The Virtual Observatory. What really is VO?

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CENTRO DE ASTROBIOLOGÍA
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

GOBIERNO DE ESPAÑA
CSIC
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Workflow

Education Outreach

Science

astronomy

Mathematics & statistics

astroinformatics

Computer sciences

New data

Advances in Astronomy

DATA

KNOWLEDGE

Data Avalanche

Tools

Standards

Archive data

Lack of interoperablity

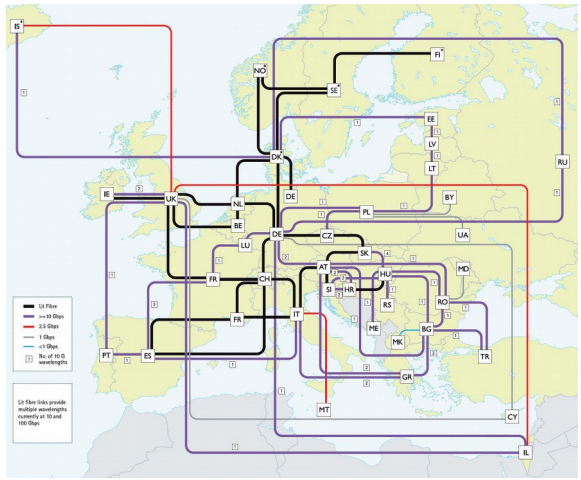
Data sharing

Astronomy has been a pioneer in scientific data sharing:

- A common data format since the 70s (FITS).
- Open data (in general after a proprietary period).
- Services driven by community needs (on-line archives).

