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for Astronomical
Research in the
Southern Hemisphere

Virtual Observatory Tools

Paolo Padovani & Evanthia Hatzminaoglou

Virtual Observatory Project Office,
ESO, Garching bei München, Germany
&
EURO-VO Facility Centre

- Astronomy in the XXI century (again!)
- The need for VO tools
- A (short) selection of VO tools

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The Milky Way

Radio (0.4 GHz)

Atomic Hydrogen

Radio (2.7 GHz)

Molecular Hydrogen

Infrared

Mid Infrared

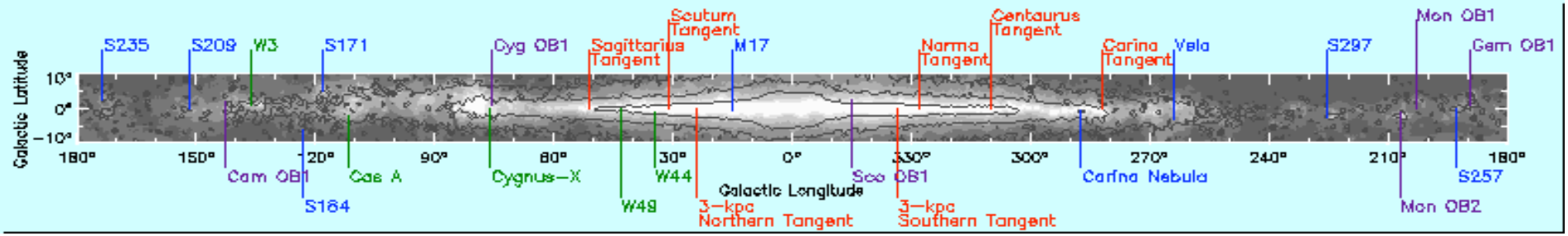
Near Infrared

Optical

X–Ray

Gamma Ray

Finder



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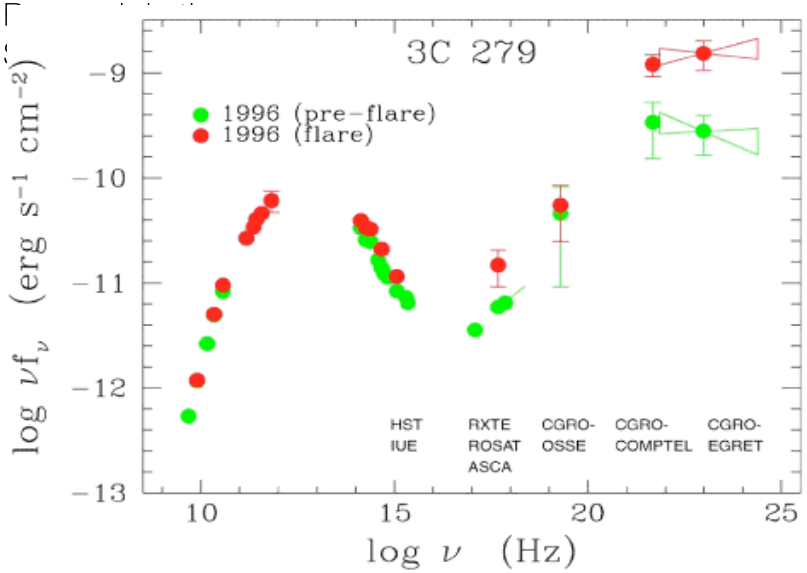
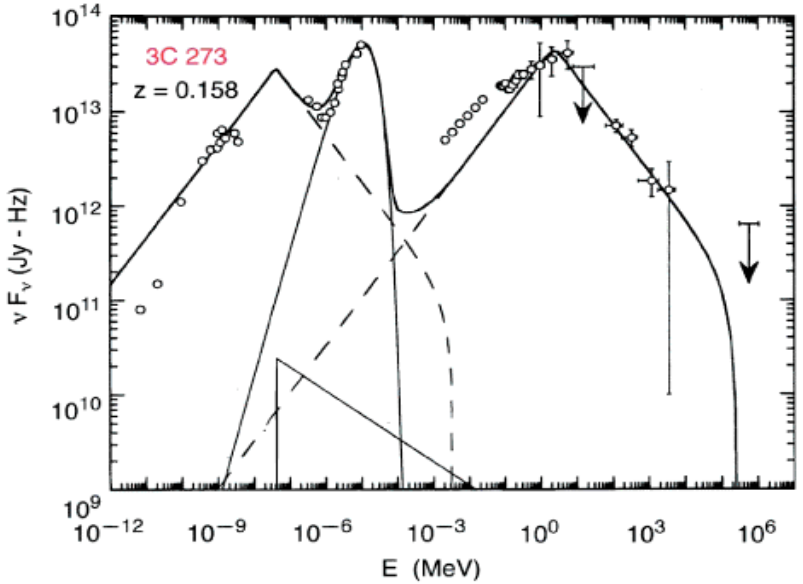
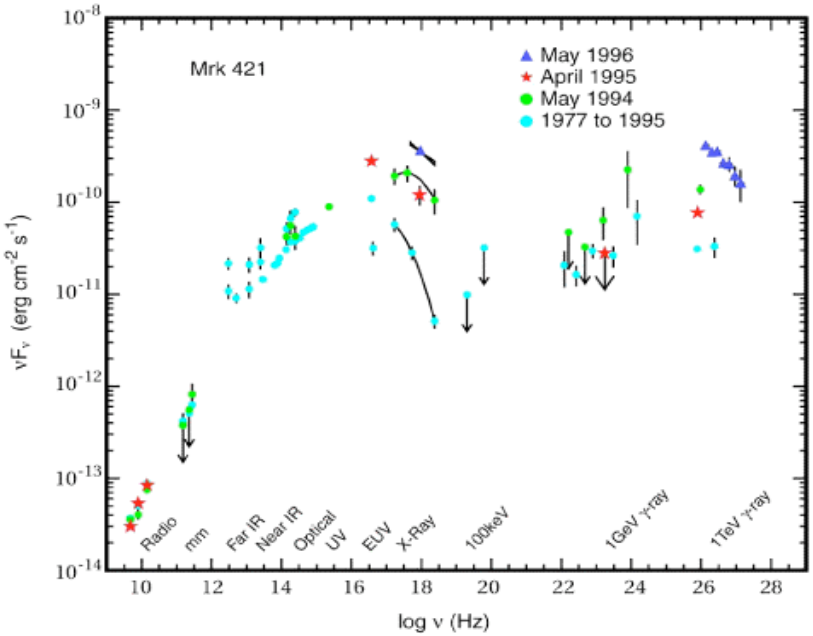
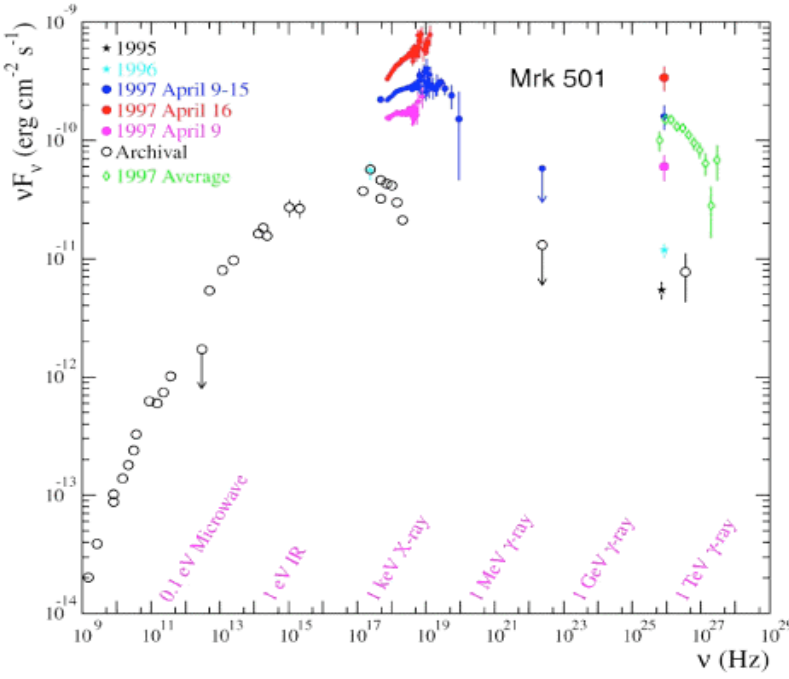
Active Galactic Nuclei









DATA MANAGEMENT & OPERATIONS DIVISION

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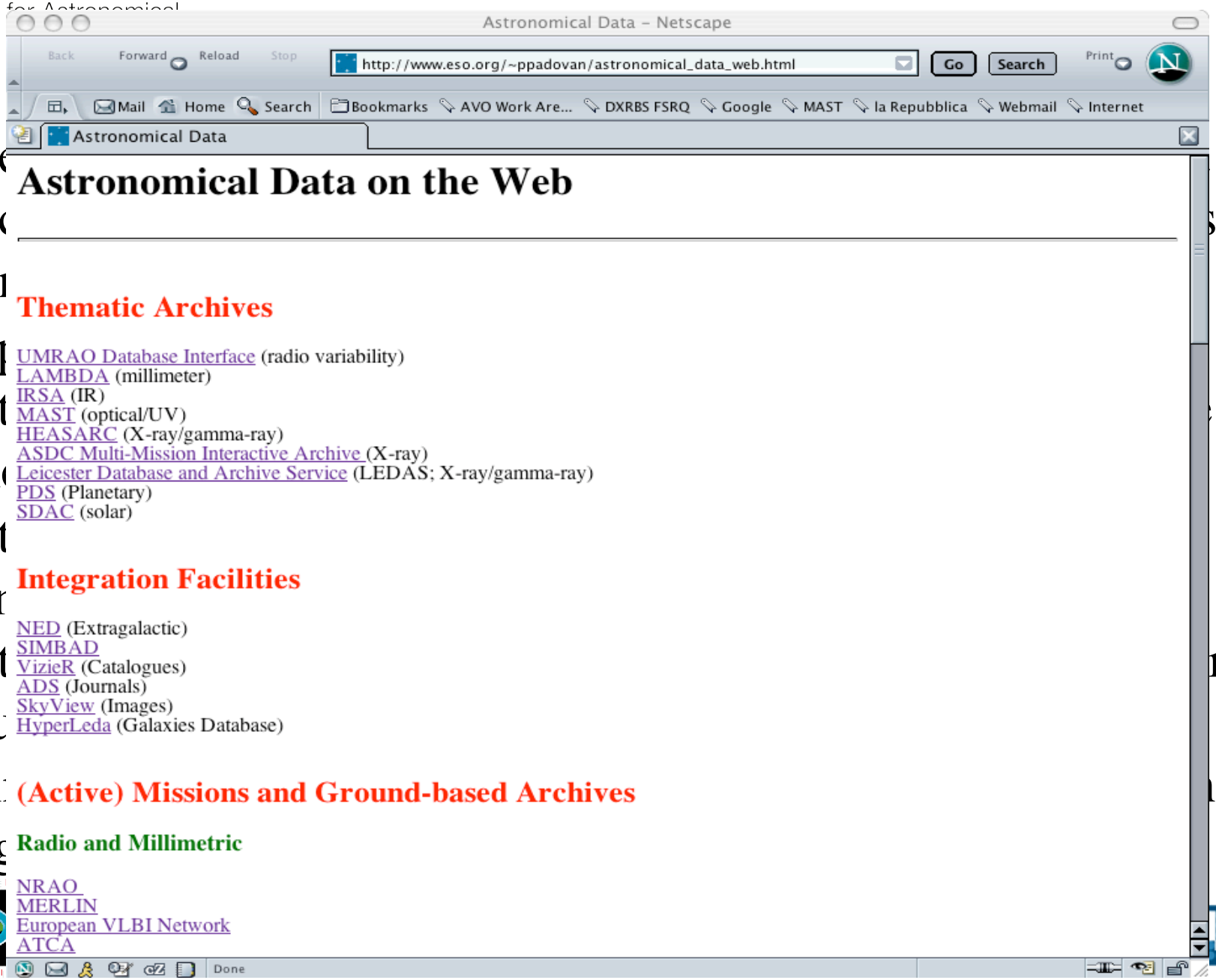
Astronomical Research in the XXI Century



