Characterization of circumstelar disks around PMS stars.

Development of a SED fitting tool.

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http://laeff.esa.es/svo/

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SVO: General framework

- Aim: Coordination of the activities of the Spanish institutes in the VO framework. Contact-point for the international VO-projects

- Work-areas:

  - ✓ Adaptation to the astronomical archives under LAEFF responsibility to the VO standards.
  - ✓ Development of data mining tools.
  - ✓ Development of VO Science Cases.
  - ✓ Development of Education and Outreach activities.

The Science Case:

"Caracterization of the circumstellar disks of pre-main sequence stars"

- Propelled by the discovery of extrasolar planetary system:

The understanding of the formation and evolution of protoplanetary disks is a crucial step.

- Open questions:

➔ What is the process driving the evolution from dense disks in PMS to debris disk in Vega-type stars?.

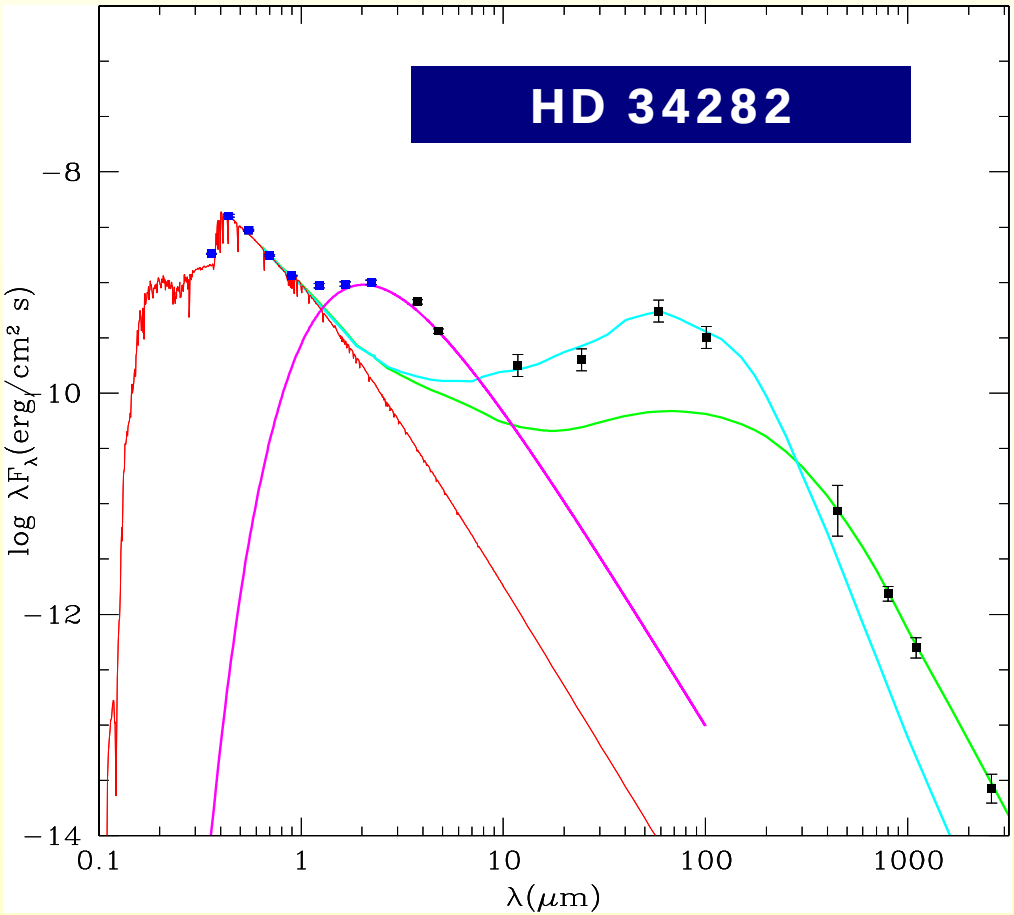
➔ Does it always occur?

➔ What does it depend on?

(From Spitzer)

The Technique

- Comparison of the observed SED with a grid of theoretical models (stellar + disks).



EXPORT simultaneous photometry.