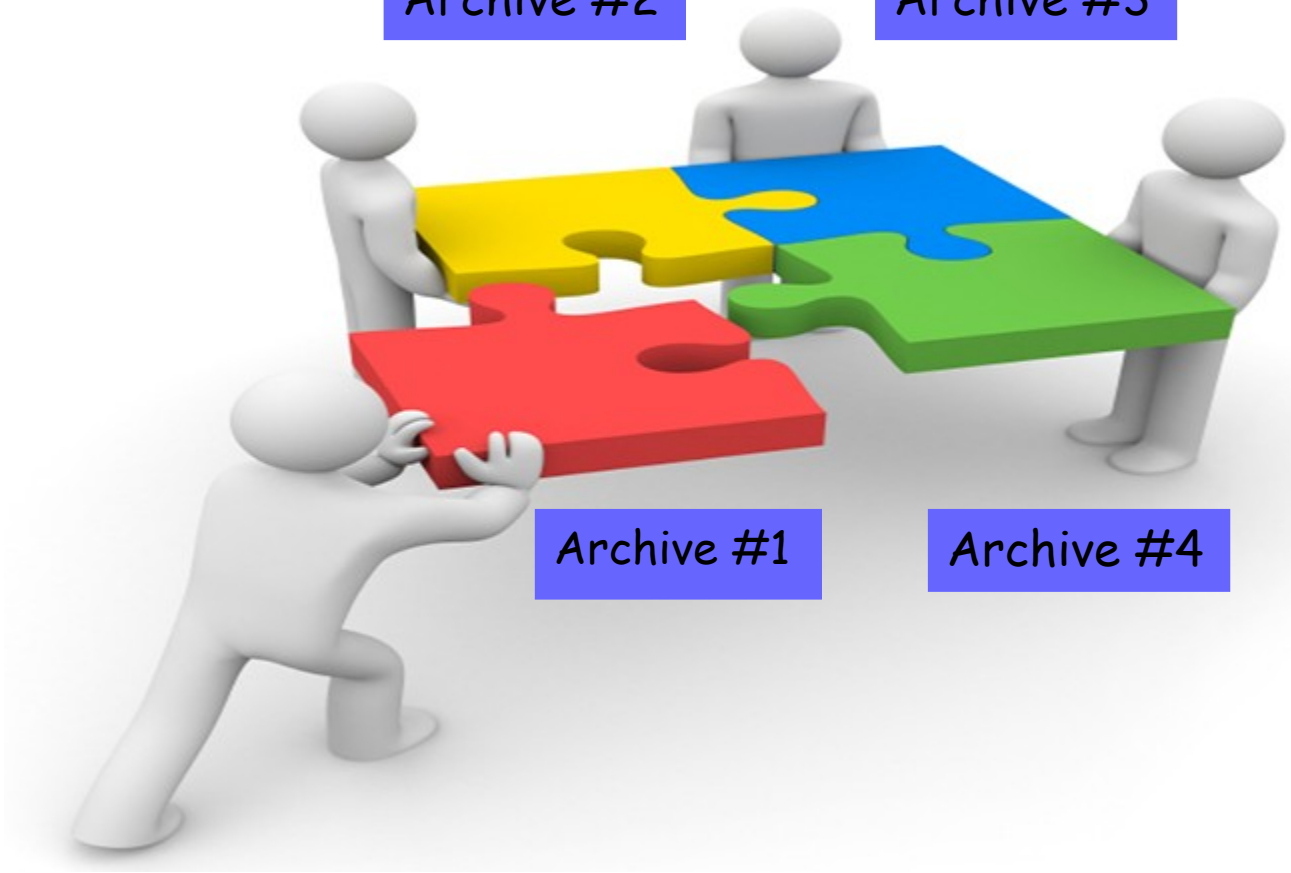
NETWORKING

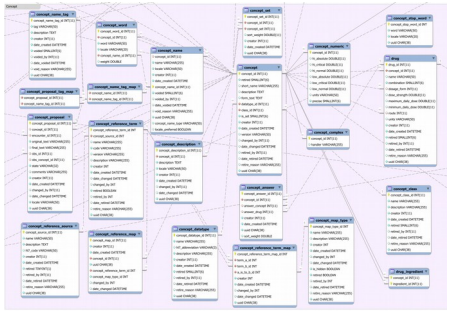
Networking



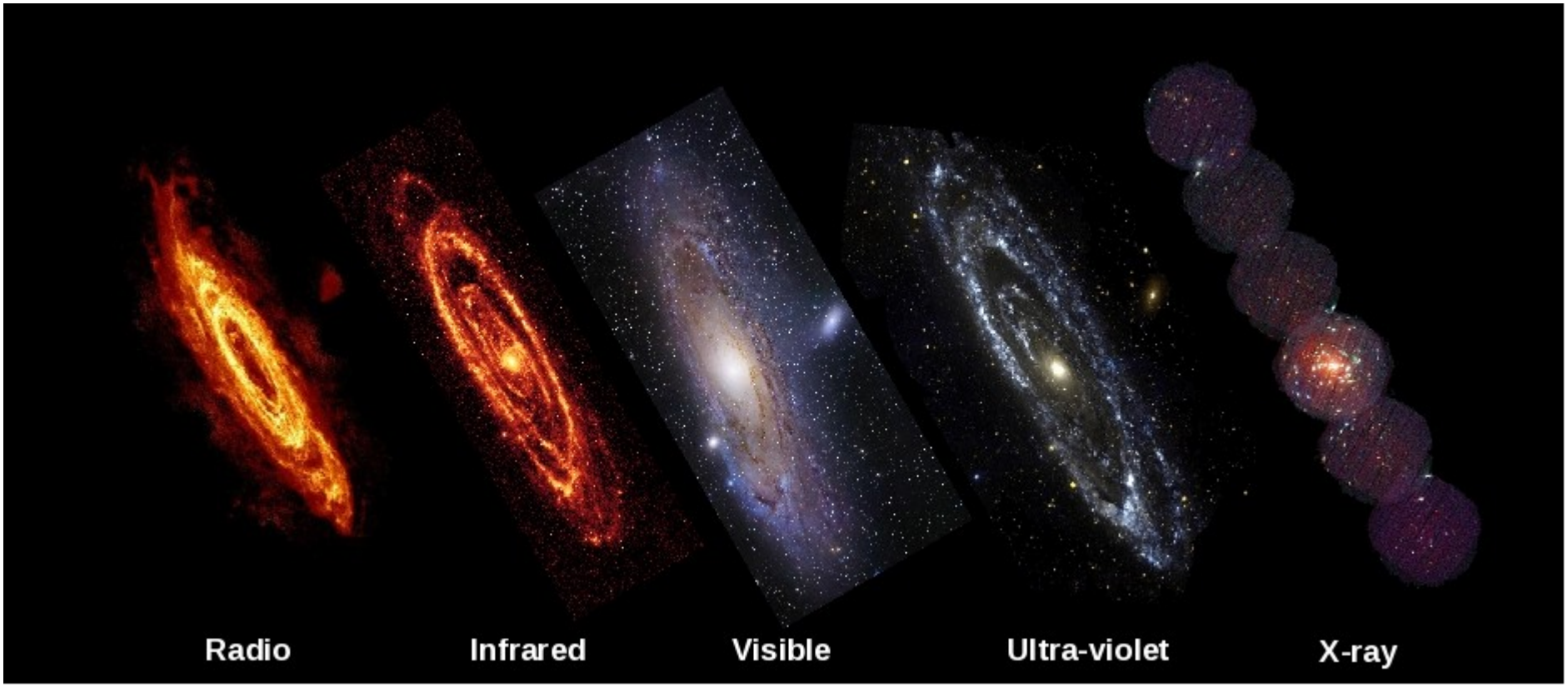
Networking is not enough

INTEROPERABILITY

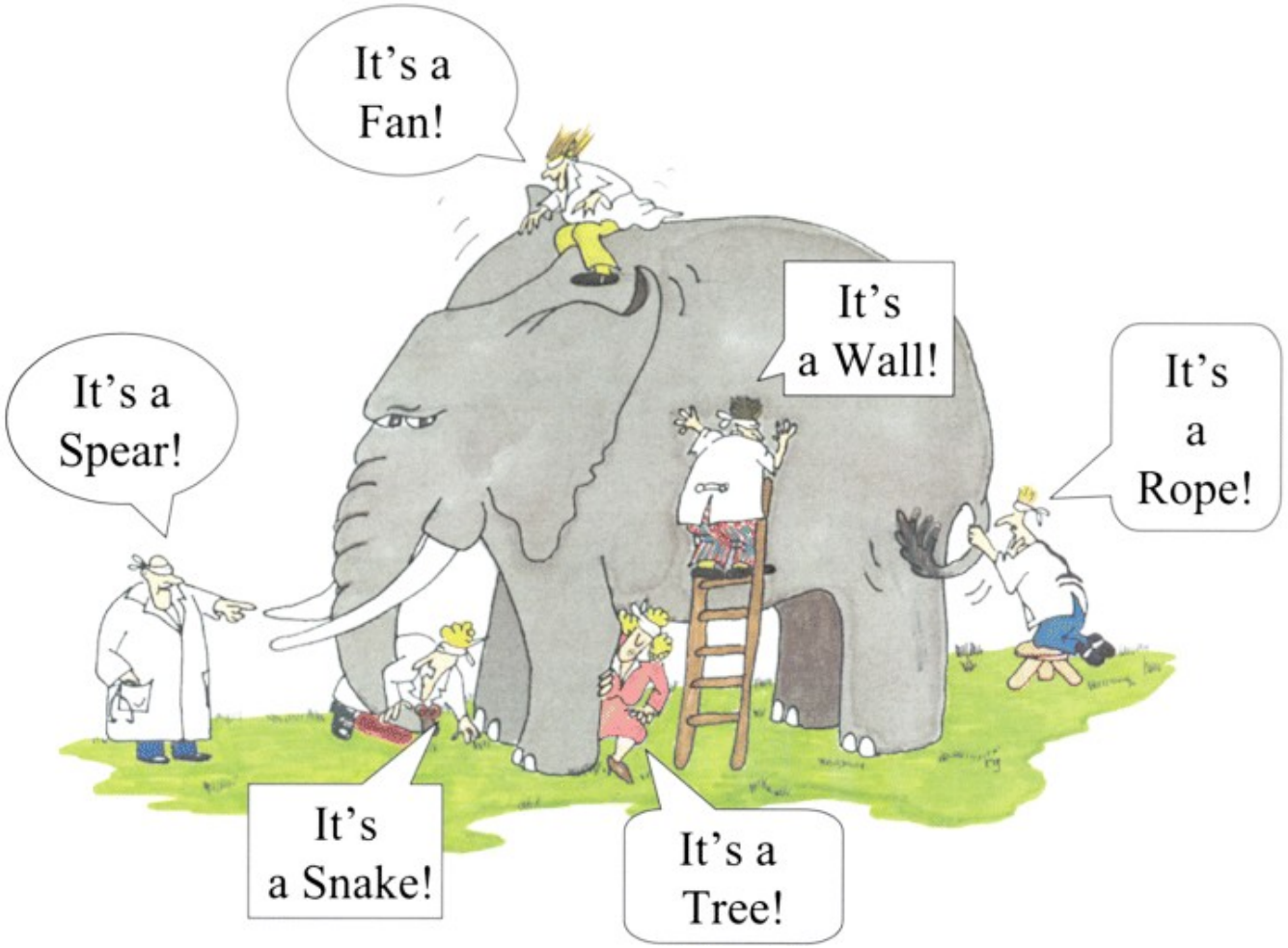




Multi-λ Astronomy



Multi-λ Astronomy



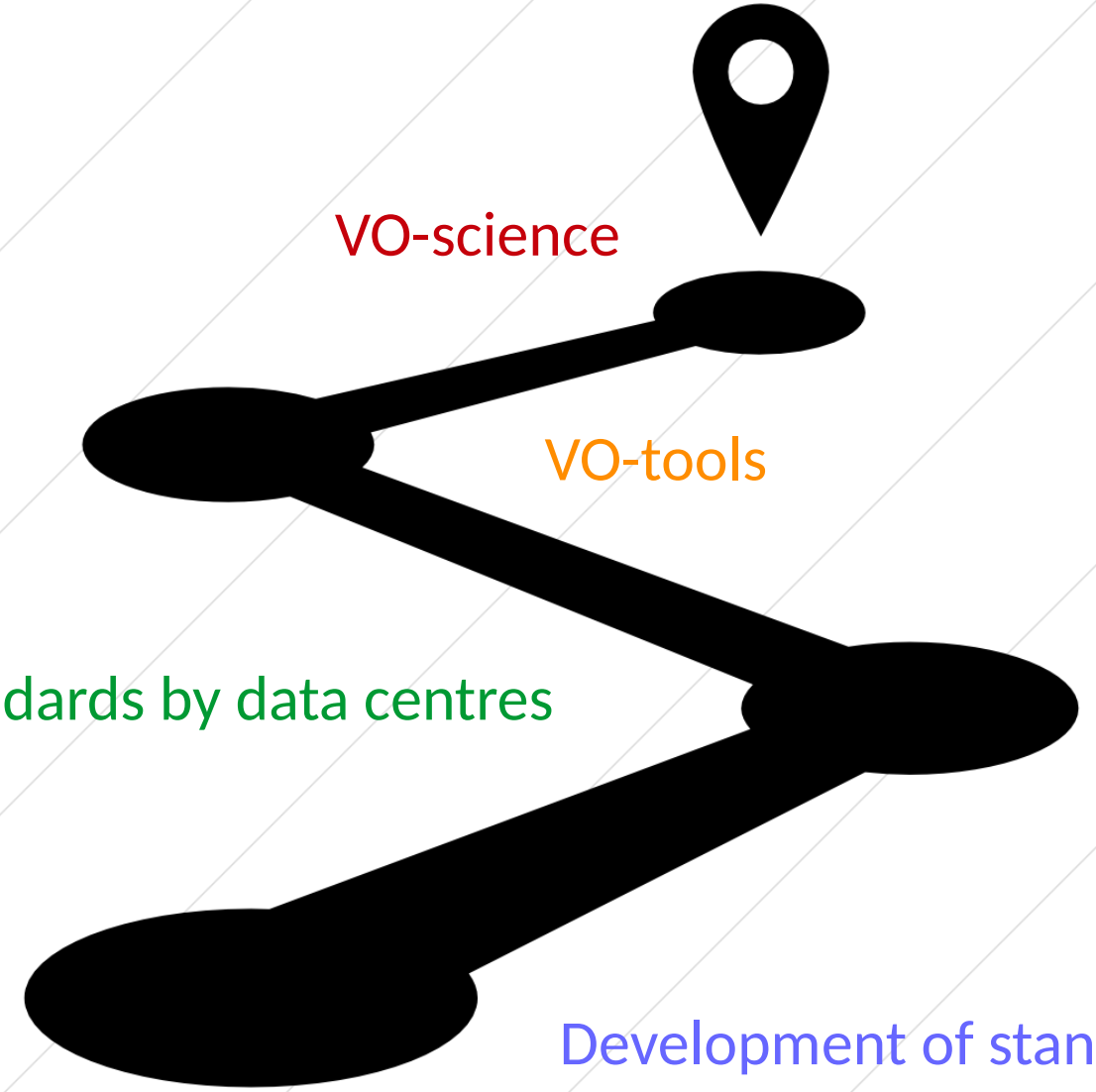
The Virtual Observatory

- Goal: Easy and efficient access and analysis of the information hosted in astronomical archives.

