

# *Science with the Virtual Observatory*

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# Quasar candidates selection in the Virtual Observatory era

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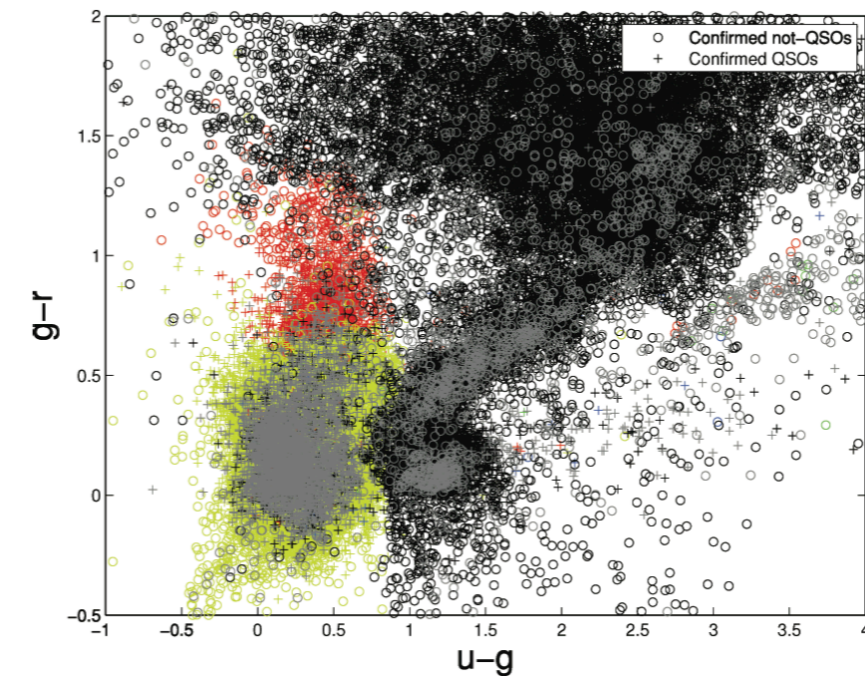
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## ABSTRACT

We present a method for the photometric selection of candidate quasars in multiband surveys. The method makes use of a priori knowledge derived from a subsample of spectroscopic confirmed quasi-stellar objects (QSOs) to map the parameter space. The disentanglement of QSOs candidates and stars is performed in the colour space through the combined use of two algorithms, the probabilistic principal surfaces and the negative entropy clustering, which are for the first time used in an astronomical context. Both methods have been implemented in the `VONEURAL` package on the Astrogrid Virtual Observatory platform. Even though they belong to the class of the unsupervised clustering tools, the performances of the method are optimized by using the available sample of confirmed quasars and it is therefore possible to learn from any improvement in the available 'base of knowledge'. The method has been applied and tested on both optical and optical plus near-infrared data extracted from the visible Sloan Digital Sky Survey (SDSS) and infrared United Kingdom Infrared Deep Sky Survey-Large Area Survey public data bases. In all cases, the experiments lead to high values of both efficiency and completeness, comparable if not better than the methods already known in the literature. A catalogue of optical candidate QSOs extracted from the SDSS Data Release 7 Legacy photometric data set has been produced and is publicly available at the URL <http://voneural.na.infn.it/qso.html>.



*VO as platform for data mining*

## EXO-DAT: AN INFORMATION SYSTEM IN SUPPORT OF THE *CoRoT*/EXOPLANET SCIENCE\*

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### ABSTRACT

*Exo-Dat* is a database and an information system that provides a united interface to several data obtained during the mission preparation. It gives consistent 4-color photometry of stars. It covers several zones in the galactic disk. *Exo-Dat* information system provides essential information for ground-based follow-up by supplying the star's fundamental parameters or identifying stars in the database is fully interfaced with VO tools such as TOPCAT or ALADIN. It is accessible to the public. It is the ideal tool to prepare ground-based systems. As a VO-compliant system, it is suitable for general use.