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- Fi at
- leg

DATA MANAGEME & OPERATIONS DIVISI

VO Tools

Data Discovery	Spectral Analysis	Data visualisation and handling	SED building and fitting
Aladin ✔	SPLAT ✔	TopCat ✔	VOSED
VO Desktop ✔	VOSpec ✔	STILTS	Yafit
Datascope	Specview ✔	VOPlot	easy-z
Octet	Euro-3D	VisIVO	GOSSIP
OpenSkyQuery	*NVO Spectrum*	VOCat	*NVO Filter*
VoEventNet		*Montage*	
ASPID		*VOStat*	
NED		*NVO Footprint*	

italics: Web services

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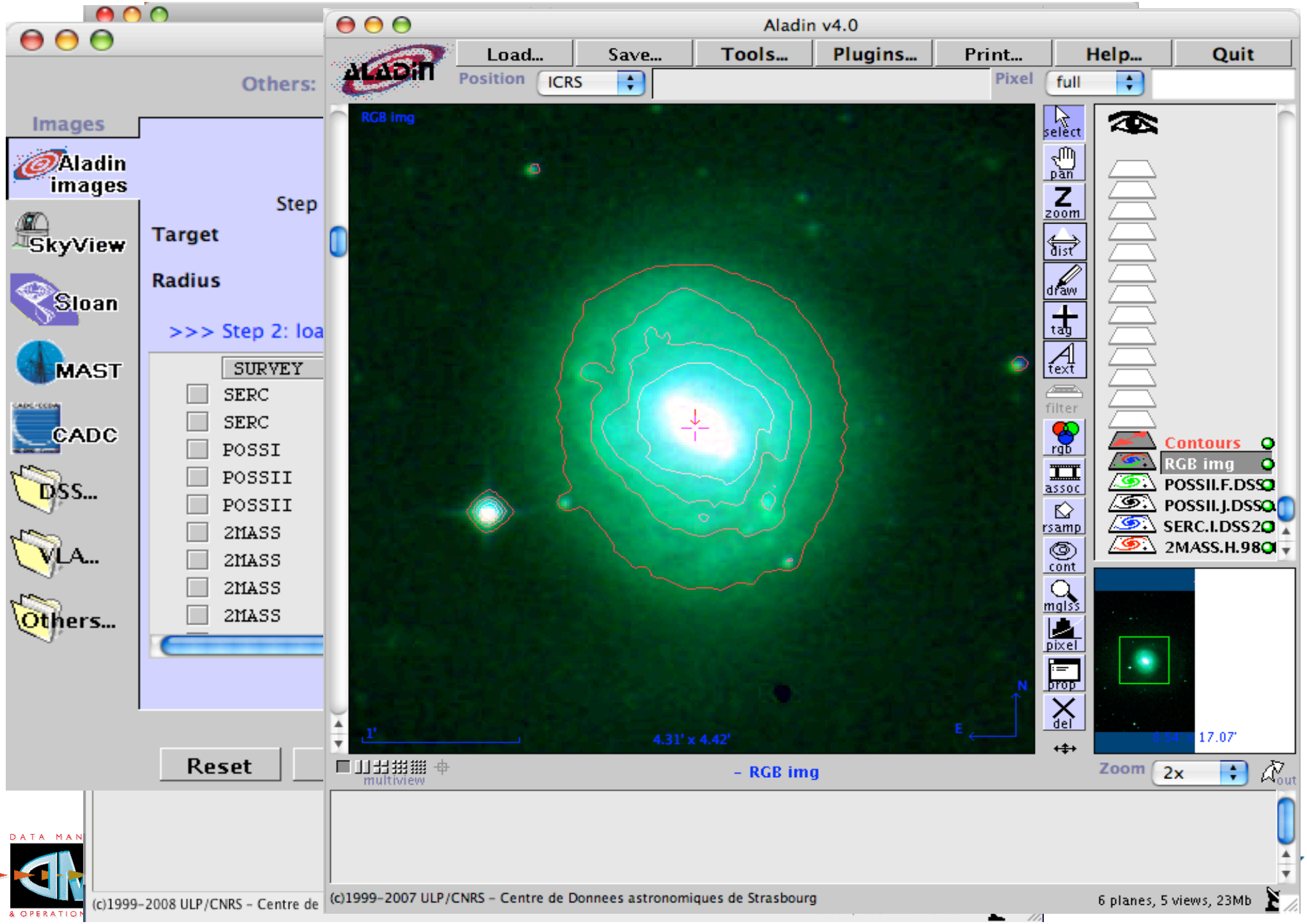
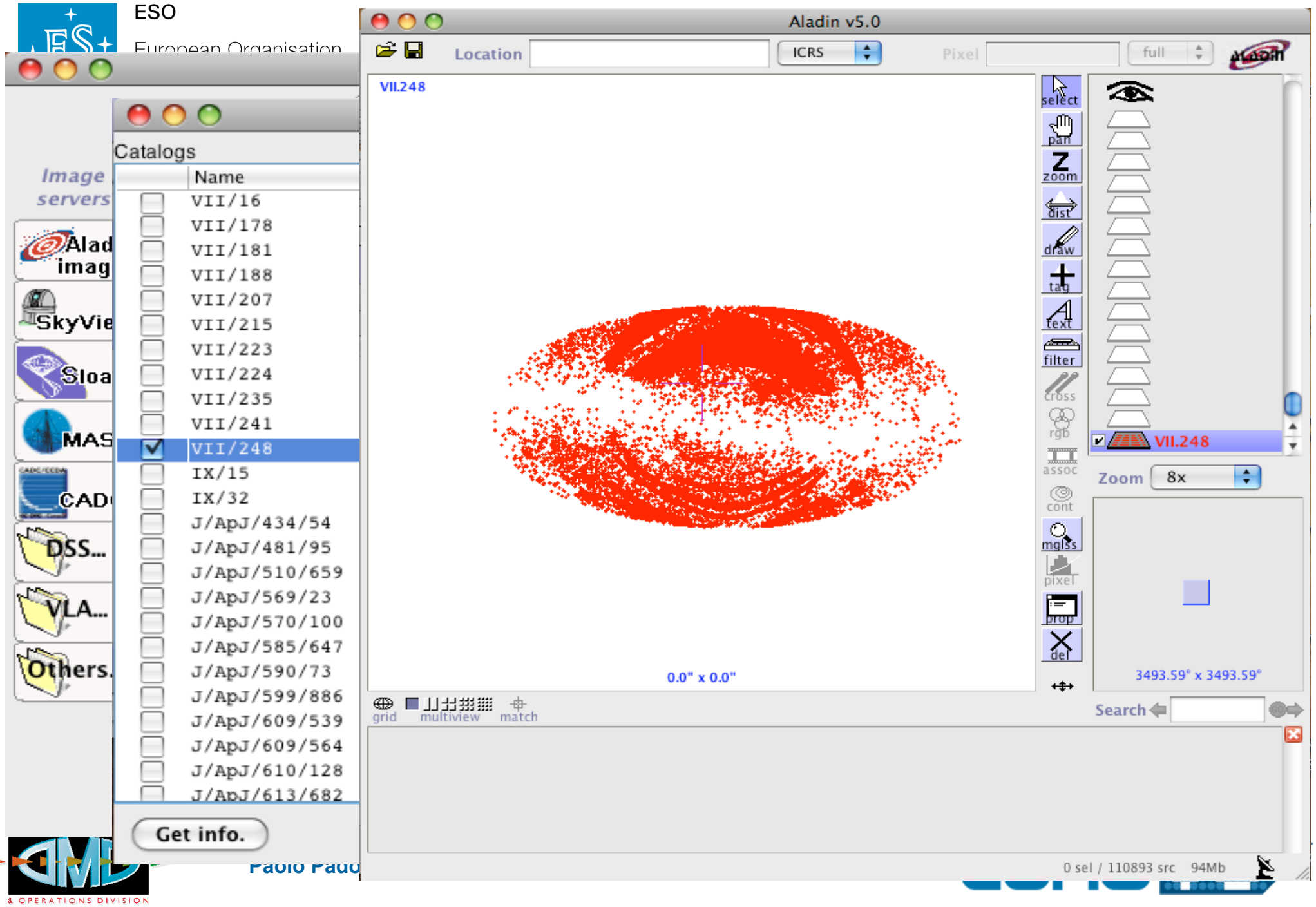
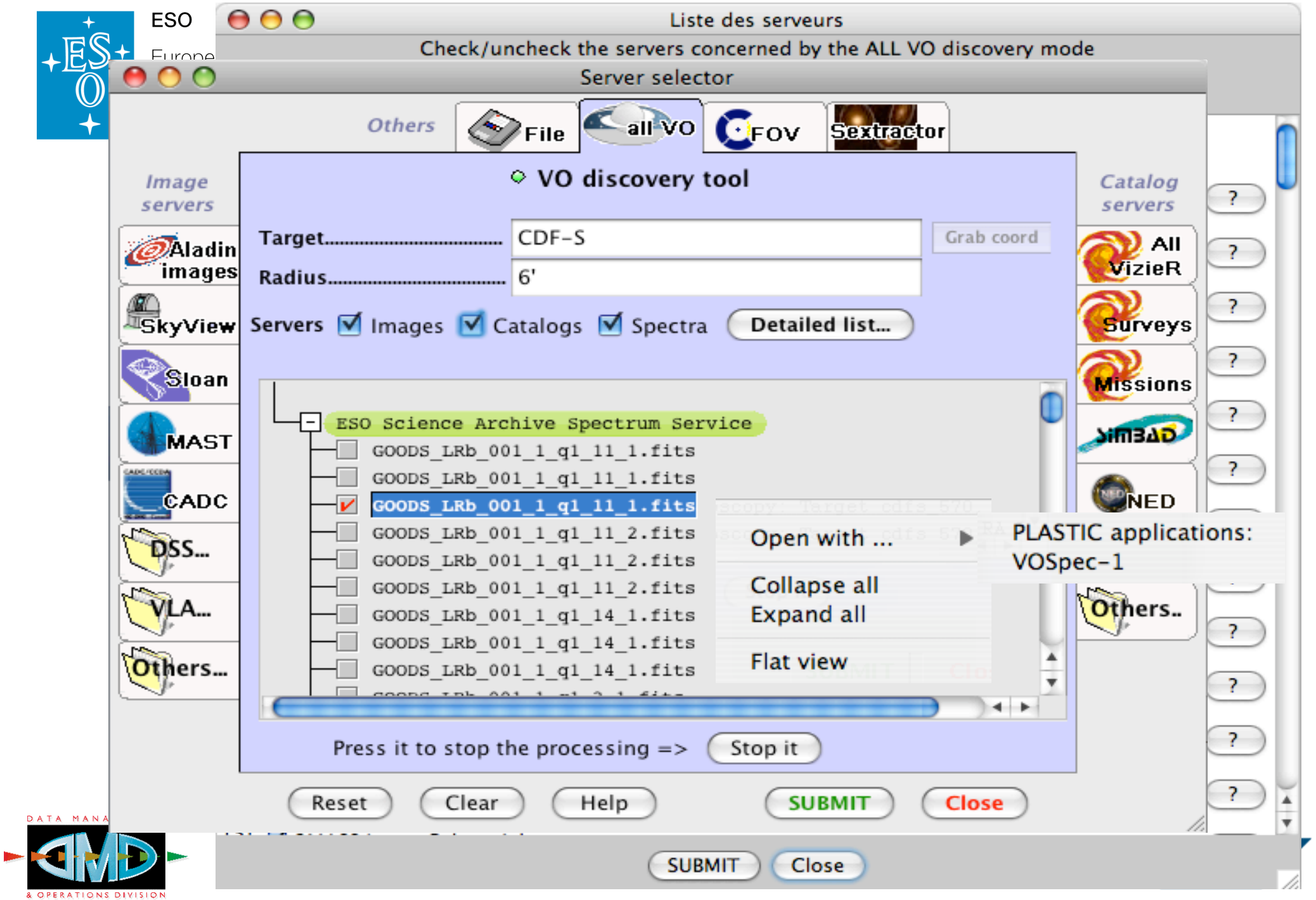
Aladin Sky Atlas: http://aladin.u-strasbg.fr/

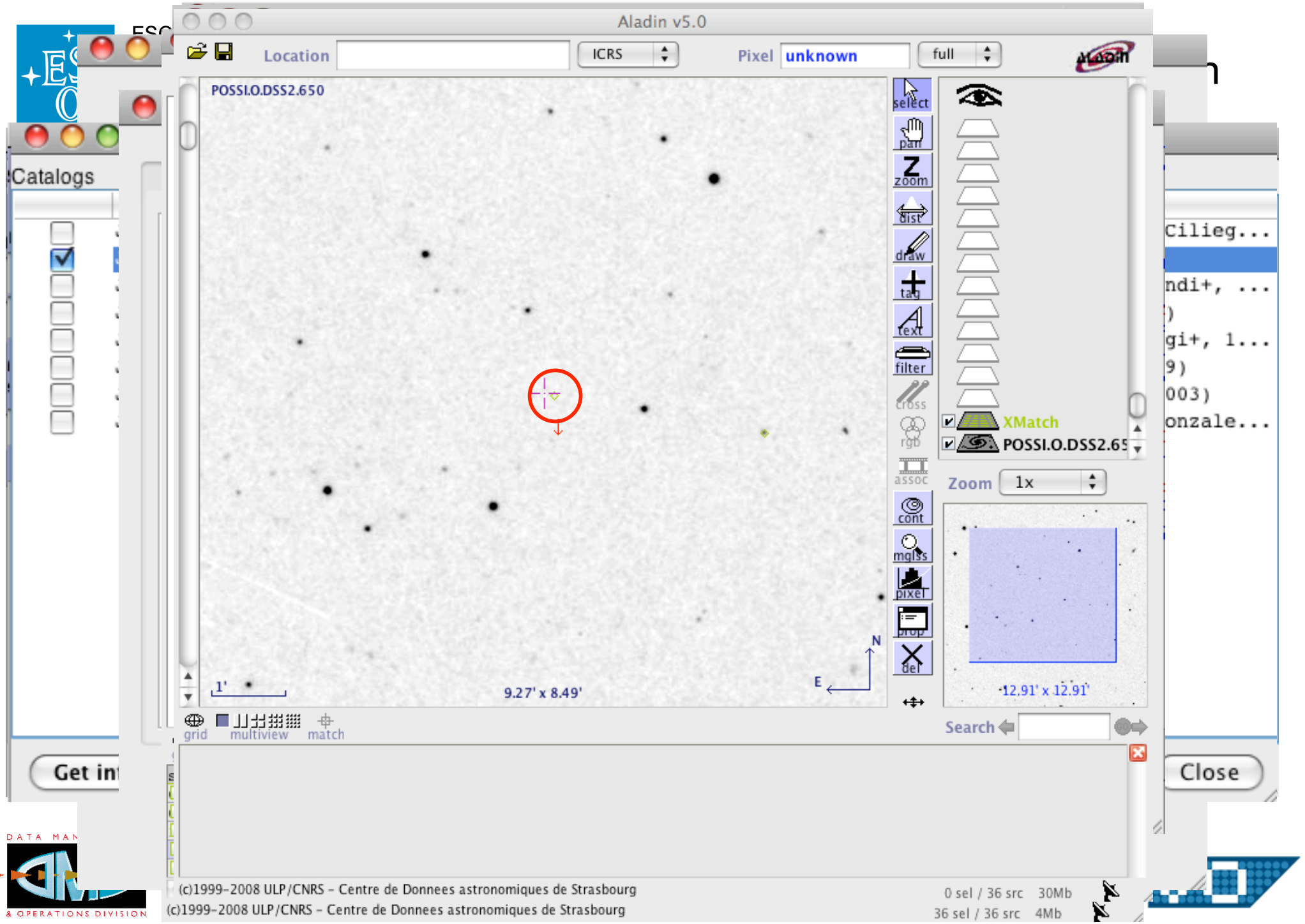
Aladin is an interactive software sky atlas allowing the user to visualize digitized astronomical images, superimpose entries from astronomical catalogues or databases, and interactively access related data and information from the Simbad database, the VizieR service and other archives for all known sources in the field.

The Aladin sky atlas is available in three modes: a Java Standalone application, a Java applet interface and a simple previewer.


