

# The Virtual Observatory

The e-Science Environment for Discovery  
& Collaboration in Astrophysics

Juan de Dios Santander-Vela

**AMIGA, Wf4Ever, VIA→SKA** Project

# Talk Outline

- AMIGA in one slide
- What is the VO?
- VO and e-Science
- VO and the IAA Science cases
- Collaborating with(in) the VO

# AMIGA

**CIG**  
(Catalogue of Isolated Galaxies)  
Karachentseva 1973)

## Refinement

Positions

Velocity

mB/LB

Morphologies

Isolation

## AMIGA sample

## Technical development

Global

### SF/AGN

- FIR
- radiocont
- SDSS spectra
- H $\alpha$
- CO/HCN
- HI

### Selected subsamples

#### Kinem/dyn

- HI, H $\alpha$

GCs

#### SF inner

H $\alpha$

CO/HCN

#### SF outer

HI

CO

XUV

mm/submm  
calibration

Phase transfer



Fast switching

Archiving

Tools

### VO compliant

MOVOIR

3D data analysis  
GIPSY



### VO compliant

Data model

Web Interface



Robledo

30-IRAM

# AMIGA Software & Tools

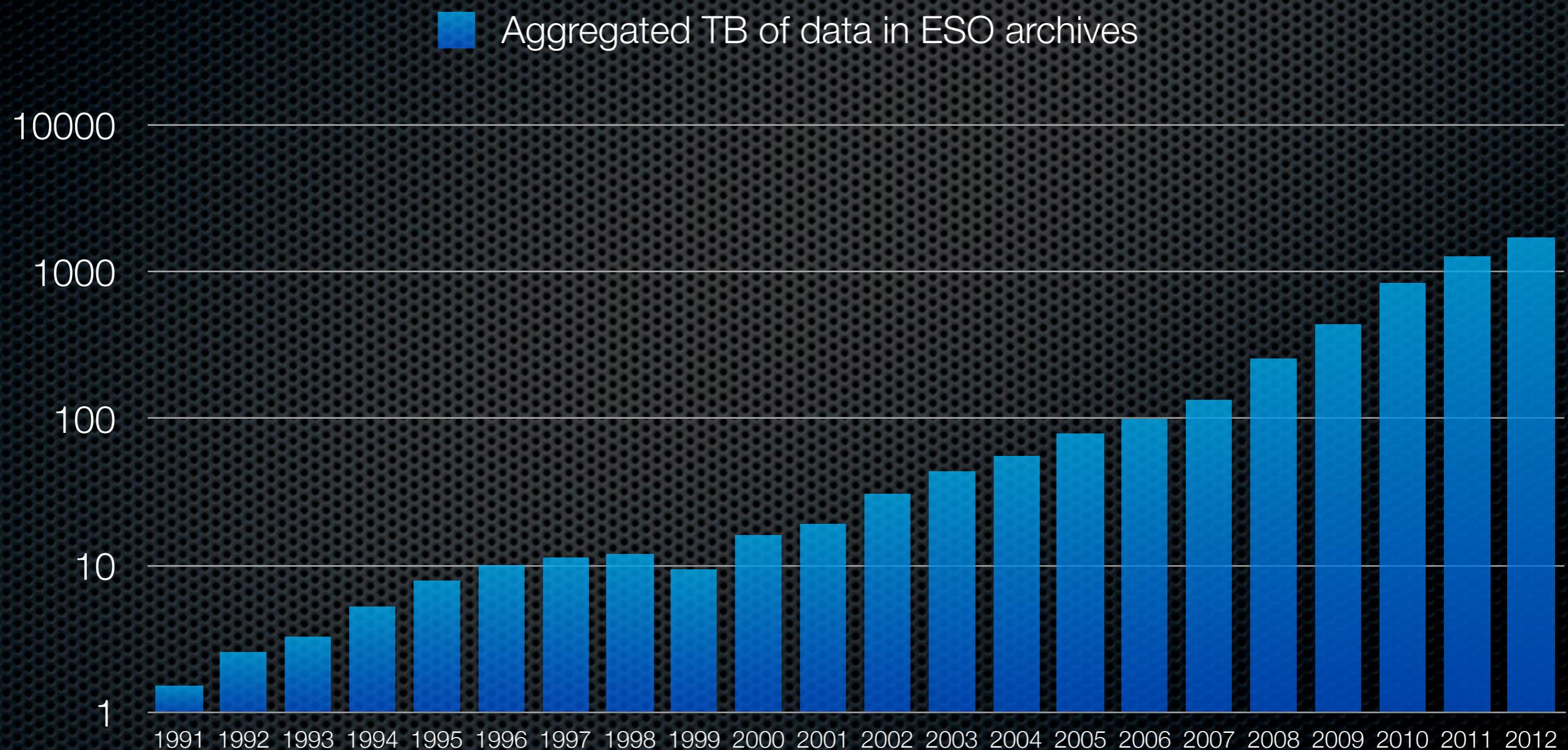
- Devoted to create software tools for AMIGA users, others
- making data analysis easier
- science more robust
- Personnel
  - Pique
  - Susana
  - Julián
  - Juande

What is the VO  
and why we need it

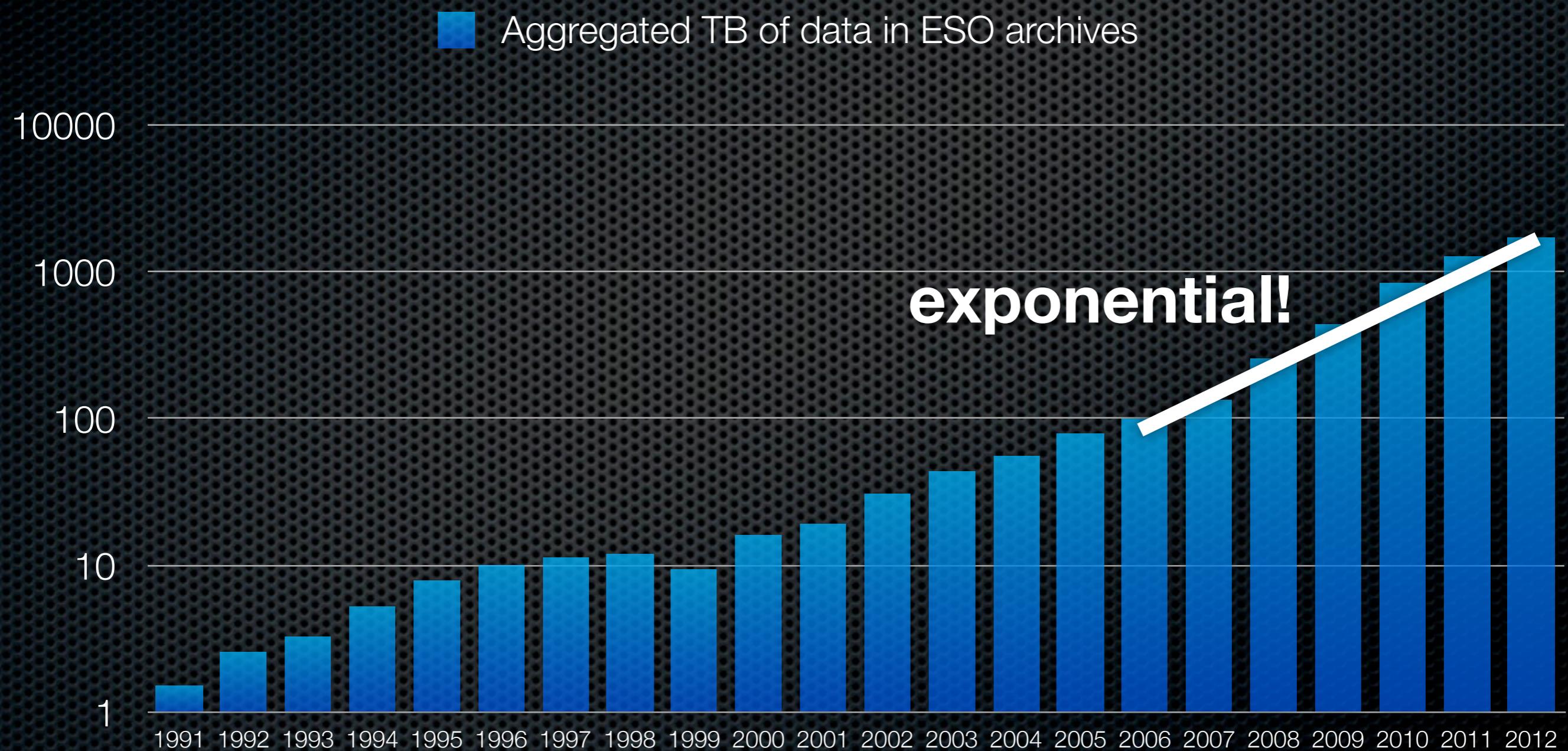
# Astronomy in the era of archives

- Number of archives blooming
- Internet brings us remote access to most of them
- However... we're cursed!
  - We cannot keep up with the data feeding rhythm
  - We cannot interoperate archives

# Astronomical Data Deluge



# Astronomical Data Deluge



# The Archive Babel

- Archives from different instruments use:
  - Different **formats**
  - Different **conventions**
  - Different **access queries**

Even for the same  
kind of instruments

# ESO vs ING archive



## ESO Archive Query Form

[ESO Archive Overview](#) [Help Page](#) [FAQ](#)

[Archive Facility HOME](#) [ESO HOME](#)

If you would like to query the Archive for instrument specific parameters, please use the [dedicated query forms](#).  
To search for **reduced Data Products**, please have a look at the [ESO Data Products](#) page and the [Advanced Data Products](#) query form.

The checkboxes on the right of the parameters define whether or not they will be displayed on the query result page.

**SEARCH**

ShowAll

ShowNone

Reset

[query Help](#) [Status of Requests](#)

### Target, Program and Scheduling Information

**Target Name**   Resolved by SIMBAD

**RA**  **DEC**  **J2000**

**Search Box**  00 10 00    **Input** RA(h) DEC(deg)

**Output**  Sexagesimal (h, deg)

**List of Targets**  no file selected

**Night**   (DD MM YYYY)  
OR give a query range using the following start/end dates:

**Start**  12 hrs [UT] **End**  12 hrs [UT]

**Program ID**   **Program Type**  Any

**PI CoI**   **SV**  Any

**Title**

### Observing Information

Imaging	Spectroscopy	Interferometry	Other
<input type="checkbox"/> ALL <input type="checkbox"/> NONE			
<input type="checkbox"/> VLT/ <a href="#">FORST1</a>	<input type="checkbox"/> VLT/ <a href="#">CRIRES</a>	<input type="checkbox"/> VLT/ <a href="#">VINCI</a>	<input type="checkbox"/> APEX/ <a href="#">HET</a>
<input type="checkbox"/> VLT/ <a href="#">FORST2</a>	<input type="checkbox"/> VLT/ <a href="#">FORS1</a>	<input type="checkbox"/> VLT/ <a href="#">MIDI</a>	<input type="checkbox"/> APEX/ <a href="#">BOL</a>

### Data Product Info

**Type**  Any

User defined input:

# ESO vs ING archive



To request data please select the datasets in the results table by marking the checkbox in the left-most column, then press either the **Instant download** button or the **FTP or Media delivery** button. *(You will be prompted for your ESO User Portal username and password. If you do not yet have an ESO User Portal account, please fill out the [registration form](#))*

Datasets for which the proprietary period is over are highlighted in **green** and are publicly available.

Datasets that are still under the proprietary period are highlighted in **red** and can only be downloaded by the corresponding PI.

[Define new query](#) [Status of Requests](#)

**SIMBAD coordinates for eta carina : 10 45 03.5, -59 41 04.2**



[MarkAll](#)  [UnMarkAll](#)

M	M	HJD	PRV	OBJECT	T	AP	P	R	ID	Lat	Long	S	T
---	---	-----	-----	--------	---	----	---	---	----	-----	------	---	---

To request data please select the datasets in the results table by marking the checkbox in the left most column, then press either the [Instant download](#) button or the [FTP or Media delivery](#) button.  
(You will be prompted for your ESO User Portal username and password. If you do not yet have an ESO User Portal account, please fill out the [registration form](#).)  
Datasets for which the proprietary period is over are highlighted in **green** and are publicly available.  
Datasets that are still under the proprietary period are highlighted in **red** and can only be downloaded by the corresponding PI.