*Online-only material:* color figures

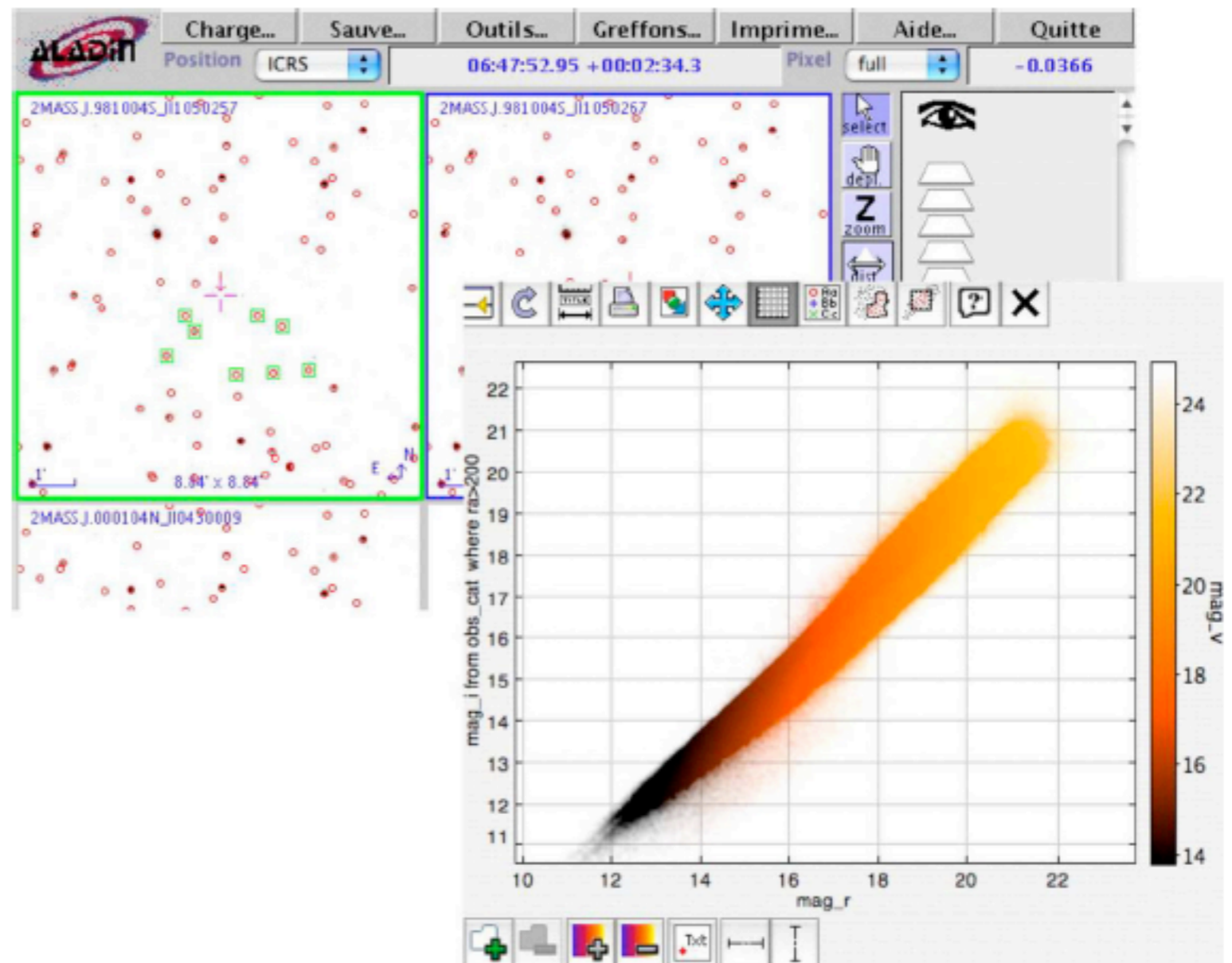


Figure 12. *Exo-Dat* visualization of data using VO tools such as *Aladin* and *TOPCAT*.  
(A color version of this figure is available in the online journal.)