Literature + IRAS + ISO

Kurucz model (star)

Teff: 8720K, log: 4.2

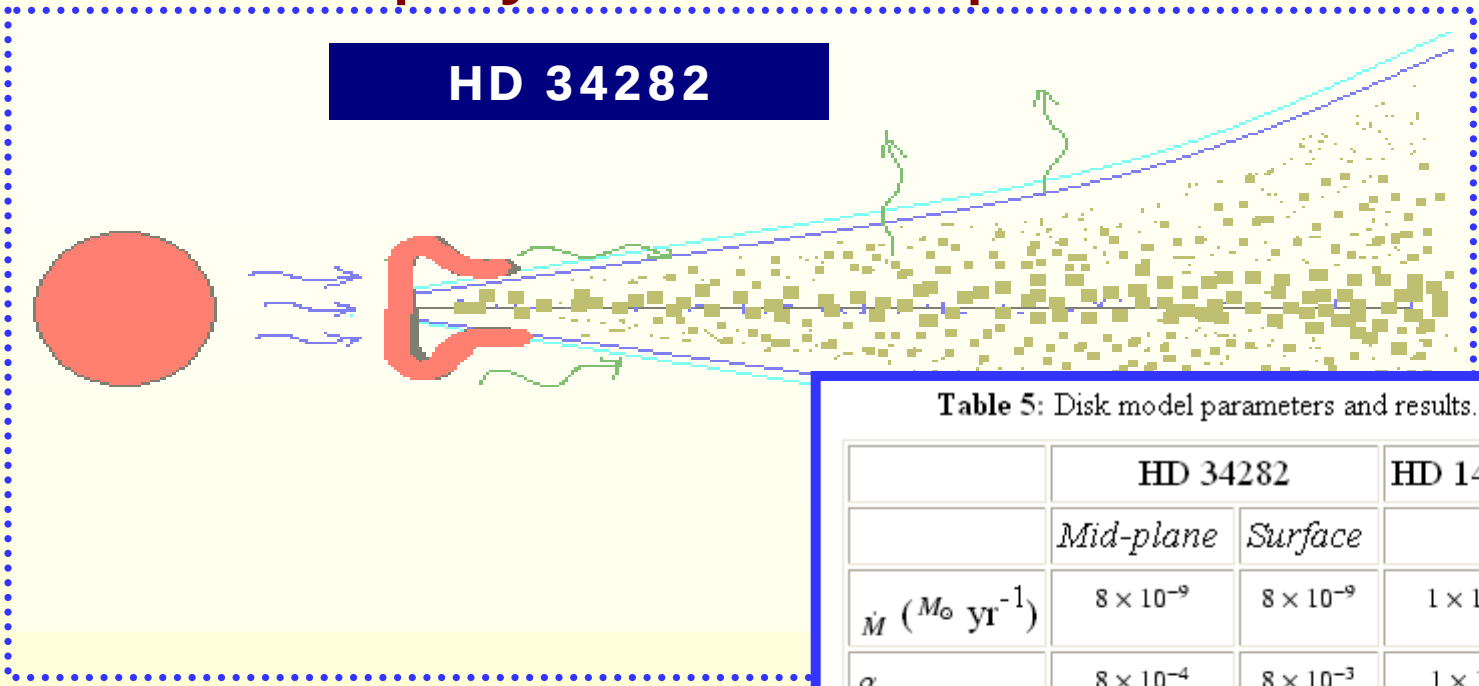
Blackbody (3μm bump, disk inner wall)

Teff: 1400K

Model1 (amax = 1cm)

Model2 (amax = 1 μm)

The physical interpretation



- Two grain sizes: thin dust par
disk, and large particles in the mi

- The black body emission at 3
edge of the disk, frontally illumina

Table 5: Disk model parameters and results.

	HD 34282		HD 141569
	Mid-plane	*Surface*	
$\dot{M}$ ($M_\odot$ yr^{-1})	8×10^{-9}	8×10^{-9}	1×10^{-11}
α	8×10^{-4}	8×10^{-3}	1×10^{-3}
R_{in} (AU)	0.31	0.31	0.24
R_{out} (AU)	705	705	428
p	2.5	3.5	2.5
a_{max}	1 cm	1 μm	1 mm
Inclination	56°	56°	51°
$H_{10\,AU}$ (AU)	3.06	4.13	2.33
M_{disk} ($M_\odot$)	0.70	0.06	6.3×10^{-4}

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The goal

"To rep… alysis in a much mor… covering the full EXP… MS stars).