[Define new query](#) [Status of Requests](#)

## SIMBAD coordinates for eta carina : 10 45 03.5, -59 41 04.2



[MarkAll](#) [UnMarkAll](#)

[Instant download](#) [FTP or Media delivery](#) [Reset](#)

M	<a href="#">More</a>	<a href="#">HDR</a>	<a href="#">PRV</a>	<a href="#">OBJECT</a>	<a href="#">Target Ra, Dec</a>	<a href="#">Program ID</a>	<a href="#">Instrument</a>	<a href="#">Category</a>	<a href="#">Type</a>
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	TR_14	10:44:24.11 -59:36:29.4	<a href="#">074.C-0401(A)</a>	NAOS+CONICA	SCIENCE	SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	HD93205	10:44:24.12 -59:44:54.7	<a href="#">083.D-0589(A)</a>	FEROS	SCIENCE	OBJECT,SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	HD93205	10:44:24.26 -59:44:56.1	<a href="#">083.D-0589(A)</a>	FEROS	SCIENCE	OBJECT,SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	HD-93204	10:44:24.37 -59:44:40.3	<a href="#">074.D-0300(A)</a>	FEROS	SCIENCE	OBJECT,SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	TR_14	10:44:24.45 -59:36:32.0	<a href="#">074.C-0401(A)</a>	NAOS+CONICA	SCIENCE	SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	HD93205	10:44:24.46 -59:45:02.0	<a href="#">083.D-0589(A)</a>	FEROS	SCIENCE	OBJECT,SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	HD93205	10:44:24.62 -59:44:54.3	<a href="#">083.D-0589(A)</a>	FEROS	SCIENCE	OBJECT,SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	TR_14	10:44:25.17 -59:36:37.4	<a href="#">074.C-0401(A)</a>	NAOS+CONICA	SCIENCE	SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	TR_14	10:44:25.55 -59:36:40.3	<a href="#">074.C-0401(A)</a>	NAOS+CONICA	SCIENCE	SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	HD-93205	10:44:25.96 -59:44:24.4	<a href="#">074.D-0300(A)</a>	FEROS	SCIENCE	OBJECT,SKY
<input checked="" type="checkbox"/>		<a href="#">Header</a>	-	TR_14	10:44:27.37 -59:36:09.1	<a href="#">074.C-0401(A)</a>	NAOS+CONICA	SCIENCE	SKY

# ESO vs ING archive



## Astronomical Data Centre

[top](#) » [archives](#) » [ingarch](#)

[Register](#) | [Log in](#)

### Archives & Catalogues

[ING Archive](#)

[AAT Data Archive](#)<sup>NEW!</sup>

[UKIRT](#)

[Carslberg Meridian  
Telescope](#)

[WFCAM Raw Data  
Archive](#)

[Wide Field Survey](#)

[VizieR Mirror](#)

[Hipparchos Catalogue](#)

[Tycho Catalogue](#)

[APM Catalogue](#)

### Actions

[Query ING Archive](#)

[Last ING Archive Query](#)

### Help

[Help Topics](#)

### Query ING Archive

This form gives access to the catalogue of all observations made on the 4.2m William Herschel Telescope, the 2.5m Isaac Newton Telescope and the 1.0m Jacobus Kapteyn Telescope at ING since the early 1980s. If you find any problem using this form, please [email us](#)

#### Target Parameters

Target Name  [FITS Header](#)

Coordinates

Search Box  (dd mm ss)

#### Observation Parameters

Telescope [INT - Isaac Newton Telescope](#)

Instrument [All](#)

Filter

Exposure Time  (in seconds, e.g. <600)

Airmass  (e.g. 1.0..1.4)

Obsevation Date  (yyyymmdd)

Project ID

Observer

## Archives &amp; Catalogues

ING Archive

AAT Data Archive **NEW!**

UKIRT

Carslberg Meridian Telescope

WFCAM Raw Data Archive

Wide Field Survey

VizieR Mirror

Hipparchos Catalogue

Tycho Catalogue

APM Catalogue

## Actions

Query ING Archive

Last ING Archive Query

## Help

Help Topics

In order to download some datasets please register/log in.

Records 0 - 20 (total: 100)

(0  )Page size: (20 

	Run	Coordinates (J2000)	Object	Filter	Exp Time (s)	Observing Date	Airmass	Type	Instrument	Telescope	Project ID
	5239	13:21:23.40 +46:52:44.8	BS17436 0016 250s	UNKNOWN	250.0	1996-05-29	1.0508	TARGET	IDS	INT	None
	5241	13:31:54.48 +47:23:49.2	BS17436 0051 450s	UNKNOWN	450.0	1996-05-29	1.05451	TARGET	IDS	INT	None
	5668	13:30:29.88 +47:19:14.9	BS17436_50 600s	UNKNOWN	600.0	1996-06-01	1.16531	TARGET	IDS	INT	None
	160824	13:29:33.64 +47:06:21.6	47404	UNKNOWN	1800.0	1999-04-22	1.145612	TARGET	IDS	INT	None
	388738	13:29:52.37 +47:11:40.9	M51	Hbeta broad	299.92	2004-02-10	1.055764	TARGET	WFC	INT	S/D
	388737	13:29:52.37 +47:11:40.8	M51	Hbeta narrow	899.58	2004-02-10	1.059068	TARGET	WFC	INT	S/D
	342236	13:29:52.40 +47:11:43.0	M51 SII	SII_6725_80	120.0	2003-03-30	1.226487	TARGET	WFC	INT	UK/03a/33
	213559	13:29:52.30 +47:11:54.0	M51 r	r	100.07	2000-03-28	1.346206	TARGET	WFC	INT	wfs1
	335248	13:27:48.00 +47:27:00.0	M51_1	r	100.02	2003-02-04	1.073369	TARGET	WFC	INT	C13
	335258	13:28:48.00 +47:57:00.0	M51_2	r	100.03	2003-02-04	1.057563	TARGET	WFC	INT	C13
	335247	13:27:48.00 +47:27:00.0	M51_1	r	100.02	2003-02-04	1.075104	TARGET	WFC	INT	C13
	335257	13:28:48.00 +47:57:00.0	M51_2	r	100.03	2003-02-04	1.057914	TARGET	WFC	INT	C13
	342238	13:29:52.40 +47:11:43.0	M51 R	r	60.08	2003-03-30	1.242603	TARGET	WFC	INT	UK/03a/33
	342237	13:29:52.40 +47:11:43.0	M51	r	120.01	2003-03-30	1.236342	TARGET	WFC	INT	UK/03a/33

# The era of archival astronomy

- Number of archives blooming
- Internet brings us remote access to most of them
- However... **we're cursed!**
  - We **cannot keep up** with the data feeding rhythm
  - We **cannot interoperate** archives

What can we do?

# Interoperability

The ability of people,  
organizations, and  
equipment to operate  
together effectively.



BILITY  
SE STUDY

SESSIONS  
and  
CARL R. JONES

NATIONAL DEFENSE UNIVERSITY  
McNair Paper Eighteen

# Interoperability

The ability of software,  
archives, and  
computers to operate  
together effectively.



BILITY  
SE STUDY

and  
ESSONS  
CARL R. JONES

NATIONAL DEFENSE UNIVERSITY  
McNair Paper Eighteen

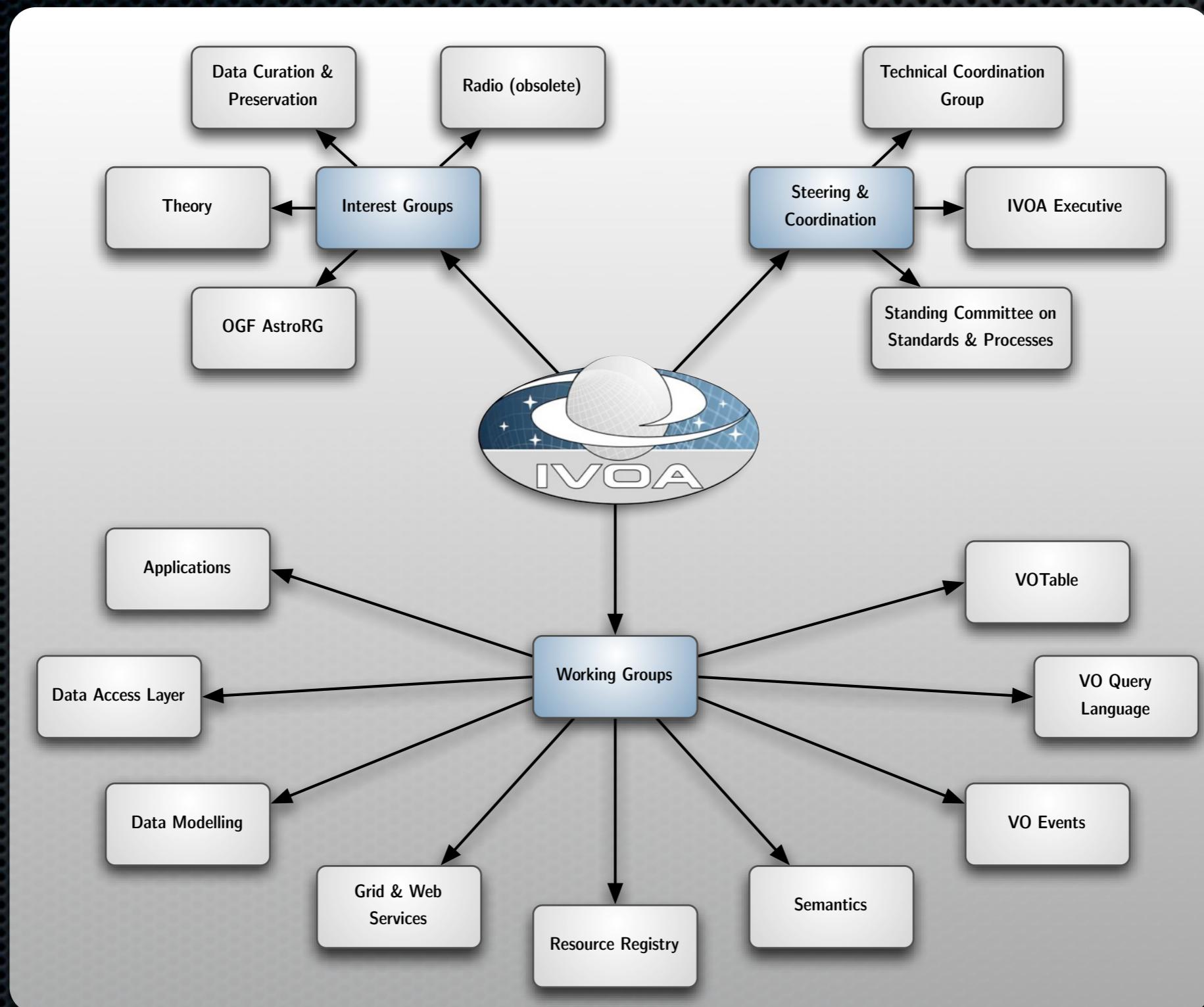
# VO Definition

- Set of data services with **common** data **access** protocols that allow for easy **discoverability** of **interoperable** data-sets, sharing a unified description by means of a common **data model**, within the realm of astronomy.

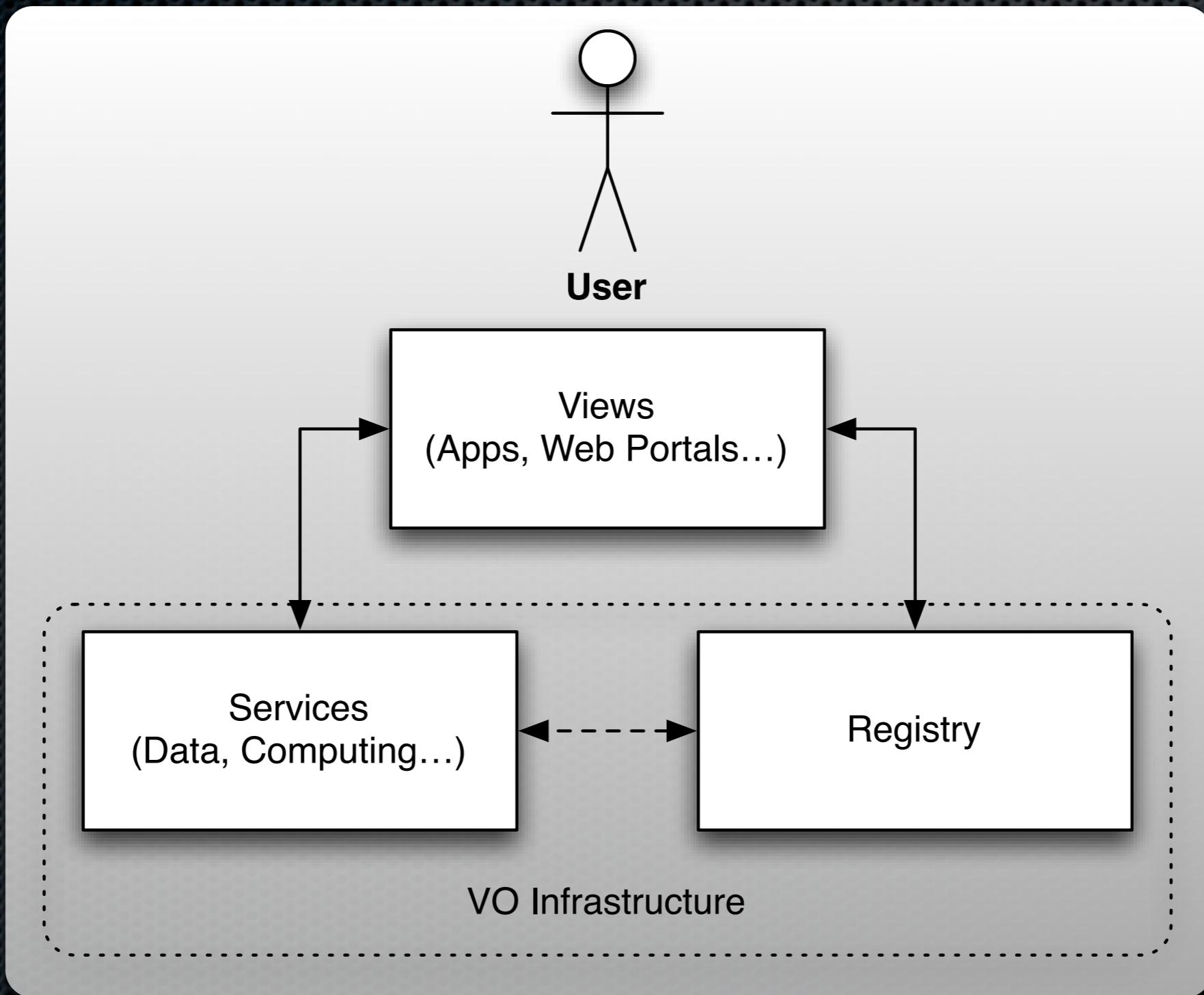
# VO Philosophy

- Describe your data as much as possible in the most self-explanatory way (**metadata, metadata, metadata**)
- If not mandatory, **don't move the data**
- Perform **search & process remotely**, move just processed data if possible

