AstroGrid and the Virtual Observatory @ iScience

Nicholas Walton
AstroGrid and Euro-VO Technology Centre Project Scientist

Institute of Astronomy
The University of Cambridge

Talk Aims

- Introduce you to the Virtual Observatory and AstroGrid's part in this
- Give an introduction to the use of the AstroGrid user software
  - VODesktop
  - Python scripting
  - TopCat
- Provide some real examples
  - such that you have an idea of how AstroGrid can be of use to you
- Close with questions and feedback
  - and after the meeting via helpdesk@astrogrid.org

After the Workshop

- Use AstroGrid
  - http://www.astrogrid.org
  - sign in to the astrogrid-announce mailing list
  - if you get stuck using the VO: helpdesk@astrogrid.org
- If you are interested in 'publishing' data to the VO
  - http://deployer.astrogrid.org
- and (for teccies!) if you are interested in the 'code'
  - http://developer.astrogrid.org
- Find out more about science with the VO
  - Euro-VO conference @ ESAC, Madrid
  -

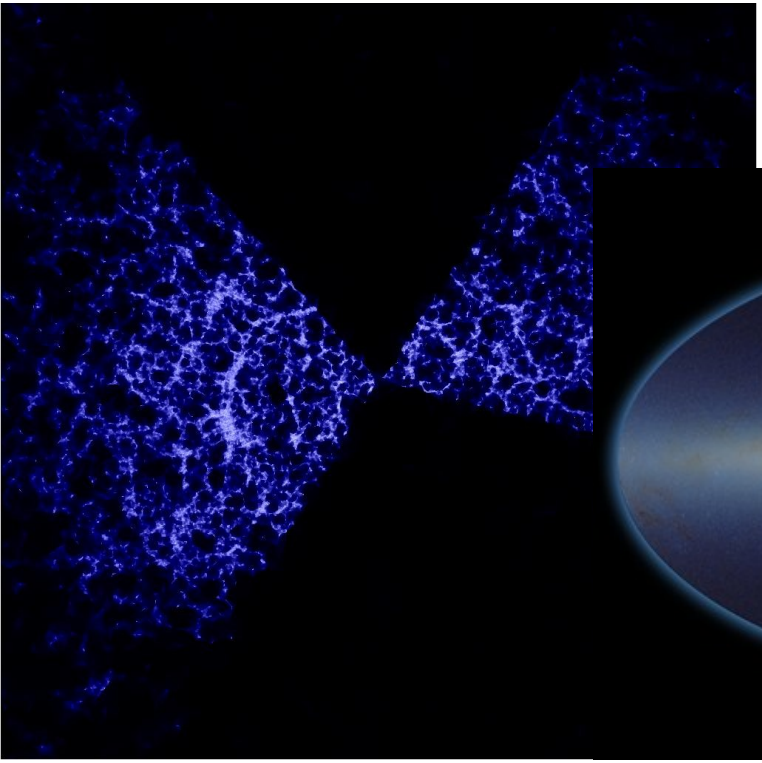
AstroGrid: a brief introduction

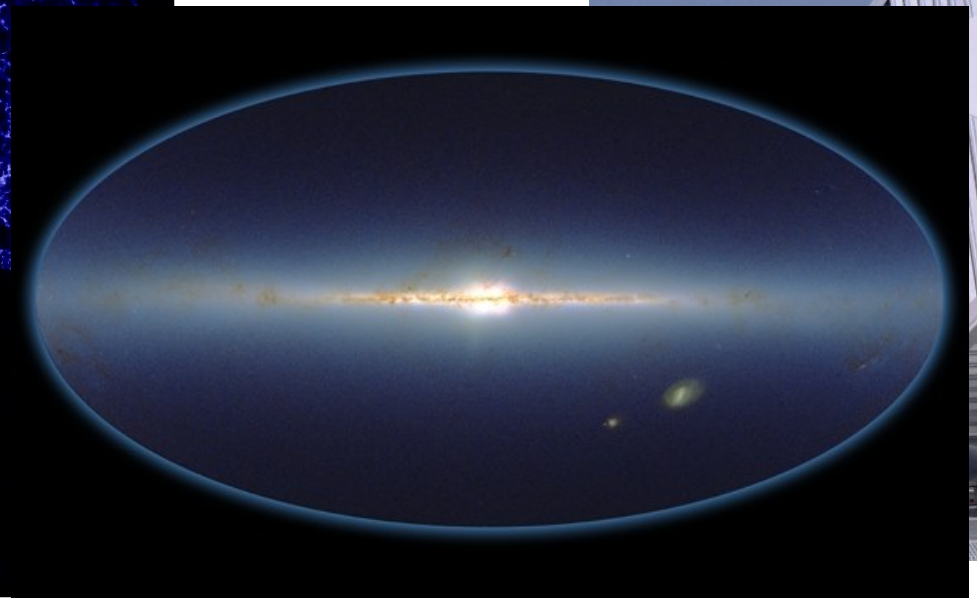
The Challenge of Data:
Access and Analysis