VO for visualisation

# VOSA: virtual observatory SED analyzer

## An application

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**Context.** The physical properties of almost a extracted from theoretical models to observal **Aims.** We want to develop an automatic proc association and apply this methodology to th **Methods.** We combine the multiwavelength sources. The key step of the work-flow is j environment.

**Results.** We present this new tool, and provic of Collinder 69, and an upper-limit for the ag **Conclusions.** This kind of study of star form the traditional methodology. Thus, they are e

**Key words.** astronomical data bases: miscell stars: Hertzsprung-Russell (HR) and C-M di

### Appendix B: work-flow

```
wget --save-cookies cookies.txt --load-cookies cookies.txt --keep-session-cookies
http://sdc.laeff.inta.es/voled/jsp/form_search.jsp
wget --save-cookies cookies.txt --load-cookies cookies.txt --keep-session-cookies
http://sdc.laeff.inta.es/voled/jsp/res_search.jsp?obj_id=6ra:83.446596de:9.9273633
&rad=0.01&sep_services=all&sep_uvbybeta=0&sep_2mass=0&sep_hip=0&sep_dalessio
=on&submit=Submit+Query
wget --save-cookies cookies.txt --load-cookies cookies.txt --keep-session-cookies
http://sdc.laeff.inta.es/voled/jsp/res_search.jsp?submitGetData=Retrieve+Marked+Data
&filas_sep=all&filas_strongren=0&filas_2mass=0 -O object1.zip
```

**Fig. B.1.** Example of the three lines per object to include in the script. With the first line, the user access the VOSED form; with the second one, a query is performed (to the services available in the VOSED form) around the position written in the fields *ra* and *de* within the radius *rad* (in degrees). Finally with the third line the available data for those coordinates is retrieved. All the information in saved in one zip-file.



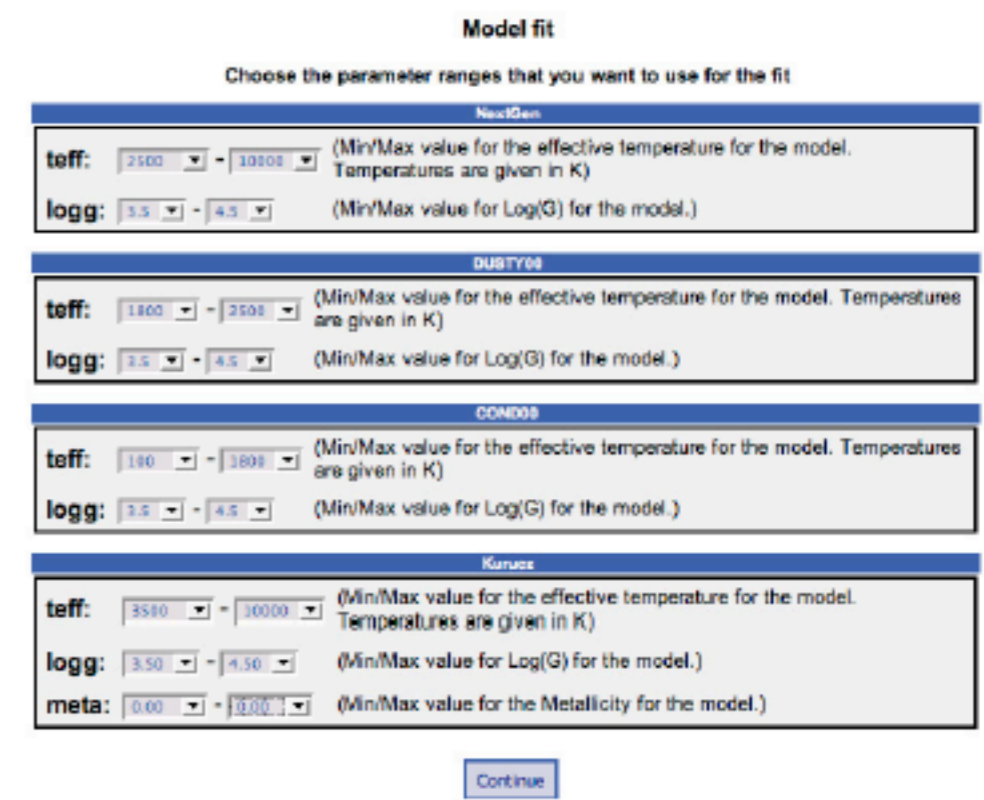
**Fig. B.2.** Part of the input data in the web interface of the SVO SED fitting tool.