- Constru… …covery of res…
- M…

✓Star: …

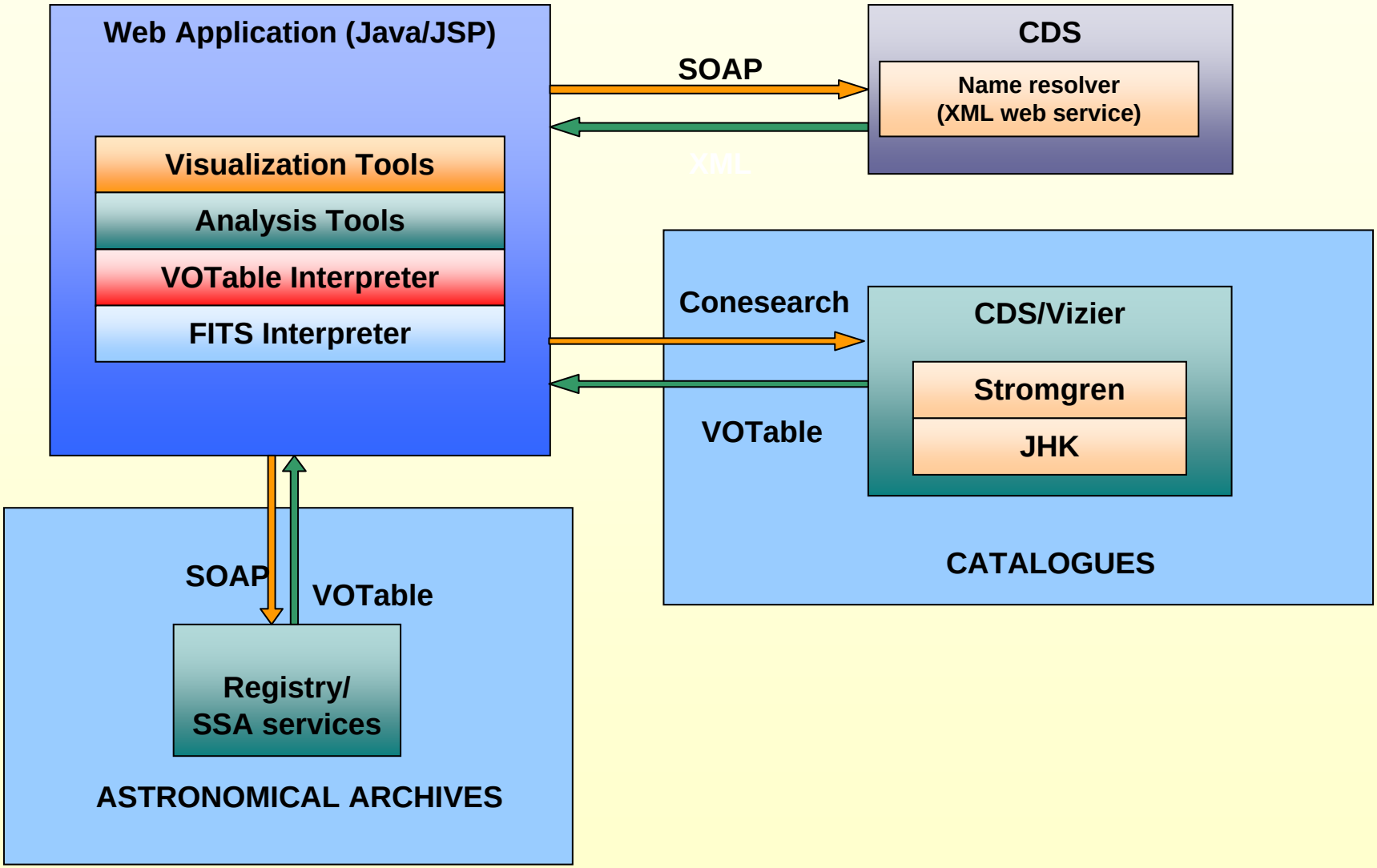
✓Disk: …

Central Star						Disk Models
T_{eff} (K)	Sp. Type	Age (Myr)	R_* ($R_\odot$)	M_* ($M_\odot$)	L_* ($L_\odot$)	
4000	K7	1	2.53	0.7	1.60	Browse
		10	1.16	0.8	0.31	Browse
4500	K4	1	3.20	1.40	3.76	Browse
		3	2.08	1.34	1.60	Browse
		10	1.2…	1.10	0.60	Browse
5000	K1	1	5.3…	3.0	16.33	Browse
		10	1.7…	1.40	1.71	Browse
8000	A6	10	1.85	1.90	12.61	Browse
9000	A2	1	5.96	4.0	210.00	Browse
		3	3.47	2.70	71.00	Browse
		10	1.70	2.00	17.08	Browse