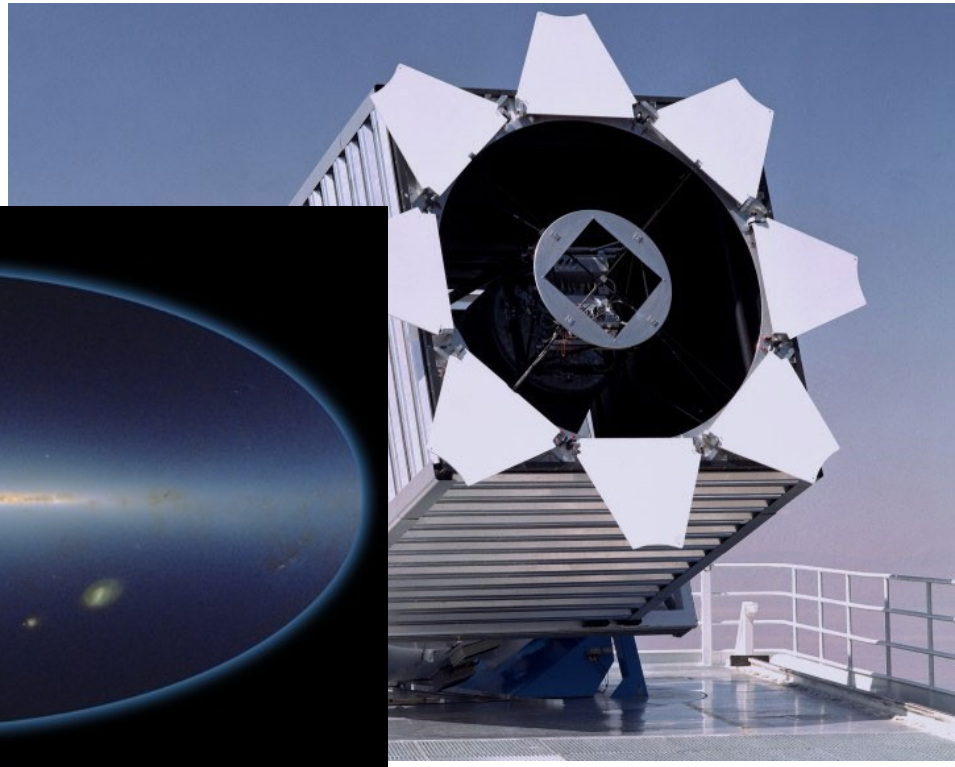
- Astronomy is an observational science
- Progress is made via understanding gained from the study of the cosmos
- Powerful observatories exist producing observational data across the wavelength domain
  - data comes in many formats/ complexity
- Data is held in Europe, USA, Asia ...
- Research collabrations are also global
- Connecting researchers with data and applications is the challenge for the Virtual Observatory