Aladin v4.0
Load...
Save...
Tools...
Plugins...
Print...
Help...
Quit
Position
ICRS
Pixel
full
RGB img
Others:
Images
Aladin images
SkyView
Sloan
MAST
CADC
DSS...
VLA...
Others...
Step
Target
Radius
>>> Step 2: loa
SURVEY
SERC
SERC
POSSI
POSSII
POSSII
2MASS
2MASS
2MASS
2MASS
Reset
select
pan
zoom
dist
draw
tag
text
filter
rgb
assoc
rsamp
cont
mgliss
pixel
prop
del
Contours
RGB img
POSSII.F.DSS
POSSII.J.DSS
SERC.I.DSS2
2MASS.H.98
1'
4.31' x 4.42'
N
E
multiview
- RGB img
Zoom
2x
out
(c)1999-2007 ULP/CNRS - Centre de Donnees astronomiques de Strasbourg
6 planes, 5 views, 23Mb
(c)1999-2008 ULP/CNRS - Centre de


ESO
European Organisation
Aladin v5.0
Location
ICRS
Pixel
full
VII.248
Catalogs
Name
VII/16
VII/178
VII/181
VII/188
VII/207
VII/215
VII/223
VII/224
VII/235
VII/241
VII/248
IX/15
IX/32
J/ApJ/434/54
J/ApJ/481/95
J/ApJ/510/659
J/ApJ/569/23
J/ApJ/570/100
J/ApJ/585/647
J/ApJ/590/73
J/ApJ/599/886
J/ApJ/609/539
J/ApJ/609/564
J/ApJ/610/128
J/ApJ/613/682
Get info.
Image servers
select
pan
zoom
dist
draw
tag
text
filter
cross
rgb
assoc
cont
mgliss
pixel
prop
del
Zoom
8x
0.0" x 0.0"
3493.59° x 3493.59°
grid
multiview
match
Search
0 sel / 110893 src
94Mb
& OPERATIONS DIVISION


ESO
Liste des serveurs
Check/uncheck the servers concerned by the ALL VO discovery mode
Server selector
Others
File
all VO
FOV
Sextractor
VO discovery tool
Image servers
Catalog servers
Aladin images
SkyView
Sloan
MAST
CADC
DSS...
VLA...
Others...
All VizieR
Surveys
Missions
SIMBAD
NED
Others..
Target..... CDF-S
Grab coord
Radius..... 6'
Servers Images Catalogs Spectra
Detailed list...
ESO Science Archive Spectrum Service
GOODS_LRb_001_1_q1_11_1.fits
GOODS_LRb_001_1_q1_11_1.fits
GOODS_LRb_001_1_q1_11_1.fits
GOODS_LRb_001_1_q1_11_2.fits
GOODS_LRb_001_1_q1_11_2.fits
GOODS_LRb_001_1_q1_11_2.fits
GOODS_LRb_001_1_q1_14_1.fits
GOODS_LRb_001_1_q1_14_1.fits
GOODS_LRb_001_1_q1_14_1.fits
Open with ...
Collapse all
Expand all
Flat view
PLASTIC applications:
VOSpec-1
Press it to stop the processing =>
Stop it
Reset
Clear
Help
SUBMIT
Close
SUBMIT
Close


Aladin v5.0
Location
ICRS
Pixel
unknown
full
POSSI.O.DSS2.650
select
pan
zoom
dist
draw
tag
text
filter
cross
rgb
assoc
cont
mgliss
pixel
prop
del
XMatch
POSSI.O.DSS2.65
Zoom
1x
1'
9.27' x 8.49'
12.91' x 12.91'
N
E
grid
multiview
match
Search
(c)1999-2008 ULP/CNRS - Centre de Donnees astronomiques de Strasbourg
0 sel / 36 src 30Mb
36 sel / 36 src 4Mb
Catalogs
Get in
Close
Cilieg...
ndi+, ...
gi+, 1...
onzale...

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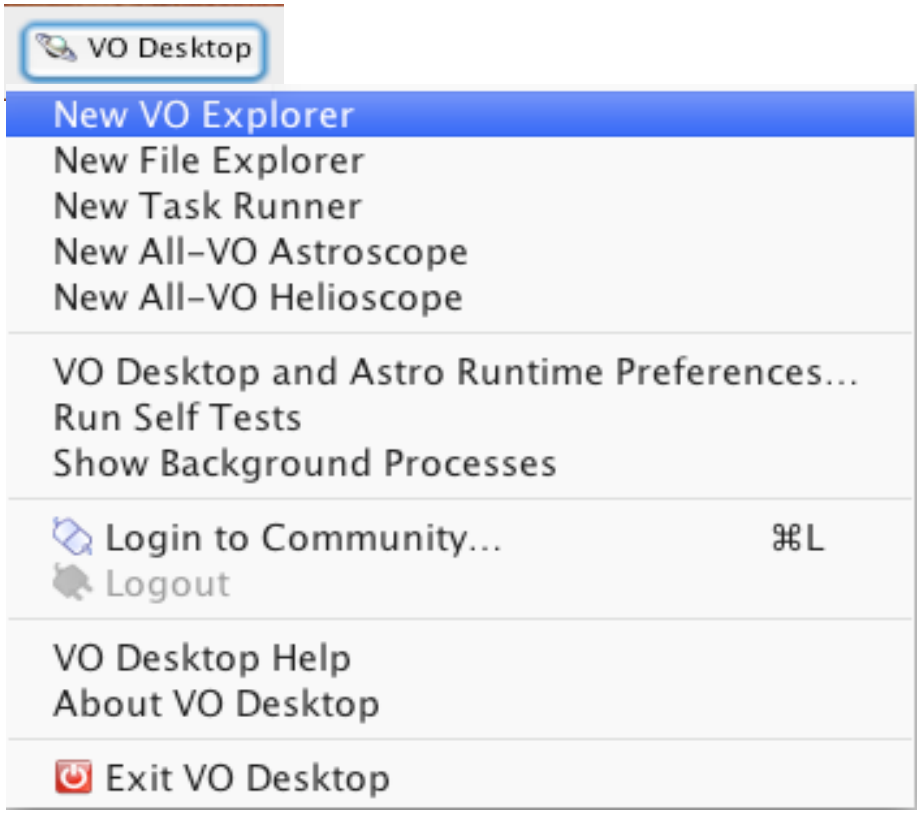
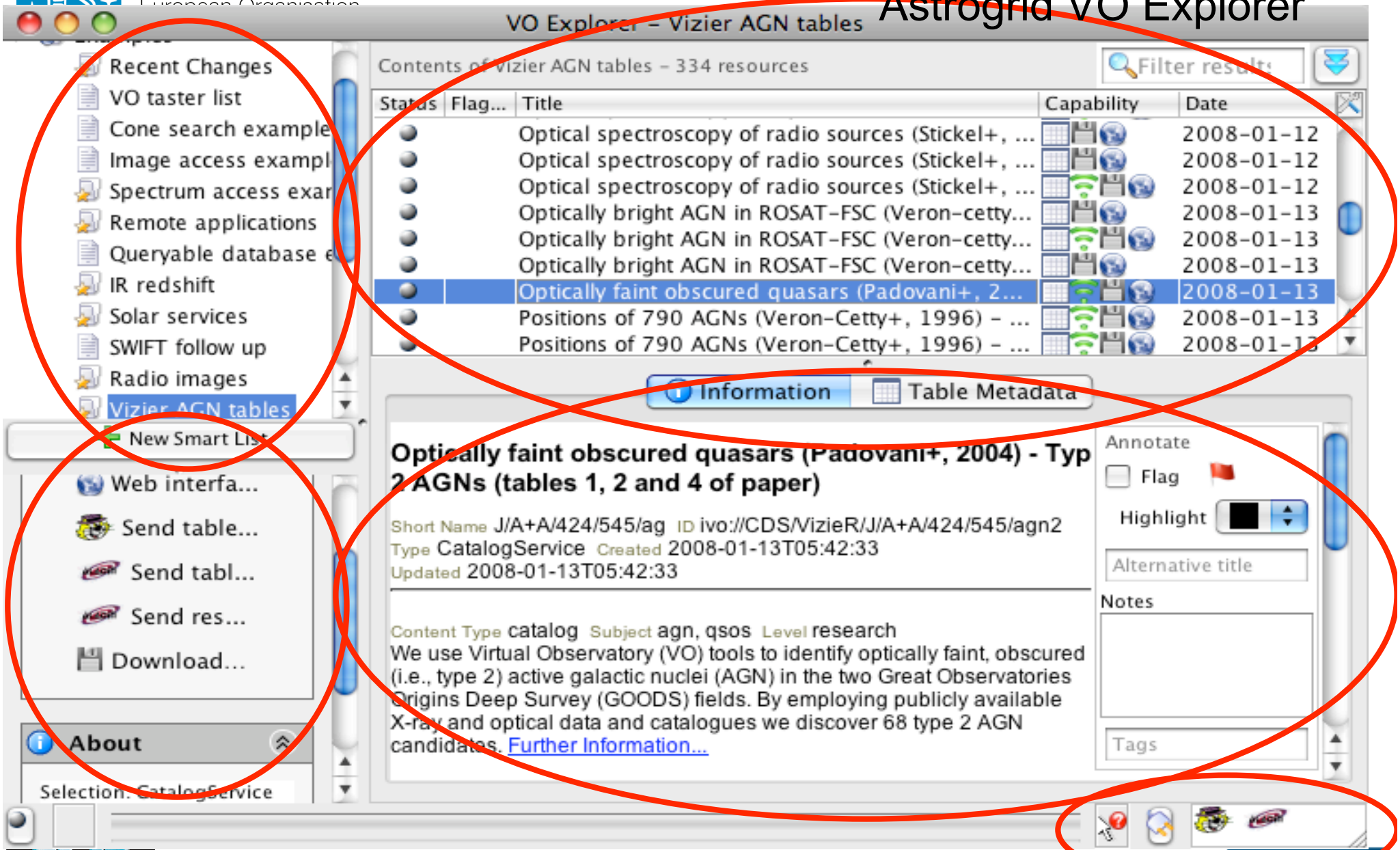
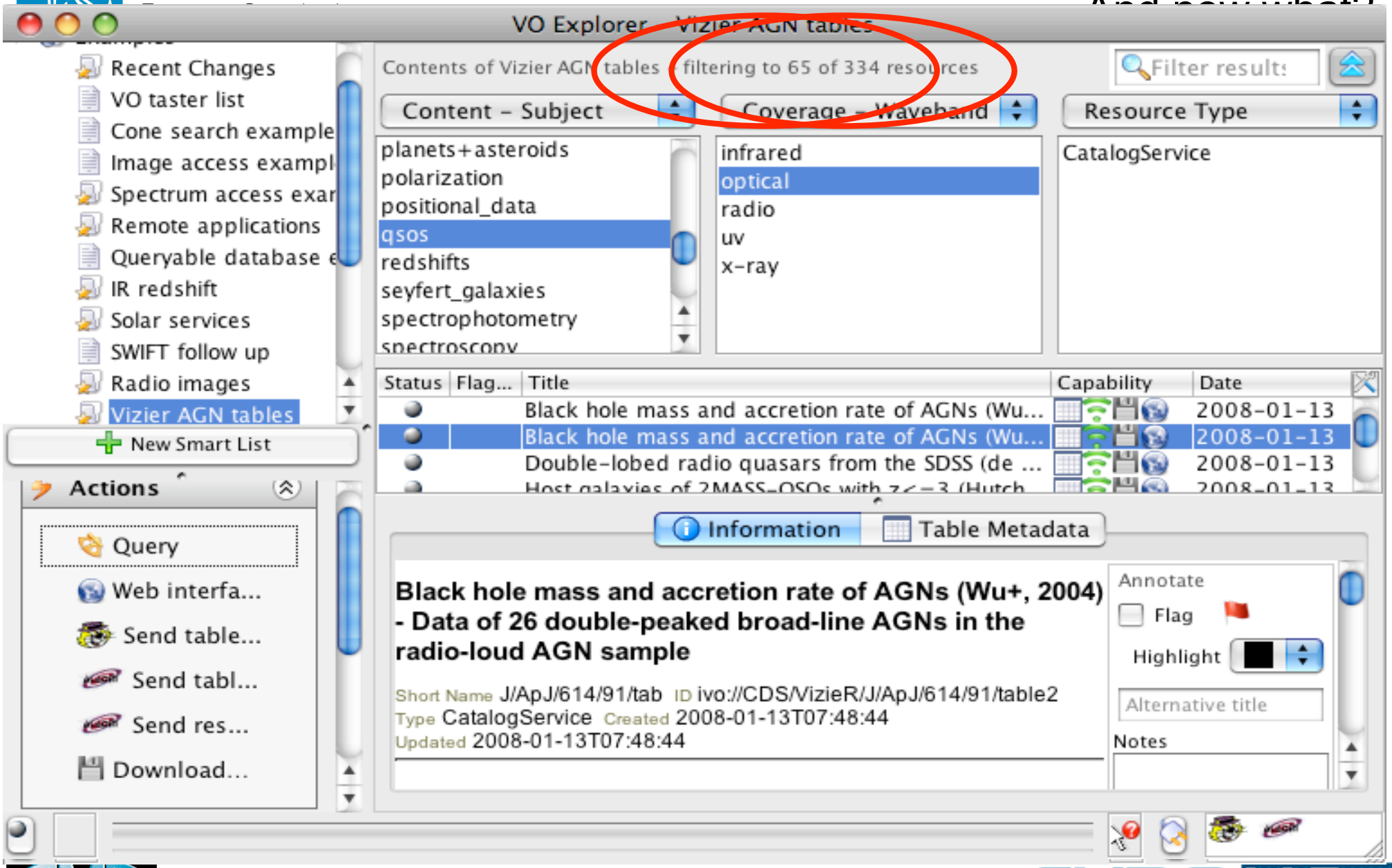
Astrogrid VO Desktop: http://www.astrogrid.org/

