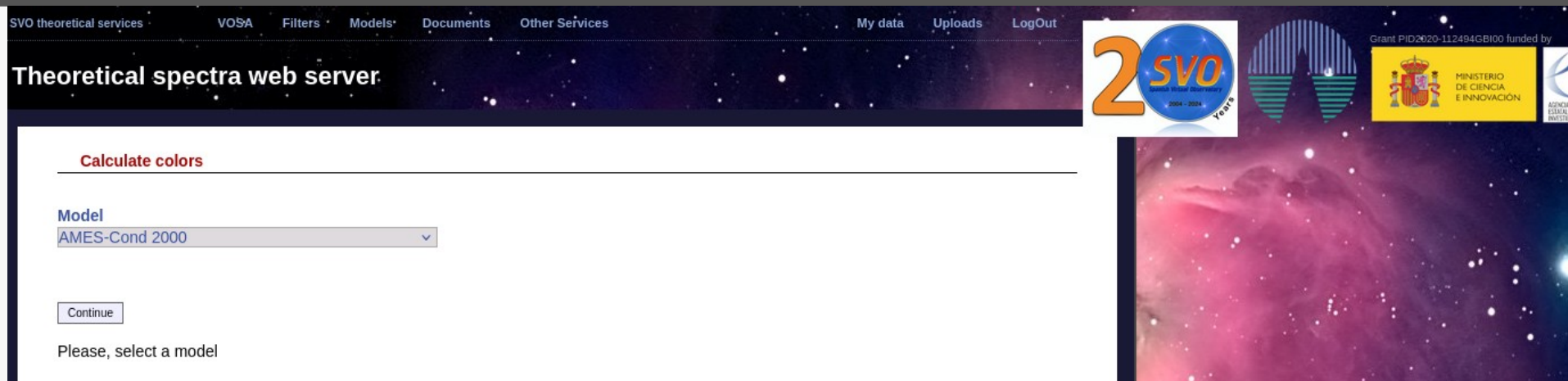
```
$ pip install space-ska
```

The minimum required `python` version is 3.8.

Documentation

Check out the documentation at <https://space-ska.readthedocs.io> or run







SVO applications making use of FPS



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<https://doi.org/10.1051/0004-6361/202449998>
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**Astronomy
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Astrophysics**

Photometric segregation of dwarf and giant FGK stars using the SVO Filter Profile Service and photometric tools

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** In Memoriam:* This work is dedicated to the memory of our dearest friend and colleague Carlos Rodrigo. The Spanish Virtual Observatory will certainly miss one of its best ambassadors.