The Evolving Scientific Process

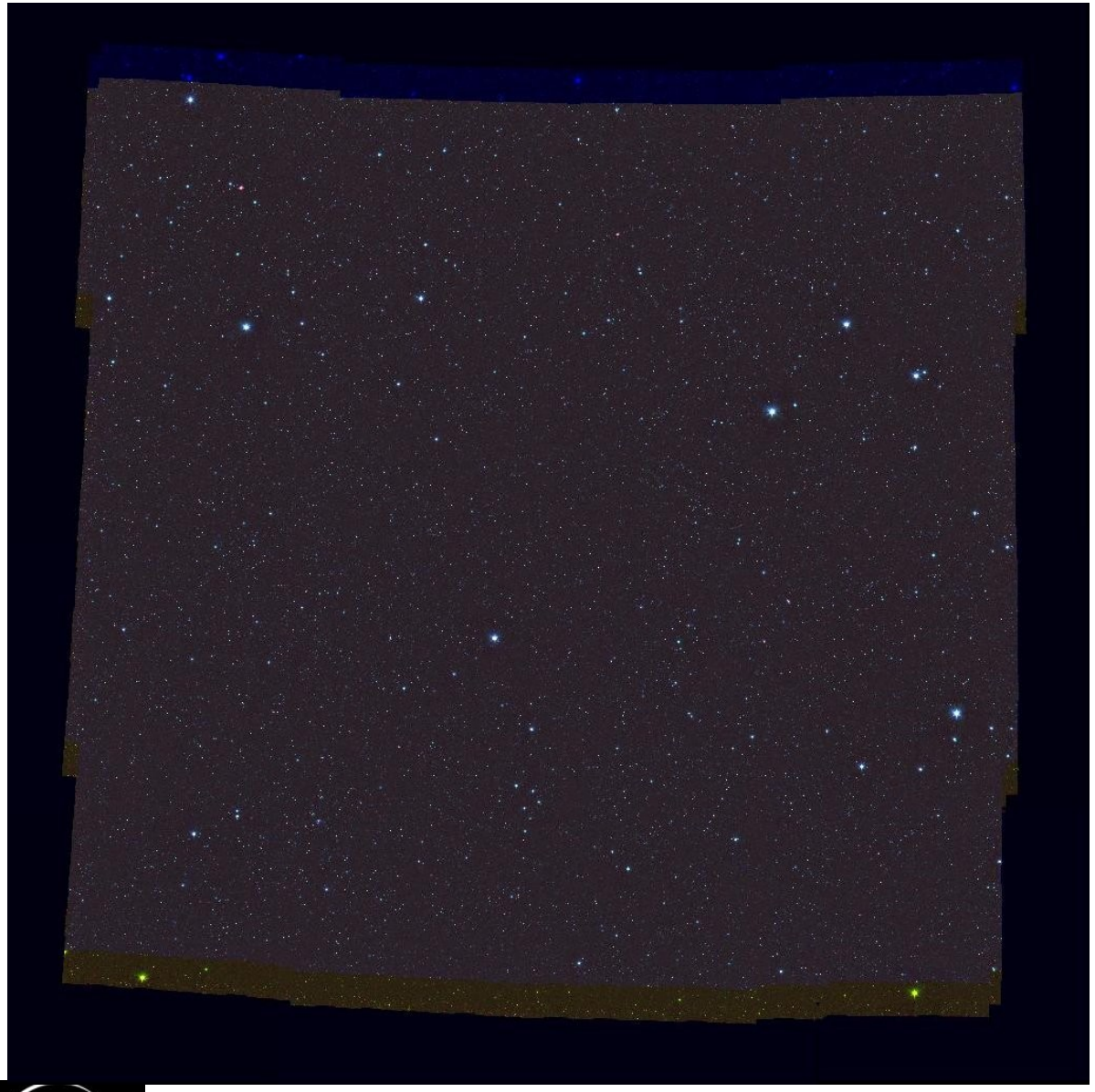
- Astronomy becomes a computational science
  - observe all the sky in many colours
  - generate large scale simulations
  - compare and contrast with observations