Jan'02

Jun'02

The VO roadmap



The VO roadmap

http://ivoa.net/documents/

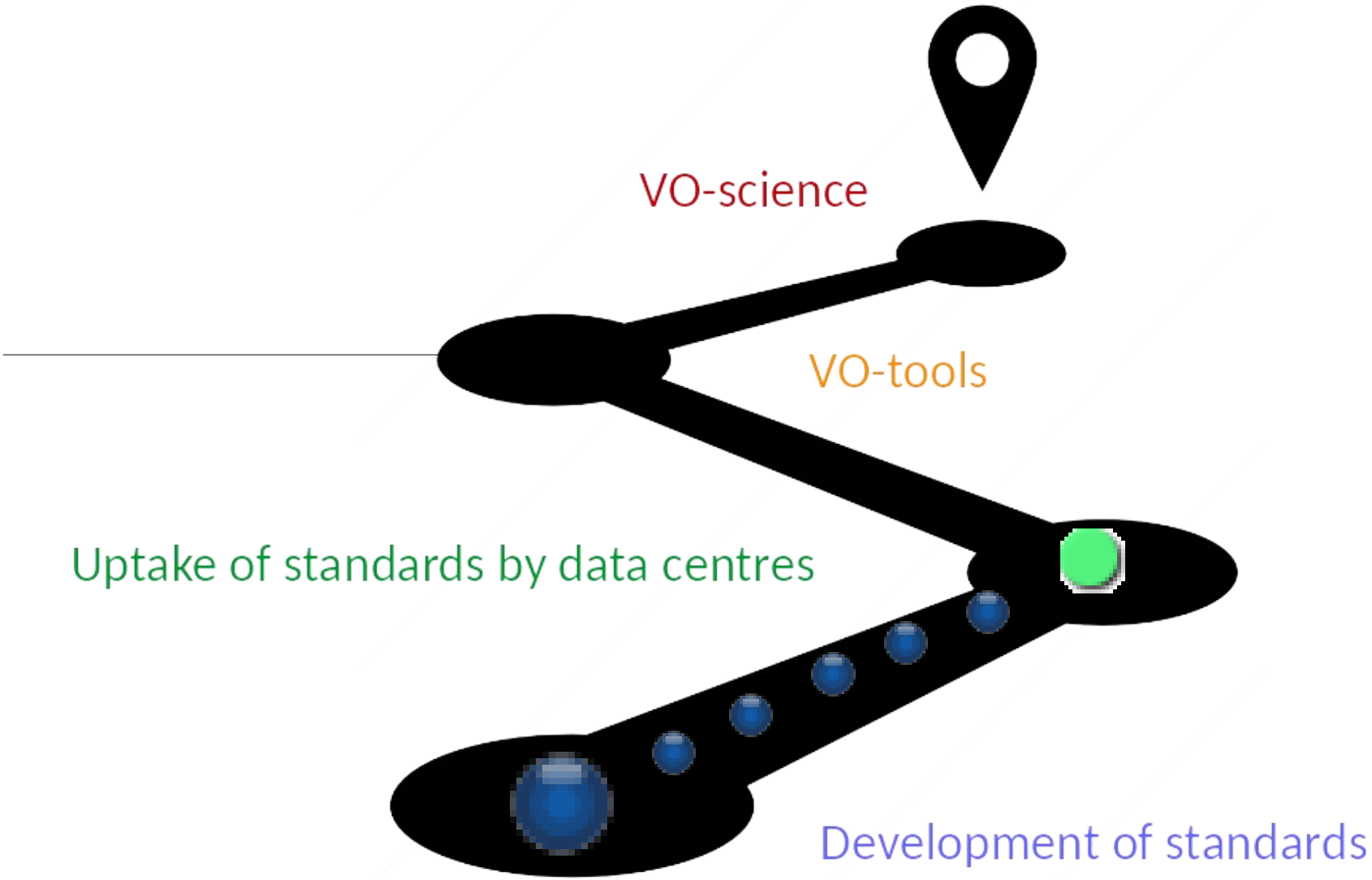
VO-scie

Uptake of standards by data centre

Group	Title	Most stable	In progress	Version history
App	SAMP - Simple Application Messaging Protocol	1.3		1.3 1.3 1.3 1.3 1.3 1.2 1.2 1.2 1.11 1.11 1.10 1.00
	VOTable - VOTable Format Definition	1.3		1.3 1.3 1.3 1.2 1.2 1.2 1.20 1.20 1.10 1.00
	MOC - HEALPix Multi-Order Coverage Map	1.0		1.0 1.0 1.0 1.0 1.0
	HiPS - Hierarchical Progressive Survey	1.0		1.0 1.0 1.0 1.0 1.0 1.0
DAL	DALI - Data Access Layer Interface	1.1		1.1 1.1 1.1 1.1 1.1 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
	DataLink	1.0		1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
	Simple Cone Search	1.03		1.03 1.02 1.01 1.00
	SIA - Simple Image Access	2.0		2.0 2.0 2.0 2.0 2.0 2.0 2.0 1.0 1.0 1.0 1.01 1.00
	SLAP - Simple Line Access	1.0		1.0 1.0 1.0 1.0 1.0 1.0
	SSA - Simple Spectral Access	1.1		1.1 1.1 1.1 1.1 1.04 1.03 1.02 1.01 1.01 1.00
	STC-S: Space-Time Coordinate Metadata Linear String Implementation	1.0		1.0
	TAP - Table Access Protocol	1.0	1.1	1.1 1.1 1.1 1.0 1.0 1.0 1.0 1.0 1.00
	TAPRegExt - A VOResource Schema Extension for Describing TAP Services	1.0		1.1 1.0 1.0 1.0 1.0 1.0 1.0 1.0
	ADQL - Astronomical Data Query Language	2.00	2.1	2.1 2.00 2.00 2.00 1.01 1.00
	SNI - IVOA SkyNode Interface	1.01		1.01 1.00
	SimDAL - Simulation Data Access Layer	1.0		1.0 1.00 1.00 1.00 1.00 1.00 1.00
	VOEvent Transport Protocol	2.00	2.00	2.00 2.00 2.00 1.00
	SODA - Server-side Operations for Data Access	1.0		1.0 1.00 1.00 1.00 1.00 1.00 1.00
DaM	PHOTDM - Photometry Data Model	1.0		1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
	SimDM - Simulation Data Model	1.0		1.0 1.0 1.0 1.0 1.0 1.0

Development of standards

Support to data centres



Support to data centres / providers

The CAB Scientific Data Centre

- ARCHES
- Calar Alto
- COROT
- DUNES
- DSS-63
- GASPS
- GAUDI
- GTC
- INES
- OMC
- Stars with Debris and Planets
- X-exoplanets
- ALHAMBRA
- CMC-15
- Joan Oró
- Mark-I
- REECL-SQM
- SVO Moving Object Catalogue
- The SVO hot subdwarf archive

SVOCat Documentation

Version 0.5, June 2016, author: Carlos Rodrigo

Home | Download | Documentation | Examples | Credits | Help-Desk

(You can see this documentation as a single web page if you wish)

Introduction

SVOCat is an application intended to make easier the publication of an astronomical catalogue, both as a web page and as a Virtua

Our intention is not no make it "magical" so that it makes all the work for you. We have tried to make it so that it's easier for you to start the installation and configuration process at different steps if you wish, and to change the application if you need to do it fo

Requirements:

- A web server (Apache, for instance) and access to a web directory to install the files.
- PHP
- MySQL database.

(See some technical details below)

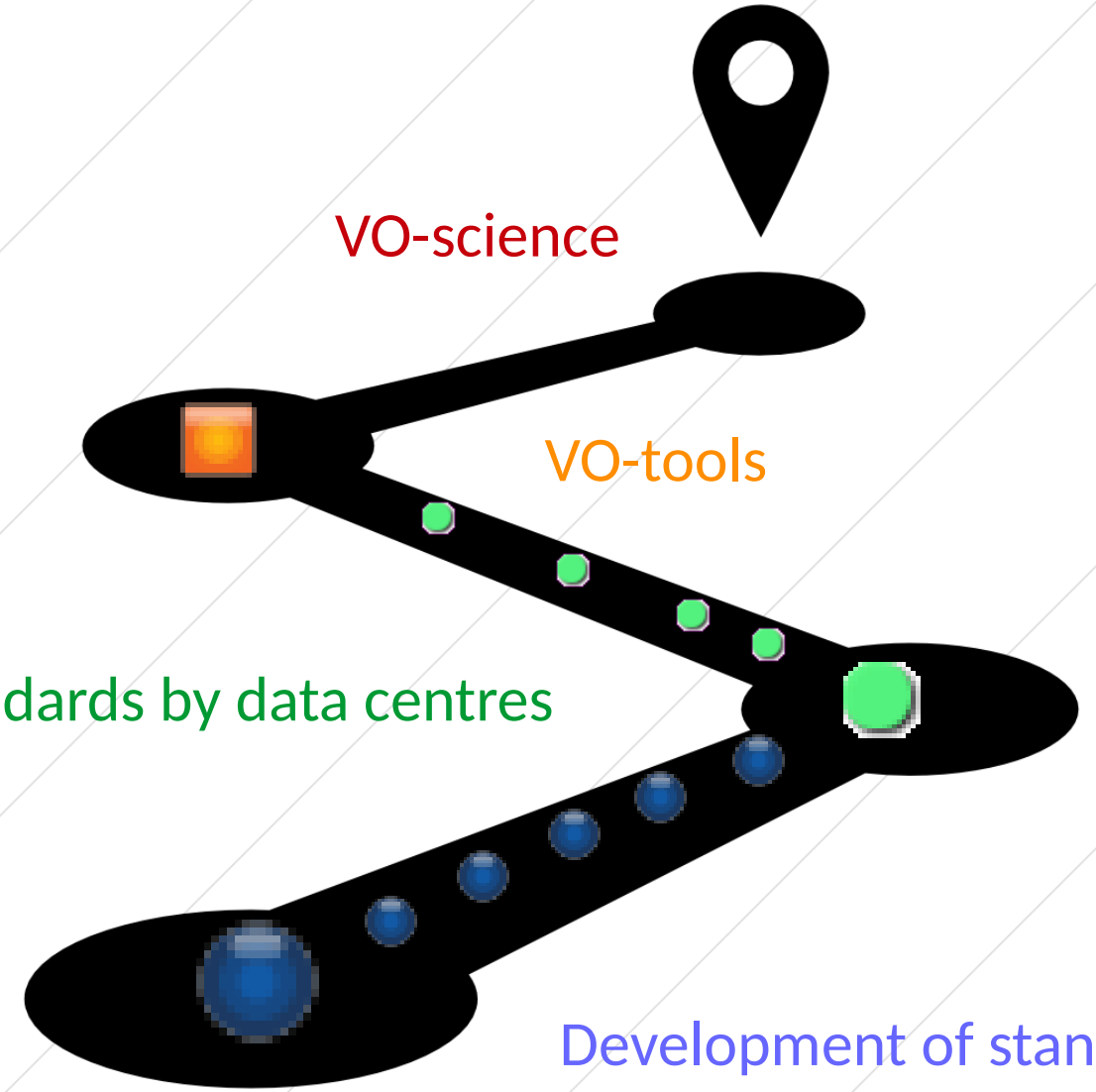
We assume that:

- Your catalogue can be seen as a single table with several columns (one for each property provided by the catalogue) and se entry, for instance, each observed object)
- Two of the columns give RA and DEC in decimal degrees.

and that your have your data either:

- as a csv file with different columns separated by commas. It can be a series of different csv files with the same structure if prefer to split it in different files.
- as a table in a mysql database.

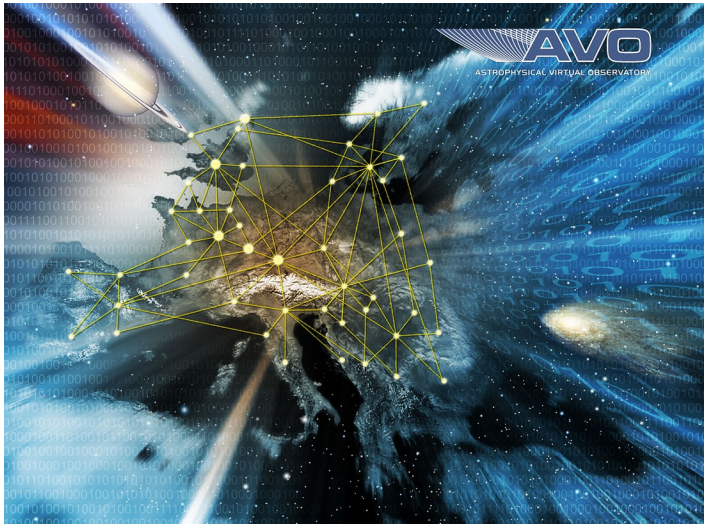
VO-tools


VO-science
VO-tools
Uptake of standards by data centres
Development of standards

VO-tools

Rediscover Astronomy

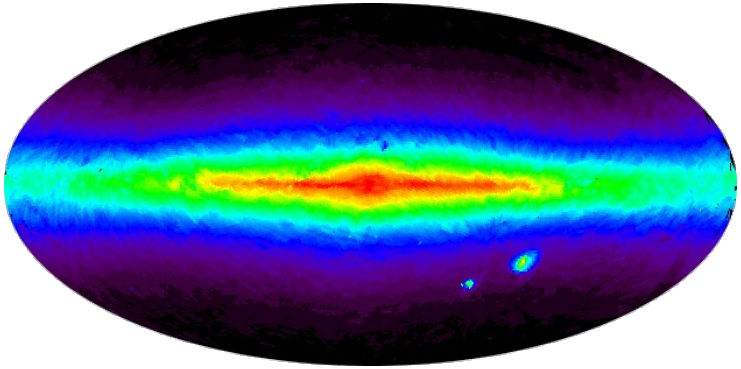
The Virtual Observatory - A New Era for Astronomy



There is a new paradigm in astronomy, the Virtual Observatory (VO).