**Fig. B.3.** Photometrical catalogs to be queried with the respective search radii.



**Fig. B.4.** 2MASS photometry found. We will use these JHKs measurements in those objects for which we do not have our own photometrical data.



**Fig. B.5.** Range of parameters queried for each collection of synthetic spectra.

**Model fit**

Hide Graphs

Object	Model	T <sub>eff</sub>	LogG	Metallicity	χ <sup>2</sup>	A <sub>V</sub>	τ <sub>1500</sub>	A <sub>1500</sub>	A <sub>1600</sub>	A <sub>1700</sub>	A <sub>1800</sub>	A <sub>1900</sub>	A <sub>2000</sub>	A <sub>2100</sub>	A <sub>2200</sub>	A <sub>2300</sub>	A <sub>2400</sub>	A <sub>2500</sub>	Date VOdata
LO9801	Kurucz	4800	3.80	0.30	1.75e+0	4.02e-1	1.81e+0	3.81e+0	0.48	1.20e+0	3.02e+0	2.82e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9802	NextGen	3800	4.8	0	1.46e+0	1.15e+0	2.04e+0	0.25e+0	0.48	1.20e+0	1.00e+0	3.18e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9803	Kurucz	4800	3.80	0.30	0.29e+0	3.82e-1	1.76e+0	3.12e+0	0.47	1.20e+0	3.19e+0	2.53e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9804	Kurucz	3700	4.80	0.30	2.28e+0	4.07e+1	1.80e+0	4.37e+0	0.48	1.20e+0	6.22e+0	2.45e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9805	NextGen	4800	4.8	0	0.28e+0	1.02e+0	1.60e+0	5.43e+0	0.48	1.20e+0	1.15e+0	2.73e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9806	Kurucz	4800	3.80	0.30	0.38e+0	3.22e+1	1.04e+0	4.31e+0	0.47	1.20e+0	1.36e+0	2.45e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9807	Kurucz	4800	4.80	0.30	0.08e+0	2.89e+1	1.33e+0	4.34e+0	0.48	1.20e+0	6.81e+0	2.11e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9808	Kurucz	4800	3.80	0.30	4.03e+0	3.15e+1	1.00e+0	3.15e+0	0.48	1.20e+0	1.13e+0	2.48e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9809	NextGen	4800	3.8	0	0.22e+0	1.82e+0	1.10e+0	3.75e+0	0.48	1.20e+0	1.36e+0	1.88e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9810	NextGen	4800	4.8	0	1.87e+0	4.00e+1	1.10e+0	3.08e+0	0.48	1.20e+0	1.75e+0	1.81e+0	46110	1.0	Photometry   Spectra   Spectrum				
LO9811	NextGen	3800	4.8	0	1.23e+0	1.11e+0	1.41e+0	4.43e+0	0.47	1.20e+0	1.26e+0	2.23e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9812	NextGen	4800	4.8	0	0.58e+0	8.73e+1	1.00e+0	4.30e+0	0.48	1.20e+0	6.22e+0	2.07e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9813	NextGen	3700	4.8	0	0.53e+0	1.15e+0	1.23e+0	0.36e+0	0.48	1.20e+0	1.13e+0	1.52e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9814	Kurucz	4800	4.80	0.30	4.78e+0	2.25e+1	1.00e+0	3.48e+0	0.48	1.20e+0	1.37e+0	1.14e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9815	Kurucz	4800	3.80	0.30	8.75e+0	3.32e+1	1.42e+0	3.05e+0	0.48	1.20e+0	0.85e+0	1.77e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9816	Kurucz	3700	4.80	0.30	6.83e+0	2.78e+1	1.01e+0	3.06e+0	0.47	1.20e+0	0.56e+0	1.84e+0	46110	1.0	Photometry   Spectra   Spectrum				