The need for a Virtual Observatory



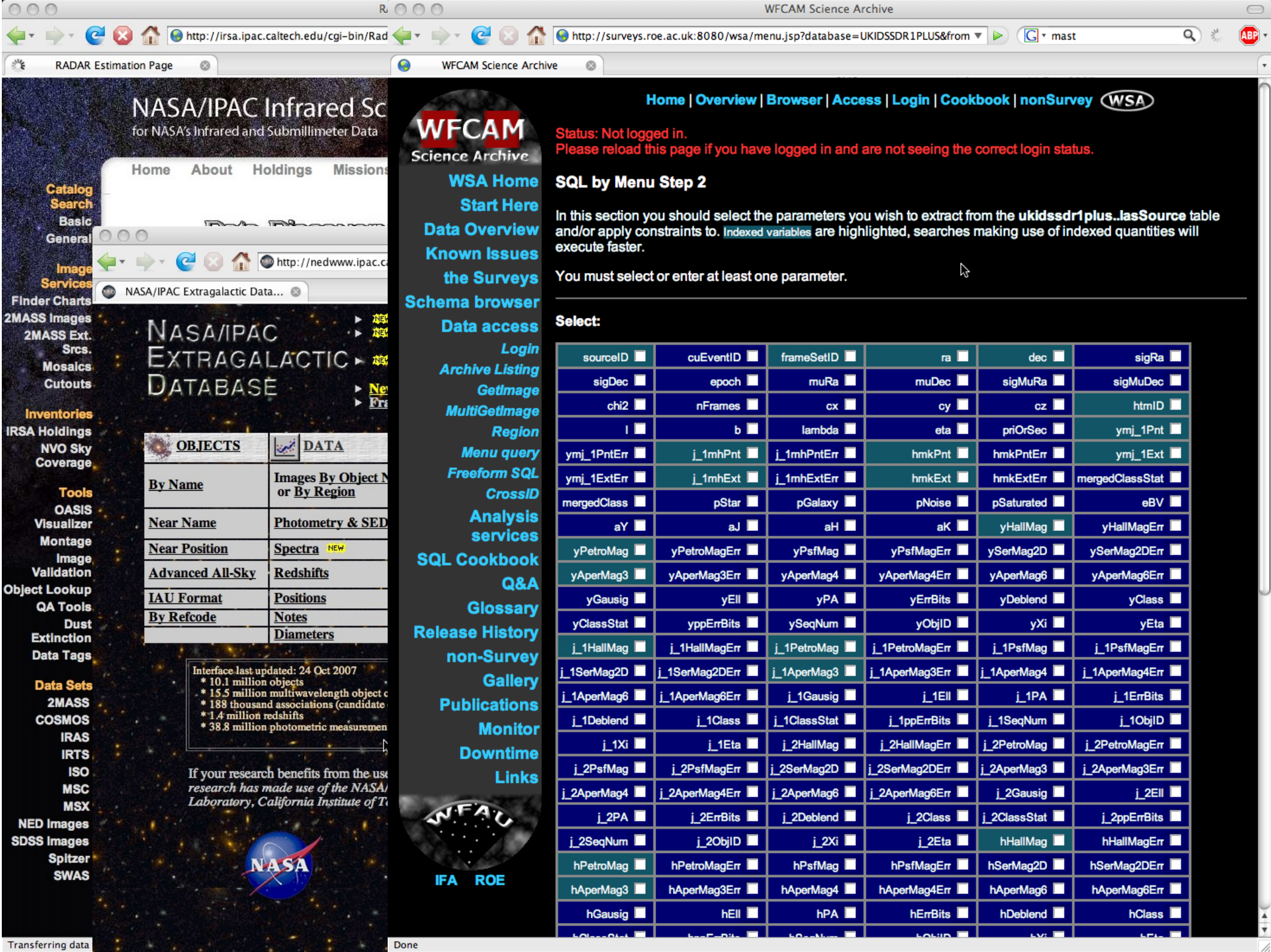
- Spitzer Wide Area Infrared Extragalactic Survey (SWIRE: PI Lonsdale) - ELAIS N1 field
- 9 sq. degrees (~3000 UDF)
- (moon ~0.2 sq. deg.)
- ~ 600,000 objects

All Sky ~40,000 sq. deg or > 3 Billion objects!

Spitzer RGB image from the IRAC bands (3.6, 4.5, 8 um)
(Credit: J Surace)

Astronomy Data

- Most astronomy data held in on-line archives
- Diversity
  - images, spectra, 3-D, tables
  - user interface varies from archive to archive
- Major astronomy archives include:
  - ESO: http://archive.eso.org
  - STScI (MAST: incl HST): http://archive.stsci.edu/
  - Chandra (X-Ray): http://cxc.harvard.edu/cda/
  - IPAC (IR): http://www.ipac.caltech.edu/
- User required to interact with many differing services: time consuming / learning curve