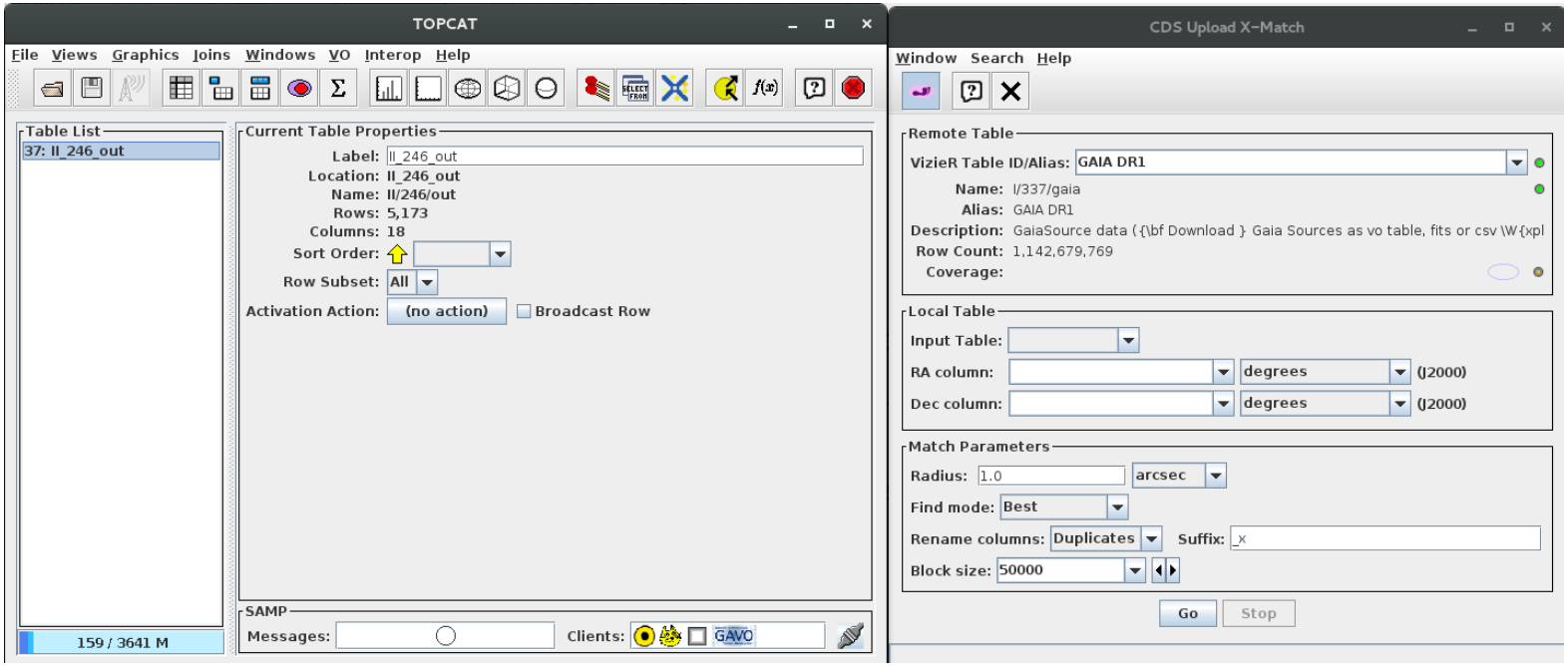
VO-tools

"I have a list of objects, I want to get the (G-Ks) colour ."



Gaia DR1
(1142679769 sources)

VO-tools


TOPCAT
File Views Graphics Joins Windows VO Interop Help
Table List
37: II_246_out
159 / 3641 M
Current Table Properties
Label: II_246_out
Location: II_246_out
Name: II/246/out
Rows: 5,173
Columns: 18
Sort Order:
Row Subset: All
Activation Action: (no action)
Broadcast Row
SAMP
Messages:
Clients:
CDS Upload X-Match
Window Search Help
Remote Table
VizieR Table ID/Alias: GAIA DR1
Name: I/337/gaia
Alias: GAIA DR1
Description: GaiaSource data ({\bf Download } Gaia Sources as vo table, fits or csv \W{xpl
Row Count: 1,142,679,769
Coverage:
Local Table
Input Table:
RA column:
degrees
(J2000)
Dec column:
degrees
(J2000)
Match Parameters
Radius: 1.0
arcsec
Find mode: Best
Rename columns: Duplicates
Suffix: _x
Block size: 50000
Go
Stop


CDS X-Match Service
X-match
Tables management
Documentation
Choose tables to cross-match
e.g. VII/260/dr7qso, or select in list
VizieR
SIMBAD
My store
e.g. VII/233/xsc, or select in list
VizieR
SIMBAD
My store
Show options
Begin the X-Match