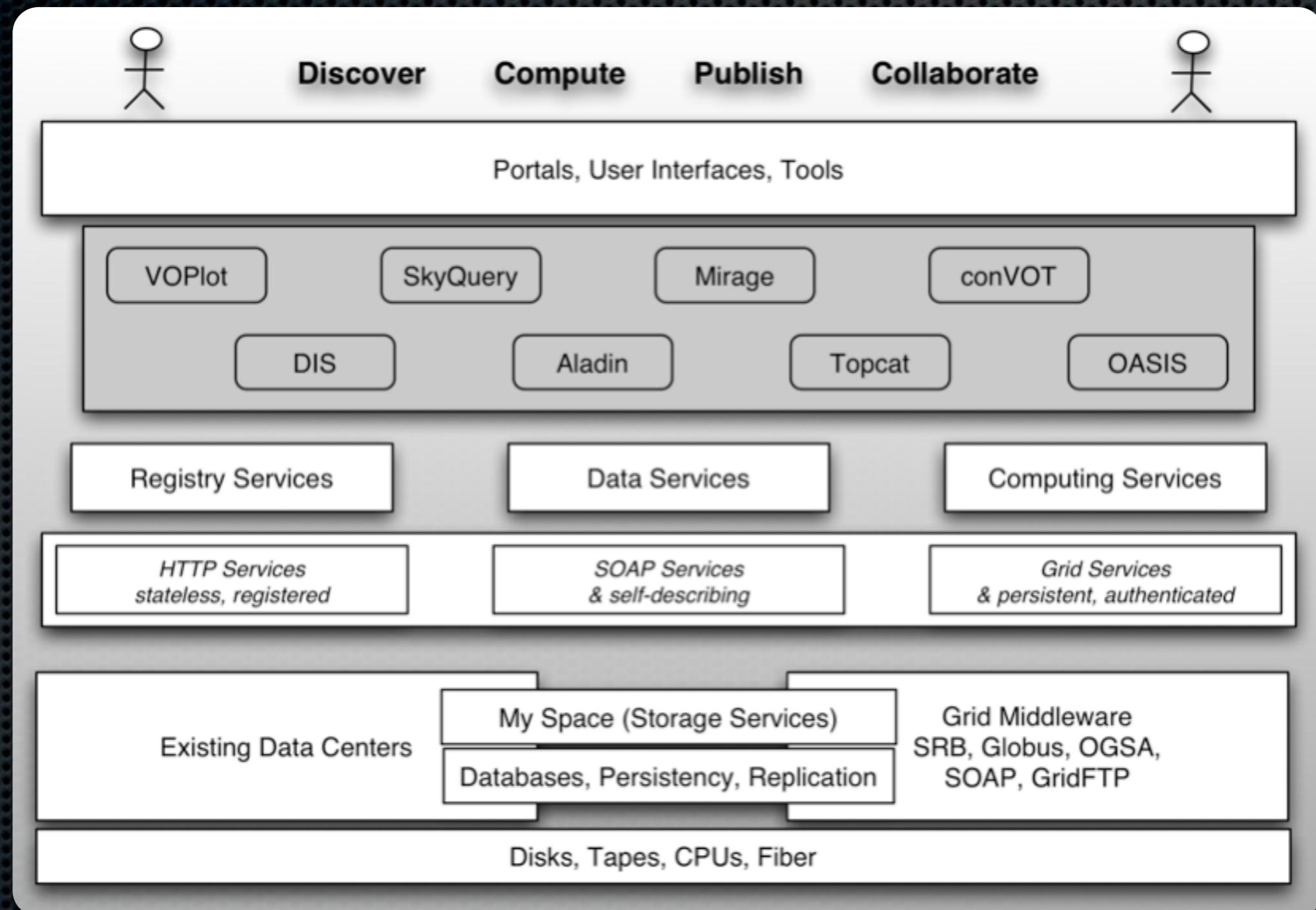
# The IVOA



# VO Building Blocks



# VO Architecture



# VO Status

- **Applications**
  - Aladin, Topcat, VOPlot, Mirage...
- **Data Services**
  - SDSS, HST, MAST, FUSE, IUE, ISO, XMM-Newton, VizieR, AMIGA\*, IRAM 30m\*, Robledo\*...
- **VO Enabled Science:** Padovani et al. 2004

\*AMIGA Group Involvement

# VO Status

Astronomy & Astrophysics manuscript no. 1153  
(DOI: will be inserted by hand later)

October 31, 2007



## **Discovery of optically faint obscured quasars with Virtual Observatory tools**

Paolo Padovani<sup>1</sup>, Mark G. Allen<sup>2</sup>, Piero Rosati<sup>3</sup>, and Nicholas A. Walton<sup>4</sup>

## **Data Services**

- SDSS, HST, MAST, FUSE, IUE, ISO, XMM-Newton, VizieR, AMIGA\*, IRAM 30m\*, Robledo\*...

- VO Enabled Science:** Padovani et al. 2004

No return point!

# VO and e-Science

and what is e-Science, anyway?

# e-Science Definition

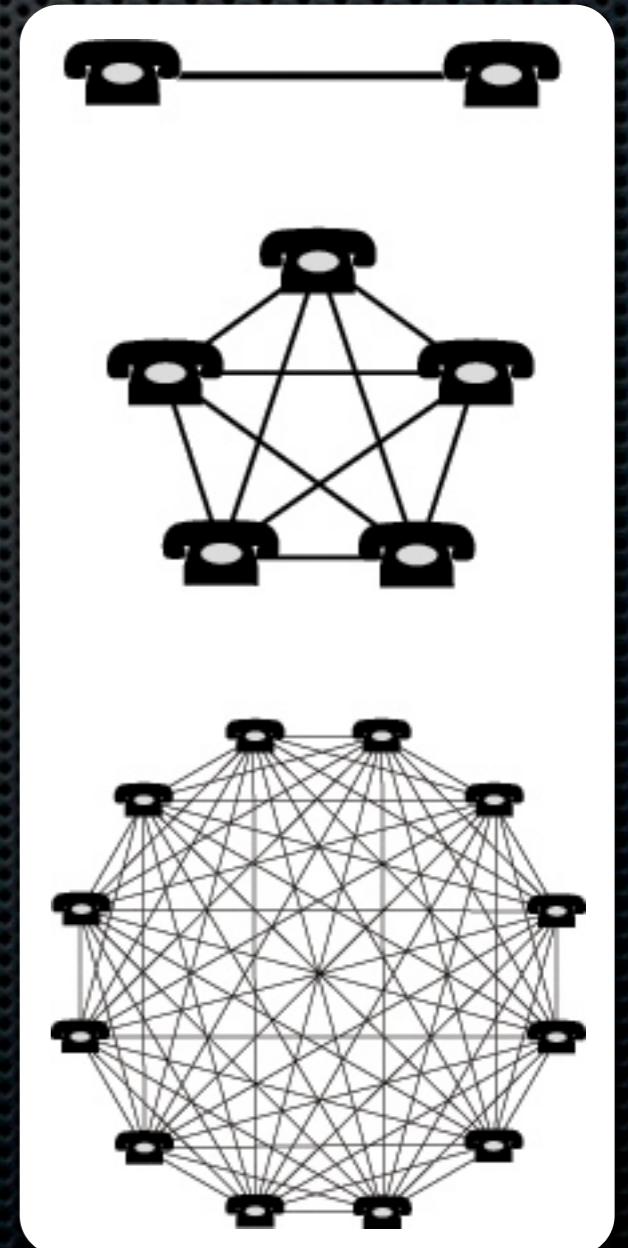
- Science carried out in a **highly distributed network** environment
- Computing is accessory, not mandatory
- Benefits from **network effect**

# The Network Effect

- Goes beyond **always on, always connected** (but includes it!)
- For a  $n$  vertices network, the number of possible interconnections is

$$f(n) = \frac{n \times (n - 1)}{2} \propto n^2$$

Non-linear!



# The Network Effect

- Network effect on dataset combination:
  - Let  $n > m > 1$  be a number of independent samples
  - Relative increase of independent datapoint pairs:

$$\frac{(m+n-1)(m+n)}{(n-1)n} \propto m^2 \quad n \gg m$$

# Evolution of e-Science

## Web 0.0

1970

FTP, UUCP,  
Gopher, WAIS...

Archie/Veronica

Folder drilling

$10^3$  units

0,3-9,6 Kbps

IUE

## Web 1.0

1990

HTTP

Yahoo!, Google

CGI Forms

$10^6$  units

28-64 Kbps

MAST

## Web 2.0

2005

Web-services

Google, Specialised  
Registries

AJAX

$10^9$  units

256-16384 Kbps

SDSS

# Astronomical data in the VO: Spectra

# VO Tools for Spectroscopy

- Infrastructure:
  - **SSAP**  
(Spectrum Access)
  - **ConeSearch**  
(photometric points)
  - **SLAP** (Line Access)
  - **TSAP**  
(Theoretical Spectra)
- Applications:
  - SpecView (STSci)
  - Splat-VO (Starlink - AstroGrid)
  - VOSpec (ESA-VO)
  - MASSA (DAMIR)
  - VOSED, VOSA (**SVO**)

# SSAP: Simple Spectra Access

endPointURL?POS=RA,DEC&  
SIZE=searchRadius&  
BAND=freqRange&  
TIME=timeRange&  
FORMAT=formatType&  
SPECRP=specResol&  
SPATRES=spatialResol&  
PUBDID=pubID&  
CREATORID=creatorID&  
COLLECTION=collectionID&  
TOP=topNumResults&  
MAXREC=maxRecords&  
MTIME=modificationTime&  
COMPRESS=compressionFlag&  
RUNID=jobRunID&

APERTURE=apertAngle&  
TIMERES=timeResol&  
SNR=signal2noise&  
REDSHIFT=redShiftRange&  
VARAMPL=amplitudeVariability&  
TARGETNAME=targetName&  
TARGETCLASS=targetClass&  
FLUXCALIB=fluxCalibKind&  
WAVECALIB=waveCalibKind