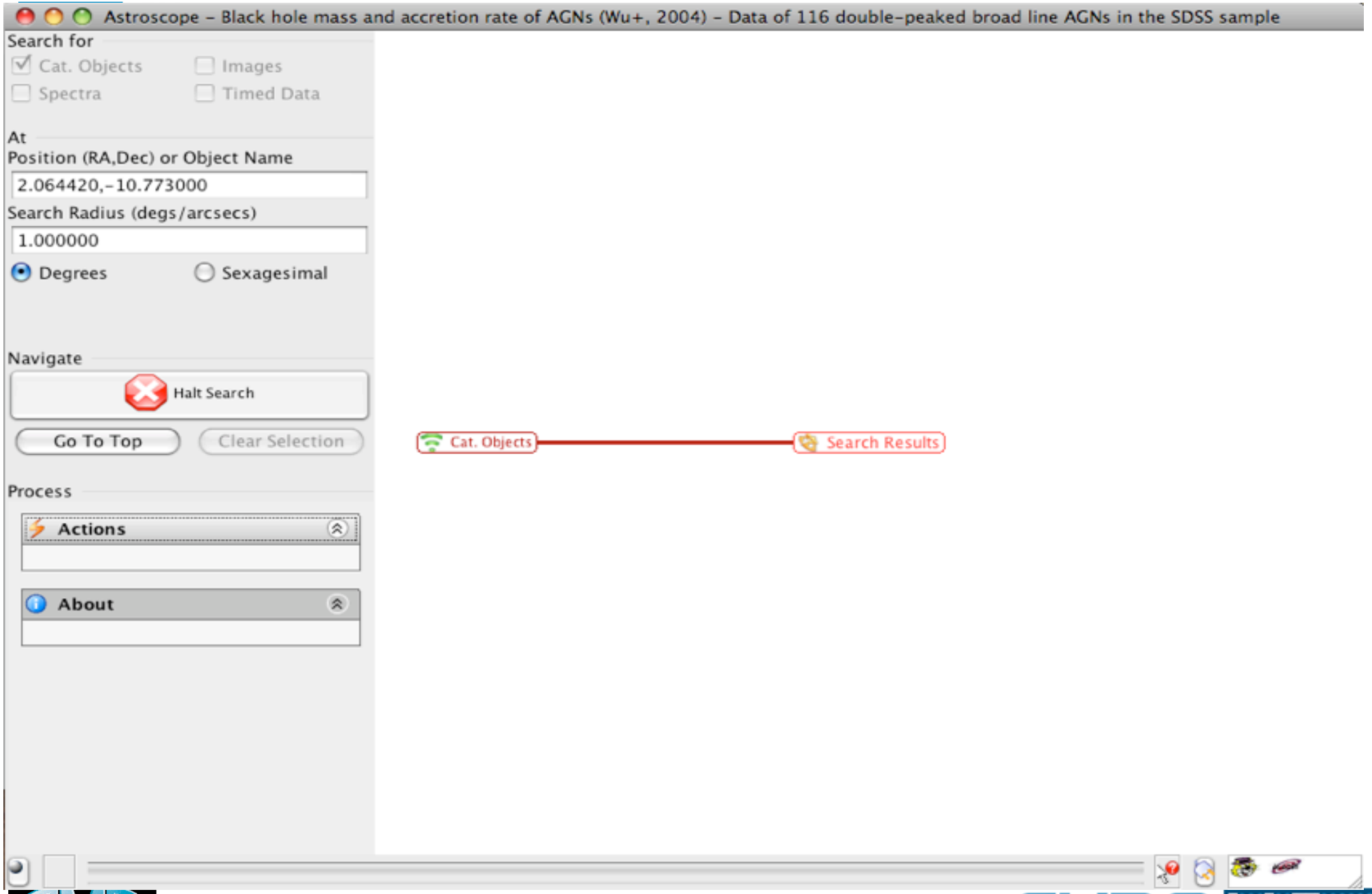


Astrogrid VO Explorer



And now what?


VO Explorer - Vizier AGN tables
Recent Changes
VO taster list
Cone search example
Image access exampl
Spectrum access exar
Remote applications
Queryable database e
IR redshift
Solar services
SWIFT follow up
Radio images
Vizier AGN tables
New Smart List
Actions
Query
Web interfa...
Send table...
Send tabl...
Send res...
Download...
Contents of Vizier AGN tables - filtering to 65 of 334 resources
Filter results
Content - Subject
Coverage - Waveband
Resource Type
planets+asteroids
polarization
positional_data
qsos
redshifts
seyfert_galaxies
spectrophotometry
spectroscopy
infrared
optical
radio
uv
x-ray
CatalogService
Status
Flag...
Title
Capability
Date
Black hole mass and accretion rate of AGNs (Wu...
2008-01-13
Black hole mass and accretion rate of AGNs (Wu...
2008-01-13
Double-lobed radio quasars from the SDSS (de ...
2008-01-13
Information
Table Metadata
Black hole mass and accretion rate of AGNs (Wu+, 2004) - Data of 26 double-peaked broad-line AGNs in the radio-loud AGN sample
Short Name J/ApJ/614/91/tab ID ivo://CDS/VizieR/J/ApJ/614/91/table2
Type CatalogService Created 2008-01-13T07:48:44
Updated 2008-01-13T07:48:44
Annotate
Flag
Highlight
Alternative title
Notes


Astroscope – Black hole mass and accretion rate of AGNs (Wu+, 2004) – Data of 116 double-peaked broad line AGNs in the SDSS sample
Search for
Cat. Objects
Images
Spectra
Timed Data
At
Position (RA,Dec) or Object Name
2.064420,-10.773000
Search Radius (degs/arcsecs)
1.000000
Degrees
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Navigate
Halt Search
Go To Top
Clear Selection
Process
Actions
About
Cat. Objects
Search Results

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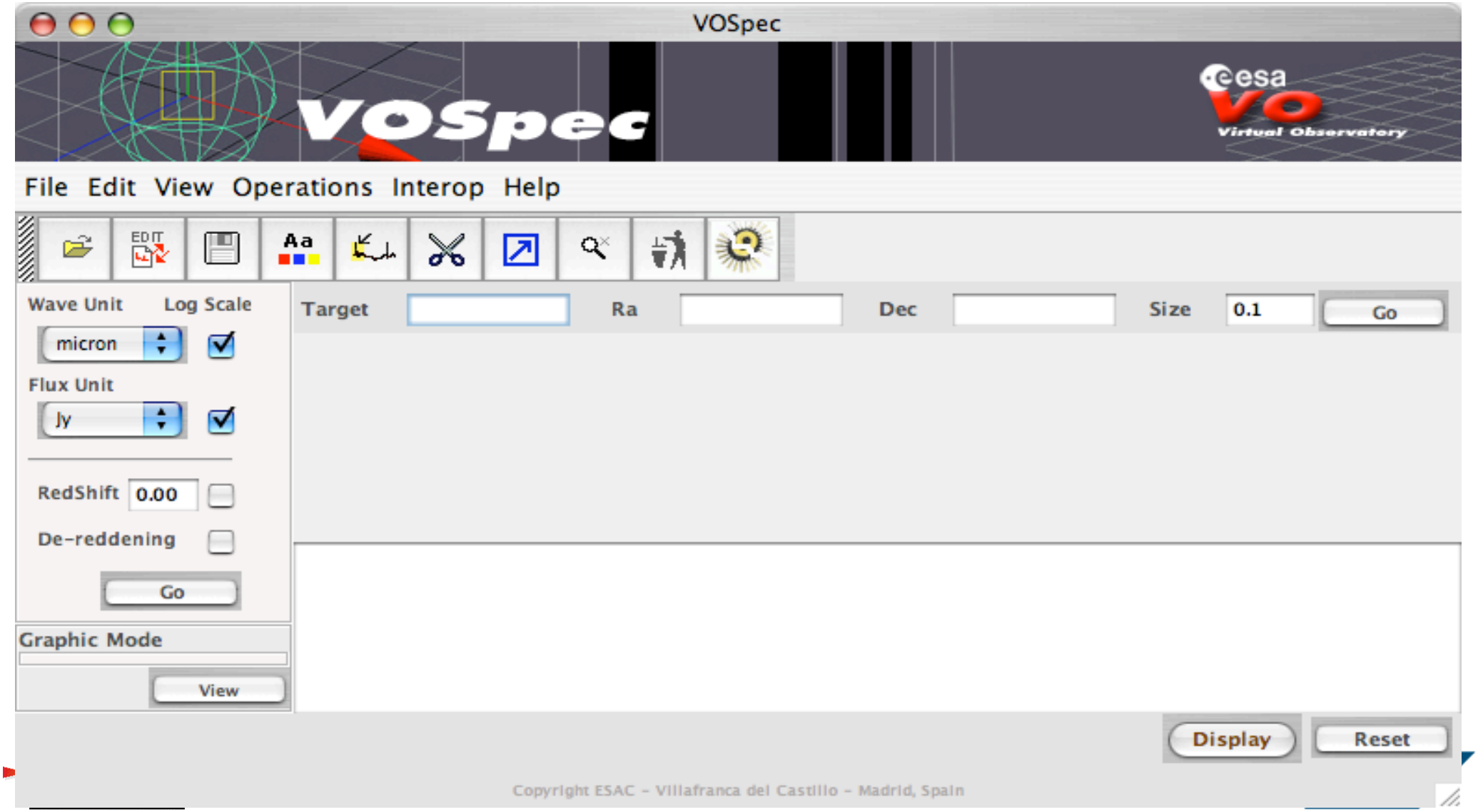
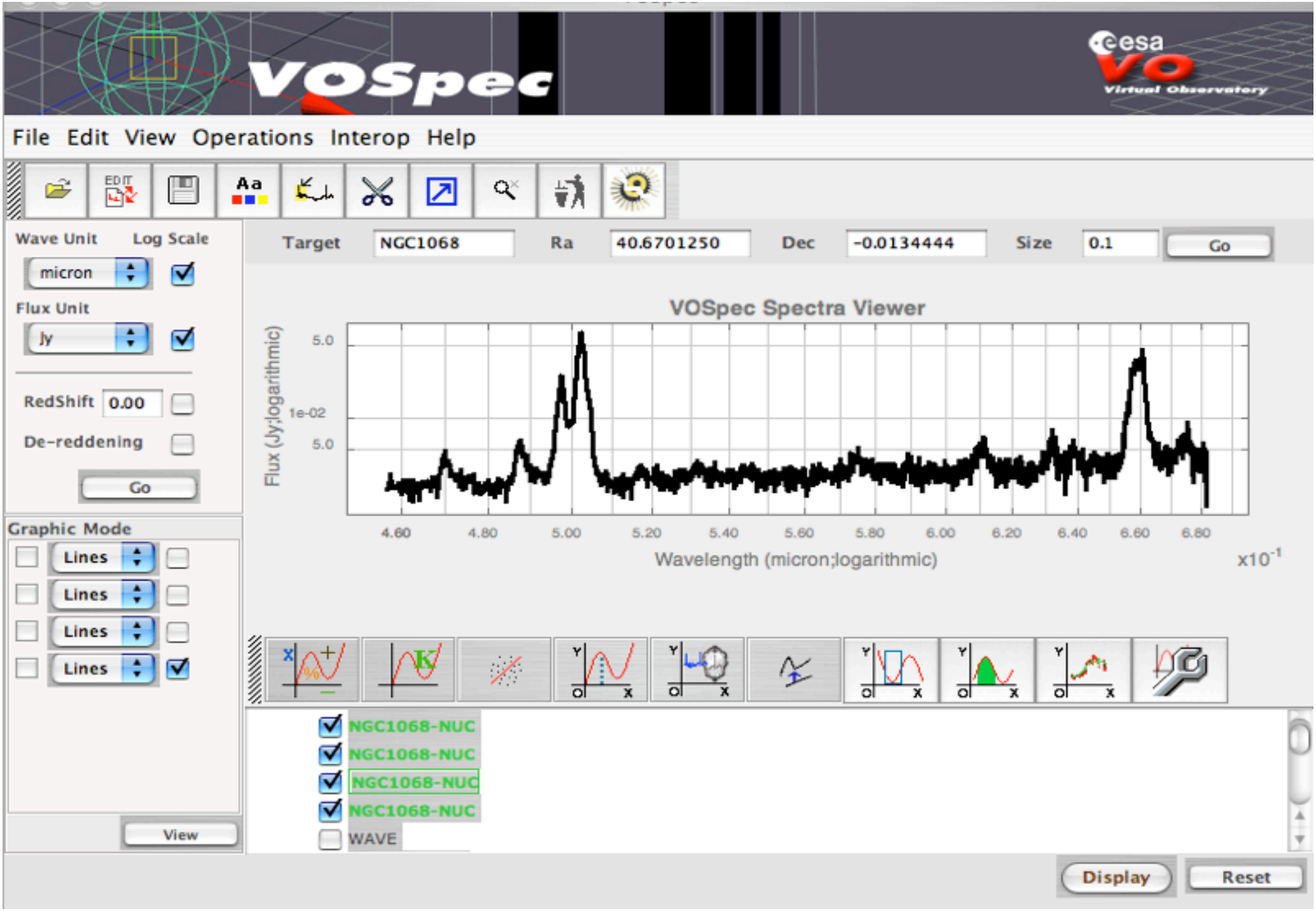
VOSpec

http://esavo.esa.int/vospec/




VOSpec
esa VO Virtual Observatory
File Edit View Operations Interop Help
Wave Unit
Log Scale
micron
Flux Unit
Jy
RedShift 0.00
De-reddening
Go
Graphic Mode
Lines
Lines
Lines
Lines
View
Target NGC1068 Ra 40.6701250 Dec -0.0134444 Size 0.1 Go
VOSpec Spectra Viewer
Flux (Jy;logarithmic)
5.0
1e-02
5.0
4.60 4.80 5.00 5.20 5.40 5.60 5.80 6.00 6.20 6.40 6.60 6.80
Wavelength (micron;logarithmic)
x10-1
NGC1068-NUC
NGC1068-NUC
NGC1068-NUC
NGC1068-NUC
WAVE
Display
Reset