LO9817	NextGen	4200	4.8	0	7.88e+0	1.18e+1	3.00e+1	2.74e+0	0.48	1.20e+0	1.42e+0	1.83e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9818	Kurucz	3700	3.80	0.30	4.31e+0	2.19e+1	3.80e+1	3.02e+0	0.47	1.20e+0	4.31e+0	1.51e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9819	Kurucz	3700	3.80	0.30	1.80e+0	2.08e+1	3.33e+1	3.04e+0	0.48	1.20e+0	4.30e+0	1.52e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9820	NextGen	3800	4.8	0	2.28e+0	1.21e+0	3.70e+1	3.02e+0	0.48	1.20e+0	4.30e+0	1.51e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9821	Kurucz	4800	3.80	0.30	0.38e+0	1.73e+1	8.20e+1	2.06e+0	0.47	1.20e+0	4.15e+0	1.53e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9822	Kurucz	3700	4.80	0.30	1.78e+0	2.03e+1	8.04e+1	2.06e+0	0.48	1.20e+0	4.29e+0	1.22e+0	57103	0.0	Photometry   Spectra   Spectrum				
LO9823	NextGen	4800	4.8	0	0.35e+0	0.80e+1	8.16e+1	0.81e+0	0.47	1.20e+0	1.56e+0	1.93e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9824	Kurucz	3700	3.80	0.30	2.02e+0	2.28e+1	8.23e+1	3.06e+0	0.48	1.20e+0	1.13e+0	1.62e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9825	NextGen	3700	4.8	0	1.25e+0	8.01e+1	1.40e+1	1.33e+0	0.48	1.20e+0	4.17e+0	2.23e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9826	NextGen	3700	4.8	0	4.81e+0	8.15e+1	8.02e+1	3.25e+0	0.48	1.20e+0	4.20e+0	1.51e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9827	NextGen	4800	4.8	0	2.29e+0	4.00e+1	7.03e+1	2.23e+0	0.48	1.20e+0	3.74e+0	1.11e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9828	Kurucz	3700	4.80	0.30	1.28e+0	1.02e+1	1.81e+1	1.80e+0	0.48	1.20e+0	2.29e+0	3.22e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9829	NextGen	3700	4.8	0	7.28e+0	1.04e+0	9.01e+1	2.54e+0	0.48	1.20e+0	4.16e+0	1.17e+0	30204	4.0	Photometry   Spectra   Spectrum				
LO9830	NextGen	3700	4.8	0	2.10e+0	8.13e+1	8.02e+1	2.20e+0	0.48	1.20e+0	1.13e+0	1.11e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9831	NextGen	3800	4.8	0	2.27e+0	0.05e+1	0.02e+1	2.24e+0	0.47	1.20e+0	3.25e+0	1.12e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9832	NextGen	3700	4.8	0	1.75e+0	0.73e+1	0.00e+1	0.01e+0	0.48	1.20e+0	3.01e+0	1.83e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9833	NextGen	3700	4.8	0	1.70e+0	0.26e+1	0.31e+1	0.06e+0	0.48	1.20e+0	1.17e+0	1.31e+0	78104	0.0	Photometry   Spectra   Spectrum				
LO9834	NextGen	3800	4.8	0	1.27e+0	2.27e+0	8.86e+1	2.18e+0	0.38	1.20e+0	4.32e+0	1.56e+0	36201	0.0	Photometry   Spectra   Spectrum				
LO9835	NextGen	3700	4.8	0	1.81e+0	3.02e+1	3.30e+1	1.02e+0	0.48	1.20e+0	3.07e+0	3.02e+0	78104	0.0	Photometry   Spectra   Spectrum				