Disk		Dust	
R_{disk}	300, 100 AU	a_{min}	0.005 mu
R_{hole}	9, 9, 11, 22 R_*	a_{max}	1, 10, 100 mu, 1mm, 1cm, 10cm
$\dot{M}$	10^{-9} 10^{-8}, 10^{-7}, 10^{-6} $M_\odot$/yr	p	3.5, 2.5
α	0.001, 0.01, 0.1	Abundances	Pollack et al. 1994
inclination i (cos i)	30° (0.86), 60° (0.5)	Scattering	Isotropic

AI. Bayesian methods.

The tool: conceptual design



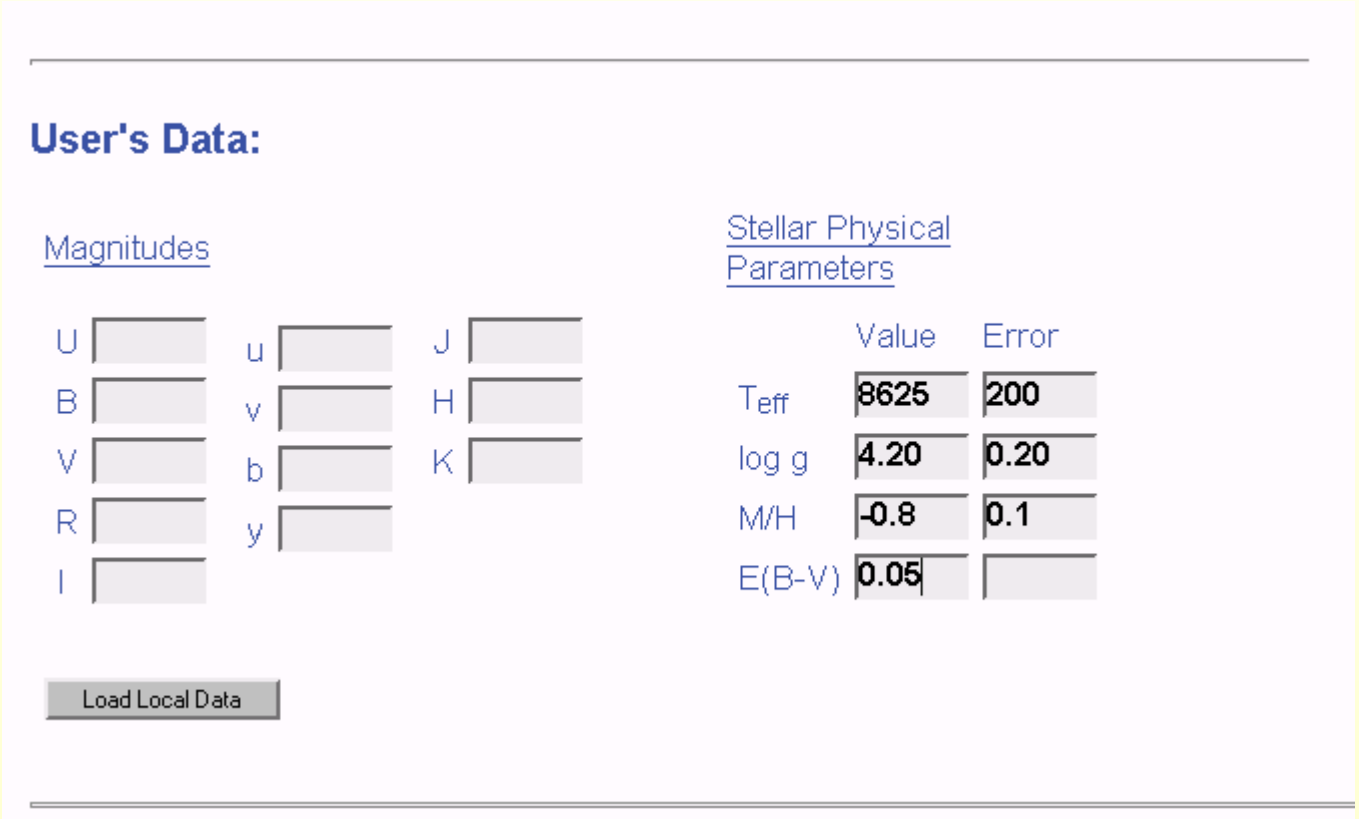
orm

Search driven by Object ID or coordinates

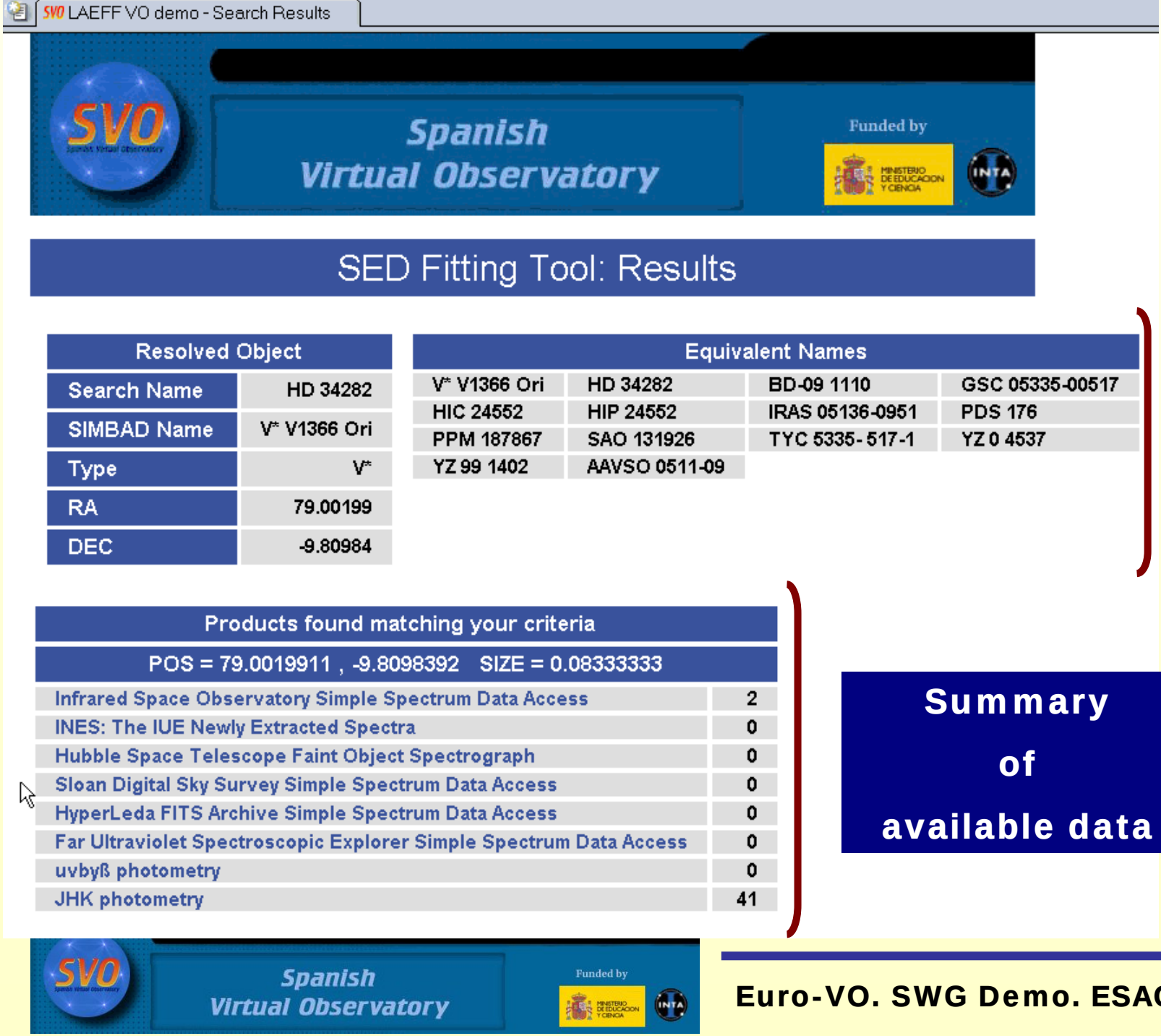
Registry: SSAP services on-the-fly

Catalogue info from Vizier

The system: input query form (II)