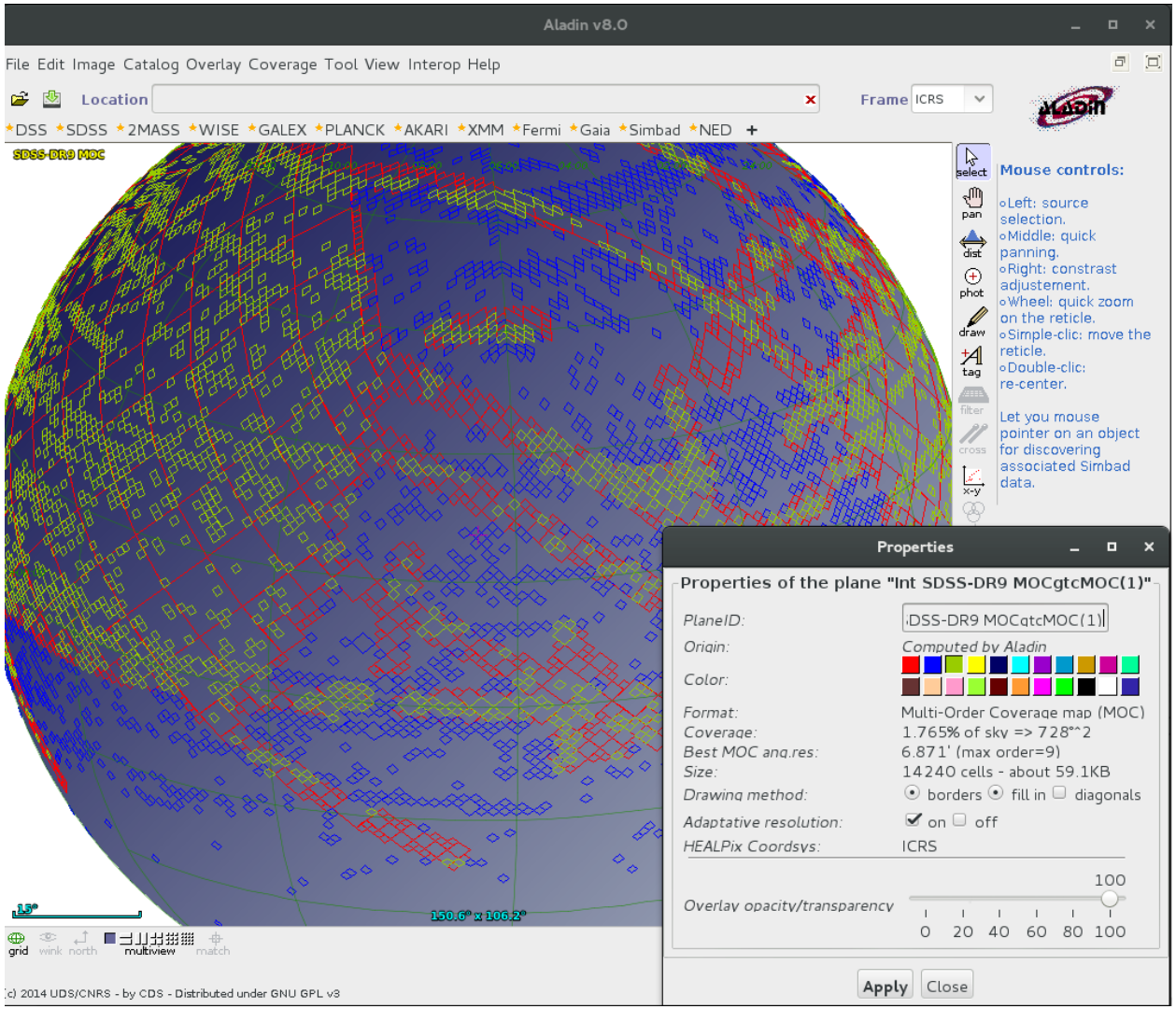
VO-tools

International Virtual Observatory Alliance

HiPS – Hierarchical Progressive Survey

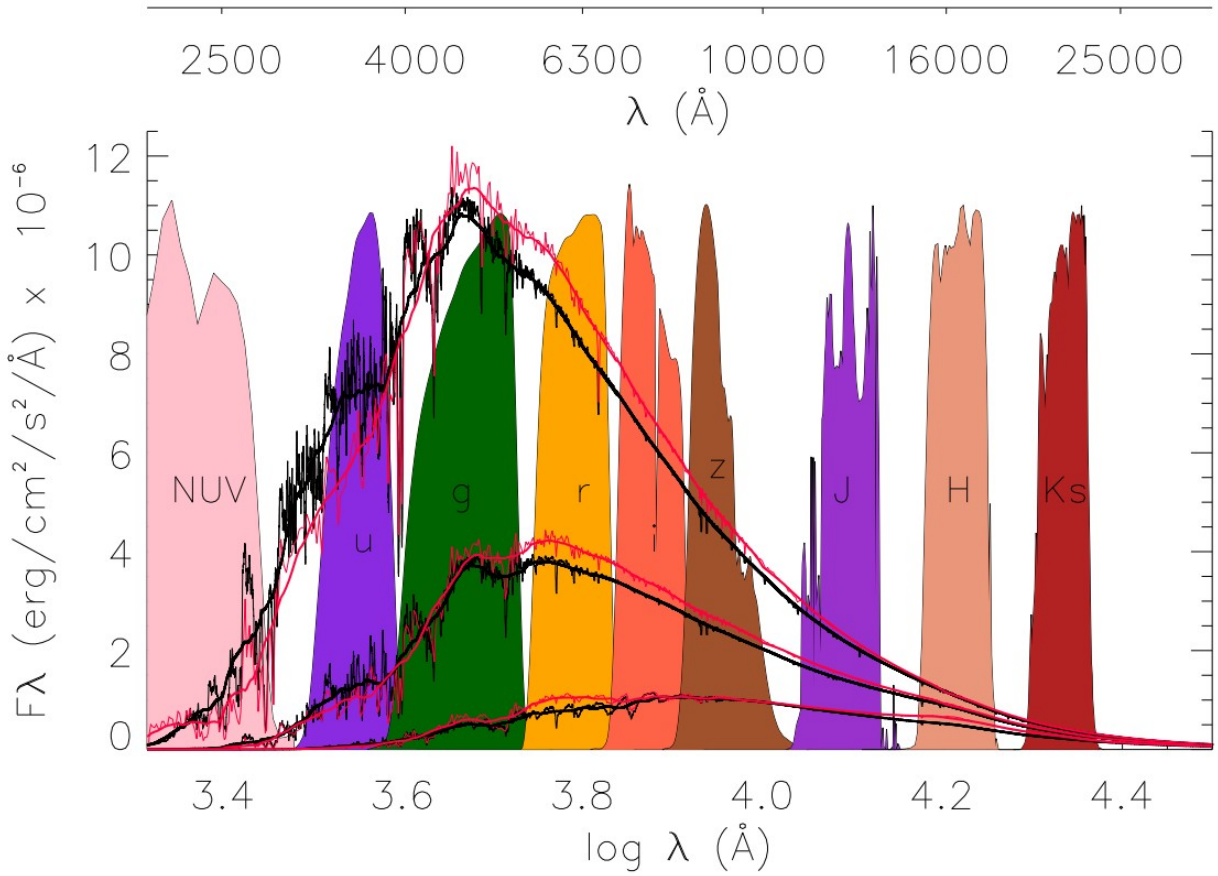
Version 1.0

IVOA Recommendation
19th May 2017

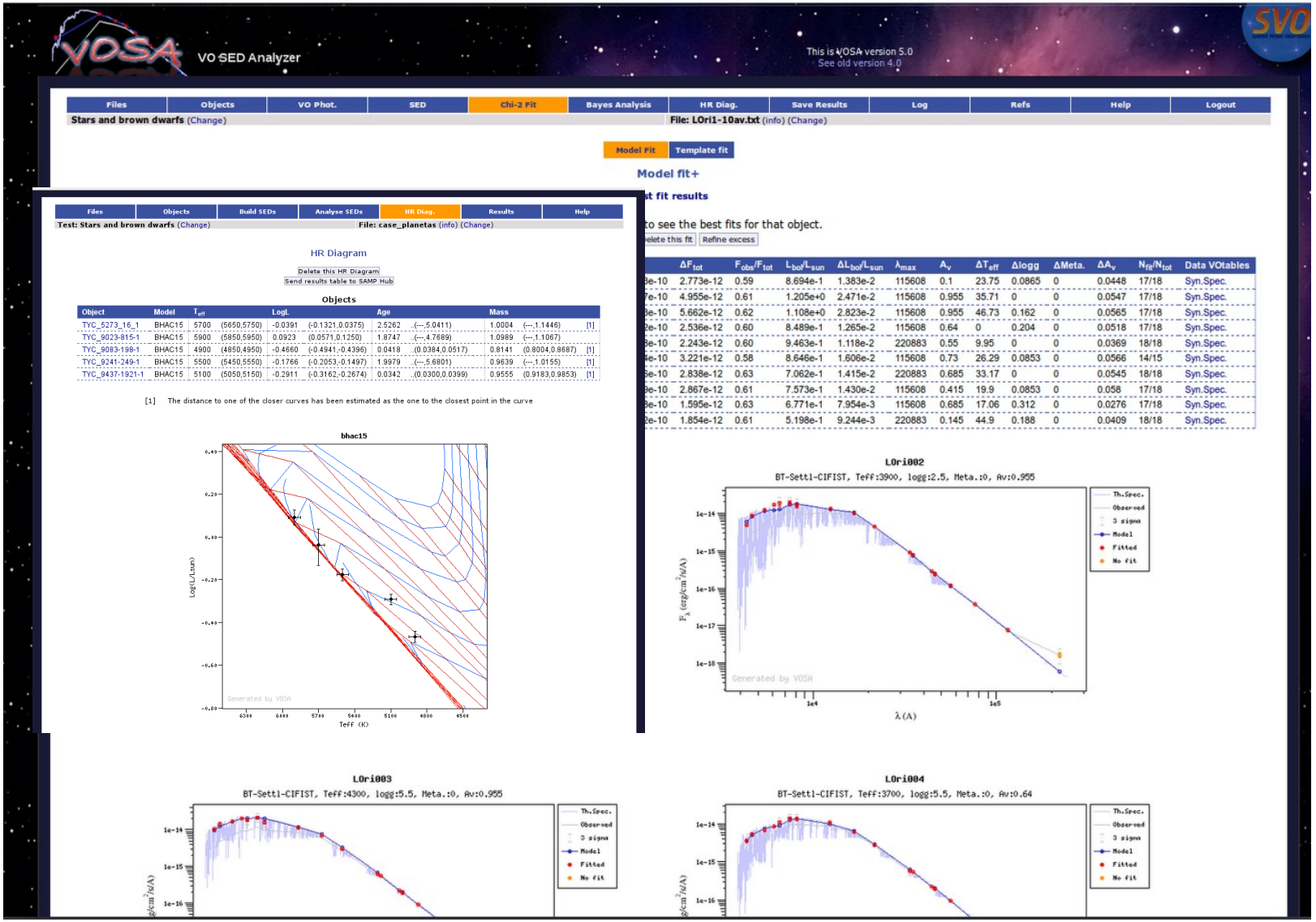


VO-tools

"I want to estimate the effective temperatures of thousands of objects from SED fitting."

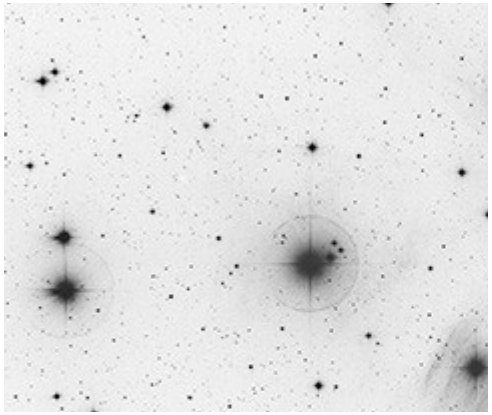


VO-tools

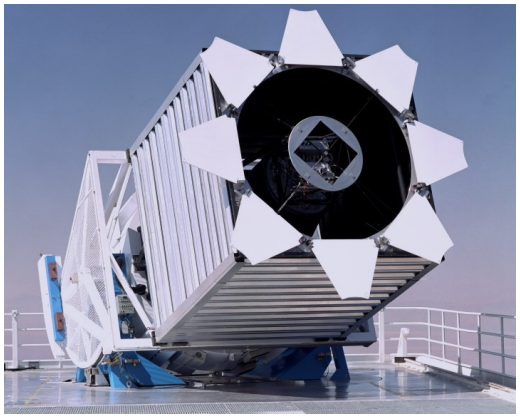

VOSA
VO SED Analyzer
This is VOSA version 5.0
See old version 4.0
Files
Objects
VO Phot.
SED
Chi-2 Fit
Bayes Analysis
HR Diag.
Save Results
Log
Refs
Help
Logout
Stars and brown dwarfs (Change)
File: LOri1-10av.txt (info) (Change)
Model Fit
Template fit
Model fit+
Build SEDs
Analyse SEDs
Results
Test: Stars and brown dwarfs (Change)
File: case_planetas (info) (Change)
HR Diagram
Delete this HR Diagram
Send results table to SAMP Hub
Objects
Object
Model
Age
Mass
TYC_5273_16_1
TYC_9023-815-1
TYC_9083-198-1
TYC_9241-249-1
TYC_9437-1921-1
[1] The distance to one of the closer curves has been estimated as the one to the closest point in the curve
bhac15
Log(L/Lsun)
Teff (K)
Generated by VOSA
to see the best fits for that object.
Delete this fit
Refine excess
Data VOtables
Syn.Spec.
LOri002
BT-Settl-CIFIST, Teff:3900, logg:2.5, Meta.:0, Av:0.955
LOri003
BT-Settl-CIFIST, Teff:4300, logg:5.5, Meta.:0, Av:0.955
LOri004
BT-Settl-CIFIST, Teff:3700, logg:5.5, Meta.:0, Av:0.64
Th.Spec.
Observed
3 sigma
Model
Fitted
No fit

The data avalanche

- Pointed observations

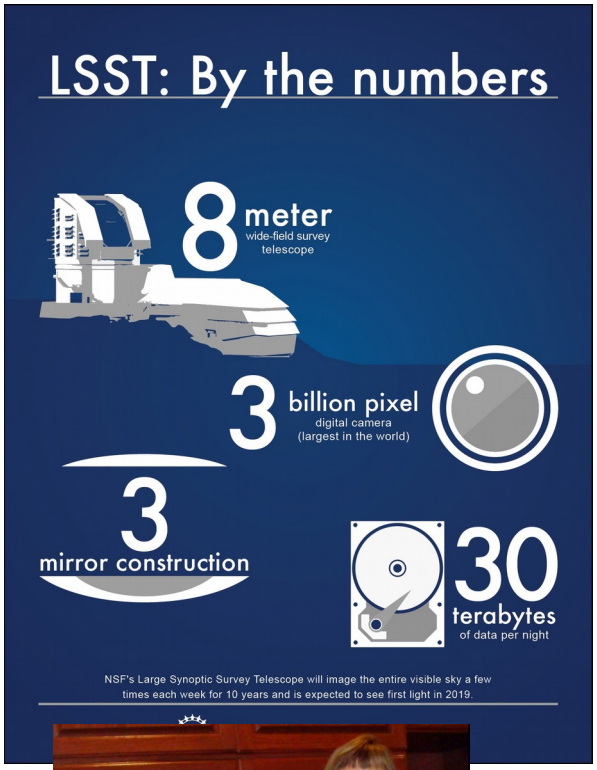


- All-sky surveys (plates)

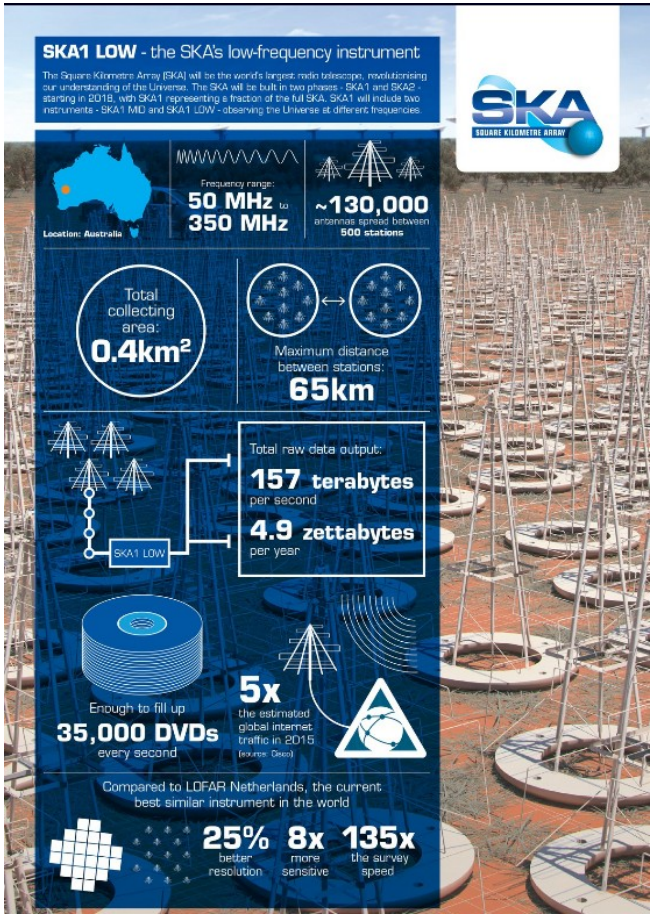


- All-sky surveys (CCDs)