# Spectrum DM Domain

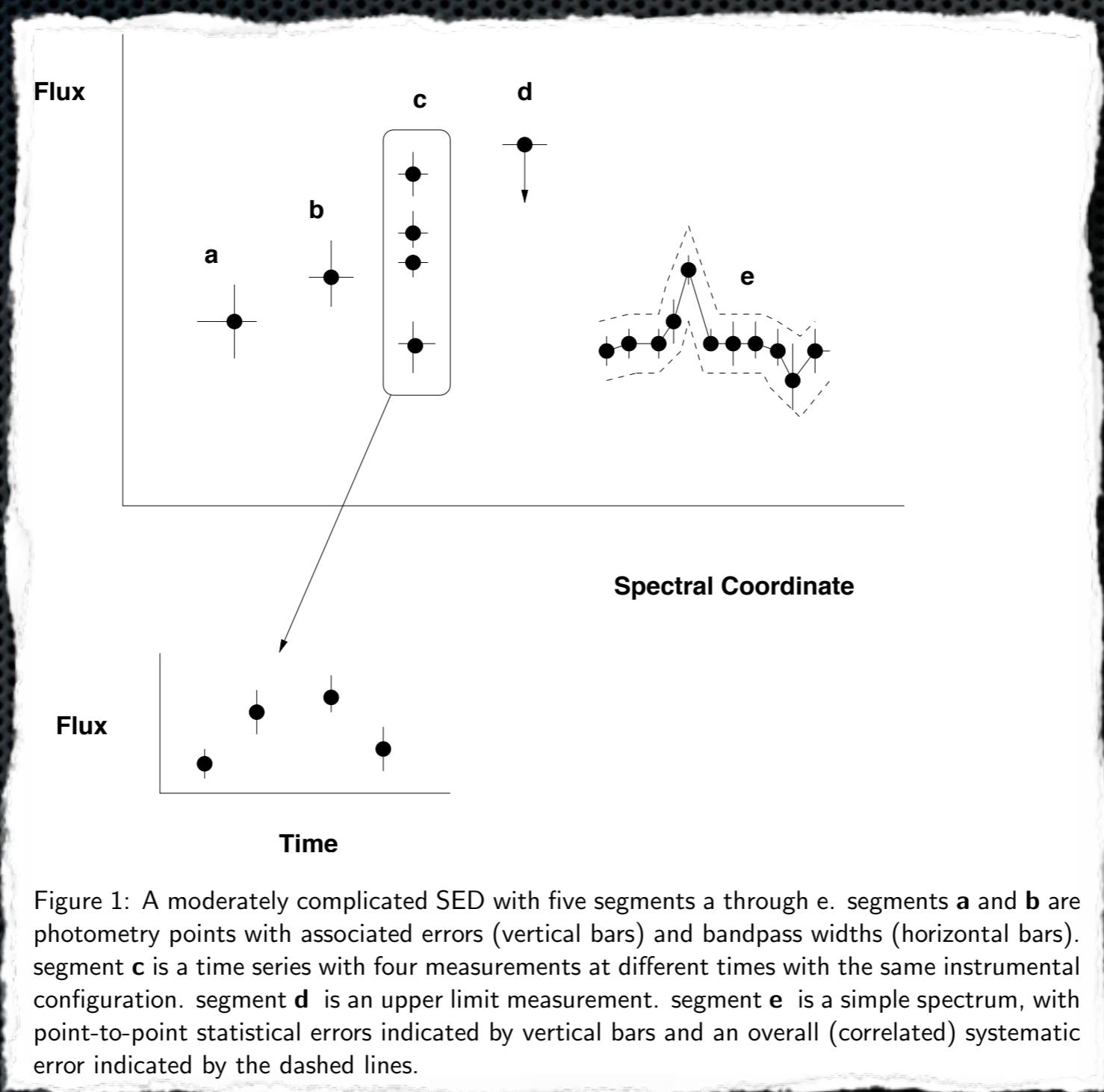
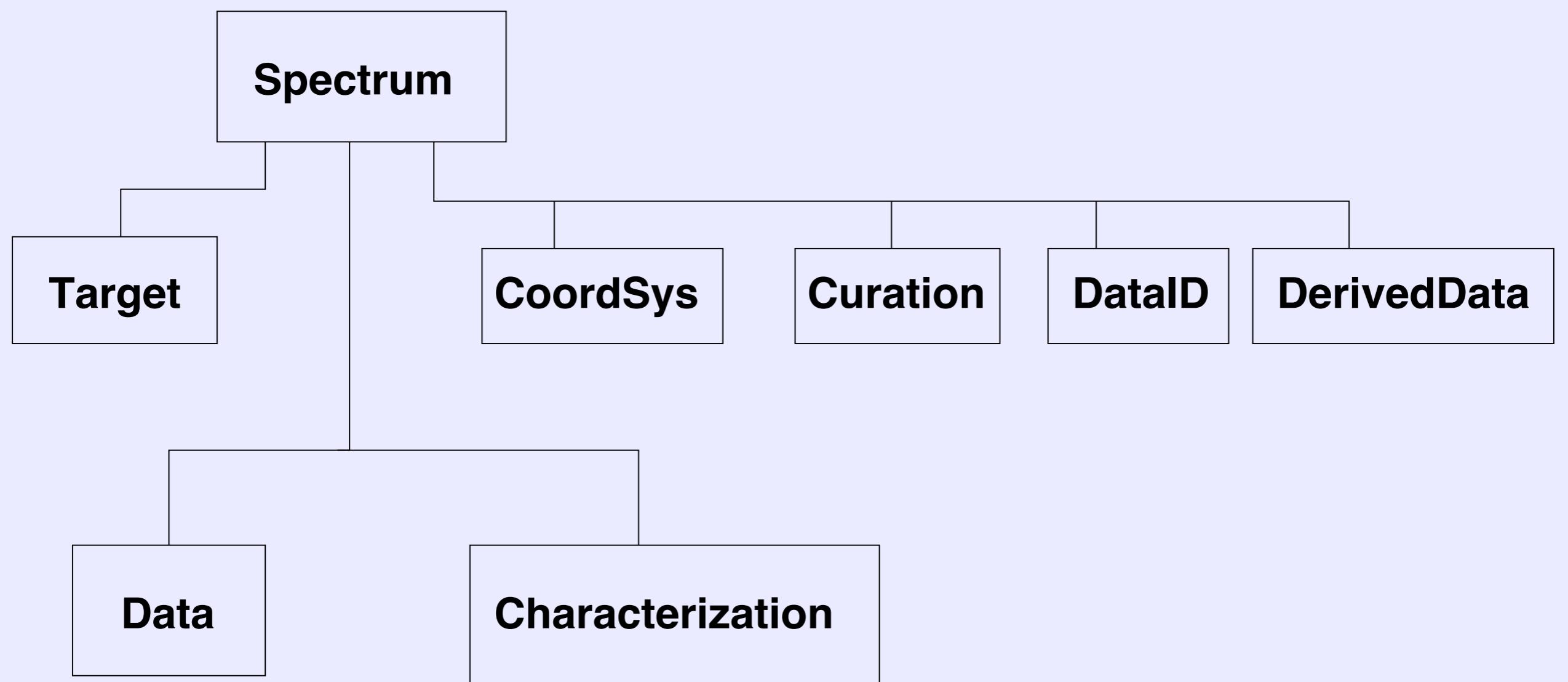


Figure 1: A moderately complicated SED with five segments a through e. segments **a** and **b** are photometry points with associated errors (vertical bars) and bandpass widths (horizontal bars). segment **c** is a time series with four measurements at different times with the same instrumental configuration. segment **d** is an upper limit measurement. segment **e** is a simple spectrum, with point-to-point statistical errors indicated by vertical bars and an overall (correlated) systematic error indicated by the dashed lines.

# Spectrum DM: Structure



# ConeSearch

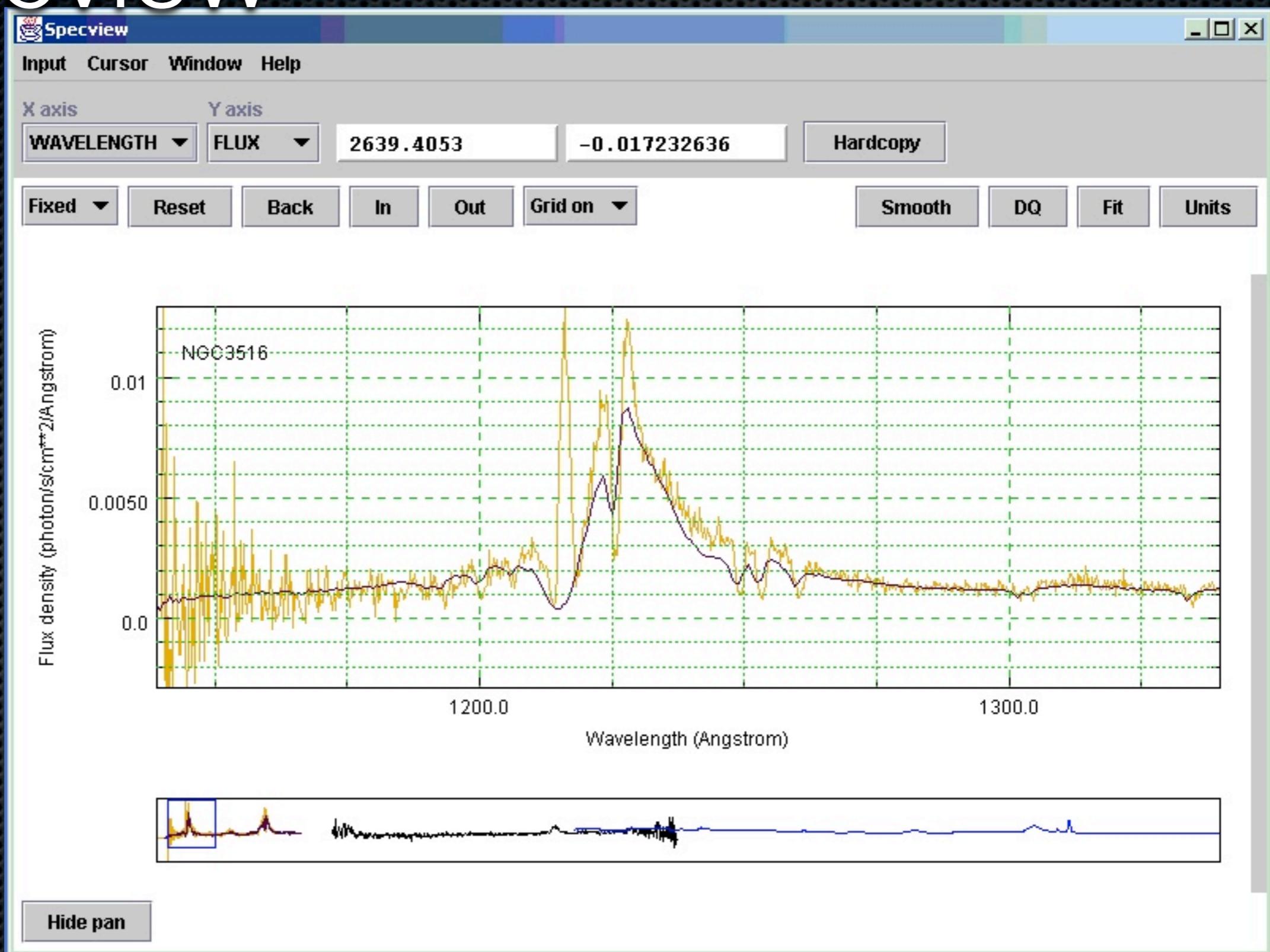
endPointURL?RA=rightAscension&  
DEC=declination&  
SR=searchRadius&  
VERB=verbosity

ConeSearch is Generic:  
Table fields must be identified

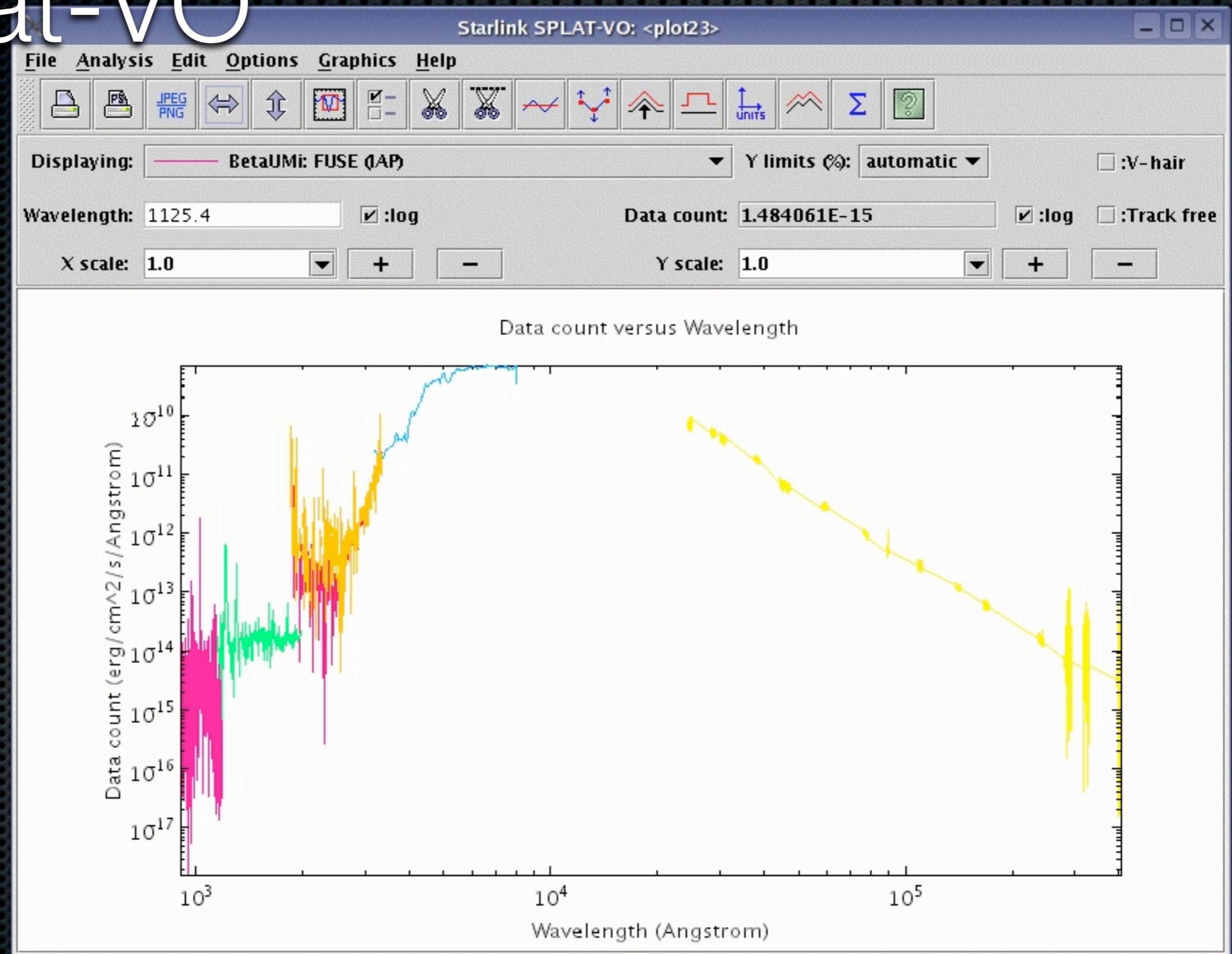
# SLAP: Simple Line Access

- Prototype service by ESA-VO
  - Incorporated into VOSpec
- Applications including similar services:
  - MASSA (actual version)
- Also TSAP, theoretical SLAP, SNAP...