Local or not SSA compliant data


SVO LAEFF VO demo - Search Results
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SED Fitting Tool: Results
Resolved Object
Search Name HD 34282
SIMBAD Name V* V1366 Ori
Type V*
RA 79.00199
DEC -9.80984
Equivalent Names
V* V1366 Ori HD 34282 BD-09 1110 GSC 05335-00517
HIC 24552 HIP 24552 IRAS 05136-0951 PDS 176
PPM 187867 SAO 131926 TYC 5335-517-1 YZ 0 4537
YZ 99 1402 AAVSO 0511-09
Products found matching your criteria
POS = 79.0019911 , -9.8098392 SIZE = 0.08333333
Infrared Space Observatory Simple Spectrum Data Access 2
INES: The IUE Newly Extracted Spectra 0
Hubble Space Telescope Faint Object Spectrograph 0
Sloan Digital Sky Survey Simple Spectrum Data Access 0
HyperLeda FITS Archive Simple Spectrum Data Access 0
Far Ultraviolet Spectroscopic Explorer Simple Spectrum Data Access 0
uvbyß photometry 0
JHK photometry 41
CDS
Summary
of
available data
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Stellar Physical Parameters			
	Value	Error	Source
T_{eff}	8625	200	User's data
log g	4.20	0.20	User's data
M/H	-0.8	0.1	User's data
E(B-V)	0.05		User's data

- Differences between the input and output parameters may indicate:
  - ➔ Non-adequate set of input values
  - ➔ Presence of peculiarities in the SED that might deserve further and more detailed analysis.

Infrared Space Observatory Simple Spectrum Data Access ^

Mark	ObsId	Reference	Target_Name	Start_Time	Start_Time
☑	83301240	FITS File	ISO SWS01 Spectrum Target: HD 34282	25-Feb-1998 18:57:46	25-Feb-1998 18:57:46
☑	86301724	FITS File	ISO LWS01 Spectrum Target: HD 34282	27-Mar-1998 20:45:03	27-Mar-1998 20:45:03

INES: The IUE Newly Extracted Spectra ^

No results found.

Hubble Space Telescope Faint Object Spectrograph ^

No results found.

Sloan Digital Sky Survey Simple Spectrum Data Access ^

HyperLeda FITS Archive Simple Spectrum Data Access ^

No results found.

The system: Results (III)

Far Ultraviolet Spectroscopic Explorer Simple Spectrum Data Access

No results found.

Magnitudes converted to fluxes using appropriate calibrations (e.g Cohen et al. 2003)

2MASS Photometry (from Vizier: II/246)

Mark	distance	RAJ2000	DEJ2000	Jmag	e_Jmag	Hmag	e_Hmag	Kmag	e_Kmag	Qflg	Rfl
20 nearest sources displayed but 41 are available.											
☑	0.00069	079.001984	-09.809830	9.256	0.026	8.475	0.033	7.678	0.023	AAA	211
☐	0.39839	079.003471	-09.816317	12.631	0.026	12.326	0.021	12.298	0.026	AAA	222
☐	0.49425	078.994559	-09.806068	16.472	0.113	15.642	0.145	14.924	0.126	BBB	222
☐	0.88232	078.999622	-09.824358	16.720	0.147	15.831	0.132	15.225	0.172	BBC	222
☐	1.00094	079.012678	-09.822778	14.571	0.036	13.888	0.047	13.674	0.051	AAA	222
☐	1.11999	078.985977	-09.819811	16.318	0.114	15.436	0.139	14.800	0.127	BBB	222
☐	1.23890	079.016739	-09.795171	16.107	0.094	15.660	0.139	15.049		ABU	220
☐	1.35891	078.979662	-09.804470	16.030	0.086	15.209	0.090	14.871	0.128	AAB	222
☐	1.74855	079.022156	-09.831158	15.411	0.040	14.807	0.060	14.453	0.089	AAA	222
☐	1.78264	078.978552	-09.828529	14.818	0.043	14.261	0.037	14.069	0.070	AAA	222
☐	1.79474	078.976085	-09.825432	14.870	0.039	14.202	0.047	14.013	0.055	AAA	222
☐	1.83664	078.973299	-09.798107	15.379	0.050	14.793	0.040	14.529	0.088	AAA	222
☐	2.11184	079.015429	-09.842451	16.596	0.145	15.603		16.219		BUU	200
☐	2.11634	079.033488	-09.826600	15.551	0.050	14.972	0.063	14.718	0.097	AAA	222
☐	2.11971	078.983575	-09.779528	15.853	0.065	15.400	0.082	15.277	0.165	AAC	222
☐	2.19043	078.992245	-09.774618	16.586	0.125	15.901	0.136	15.834	0.296	BBD	222
☐	2.28067	079.031309	-09.834544	13.053	0.027	12.382	0.026	12.228	0.026	AAA	222
☐	2.33367	078.986513	-09.845619	14.569	0.033	13.919	0.031	13.795	0.049	AAA	222
☐	2.38222	078.975203	-09.780182	13.281	0.023	12.971	0.030	12.889	0.031	AAA	222
☐	2.44655	079.002575	-09.850611	12.374	0.029	12.008	0.026	11.976	0.030	AAA	222