**Fig. B.6.** Several rows of the "master-table" with all the fittings.

VO as a ready to use tool-kit



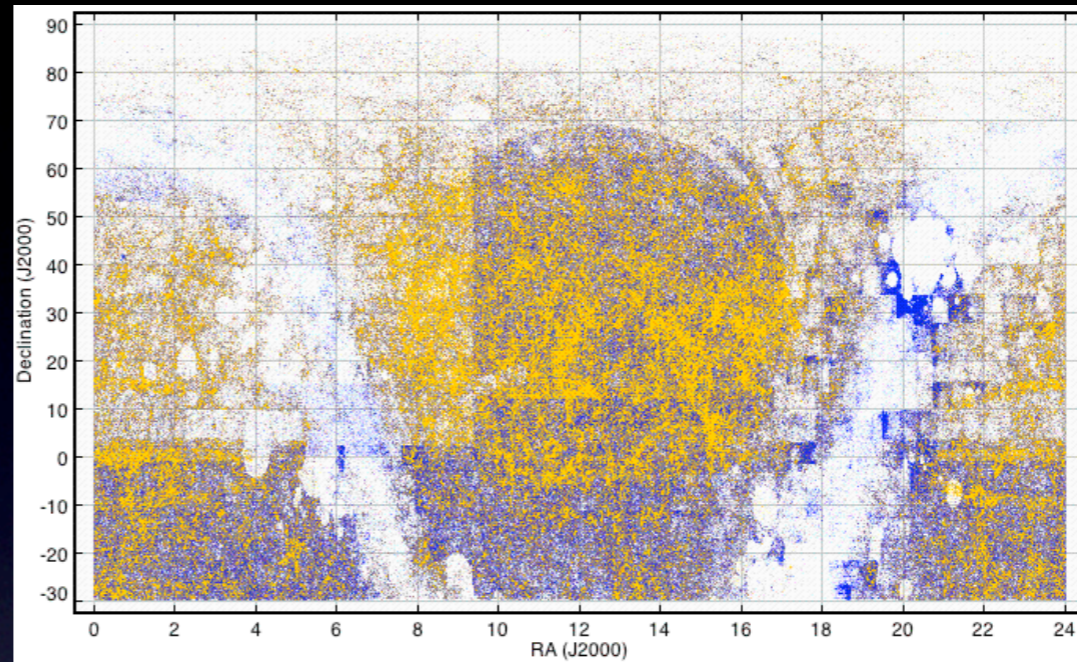
# Fathi et al., Is galaxy scale length Universal?

Defining the Sample  
Using the Sloan interface;  
X-correlate with LEDA &  
filter