# Specview

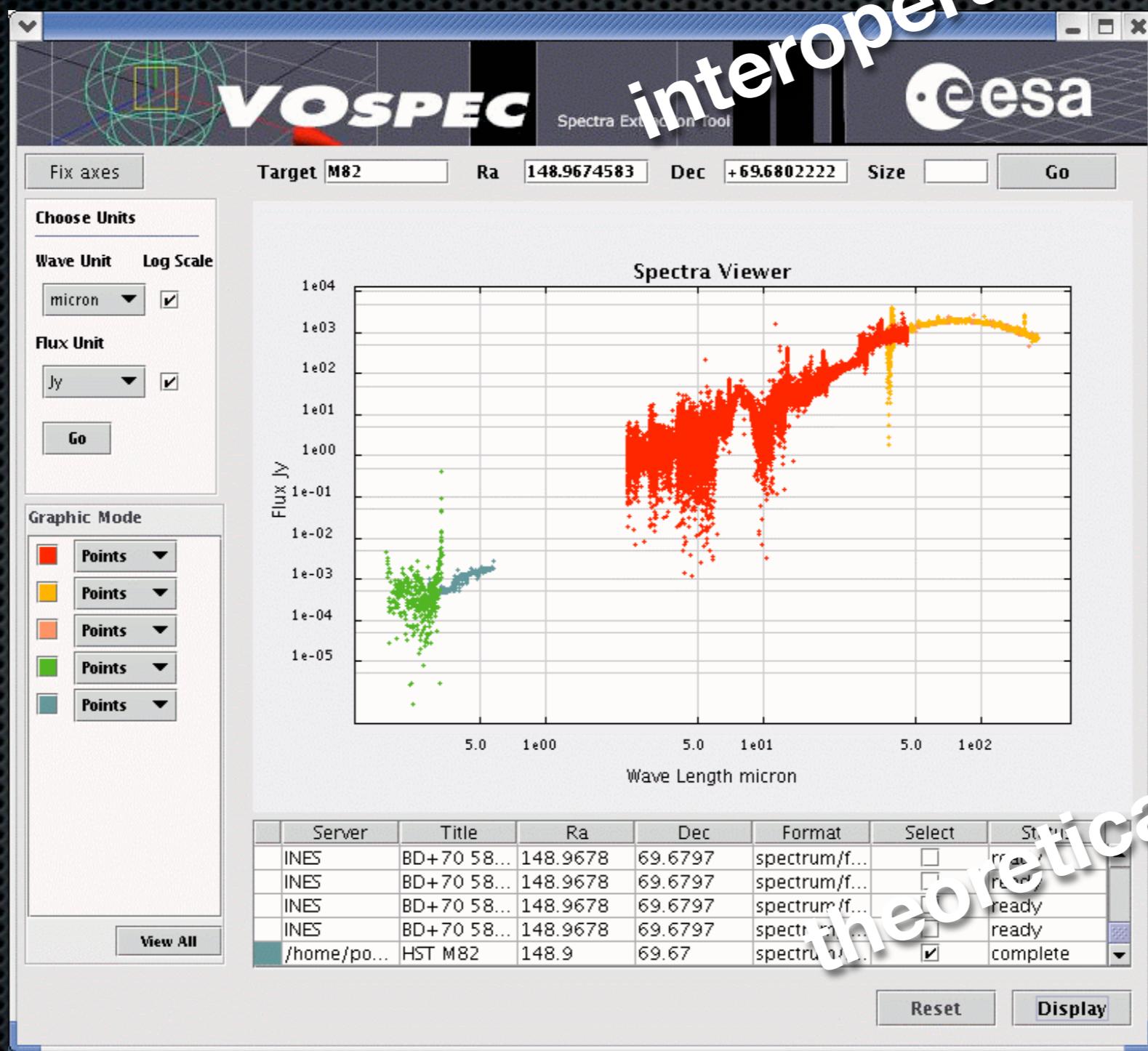


# Splat-VO



# VOSpec

units  
interoperability!



theoretical spectra!

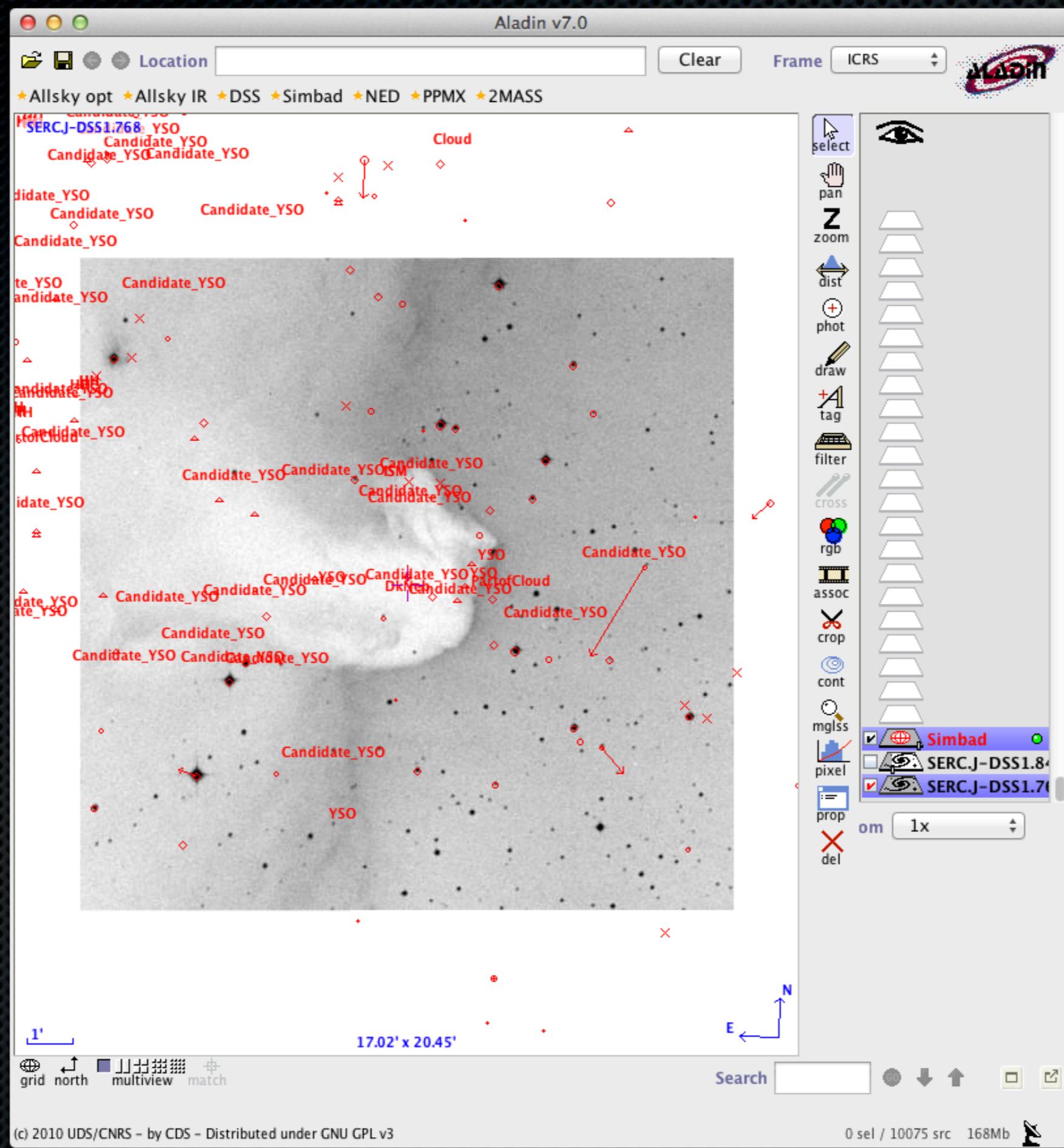
# VO Spectroscopy Tools: Wish-List

- Standard way for identifying error metadata
- More sophisticated fitting functions (modified black bodies, stellar models...)
- Better information on fitting statistics (MASSA...)
- New object models (e.g., very cold objects)
- **SLAP!**

# Astronomical data in the VO: Images

# VO Tools for Images

- Infrastructure:
  - **SIAP** (Image Access)
- Applications:
  - Aladin (CDS)



# VO Image Tools: Wish-List

- More tools!
  - Astrometry, Source Extraction, Remote Processing...
- Multidimensional images (with v2.0)

# Astronomical data in the VO: Catalogues

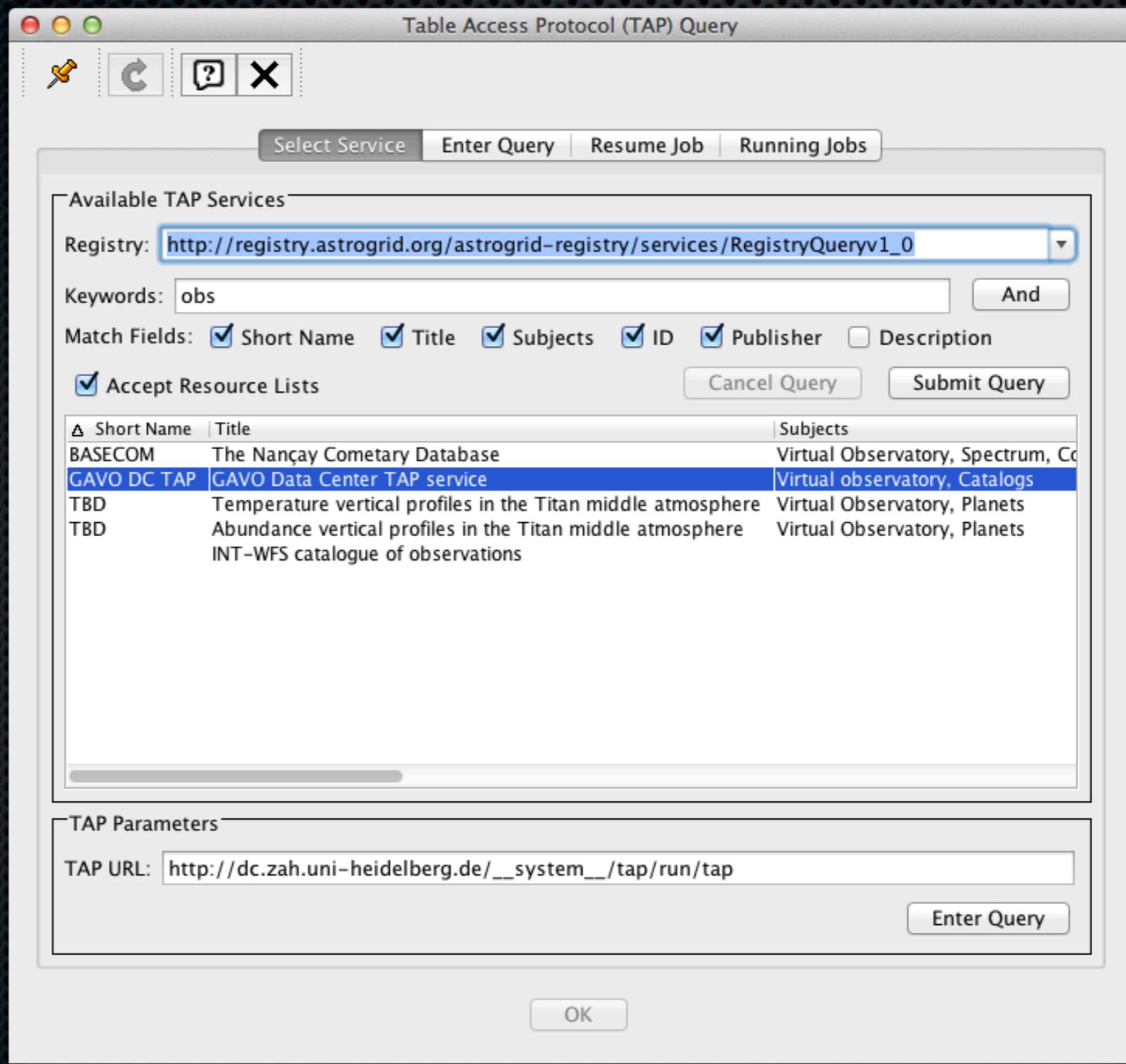
# VO Tools for Catalogues

- Infrastructure:
  - **ConeSearch**  
(positional queries)
  - **TAP** (Table Access Protocol)
  - **ObsTAP** (Fixed-Schema TAP for observations)
- Applications:
  - TOPCAT (AstroGrid)
  - GAVO ADQL query
  - More tools coming