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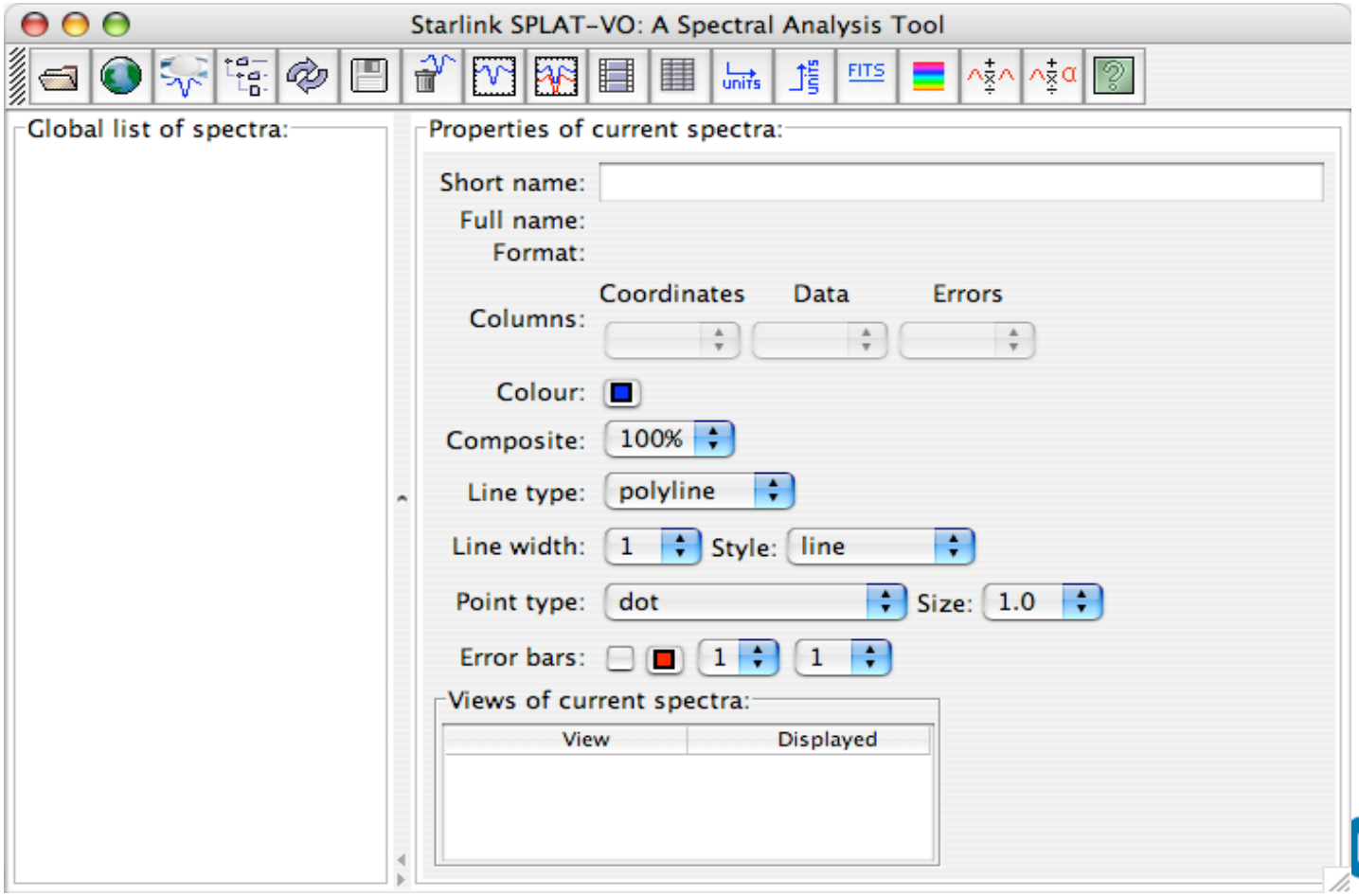
SPLAT

http://star-www.dur.ac.uk/~pdraper/splat/splat-vo/

SPLAT: Starlink SPectraL Analysis Tool



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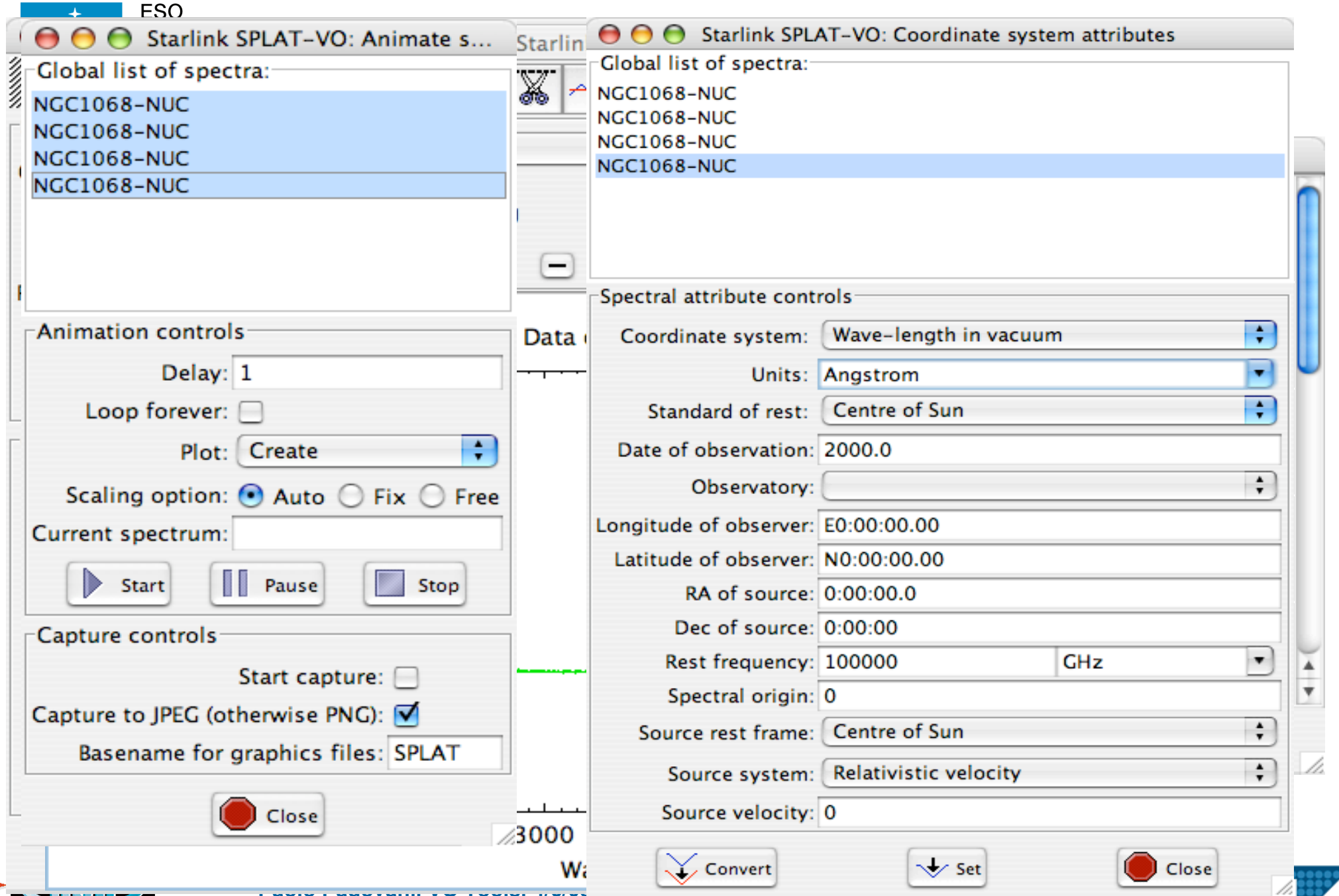
Starlink SPLAT-VO: Animate s...
Global list of spectra:
NGC1068-NUC
NGC1068-NUC
NGC1068-NUC
NGC1068-NUC
Animation controls
Delay: 1
Loop forever:
Plot: Create
Scaling option: Auto Fix Free
Current spectrum:
Start
Pause
Stop
Capture controls
Start capture:
Capture to JPEG (otherwise PNG):
Basename for graphics files: SPLAT
Close
Starlin
Data
3000
Starlink SPLAT-VO: Coordinate system attributes
Global list of spectra:
NGC1068-NUC
NGC1068-NUC
NGC1068-NUC
NGC1068-NUC
Spectral attribute controls
Coordinate system: Wave-length in vacuum
Units: Angstrom
Standard of rest: Centre of Sun
Date of observation: 2000.0
Observatory:
Longitude of observer: E0:00:00.00
Latitude of observer: N0:00:00.00
RA of source: 0:00:00.0
Dec of source: 0:00:00
Rest frequency: 100000 GHz
Spectral origin: 0
Source rest frame: Centre of Sun
Source system: Relativistic velocity
Source velocity: 0
Convert
Set
Close

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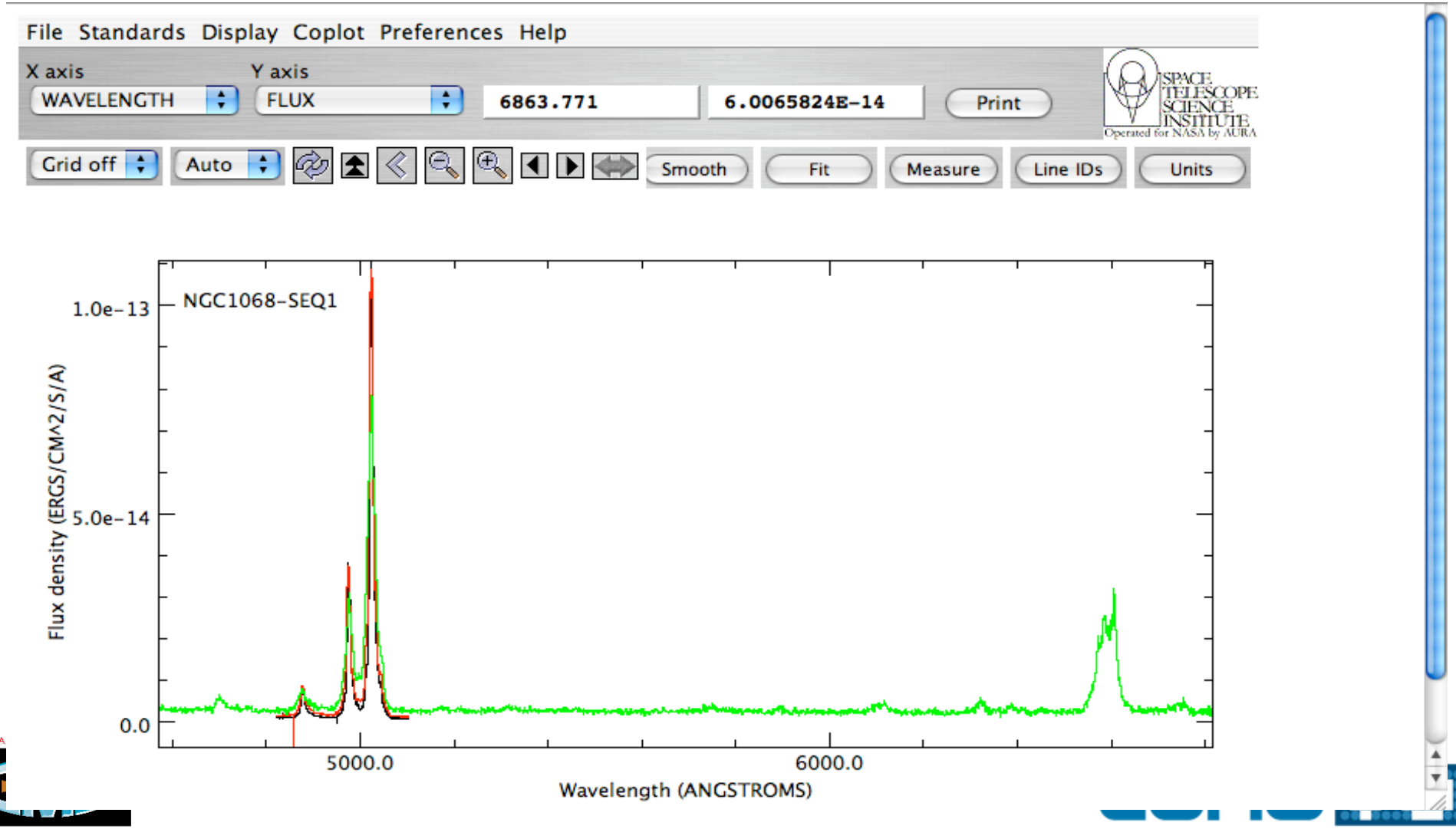
Specview

http://specview.stsci.edu/applet/specview_applet_run.html



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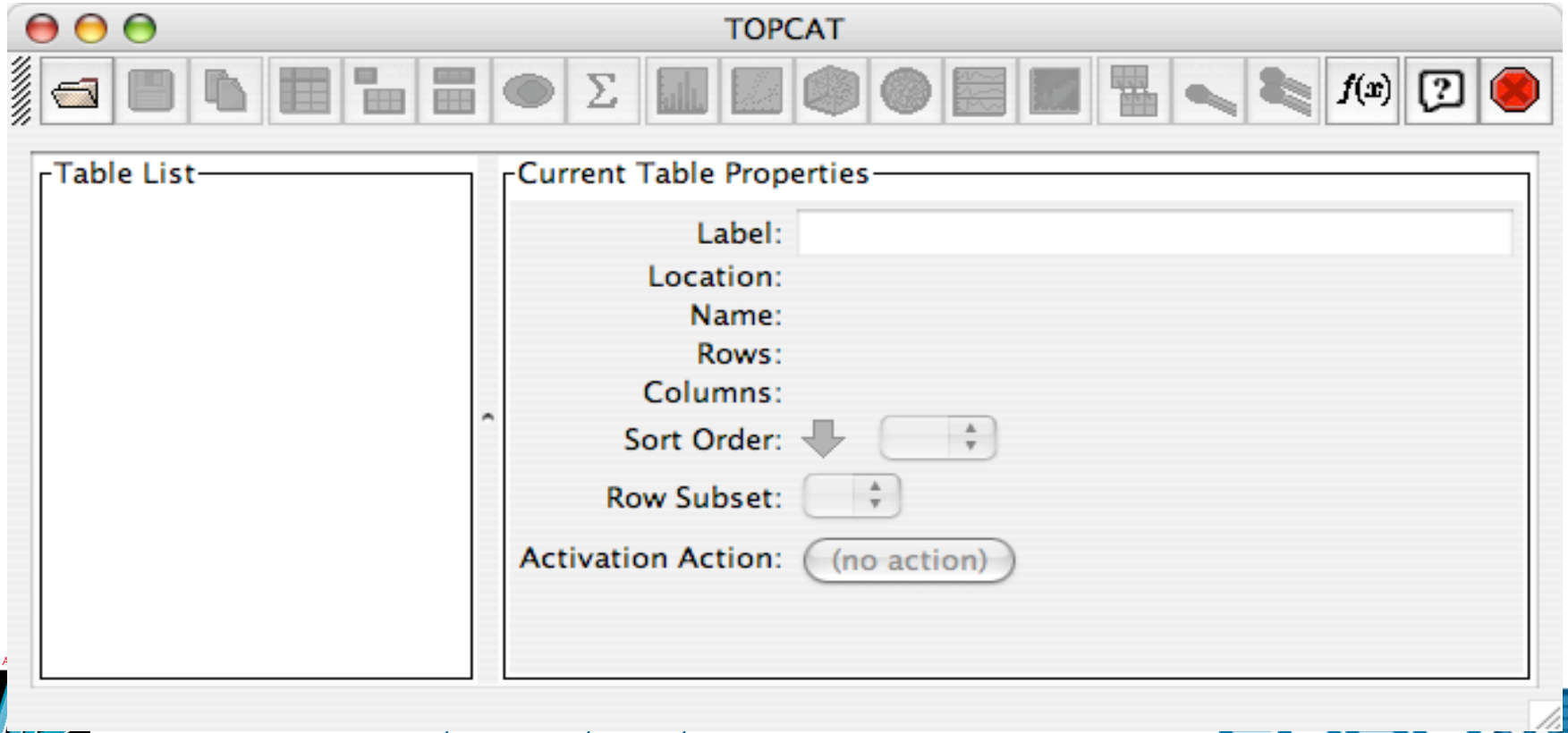
Topcat

http://www.star.bris.ac.uk/~mbt/topcat/

TOPCAT: Tool for OPerations on Catalogues And Tables

TOPCAT is an interactive graphical viewer and editor for tabular data.