TOPCAT

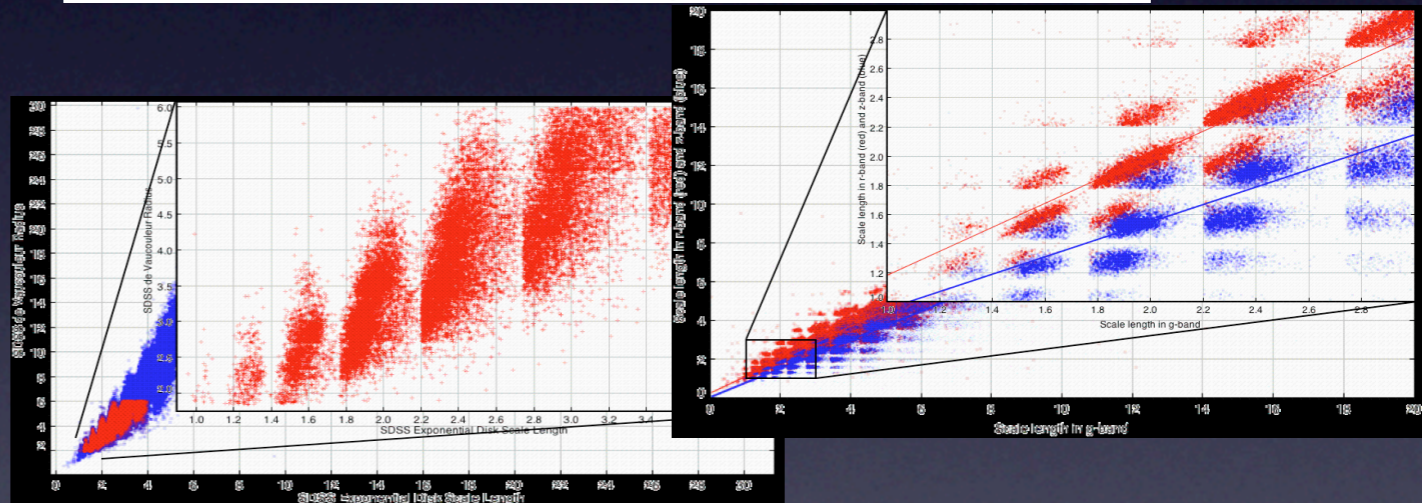
STILTS

Aladin



Investigating the SDSS  
scale length

TOPCAT



Querying and Storing

SkyView

VOSpace

50000 objects \* 5 images  
each ~300 GB of data

# VO-enabled papers



The EURO-VO projects: [VOTECH](#) [EuroVO-DCA](#) [EuroVO-AIDA](#)

Science	<h2>VO-enabled Scientific Papers</h2> <p>Selected scientific publications mainly enabled by VO tools or about VO tools and methods.</p> <p>For conference proceedings and other non-refereed publications, see <a href="#">here</a></p> <h3>REFEREED PUBLICATIONS</h3> <p><a href="#">The GalMer database: Galaxy Mergers in the Virtual Observatory</a> Chilingarian I., Di Matteo P., Combes F., Melchior A.-L., Semelin B., A&amp;A, in press</p> <p><a href="#">Scale Lengths of Disk Galaxies</a> Fathi K., Allen M., Boch Th., Hatziminaoglou E., Peletier R., MNRAS, in press</p> <p><a href="#">SDSSJ150634.27+013331.6: the second compact elliptical galaxy in the NGC5846 group</a> Chilingarian I &amp; Bergond G., MNRAS Letters, in press</p> <p><a href="#">VisIVO-Integrated Tools and Services for Large-Scale Astrophysical Visualization</a> Becciani et al., 2010, PASP, 122, 119</p> <p><a href="#">The SPECFIND V2.0 catalogue of radio cross-identifications and spectra. SPECFIND meets the Virtual Observatory</a> Vollmer et al., 2010, A&amp;A, 511, 53</p> <p><a href="#">Montage: a grid portal and software toolkit for science-grade astronomical image mosaicking</a> Jacob J.C. et al., Int. J. Computational Science and Engineering, 2009, vol 4, No. 2</p> <p><a href="#">A Population of Compact Elliptical Galaxies Detected with the Virtual Observatory</a> Chilingarian I. et al., 2009, Science, 326, 1379</p> <p><a href="#">Properties of dusty tori in active galactic nuclei - II. Type 2 AGN</a> Hatziminaoglou E., Fritz J., Jarrett T., 2009, MNRAS, 399, 1206</p>
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## Projects in progress

### **(1) Reconstructing the SED of spiral galaxies in the WINGS survey**

**Aim:** construct the SEDs of a sample of  $\sim 17000$  spiral galaxies - cluster members, analyse them as a function of galaxy position inside the cluster, galaxy masses and luminosities

**VO requirements:** collect and retrieve photometry and spectra from large catalogues (GALEX, SDSS, 2MASS, UKIDSS, 6dF) **automatically; SED building**

### **(2) Probing the ambient gas around compact radio galaxies through optical and X-ray spectroscopy**

**Aim:** collect the spectra of all young radio sources available in the VO, as well as a representative sample of large sources, to study the ionized gas properties, the different ionization mechanisms, interaction with the host ISM, AGN feedback, and the morphological and luminosity properties of both the host and radio source

**VO requirements:** retrieve spectra and photometry; **SED building**



## Projects in progress

### **(3) A common scale for the spectroscopic metallicity determination of field and open cluster stars**

**Aim:** retrieve high resolution spectra of field and open clusters stars observed with different instruments to study the metallicity distribution of the galactic disk and its evolution with time in an accurate way

**VO requirements:** retrieve high resolution **spectra** from the available SSAs (e.g. ELODIE, NARVAL)

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