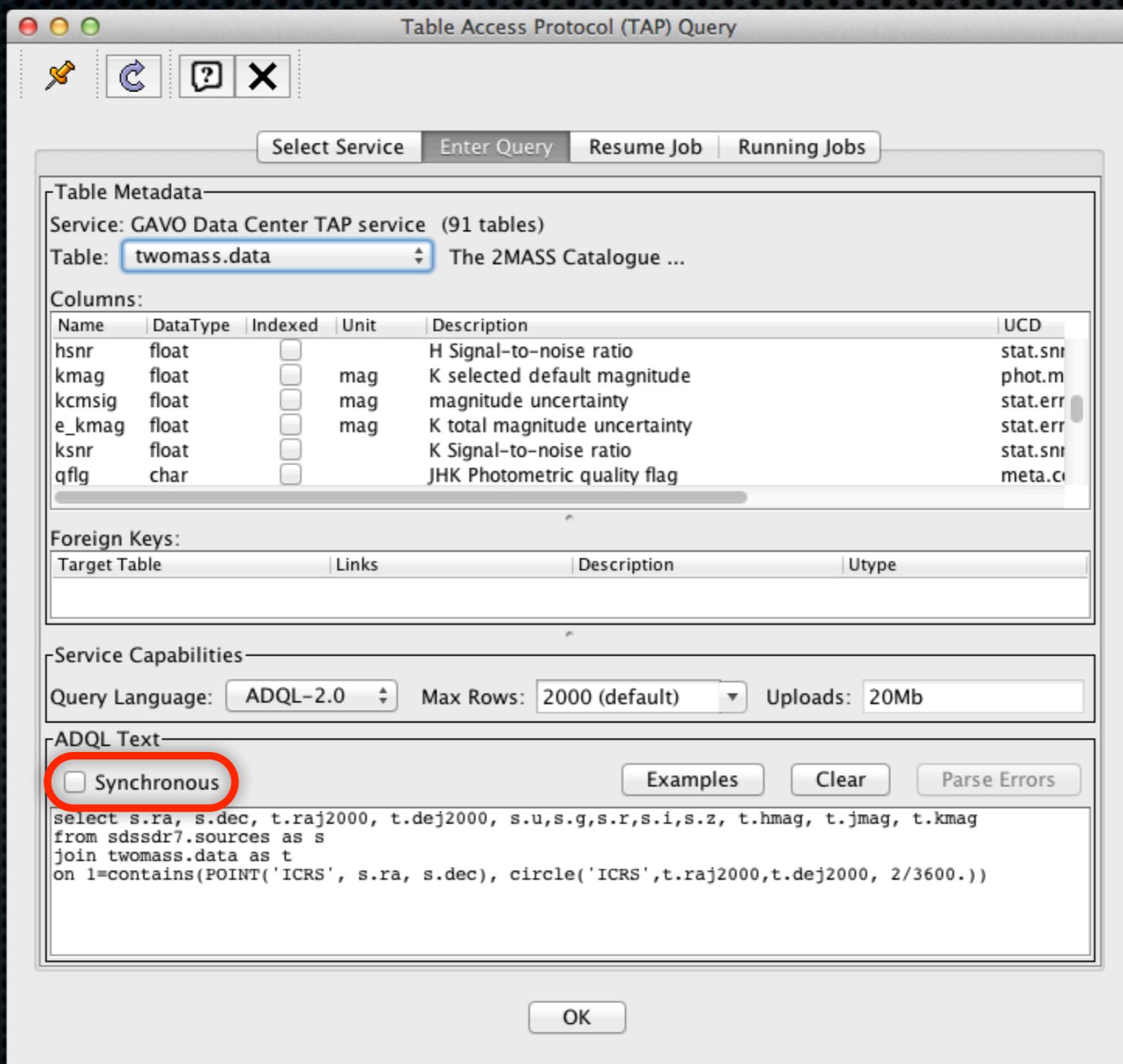
# TAP: Table Access Protocol

- Brings together all astronomical database systems
  - ...provided they comply with the TAP protocol...
  - ...and are in the VO registry
- Uses SQL or ADQL as query language
  - ADQL has spatial operations on regions

# TAP: Table Access Protocol



# TAP: Table Access Protocol



# TAP: Table Access Protocol

ADQL Text

Synchronous

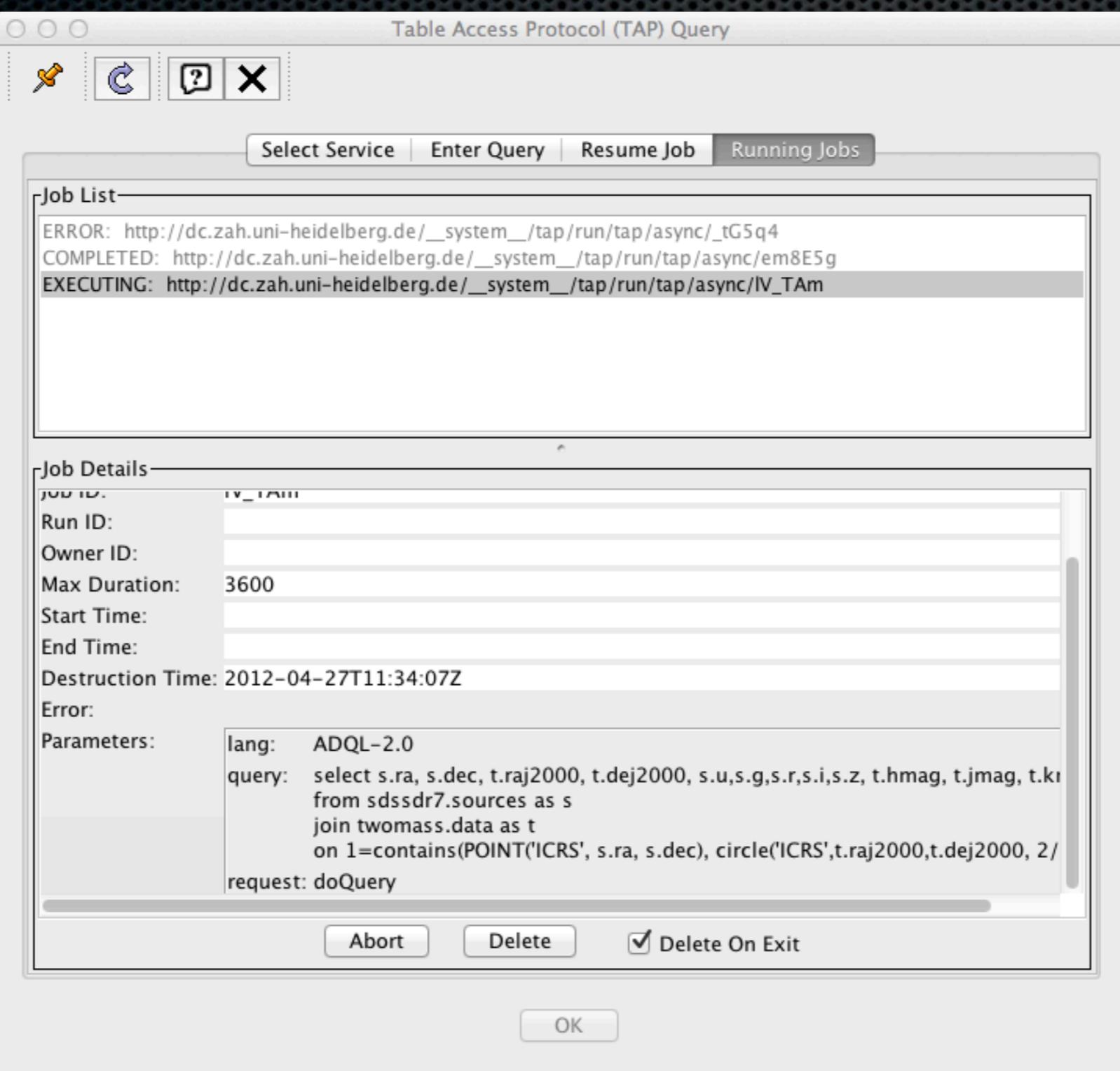
Examples

Clear

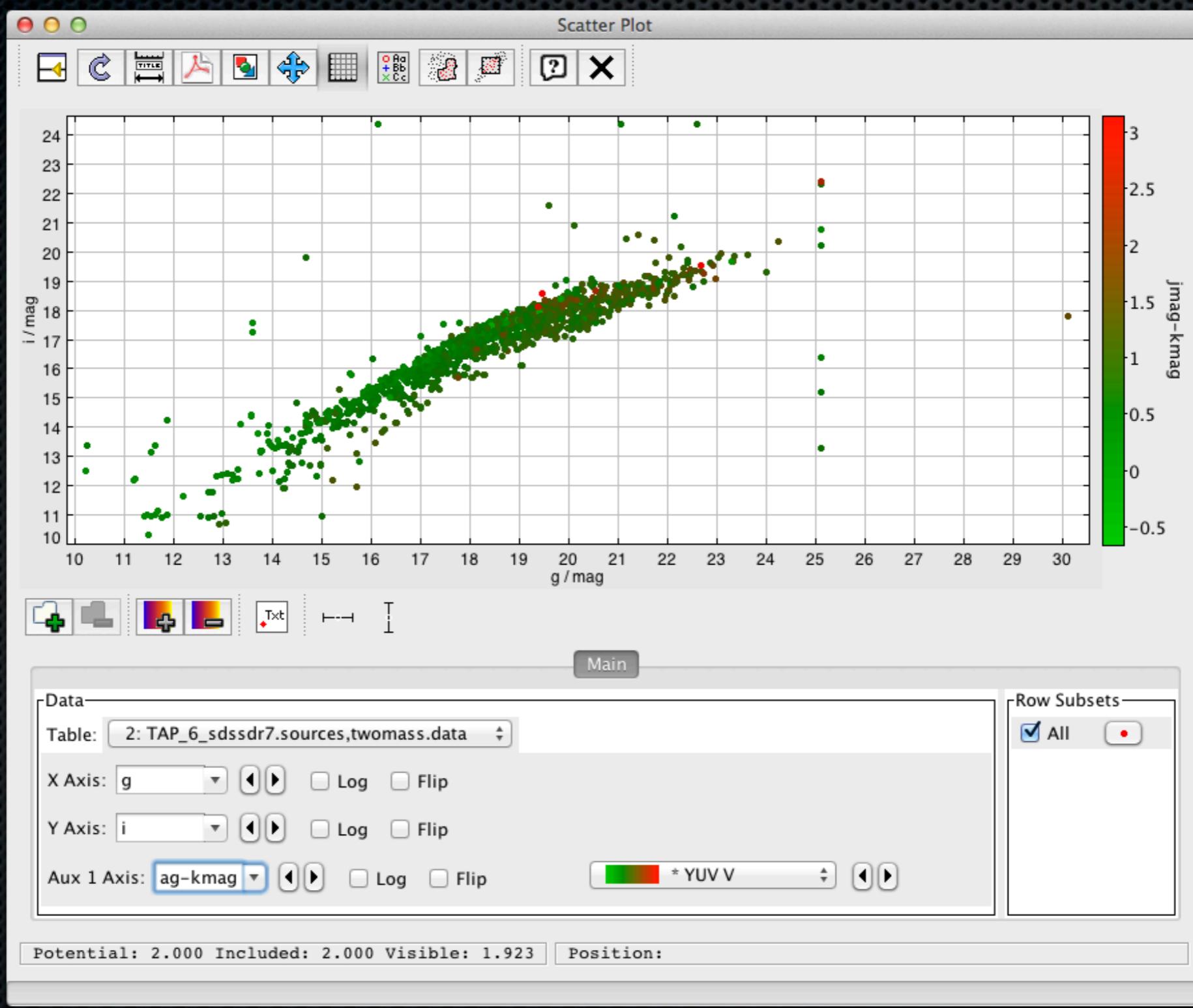
Parse Err

```
select s.ra, s.dec, t.raj2000, t.dej2000, s.u,s.g,s.r,s.i,s.z, t.hmag, t.jmag, t.kmag
from sdssdr7.sources as s
join twomass.data as t
on 1=contains(POINT('ICRS', s.ra, s.dec), circle('ICRS',t.raj2000,t.dej2000, 2/3600.))
```