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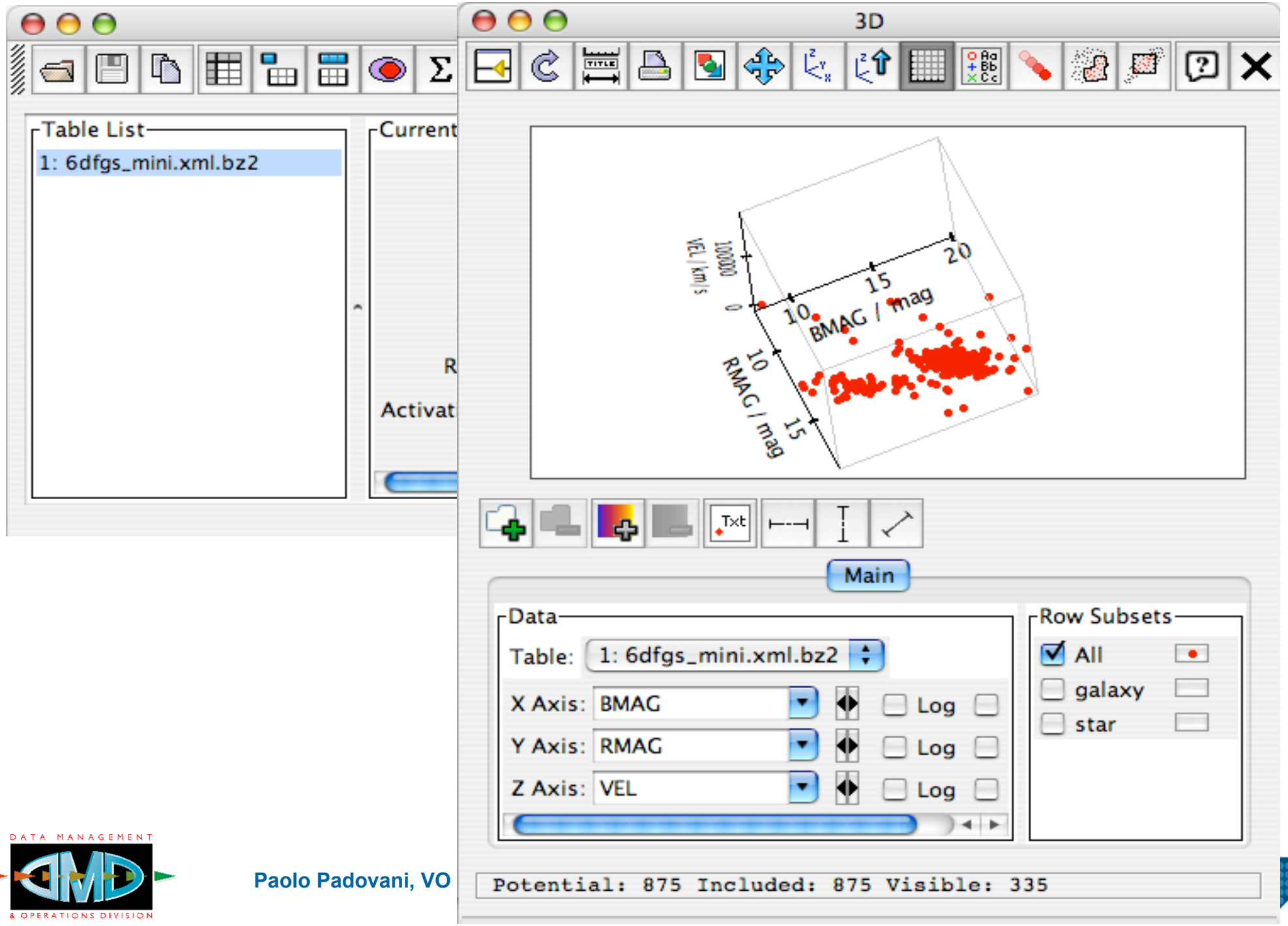
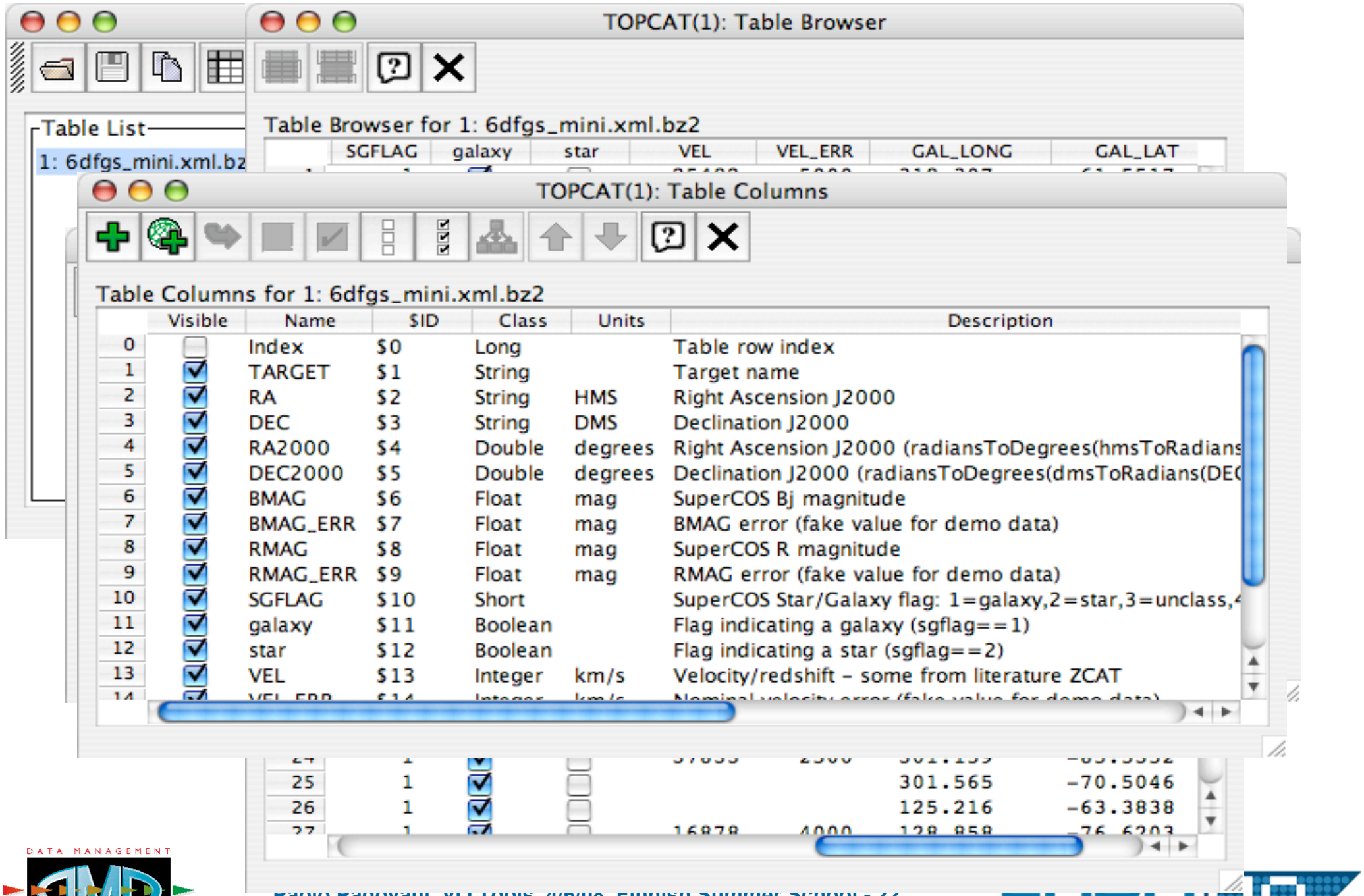
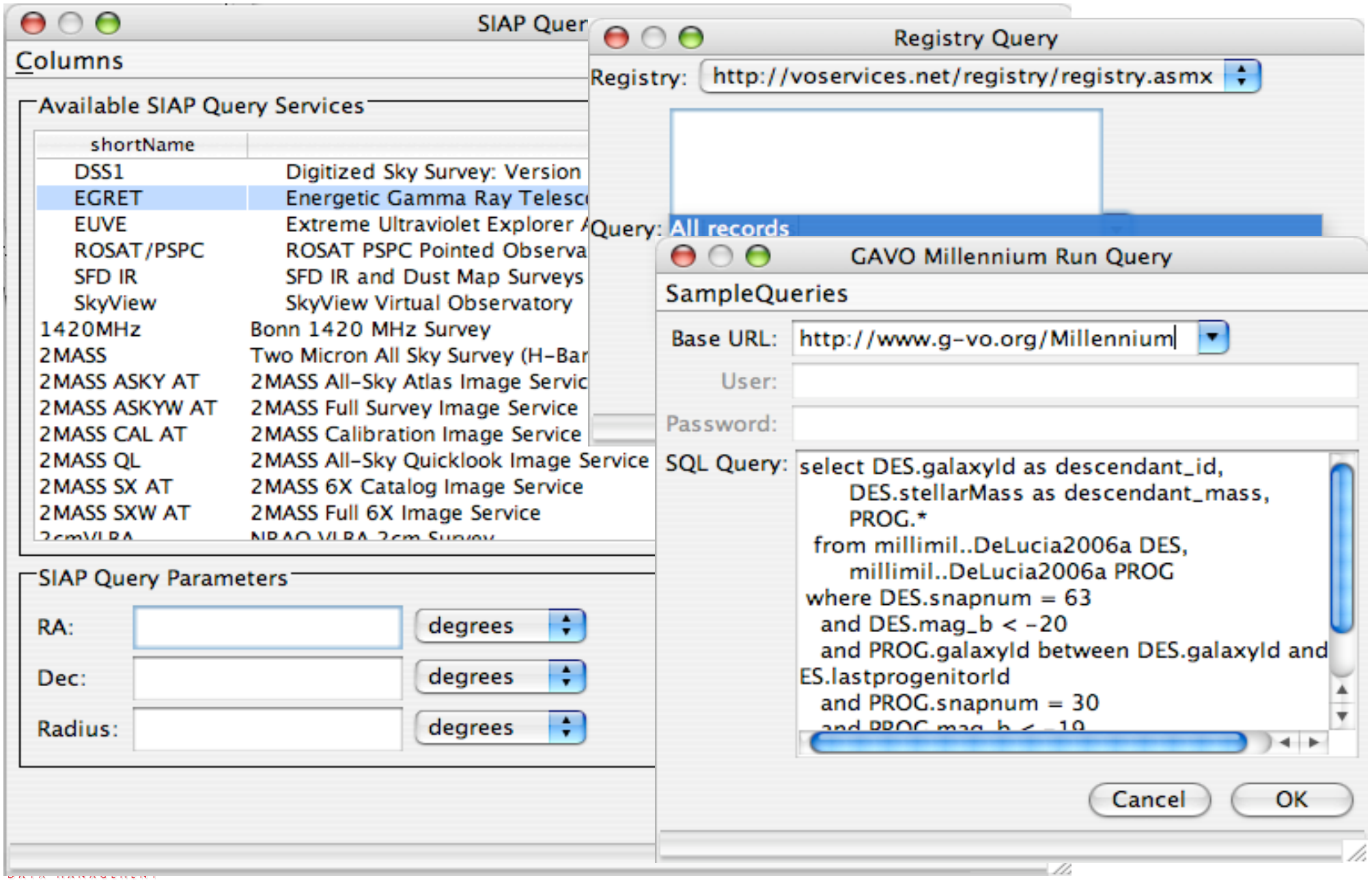
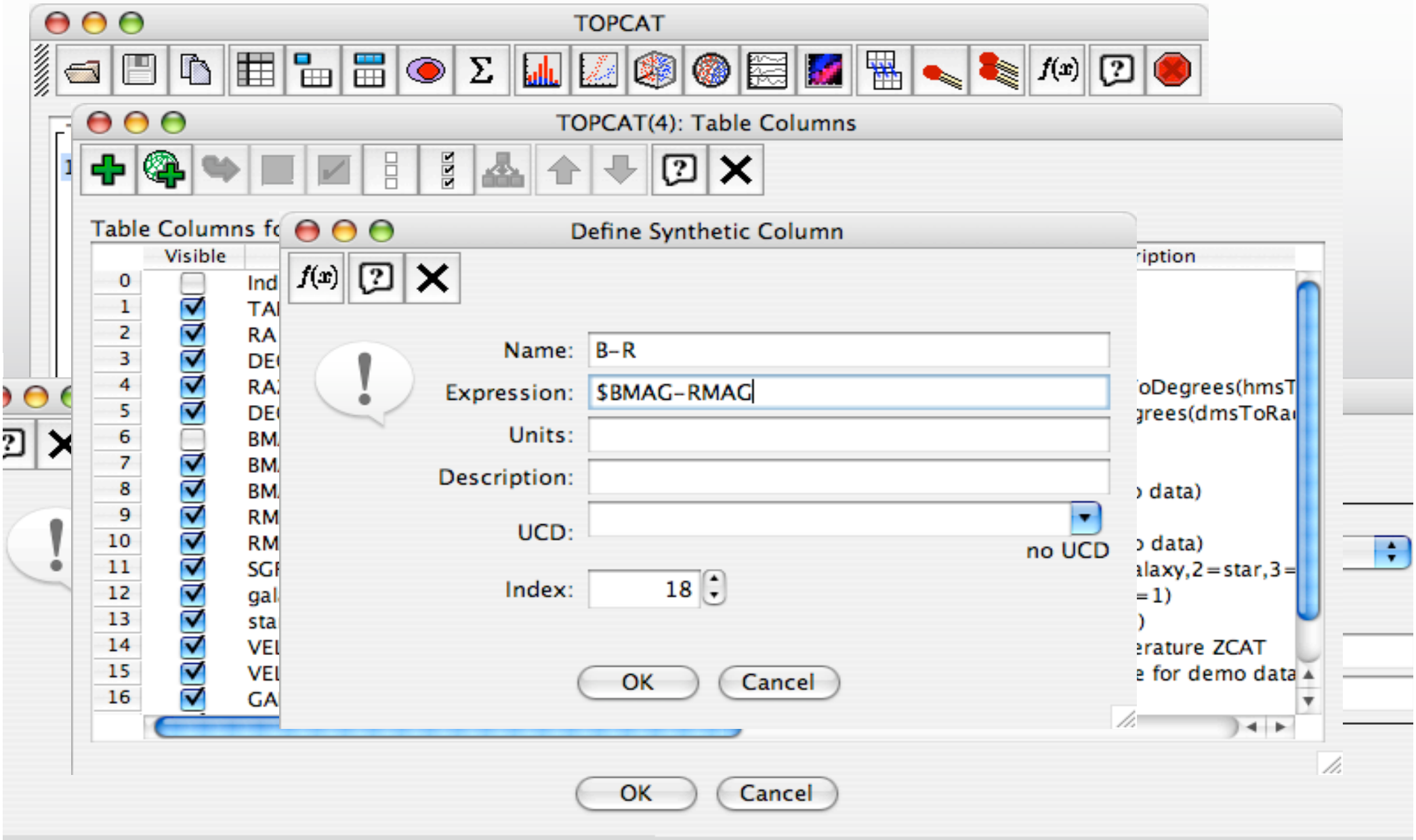
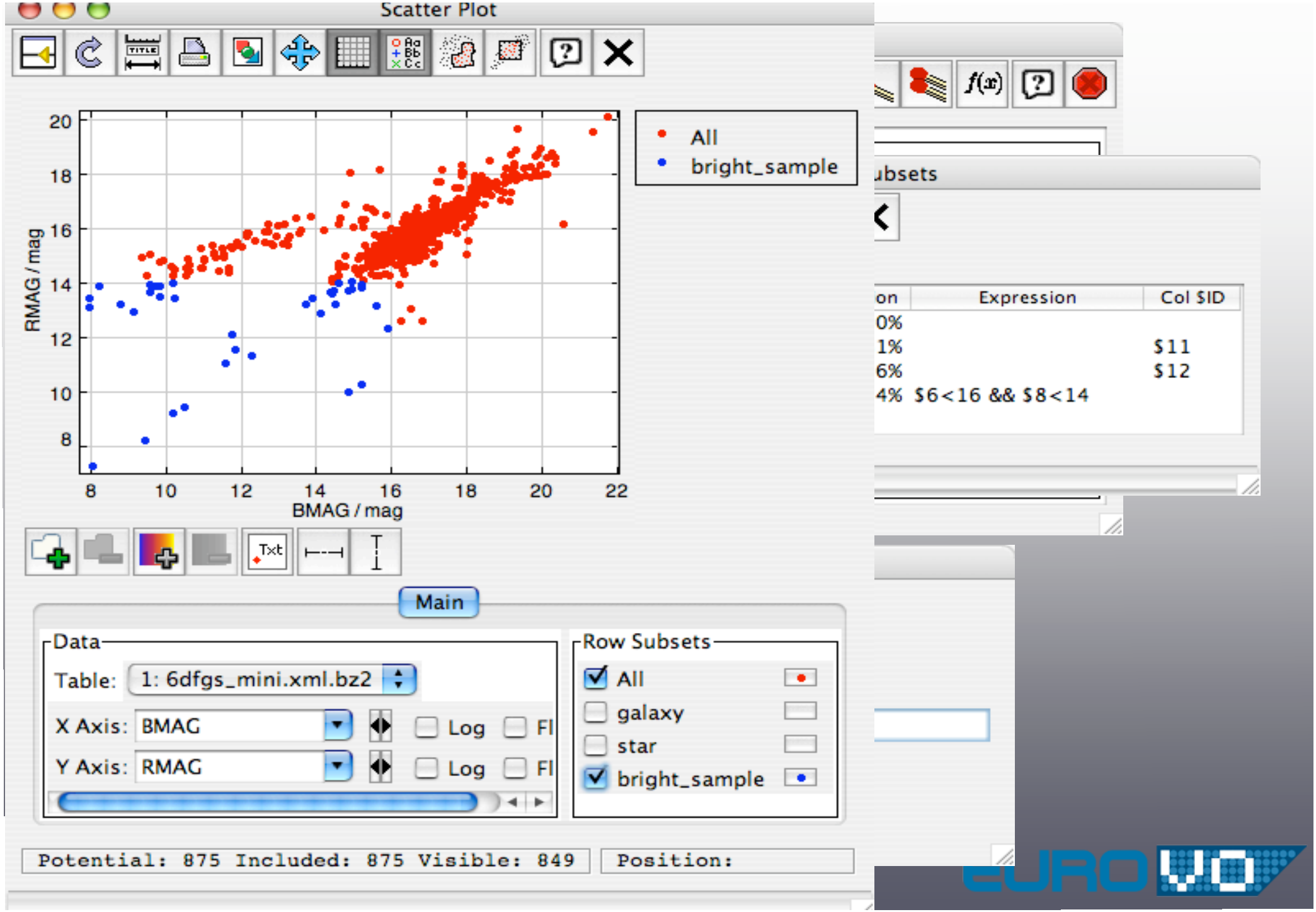
& OPERATIONS DIVISION