Display SED | Retrieve Marked Data

The fitting

- Model parameter estimation using Bayesian methods: To determine the most “a posteriori” probable set of parameters given a set of prior probability densities for the different parameters.

- Estimation of the evidence: sum of the “a posteriori” probabilities of all models of a given scenario.

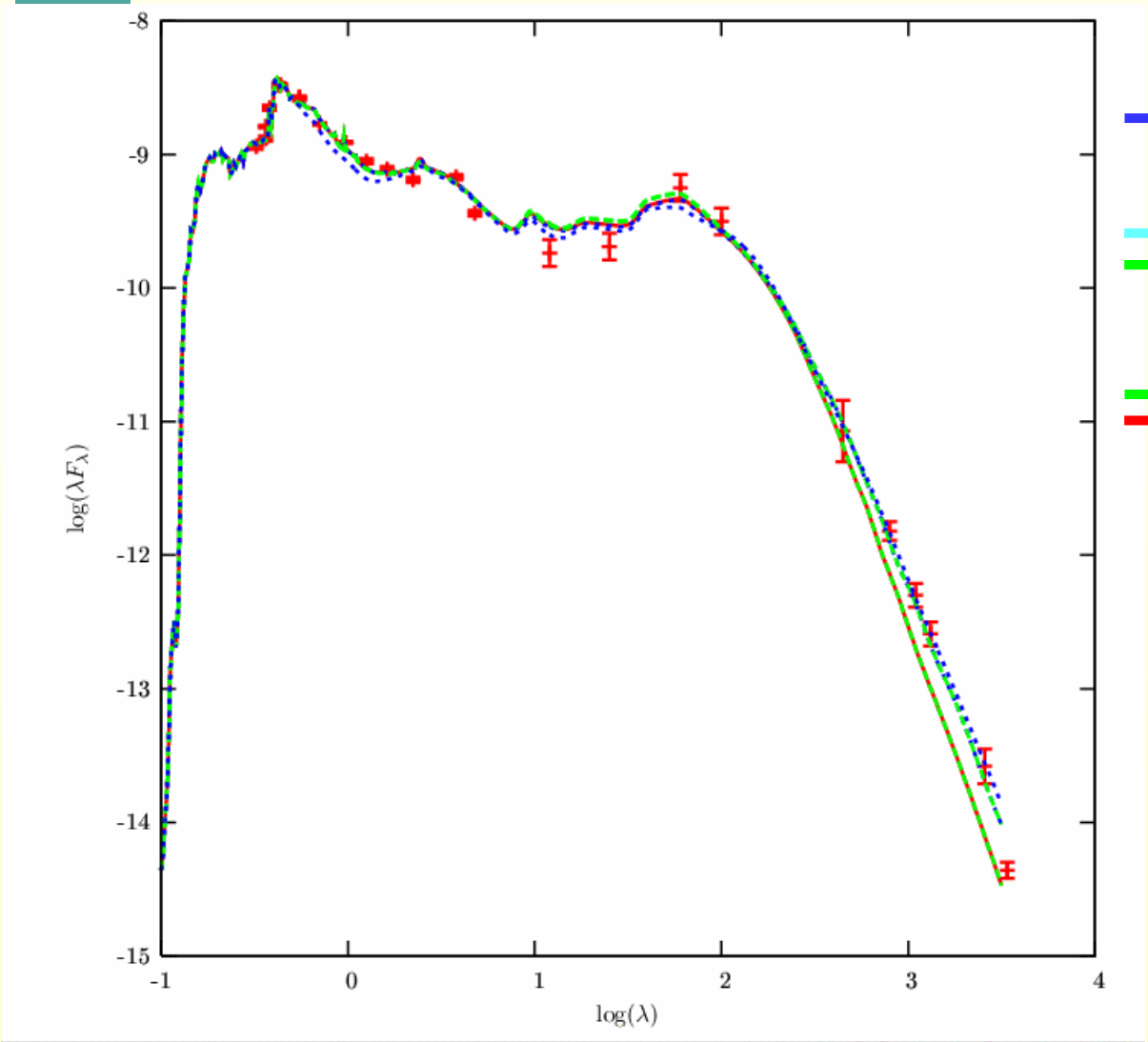
The system: Results

Table 1:

Model Complexity	Evidence
Star + Disk1	0.0
Star + Disk1 + Inner Wall	4.0×10^{-6}
Star + Disk1 + Disk2	1.0E-20
Star + Disk1 + Disk2 + Inner Wall	1.0

	D	I	S	K	1		+	D	I	S	K	2	
Norm. Probability	Angle	Rext	Rin	Mdot	p	amax		Angle	Rext	Rin	M dot	p	amax
Closest in grid	60	800	44	1,00E-008	3,5	1,00E-006		60	800	49	1,00E-007	2,5	1,00E-002
1,00E+000	60	800	44	1,00E-009	3,5	1,00E-006		60	800	49	1,00E-007	3,5	1,00E-001
6,21E-001	60	800	44	1,00E-009	2,5	1,00E-006		60	800	49	1,00E-007	3,5	1,00E-001
3,46E-001	60	800	44	1,00E-009	3,5	1,00E-006		60	800	44	1,00E-008	3,5	1,00E-003
2,58E-001	60	800	44	1,00E-009	2,5	1,00E-006		60	800	44	1,00E-008	3,5	1,00E-003
2,05E-001	60	800	44	1,00E-009	3,5	1,00E-006		60	300	49	1,00E-007	3,5	1,00E-001
1,37E-001	60	800	44	1,00E-009	2,5	1,00E-006		60	300	49	1,00E-007	3,5	1,00E-001