The data avalanche

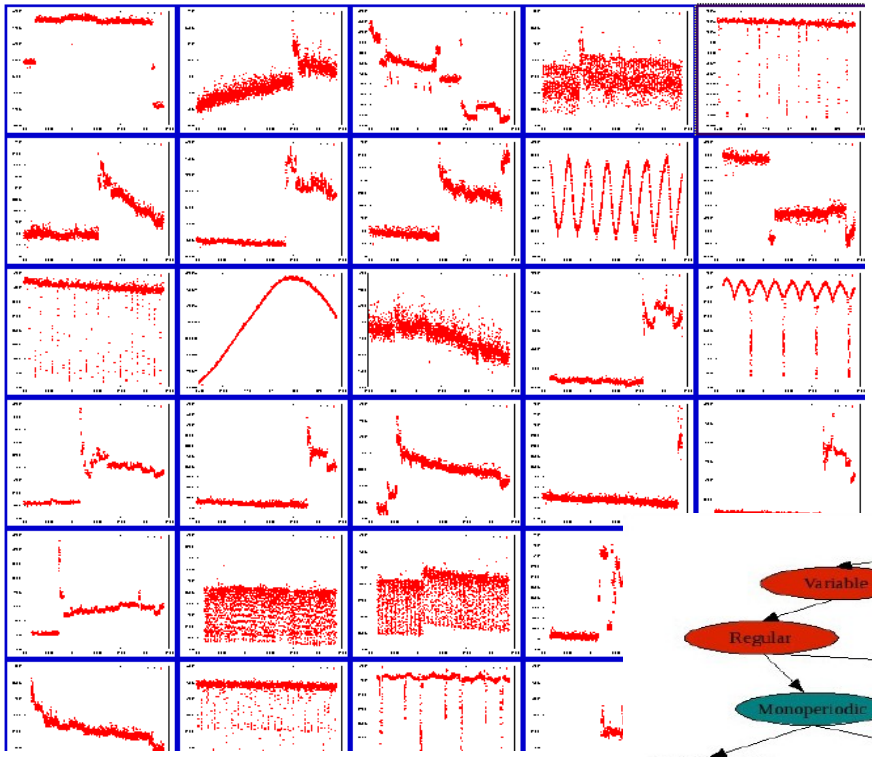


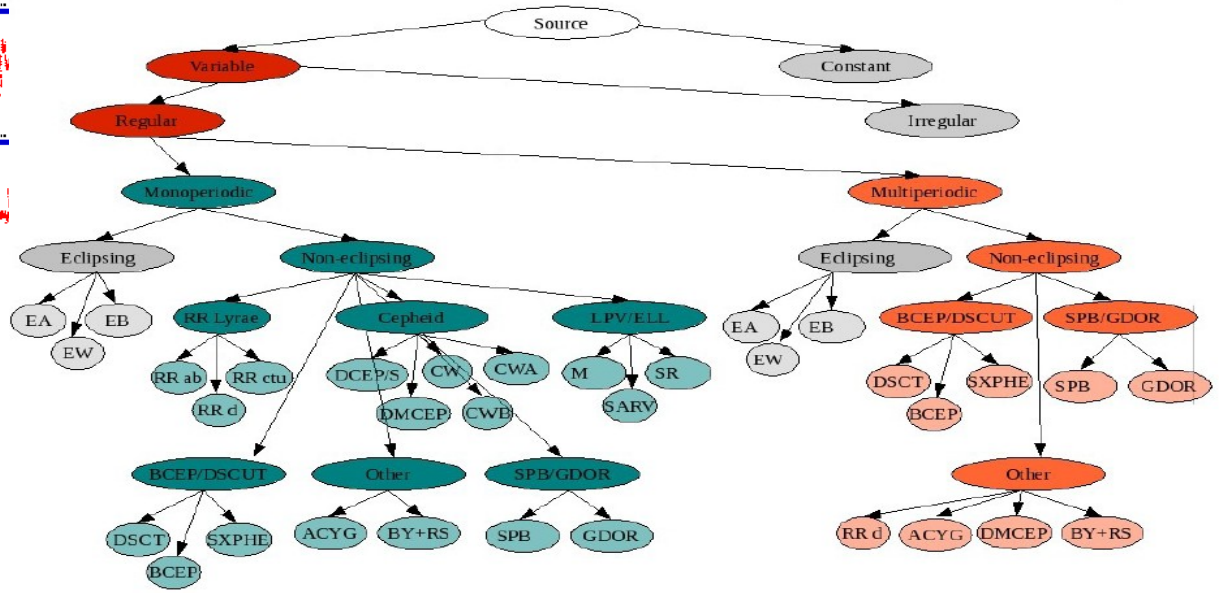
Credits: P. Skoda



1 ZB= 10^3 EB = 10^6 PB = 10^9 TB = 10^12 GB

The data avalanche





The data avalanche

Data

Data Science

- Statistics
- Machine Learning
- Data Mining
- Patter Recognition
- Signal Processing
- Predictive Modeling
- Data Analytics
- etc.

Knowledge

The data avalanche

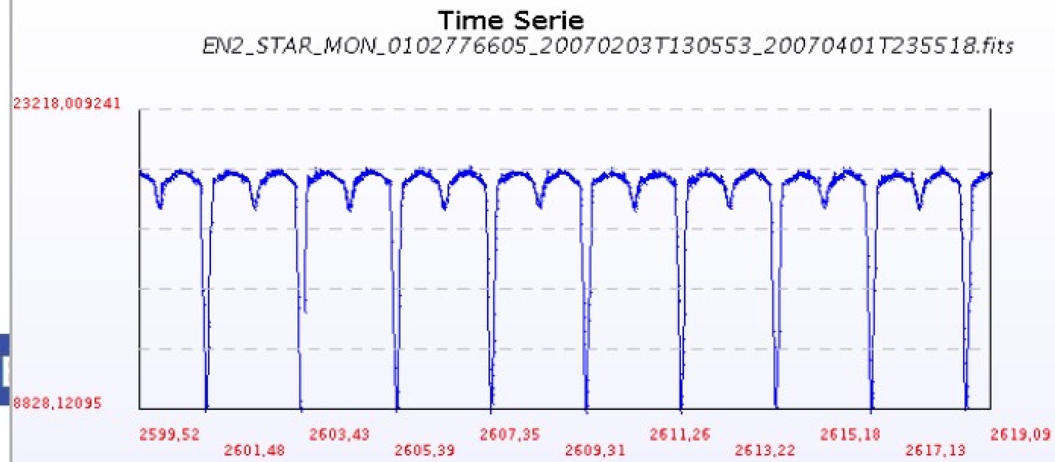
THE COROT PUBLIC ARCHIVE

Found 255 records, displaying page 1 of 6

Retrieval Format: zip   Mark Fits:

Retrieve Marked Data

EXOPLANET

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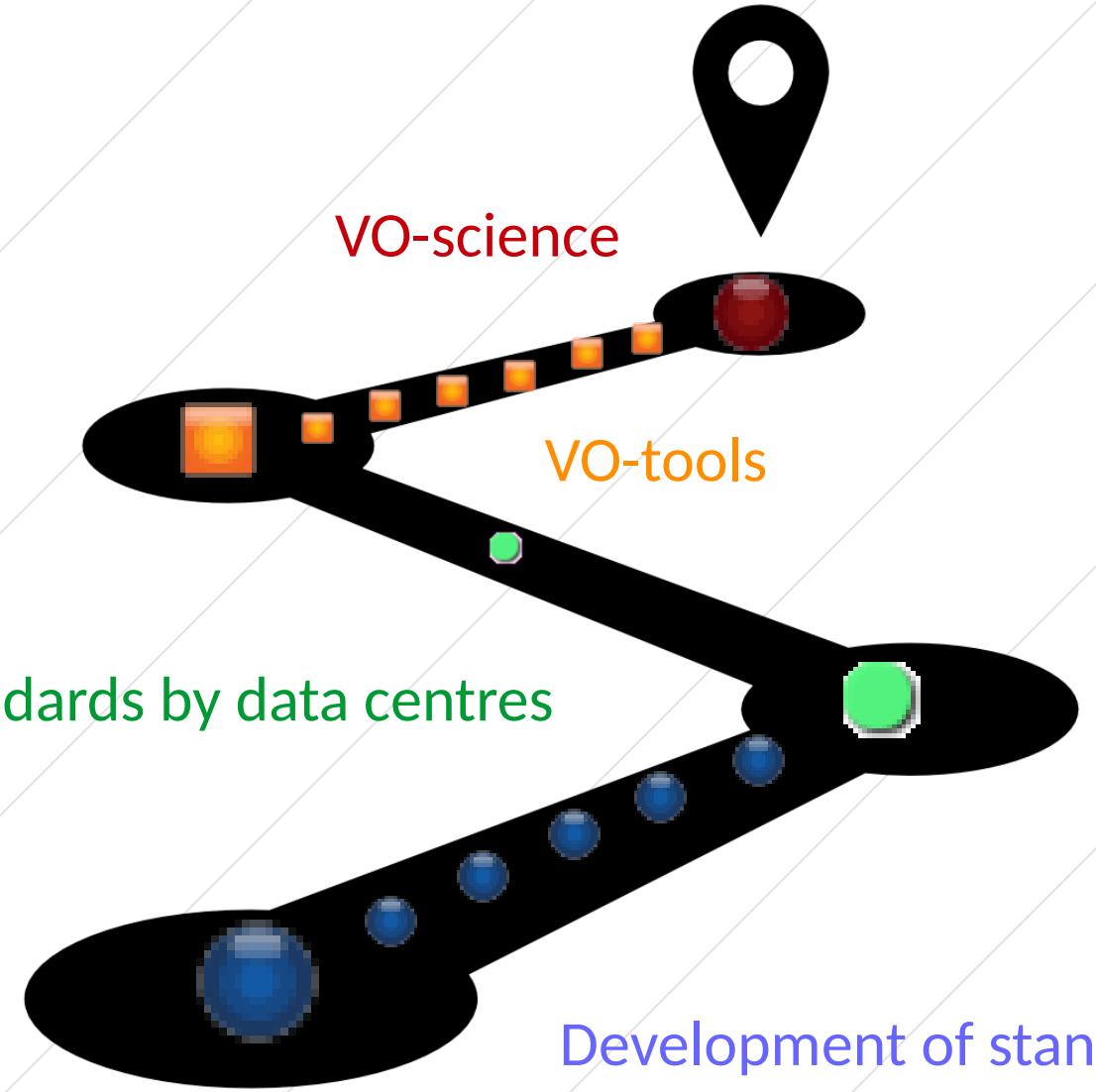
BITPIX  =                   16 / Number of bits per data pixel
NAXIS   =                    0 / Number of data axes
EXTEND  =                    T / FITS data may contain extensions
TELESCOP= 'COROT   '           / Telescope name
ORIGIN  = 'CDC     '           / Processing site
CREA_DAT= '2009-03-31T20:12:22' / File creation date
FILENAME= 'EN2_STAR_MON_0102776605_20070203T130553_2007040
PIPE_VER= '0.8     '           / Name and version of the process that gene
N2_VER  = '2.1     '           / Reference version of the N2 data specificati
COMMENT FITS (Flexible Image Transport System) format is defined in 'A
COMMENT and Astrophysics', volume 376, page 359; bibcode 2001A&A
```

Leyend colour
Dot colour
Dot Format
Dot Union Yes No
Zoom Cancel Zoom

RUN	COROT ID	TYPE	RA(J2000)	DE(J2000)	START DATE	END DATE	SpType	LUM	VMAG	B-V	BROWSE	FETCH/MARK	VAR1	PROB1	VAR2	PROB2
IRa01	102776605	monochromatic	101.34364	-0.65412	2007-02-03 13:05:53.0	2007-04-01 23:55:18.0	K3	V	16.226	0.839	FITS	FITS	ECL	0.999967	MISC	3.3E-5
IRa01	102897917	monochromatic	102.12041	-0.72015	2007-02-03 13:05:53.0	2007-04-01 23:55:18.0	K3	V	16.126	0.914	FITS	FITS	ECL	0.999967	ELL	2.5E-5
IRa01	102897917	monochromatic	102.12041	-0.72015	2007-02-03 13:05:53.0	2007-04-01 23:55:18.0	K3	V	16.126	0.914	FITS	FITS	ECL	0.999967	ELL	2.5E-5
IRa01	102897917	monochromatic	102.12041	-0.72015	2007-02-03 13:05:53.0	2007-04-01 23:55:18.0	K3	V	16.126	0.914	FITS	FITS	ECL	0.999967	ELL	2.5E-5
IRa01	102776605	monochromatic	101.34364	-0.65412	2007-02-03 13:05:53.0	2007-04-01 23:55:18.0	K3	V	16.226	0.839	FITS	FITS	ECL	0.999967	MISC	3.3E-5
IRa01	102776605	monochromatic	101.34364	-0.65412	2007-02-03 13:05:53.0	2007-04-01 23:55:18.0	K3	V	16.226	0.839	FITS	FITS	ECL	0.999967	MISC	3.3E-5

VO-science


VO-science
VO-tools
Uptake of standards by data centres
Development of standards

VO-schools

- Goal:
  - Teach participants on how to efficiently use the VO tools for their own research.
  -
- Methodology:
  - Tutorials based on real science cases.
- Ample experience.

Madrid. Dec'15
Strasbourg. Nov'16
Madrid. Nov'17
Strasbourg. 2018

Not restricted to project's partners.
Open to all European institutes.

VO-projects

Hide highlights | Show abstracts

2017MNRAS.466.2983G 2017/04

Discovery of wide low and very low-mass binary systems using Virtual Observatory tools

Gálvez-Ortiz, M. C.; Solano, E.; Lodieu, N. *and 1 more*

> *Discovery of wide low and very low-mass binary systems using Virtual Observatory tools theoretical models. Taking advantage of the virtual observatory capabilities, we looked for comoving low*

2017A&A...598A..92L 2017/02

New ultracool subdwarfs identified in large-scale surveys using Virtual Observatory tools

Lodieu, N.; Espinoza Contreras, M.; Zapatero Osorio, M. R. *and 4 more*

> *New ultracool subdwarfs identified in large-scale surveys using Virtual Observatory tools as part of the Virtual Observatory tools. We considered different photometric and proper motion criteria*