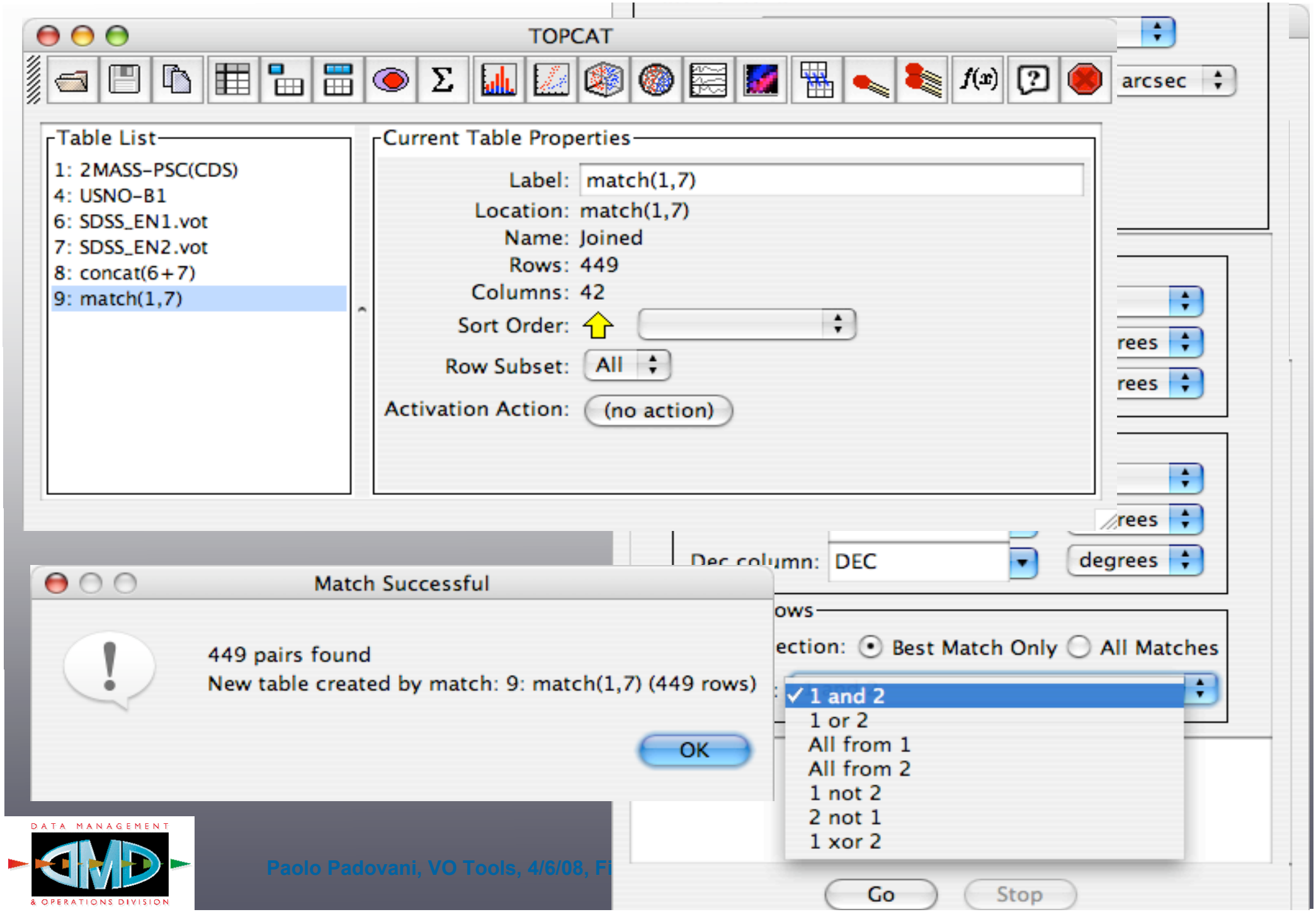

3D
Table List
1: 6dfgs_mini.xml.bz2
Current
Activat
100000
VEL / km/s
0
10
15
20
BMAG / mag
10
RMAG / mag
15
Txt
Main
Data
Table:
1: 6dfgs_mini.xml.bz2
X Axis:
BMAG
Log
Y Axis:
RMAG
Log
Z Axis:
VEL
Log
Row Subsets
All
galaxy
star
Potential: 875 Included: 875 Visible: 335


TOPCAT(1): Table Browser
Table List
1: 6dfgs_mini.xml.bz
Table Browser for 1: 6dfgs_mini.xml.bz2
SGFLAG
galaxy
star
VEL
VEL_ERR
GAL_LONG
GAL_LAT
TOPCAT(1): Table Columns
Table Columns for 1: 6dfgs_mini.xml.bz2
Visible
Name
$ID
Class
Units
Description
0 Index $0 Long Table row index
1 TARGET $1 String Target name
2 RA $2 String HMS Right Ascension J2000
3 DEC $3 String DMS Declination J2000
4 RA2000 $4 Double degrees Right Ascension J2000 (radiansToDegrees(hmsToRadians
5 DEC2000 $5 Double degrees Declination J2000 (radiansToDegrees(dmsToRadians(DE(
6 BMAG $6 Float mag SuperCOS Bj magnitude
7 BMAG_ERR $7 Float mag BMAG error (fake value for demo data)
8 RMAG $8 Float mag SuperCOS R magnitude
9 RMAG_ERR $9 Float mag RMAG error (fake value for demo data)
10 SGFLAG $10 Short SuperCOS Star/Galaxy flag: 1=galaxy,2=star,3=unclass,
11 galaxy $11 Boolean Flag indicating a galaxy (sgflag==1)
12 star $12 Boolean Flag indicating a star (sgflag==2)
13 VEL $13 Integer km/s Velocity/redshift - some from literature ZCAT
25 1 301.565 -70.5046
26 1 125.216 -63.3838


SIAP Quer
Columns
Available SIAP Query Services
shortName
DSS1 Digitized Sky Survey: Version
EGRET Energetic Gamma Ray Telesc
EUVE Extreme Ultraviolet Explorer A
ROSAT/PSPC ROSAT PSPC Pointed Observa
SFD IR SFD IR and Dust Map Surveys
SkyView SkyView Virtual Observatory
1420MHz Bonn 1420 MHz Survey
2MASS Two Micron All Sky Survey (H-Bar
2MASS ASKY AT 2MASS All-Sky Atlas Image Servic
2MASS ASKYW AT 2MASS Full Survey Image Service
2MASS CAL AT 2MASS Calibration Image Service
2MASS QL 2MASS All-Sky Quicklook Image Service
2MASS SX AT 2MASS 6X Catalog Image Service
2MASS SXW AT 2MASS Full 6X Image Service
SIAP Query Parameters
RA:
degrees
Dec:
degrees
Radius:
degrees
Registry Query
Registry: http://voservices.net/registry/registry.asmx
Query: All records
GAVO Millennium Run Query
SampleQueries
Base URL: http://www.g-vo.org/Millennium
User:
Password:
SQL Query:
select DES.galaxyId as descendant_id,
DES.stellarMass as descendant_mass,
PROG.*
from millimil..DeLucia2006a DES,
millimil..DeLucia2006a PROG
where DES.snapnum = 63
and DES.mag_b < -20
and PROG.galaxyId between DES.galaxyId and
ES.lastprogenitorId
and PROG.snapnum = 30
Cancel
OK


TOPCAT
TOPCAT(4): Table Columns
Table Columns fo
Visible
Define Synthetic Column
Name: B-R
Expression: $BMAG-RMAG
Units:
Description:
UCD:
no UCD
Index: 18
OK
Cancel
OK
Cancel


Scatter Plot
All
bright_sample
RMAG / mag
BMAG / mag
20
18
16
14
12
10
8
8
10
12
14
16
18
20
22
ubsets
on
Expression
Col $ID
0%
1%
$11
6%
$12
4%
$6<16 && $8<14
Main
Data
Table:
1: 6dfgs_mini.xml.bz2
X Axis:
BMAG
Log
Y Axis:
RMAG
Log
Row Subsets
All
galaxy
star
bright_sample
Potential: 875 Included: 875 Visible: 849
Position:


TOPCAT
Table List
1: 2MASS-PSC(CDS)
4: USNO-B1
6: SDSS_EN1.vot
7: SDSS_EN2.vot
8: concat(6+7)
9: match(1,7)
Current Table Properties
Label: match(1,7)
Location: match(1,7)
Name: Joined
Rows: 449
Columns: 42
Sort Order:
Row Subset: All
Activation Action: (no action)
arcsec
Dec column: DEC
degrees
ection: Best Match Only All Matches
1 and 2
1 or 2
All from 1
All from 2
1 not 2
2 not 1
1 xor 2
Go
Stop
Match Successful
449 pairs found
New table created by match: 9: match(1,7) (449 rows)
OK

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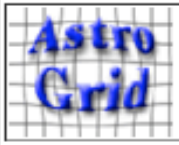
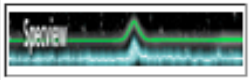
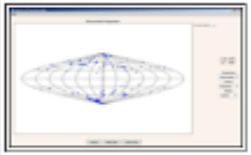
The Euro-VO proje

- Science
  - Software
  - Recipes User Manu
  - Scientific Workflow
  - Research Initiative
  - Science Cases
  - Scientific Papers
  - Science Advisory Committee
  - Acknowledging
  - Helpdesk
- Technical
  - Software
  - Registries
  - Tutorials
  - IVOA Standards ⇒
- Data Centres
  - Overview
  - Partners
  - Work Packages

	Tool/Description	Version	Download/Launch
	DATA DISCOVERY		
	**Aladin:** An interactive software sky atlas allowing the user to visualize digitized images of any part of the sky, to superimpose entries from astronomical catalogs	V5 (February 2008)	Standalone version
	**Workbench:** A desktop application for working with the Virtual Observatory. It can explore data resources, query remote catalogs, and construct workflows to automate tasks.	2007.1.1	Download Page
	**Datascope:** A Web Service for discovering and exploring data in the Virtual Observatory from archives and data centres around the world.	V2.1 (March 2007)	Web Service
	SPECTRAL ANALYSIS		
	**VOSpec:** A multiwavelength spectra analysis tool, with access to both Spectral services (SSAP) and Theoretical Spectral services (TSAP).	V3.0	Launch java applet
	**SPLAT:** A spectra analysis tool.	Version: 3.8-5	Download Page
	**Specview:** 1-D spectral visualization and analysis	2.14.1	Download Page or Run Applet
	**Euro3D:** Analyse datasets in Euro3D FITS format.		Launch Java Webstart or Java applet
	DATA VISUALISATION AND DATA HANDLING		
	**Topcat:** An interactive graphical viewer and editor for tabular data. It understands a number of different astronomically important formats (including FITS and VOTable) and more formats can be added.	3.2 (January 2008)	Download Page
	**VOPlot:** A tool to visualise astronomica data.	1.4.1 Beta	Download Page
	**VisIVO:** A visualisation and analysis software for astrophysical data.		

(IVOA). EuroVO-DCA operates by coordinating the sharing of expertise, organizing Workshops, and providing assistance, in

& OPERATIONS DIVISION

VirGO: the new Virtual Browser for the ESO Science Archive Facility

Developed by the VO Systems Department at ESO

ESO

European Organisation for Astronomical Research in the Southern Hemisphere

http://archive.eso.org/e

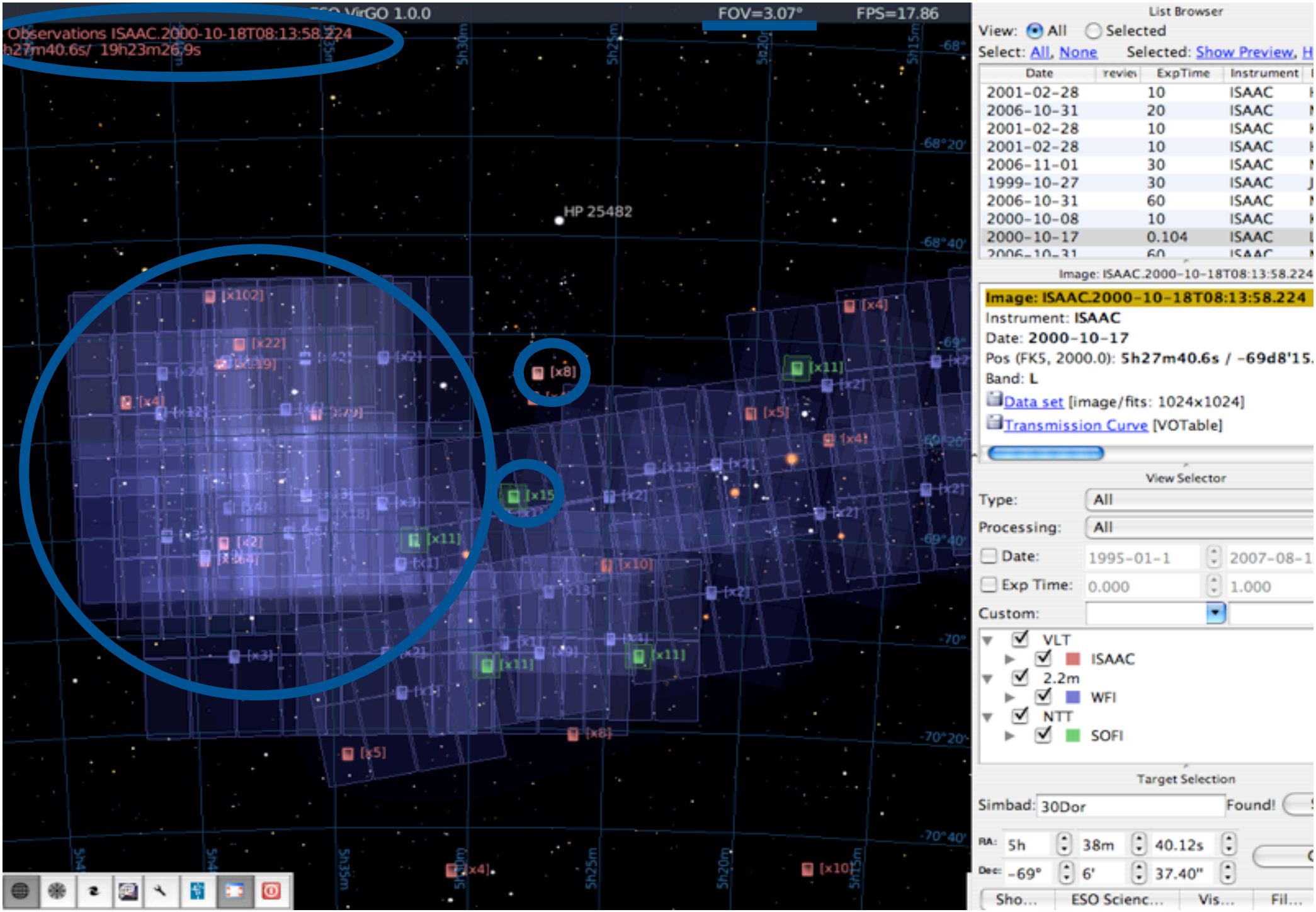
Archive query @ ESO
30 Doradus, r = 10':
~ 2600 science entries,
~ 120 pages of output

Summary table:

EFOSC	48
EFOSC/2.9	5
EFOSC/3.3	4
EFOSC/4.6	55
EMMI #1	99
EMMI/1.47	1
EMMI/2.11	2
EMMI/2.15	25
EMMI/2.3	6
EMMI/2.6	9
EMMI/3.2	1
EMMI/5.11	106
EMMI/5.7	8
FEROS	12
FORS1	146
FORS2	18
GIRAFFE	130
ISAAC	354
NAOS+CONICA	72
SINFONI	279
SOFI	787
SUSI #1	5
SUSI2	95
UVES	74
WFI	45
Total	2539

SCIENCE - EMMI/5.11 - R#773	0	h	0	min	10	s
SCIENCE - EMMI/5.11 - SII#655	0	h	57	min	30	s
SCIENCE - EMMI/5.7 - FREE	0	h	36	min	0	s
SCIENCE - FEROS -	4	h	36	min	31	s
SCIENCE - FORS1 -	2	h	0	min	40	s
SCIENCE - FORS1 - FILT_485_37	0	h	2	min	0	s
SCIENCE - FORS1 - FILT_503_5	0	h	4	min	0	s
SCIENCE - FORS1 - GG375	3	h	24	min	31	s
SCIENCE - FORS1 - H_ALPHA	0	h	1	min	40	s
SCIENCE - FORS1 - I_BESS	0	h	4	min	30	s
SCIENCE - FORS1 - R_BESS	0	h	34	min	27	s
SCIENCE - FORS2 - B_BESS	0	h	1	min	30	s
SCIENCE - FORS2 - GG435	1	h	6	min	40	s
SCIENCE - FORS2 - I_BESS	0	h	7	min	15	s
SCIENCE - FORS2 - R_SPECIAL	0	h	6	min	0	s
SCIENCE - FORS2 - V_BESS	0	h	0	min	45	s
SCIENCE - GIRAFFE - HR14,A,10	7	h	55	min	44	s
SCIENCE - GIRAFFE - HR15,B,10	2	h	53	min	59	s
SCIENCE - ISAAC -	2	h	12	min	30	s
SCIENCE - ISAAC - JS,OPEN	0	h	13	min	46	s
SCIENCE - ISAAC - KS,OPEN	0	h	17	min	46	s
SCIENCE - ISAAC - OPEN,NB_1.21	0	h	3	min	0	s
SCIENCE - ISAAC - OPEN,NB_1.28	0	h	3	min	0	s
SCIENCE - ISAAC - SH,OPEN	0	h	20	min	0	s
SCIENCE - ISAAC - SK,OPEN	0	h	38	min	20	s
SCIENCE - ISAAC - SL,OPEN	0	h	0	min	18	s

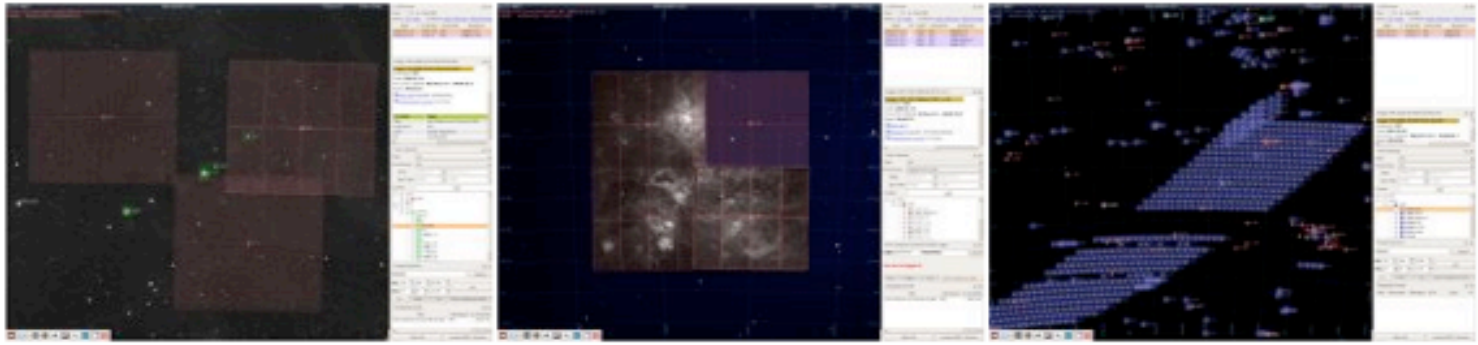
DATA MANAGEMENT & OPERATIONS DIVISION


Observations ISAAC.2000-10-18T08:13:58.224
h27m40.6s/ 19h23m26.9s
FOV=3.07°
FPS=17.86
HP 25482
List Browser
View: All Selected
Select: All, None
Selected: Show Preview, H
Date
ExpTime
Instrument
2001-02-28 10 ISAAC
2006-10-31 20 ISAAC
2001-02-28 10 ISAAC
2001-02-28 10 ISAAC
2006-11-01 30 ISAAC
1999-10-27 30 ISAAC
2006-10-31 60 ISAAC
2000-10-08 10 ISAAC
2000-10-17 0.104 ISAAC
Image: ISAAC.2000-10-18T08:13:58.224
Image: ISAAC.2000-10-18T08:13:58.224
Instrument: ISAAC
Date: 2000-10-17
Pos (FK5, 2000.0): 5h27m40.6s / -69d8'15.
Band: L
Data set [image/fits: 1024x1024]
Transmission Curve [VOTable]
View Selector
Type: All
Processing: All
Date: 1995-01-1 2007-08-1
Exp Time: 0.000 1.000
Custom:
VLT
ISAAC
2.2m
WFI
NTT
SOFI
Target Selection
Simbad: 30Dor Found!
RA: 5h 38m 40.12s
Dec: -69° 6' 37.40"
Sho... ESO Scienc... Vis... Fil...

Data Availability Status
Related External Services
ESO & HST Image Galleries
ESO Archive News

Screenshots

These screenshots illustrate some of the main features of VirGO such as footprints, DSS background, images previews or browsing through large number of data sets.



Download

VirGO-1.3.1 (February 20th 2008) is distributed as a binary compiled for linux-i386, MacOSX and windows. The package contains a binary version of Stellarium 0.9.1, the VirGO plug-in for ESO archive access and some extra star catalogs and landscapes.

It is possible to add some extra star catalogs to allow seeing more than the default 2.3 million stars (up to 210 millions) by downloading the files star5-8 and saving them in the VirGO-1.3.1-xxxx/stars/default/ directory, then restarting the program.

for Linux i386 32bits	VirGO-1.3.1-linux32.tgz	(66mb)	*md5sum = 99e72292b283e1a94b50cb116a63009d*
for MacOSX powerpc	VirGO-1.3.1-macosx-powerpc.tgz	(102mb)	*md5sum = 57baccfb987424374b66c5f2852a6a8c*
for MacOSX Intel	VirGO-1.3.1-macosx-intel.tgz	(106mb)	*md5sum = 489ff6f49a0edc760ee954bfafdd9d1a*