5,90E-002	60	800	44	1,00E-009	2,5	1,00E-006		60	800	49	1,00E-007	2,5	1,00E-002
5,33E-002	60	800	44	1,00E-009	2,5	1,00E-006		60	300	49	1,00E-007	2,5	1,00E-003
4,97E-002	60	800	44	1,00E-009	3,5	1,00E-006		60	800	44	1,00E-008	3,5	1,00E-002
4,91E-002	60	800	44	1,00E-009	3,5	1,00E-006		60	300	49	1,00E-007	2,5	1,00E-003
4,42E-002	60	800	44	1,00E-009	2,5	1,00E-006		60	800	44	1,00E-008	3,5	1,00E-002
4,32E-002	60	300	44	1,00E-009	2,5	1,00E-006		60	300	49	1,00E-007	3,5	1,00E-001
4,13E-002	60	800	44	1,00E-009	3,5	1,00E-005		60	800	49	1,00E-007	3,5	1,00E-001
3,26E-003	60	800	44	1,00E-009	3,5	1,00E-006		60	800	49	1,00E-007	2,5	1,00E-002
3,08E-002	60	800	44	1,00E-009	3,5	1,00E-004		60	800	49	1,00E-007	3,5	1,00E-001

The system: the results (II)



Merín et al (2004)

Models 1 and 2

Models 3 and 4

What's next?

In the short term…

- Overall improvement (documentation,…)
- New data (Johnson photometry)
- Visualization tools → VOSpec
- External applications → PHYSPAR
- Letter submission: "First Science with the SVO"

In the medium term…

- New data (Spitzer) / New models (Vega-type stars)
- More general scientific paper covering the full EXPORT sample (30 PMS)
- THIS IS A GENERAL PURPOSE TOOL. Application to other science cases.