# TAP: Table Access Protocol



# TAP: Table Access Protocol



# ObsTAP: TAP for Observations

- Mandates same schema across all observatories
- Allows for *write once, query many* types of queries
- Observation-kind (mostly) agnostic

# ObsTAP: TAP for Observations

Column Name	Unit	Type	Description
dataproduct_type	unitless	string	Logical data product type (image etc.)
calib_level	unitless	enum integer	Calibration level {0, 1, 2, 3}
obs_collection	unitless	string	Name of the data collection
obs_id	unitless	string	Observation ID
obs_publisher_did	unitless	string	Dataset identifier given by the publisher
access_url	unitless	string	URL used to access (download) dataset
access_format	unitless	string	File content format (see in App. BB.5.2 )
access_estsize	kbyte	integer	Estimated size of dataset in kilo bytes
target_name	unitless	string	Astronomical object observed, if any
s_ra	deg	double	Central right ascension, ICRS
s_dec	deg	double	Central declination, ICRS
s_fov	deg	double	Diameter (bounds) of the covered region
s_region	unitless	AstroCoordArea	Region covered as specified in STC or ADQL
s_resolution	arcsec	float	Spatial resolution of data as FWHM
t_min	d	double	Start time in MJD
t_max	d	double	Stop time in MJD
t_exptime	s	float	Total exposure time
t_resolution	s	float	Temporal resolution FWHM
em_min	m	double	Start in spectral coordinates
em_max	m	double	Stop in spectral coordinates
em_res_power	unitless	double	Spectral resolving power
o_ucd	unitless	string	UCD of observable (e.g. phot.flux.density)
pol_states	unitless	string	List of polarization states or NULL if not applicable
facility_name	unitless	string	Name of the facility used for this observation
instrument_name	unitless	string	Name of the instrument used for this observation

Collaborating with the VO  
welcome on board, everyone!

*Ask not what your country can do for you,  
but what you can do for your country*

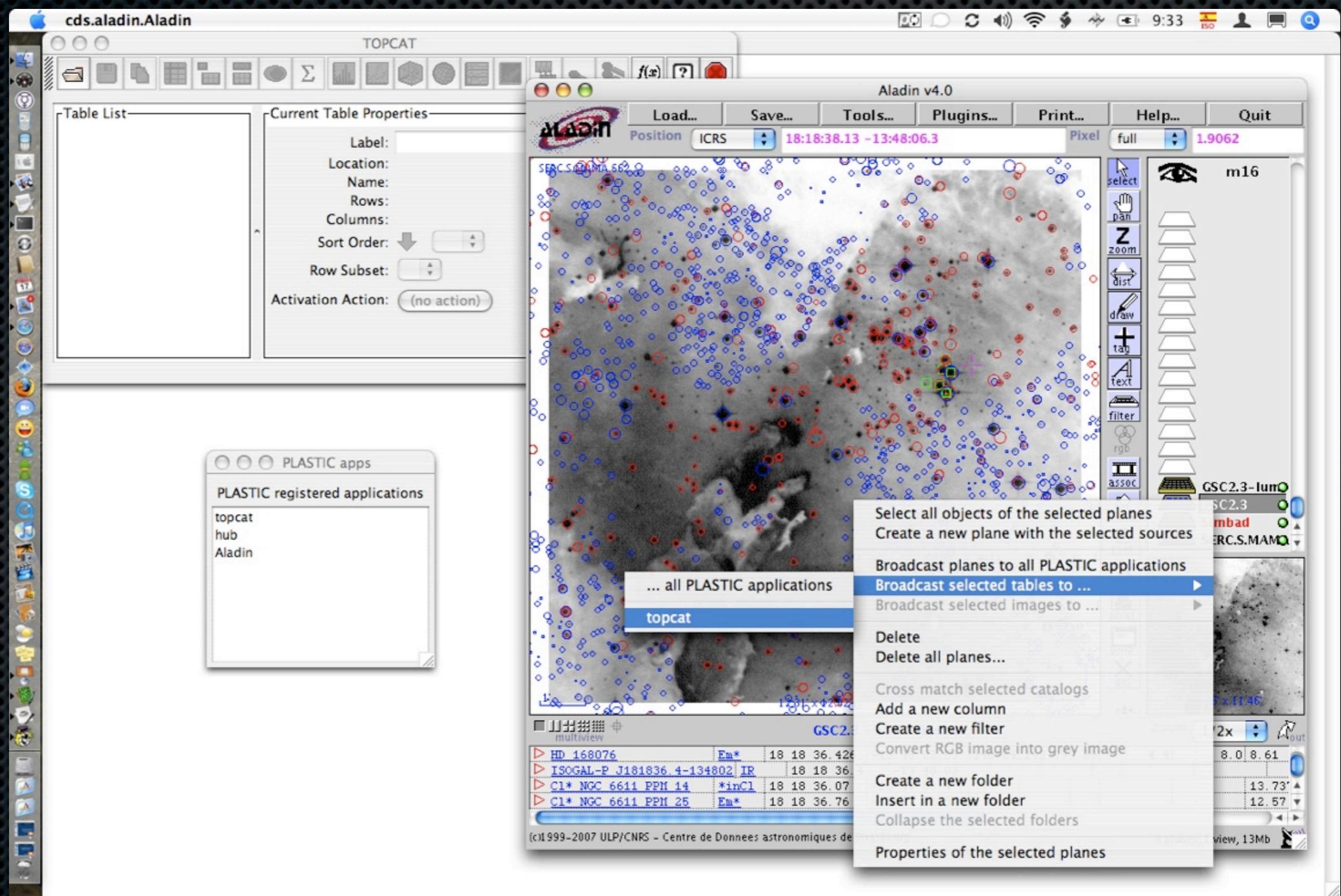
J.F. Kennedy's  
Inaugural Address

*Ask not only what the VO can do for you,  
but what you can do for the VO*

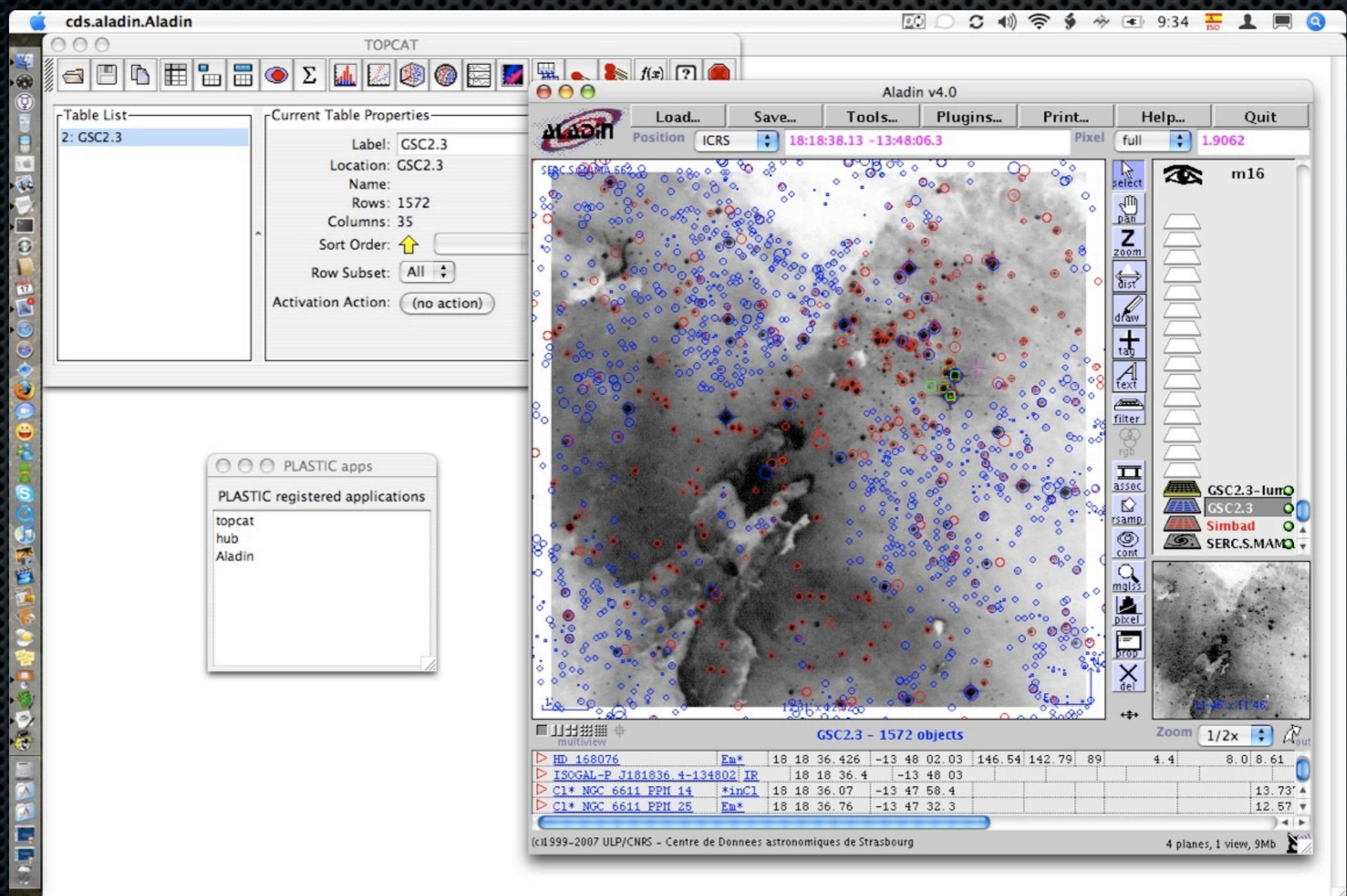
The VO already provides  
quite a lot!

Some guy,  
IVOA InterOp

# Local collaboration



# Local collaboration



# Local collaboration

TOPCAT(2): Table Columns

	Visible	Name	\$ID	Class	Units	Description
0	<input type="checkbox"/>	Index	\$0	Long		Table row index
1	<input checked="" type="checkbox"/>	_RAJ2000	\$1	Double		
2	<input checked="" type="checkbox"/>	_DEJ2000	\$2	Double		
3	<input checked="" type="checkbox"/>	_r	\$3	Float	arcmin	Distance from center (RAJ2000=274.700000, DEJ2000=-13.816000)
4	<input checked="" type="checkbox"/>	GSC2.3	\$4	String		[NS0-9A-Z] Identification of the object (1)
5	<input checked="" type="checkbox"/>	GSC1	\$5	String		Identification in GSC Version 1 (Cat. I/254)
6	<input checked="" type="checkbox"/>	HTM6	\$6	String		[NS0-3] HTM-6 designation as in GSC2.2 (1)
7	<input checked="" type="checkbox"/>	RAJ2000	\$7	Double	deg	Right Ascension in ICRS (J2000), at "Epoch"
8	<input checked="" type="checkbox"/>	DEJ2000	\$8	Double	deg	Declination in ICRS (J2000)
9	<input checked="" type="checkbox"/>	e_RAdeg	\$9	Float	arcsec	Mean error on RAdeg (2)
10	<input checked="" type="checkbox"/>	e_DEdeg	\$10	Float	arcsec	Mean error on DEdeg (2)
11	<input checked="" type="checkbox"/>	Epoch	\$11	Double	yr	Epoch of the position
12	<input checked="" type="checkbox"/>	Fmag	\$12	Float	mag	? Magnitude in F photographic band (red)
13	<input checked="" type="checkbox"/>	e_Fmag	\$13	Float	mag	? Mean error on Rmag
14	<input checked="" type="checkbox"/>	n_Fmag	\$14	Short		? Coded emulsion / bandpass / filter (2)
15	<input checked="" type="checkbox"/>	jmag	\$15	Float	mag	? Magnitude in Bj photographic band (blue)
16	<input checked="" type="checkbox"/>	e_jmag	\$16	Float	mag	? Mean error on jmag
17	<input checked="" type="checkbox"/>	n_jmag	\$17	Short		? Coded emulsion / bandpass / filter (2)
18	<input checked="" type="checkbox"/>	Vmag	\$18	Float	mag	? Magnitude in V photographic band (green)
19	<input checked="" type="checkbox"/>	e_Vmag	\$19	Float	mag	? Mean error on Vmag
20	<input checked="" type="checkbox"/>	n_Vmag	\$20	Short		? Coded emulsion / bandpass / filter (2)
21	<input checked="" type="checkbox"/>	Nmag	\$21	Float	mag	? Magnitude in N photographic band (0.8{mu}m)
22	<input checked="" type="checkbox"/>	e_Nmag	\$22	Float	mag	? Mean error on Nmag
23	<input checked="" type="checkbox"/>	n_Nmag	\$23	Short		? Coded emulsion / bandpass / filter (2)
24	<input checked="" type="checkbox"/>	Umag	\$24	Float	mag	? Magnitude in U band (Johnson)
25	<input checked="" type="checkbox"/>	e_Umag	\$25	Float	mag	? Mean error on Umag
26	<input checked="" type="checkbox"/>	n_Umag	\$26	Short		? Coded emulsion / bandpass / filter (2)
27	<input checked="" type="checkbox"/>	Bmag	\$27	Float	mag	? Magnitude in B band (Johnson blue)
28	<input checked="" type="checkbox"/>	e_Bmag	\$28	Float	mag	? Mean error on Bmag
29	<input checked="" type="checkbox"/>	n_Bmag	\$29	Short		? Coded emulsion / bandpass / filter (2)
30	<input checked="" type="checkbox"/>	Class	\$30	Short		[0,5] Object class (3)
31	<input checked="" type="checkbox"/>	Status	\$31	Integer		Source status flag (4)
32	<input checked="" type="checkbox"/>	M	\$32	String		[M] 'M' for multiple object (5)
33	<input checked="" type="checkbox"/>	a	\$33	Float	pix	? Semi-major axis of fitting ellipse
34	<input checked="" type="checkbox"/>	e	\$34	Float		? Eccentricity of fitting ellipse
35	<input checked="" type="checkbox"/>	aPA	\$35	Float	deg	? Position angle (N->E) of fitting ellipse