2017A&A...597C...3L 2017/01

New ultracool subdwarfs identified in large-scale surveys using Virtual Observatory tools (Corrigendum). I. UKIDSS LAS DR5 vs. SDSS DR7

Lodieu, N.; Espinoza Contreras, M.; Zapatero Osorio, M. R. *and 3 more*

> *New ultracool subdwarfs identified in large-scale surveys using Virtual Observatory tools*

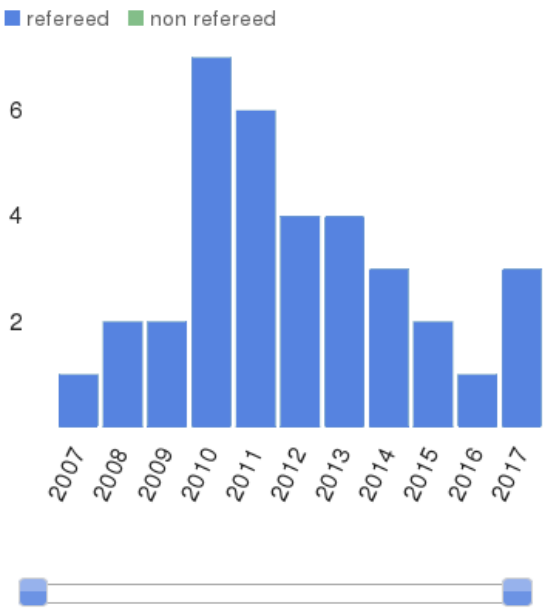
2016MNRAS.457.3396P 2016/04

A search for new hot subdwarf stars by means of virtual observatory tools II

Pérez-Fernández, E.; Ulla, A.; Solano, E. *and 2 more*

35 selected | clear all

Years | Citations | Reads



Limit results to papers from 2007 to 2017 Apply

VO-science

MONTHLY NOTICES
of the Royal Astronomical Society

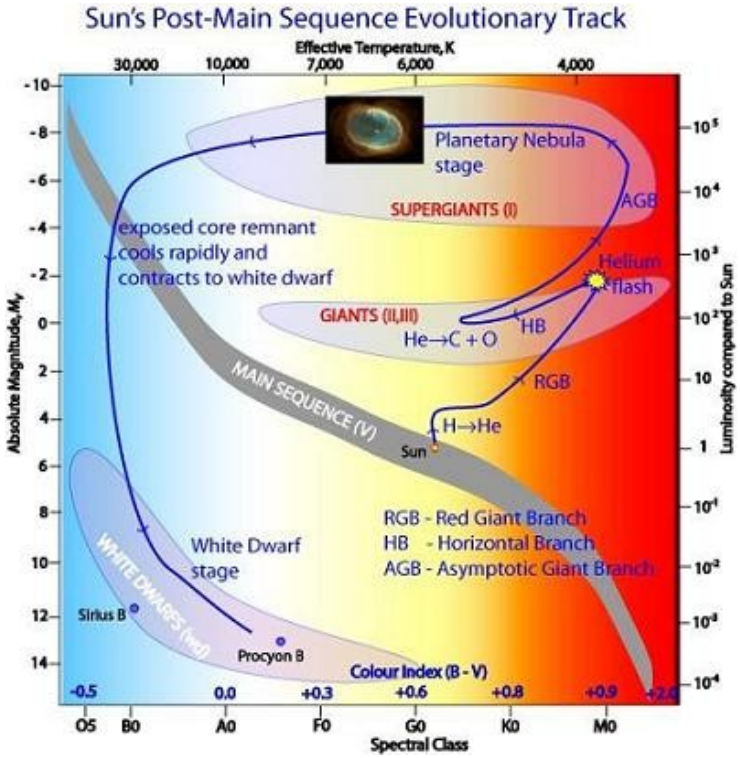
ABOUT THIS JOURNAL CONTACT THIS JOURNAL SUBSCRIPTIONS CURR

Oxford Journals › Science & Mathematics › MNRAS › Volume 457, Issue 3 › Pp. 3396-3408.

A search for new hot subdwarf stars by means of virtual observatory tools II

E. Pérez-Fernández[1,2,*], A. Ulla[2], E. Solano[3,4], R. Oreiro[5] and C. Rodrigo[3,4]

- Teff > 19000 K
- logg > 5 dex.
- Menv < 0.05 Msun
- R: 0.3-0.5 Rsun
- M: 0.5 Msun



Increase the number of hot subdwarfs

More robust statistical confrontation with theoretical evolutionary scenarios.

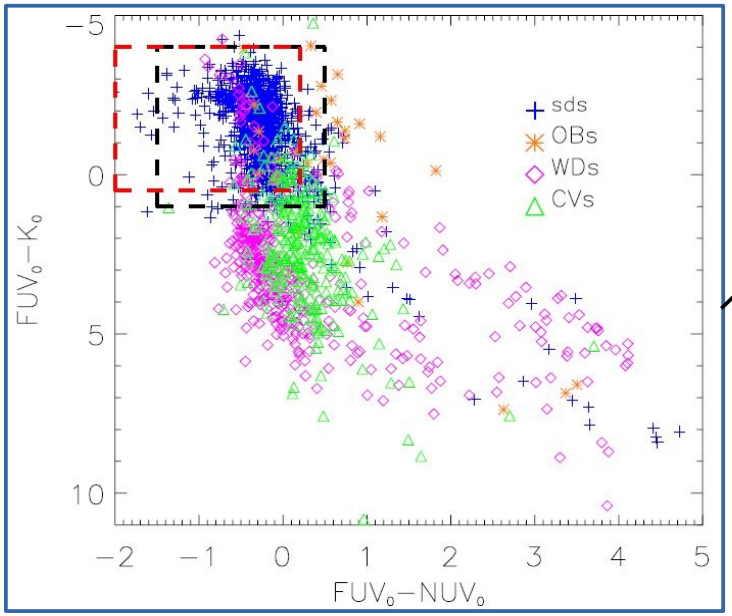
VO-science: Methodology

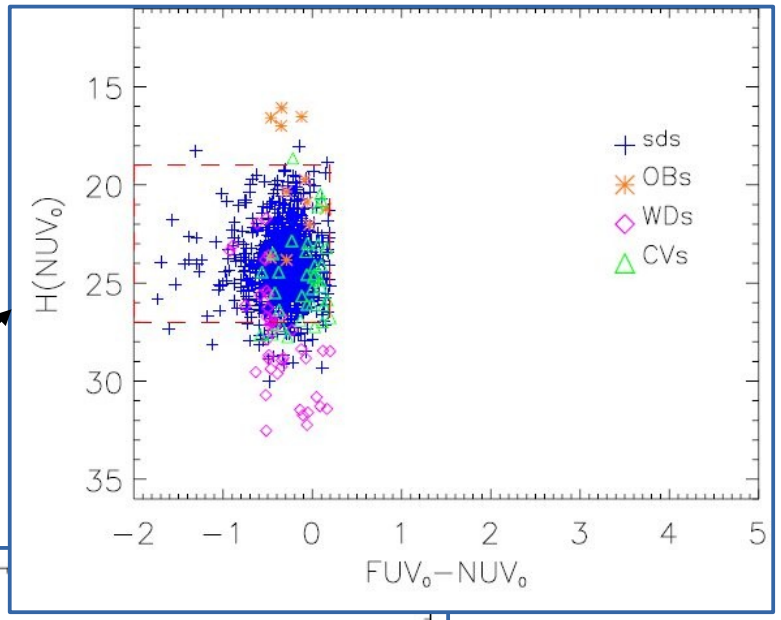
Described in Oreiro et al. (2011)

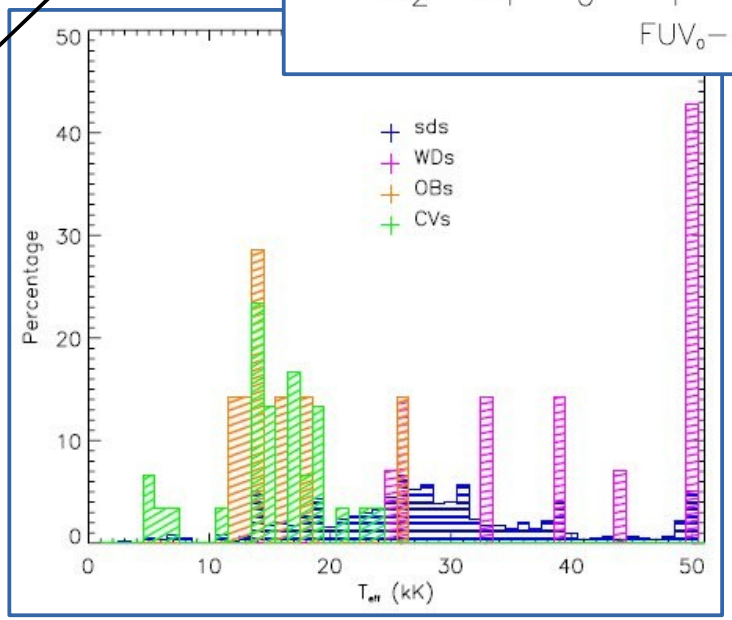
Photometric, astrometric and phys. param criteria.

GALEX (GR6/GR7), 2MASS (PSC), SDSS (DR7), Supercosmos

High rate of success: > 80%





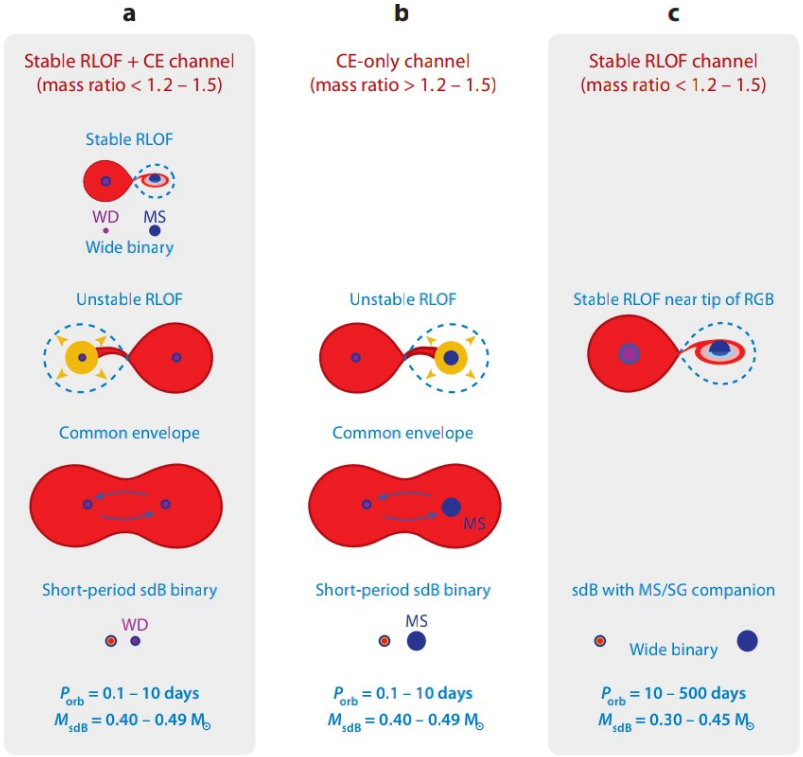


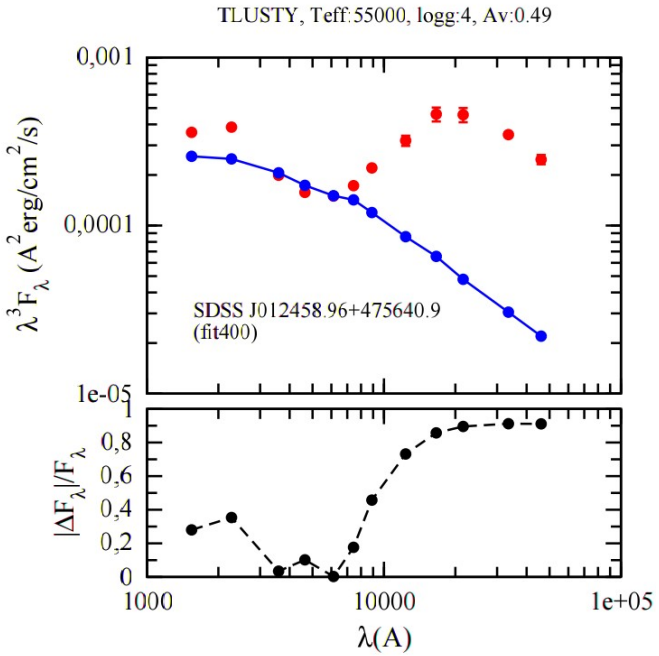
This work:

- Wide sky region>11600 deg²

VO-science: Results

437 new subdwarf candidates (>20%).
189 are binary systems.





- Excess from *B*,*V* or *g* band: type F (17 objects)
- Excess from *r* band: types F, G (6 objects)
- Excess from *i* band: types F, G, K (86 objects)
- Excess from *z* or *J* band: types G, K (69 objects)
- Excess from *H*, *Ks* or *W*1 band: type K (11 objects)

Binary fraction (literature):
sdBs ~ 40%. (Heber 2009)
SdOs ~ 20%-40%
Binary fraction (this work): 45%.

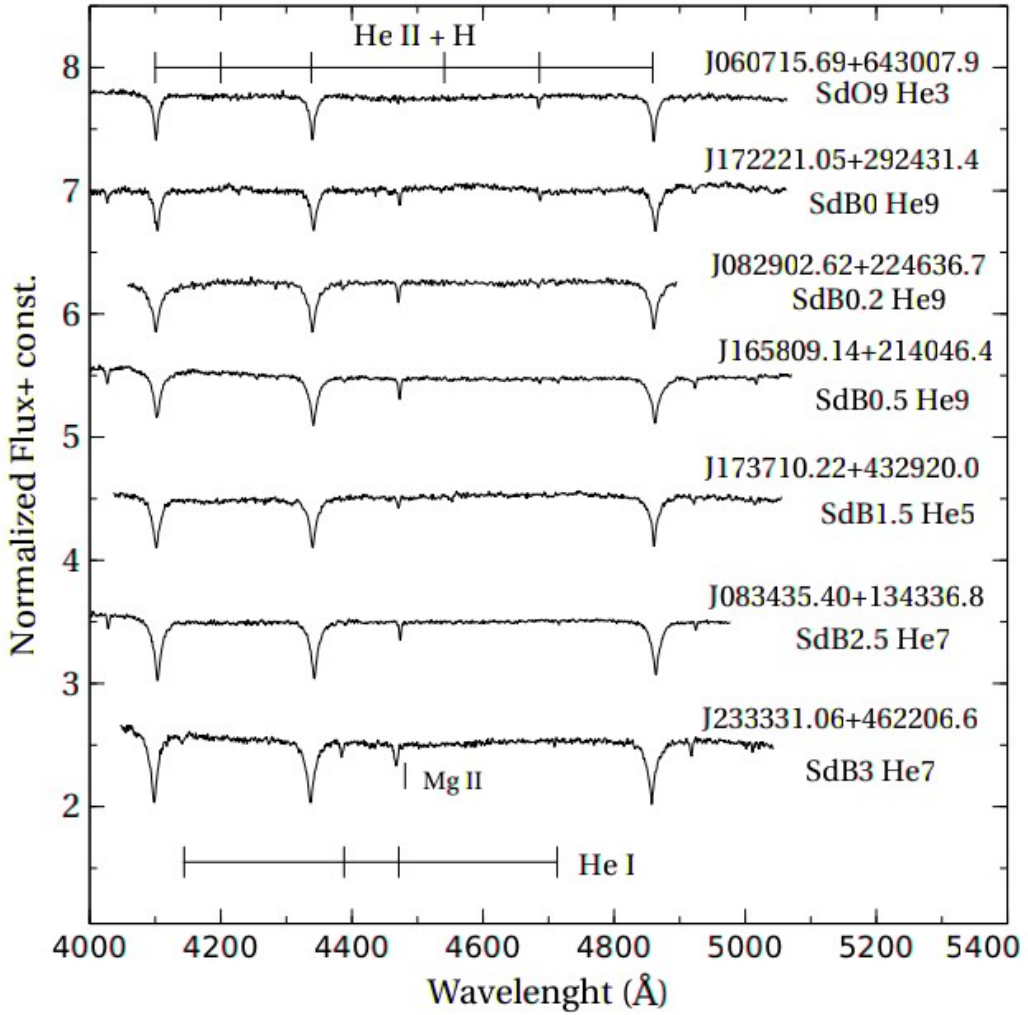
VO-science: Spectral classification

Only 67 stars (16%) of our list of sds candidates have SDSS spectrum.

- 1 white dwarf
- 1 CV
- 65 subdwarfs
  - 5 sdOs
  - 25 sdOBs
  - 35 sdBs

Success rate: 95.6% !!

Teffs derived using spectral types in agreement from SED-fitting Teffs (VOSA).



Summary

New data

Archive data

Standards

Tools

Science

Discovery of wide low and very low-mass binary systems using Virtual Observatory tools

M. C. Gálvez-Ortiz ✉, E. Solano ✉, N. Lodieu, M. Aberasturi

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To know more

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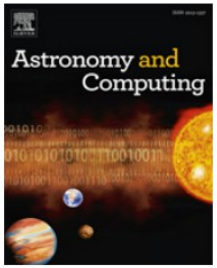

Full length article

Euro-VO—Coordination of virtual observatory activities in Europe

Françoise Genova [a,*], Mark G. Allen [a], Christophe Arviset [b], Andy Lawrence [c], Fabio Pasian [d], Enrique Solano [e,f], Joachim Wambsganss [g]