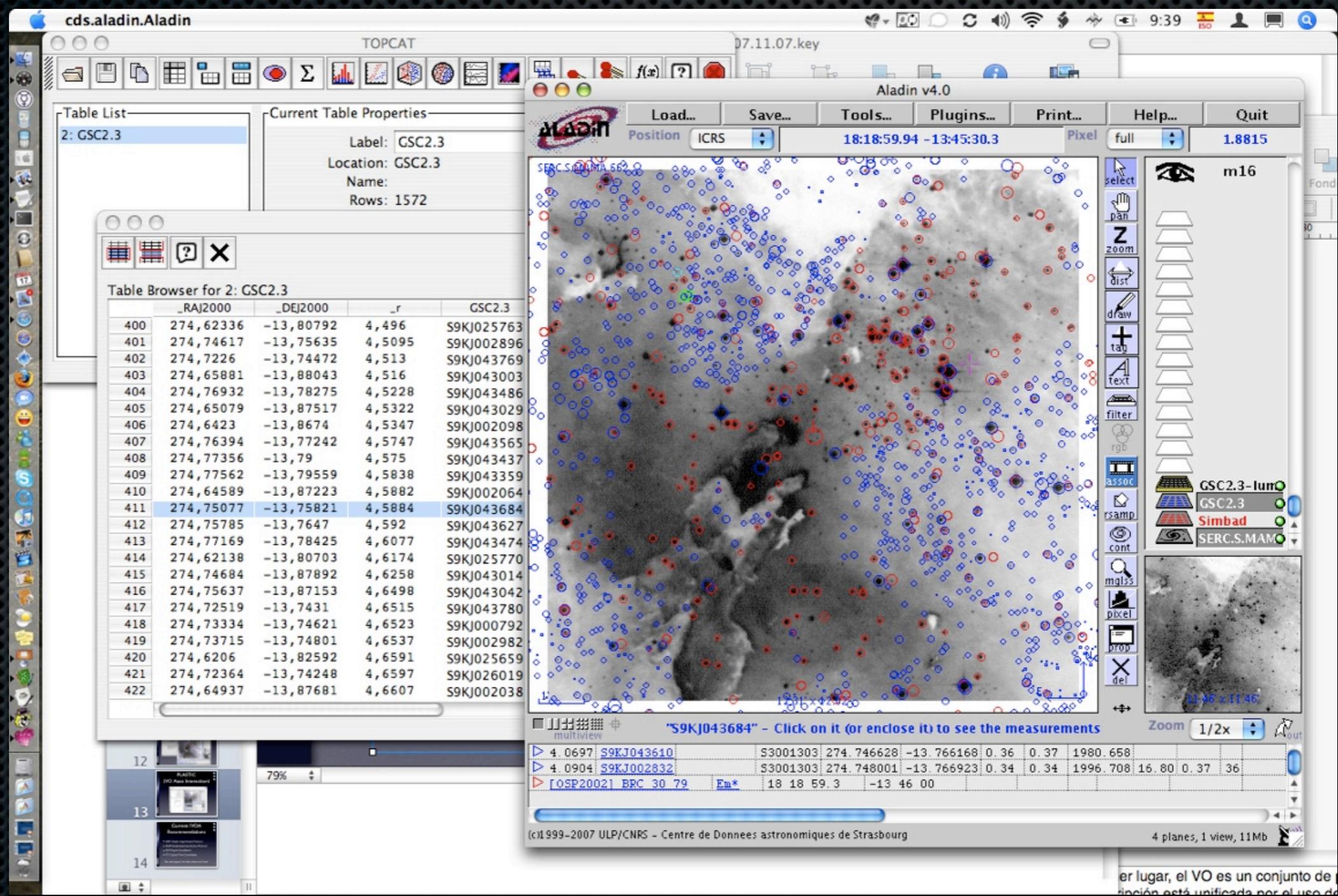
# Local collaboration

TOPCAT(2): Table Browser

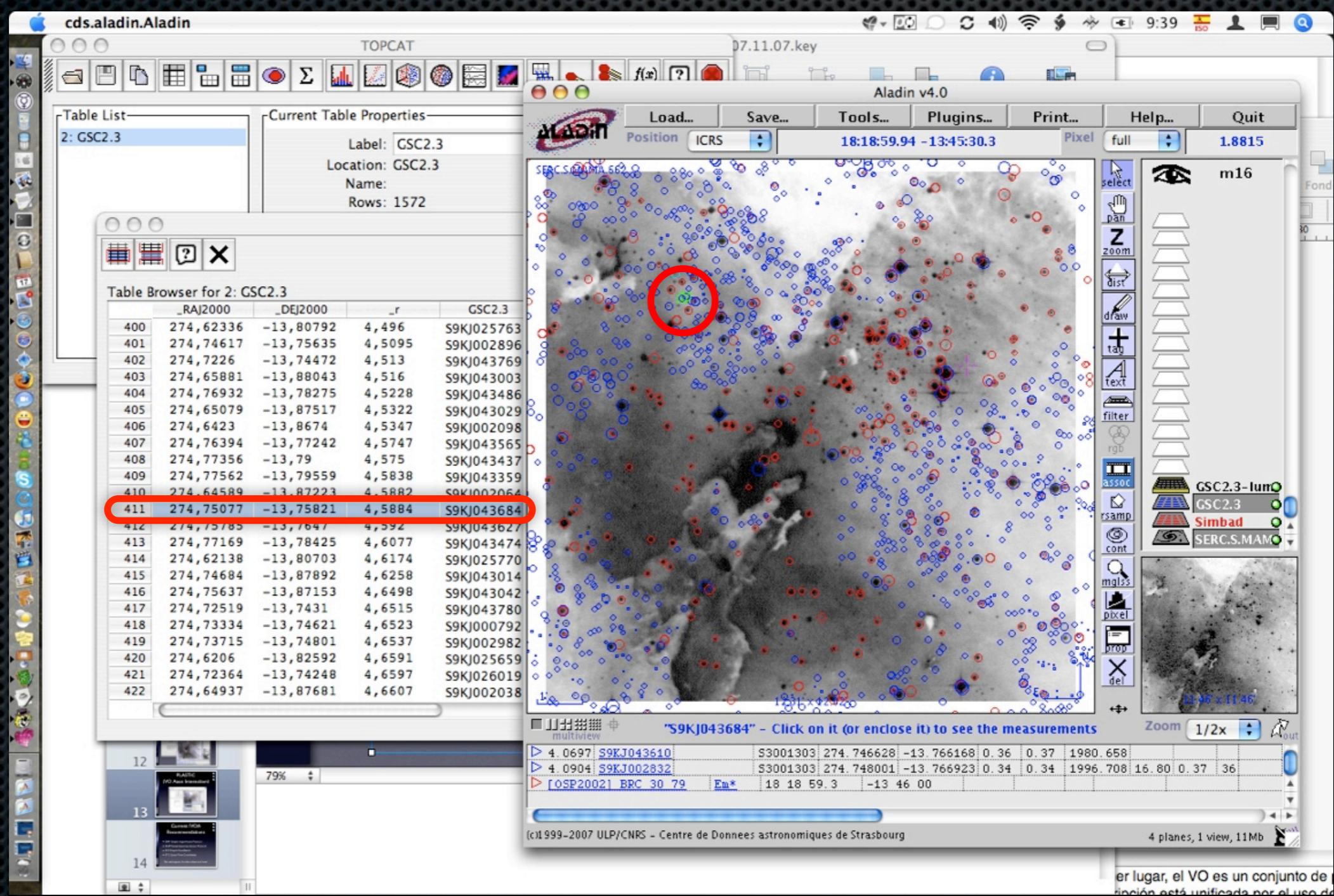
Table Browser for 2: GSC2.3

	_RAJ2000	_DEJ2000	_r	GSC2.3	GSC1	HTM6	RAJ2000	DEJ2000	e_RAdeg	e_DEdeg
1	274,69173	-13,82301	0,6141	S9KJ000845	5689-00251	S3001303	274,69173	-13,82301	0,09	0,11
2	274,71117	-13,80354	1,0216	S9KJ000836	5689-00433	S3001303	274,71117	-13,80354	0,06	0,07
3	274,6843	-13,82465	1,0323	S9KJ002476		S3001303	274,6843	-13,82465	0,34	0,34
4	274,68194	-13,82432	1,1478	S9KJ002482		S3001303	274,68194	-13,82432	0,34	0,34
5	274,68271	-13,80687	1,1664	S9KJ002615		S3001303	274,68271	-13,80687	0,34	0,34
6	274,6875	-13,8326	1,202	S9KJ0043188		S3001303	274,6875	-13,8326	0,36	0,37
7	274,68326	-13,83	1,2616	S9KJ002436		S3001303	274,68326	-13,83	0,34	0,34
8	274,68053	-13,80599	1,3028	S9KJ002628		S3001303	274,68053	-13,80599	0,34	0,34
9	274,67742	-13,82043	1,3346	S9KJ025706		S3001303	274,67742	-13,82043	0,47	0,46
10	274,71947	-13,8285	1,3382	S9KJ000847	5689-00439	S3001303	274,71947	-13,8285	0,01	0,02
11	274,67701	-13,81743	1,3405	S9KJ002535		S3001303	274,67701	-13,81743	0,34	0,34
12	274,67824	-13,80904	1,3477	S9KJ002596		S3001303	274,67824	-13,80904	0,34	0,34
13	274,67964	-13,82752	1,353	S9KJ025652		S3001303	274,67964	-13,82752	0,47	0,46
14	274,68081	-13,83101	1,4111	S9KJ002425		S3001303	274,6808	-13,83101	0,34	0,34
15	274,67633	-13,82403	1,4478	S9KJ025679		S3001303	274,67633	-13,82402	0,47	0,46
16	274,67569	-13,82254	1,4598	S9KJ025691		S3001303	274,67569	-13,82254	0,47	0,46
17	274,67918	-13,83059	1,4729	S9KJ002428		S3001303	274,67918	-13,83059	0,34	0,34
18	274,67501	-13,82088	1,4778	S9KJ002510		S3001303	274,67501	-13,82088	0,34	0,34
19	274,68184	-13,83395	1,4815	S9KJ002397		S3001303	274,68184	-13,83395	0,34	0,34
20	274,68068	-13,83286	1,4871	S9KJ002407		S3001303	274,68068	-13,83286	0,34	0,34
21	274,67503	-13,80867	1,5319	S9KJ002601		S3001303	274,67503	-13,80867	0,34	0,34
22	274,68223	-13,83576	1,5443	S9KJ002386		S3001303	274,68223	-13,83576	0,34	0,34
23	274,67395	-13,82286	1,5628	S9KJ025688		S3001303	274,67395	-13,82286	0,47	0,46

# Local collaboration



# Local collaboration



# The VO needs

- **Data, data, data!**
- More, **better tools**
- Including **remote processing** tools

*Users and  
data providers!*

**¡Gracias!**