WFCAM Science Archive
http://surveys.roe.ac.uk:8080/wsa/menu.jsp?database=UKIDSSDR1PLUS&from
mast
RADAR Estimation Page
WFCAM Science Archive
NASA/IPAC Infrared Sc
for NASA's Infrared and Submillimeter Data
Home About Holdings Missions
Catalog Search
Basic
General
Image Services
Finder Charts
2MASS Images
2MASS Ext. Srcs.
Mosaics
Cutouts
Inventories
IRSA Holdings
NVO Sky Coverage
Tools
OASIS Visualizer
Montage
Image Validation
Object Lookup
QA Tools
Dust Extinction
Data Tags
Data Sets
2MASS
COSMOS
IRAS
IRTS
ISO
MSC
MSX
NED Images
SDSS Images
Spitzer
SWAS
http://nedwww.ipac.c
NASA/IPAC Extragalactic Data...
NASA/IPAC EXTRAGALACTIC DATABASE
OBJECTS
DATA
By Name
Images By Object N or By Region
Near Name
Photometry & SED
Near Position
Spectra NEW
Advanced All-Sky
Redshifts
IAU Format
Positions
By Refcode
Notes
Diameters
Interface last updated: 24 Oct 2007
* 10.1 million objects
* 15.5 million multiwavelength object c
* 188 thousand associations (candidate
* 1.4 million redshifts
* 38.8 million photometric measuremen
If your research benefits from the use
research has made use of the NASA/
Laboratory, California Institute of T
NASA
Transferring data
WFCAM Science Archive
WSA Home
Start Here
Data Overview
Known Issues
the Surveys
Schema browser
Data access
Login
Archive Listing
GetImage
MultiGetImage
Region
Menu query
Freeform SQL
CrossID
Analysis services
SQL Cookbook
Q&A
Glossary
Release History
non-Survey
Gallery
Publications
Monitor
Downtime
Links
WFAU
IFA ROE
Home | Overview | Browser | Access | Login | Cookbook | nonSurvey WSA
Status: Not logged in.
Please reload this page if you have logged in and are not seeing the correct login status.
SQL by Menu Step 2
In this section you should select the parameters you wish to extract from the ukidssdr1plus..lasSource table and/or apply constraints to. Indexed variables are highlighted, searches making use of indexed quantities will execute faster.
You must select or enter at least one parameter.
Select:
sourceID cuEventID frameSetID ra dec sigRa
sigDec epoch muRa muDec sigMuRa sigMuDec
chi2 nFrames cx cy cz htmID
l b lambda eta priOrSec ymj_1Pnt
ymj_1PntErr j_1mhPnt j_1mhPntErr hmkPnt hmkPntErr ymj_1Ext
ymj_1ExtErr j_1mhExt j_1mhExtErr hmkExt hmkExtErr mergedClassStat
mergedClass pStar pGalaxy pNoise pSaturated eBV
aY aJ aH aK yHallMag yHallMagErr
yPetroMag yPetroMagErr yPsfMag yPsfMagErr ySerMag2D ySerMag2DErr
yAperMag3 yAperMag3Err yAperMag4 yAperMag4Err yAperMag6 yAperMag6Err
yGausig yEll yPA yErrBits yDeblend yClass
yClassStat yppErrBits ySeqNum yObjID yXi yEta
j_1HallMag j_1HallMagErr j_1PetroMag j_1PetroMagErr j_1PsfMag j_1PsfMagErr
j_1SerMag2D j_1SerMag2DErr j_1AperMag3 j_1AperMag3Err j_1AperMag4 j_1AperMag4Err
j_1AperMag6 j_1AperMag6Err j_1Gausig j_1Ell j_1PA j_1ErrBits
j_1Deblend j_1Class j_1ClassStat j_1ppErrBits j_1SeqNum j_1ObjID
j_1Xi j_1Eta j_2HallMag j_2HallMagErr j_2PetroMag j_2PetroMagErr
j_2PsfMag j_2PsfMagErr j_2SerMag2D j_2SerMag2DErr j_2AperMag3 j_2AperMag3Err
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j_2PA j_2ErrBits j_2Deblend j_2Class j_2ClassStat j_2ppErrBits
j_2SeqNum j_2ObjID j_2Xi j_2Eta hHallMag hHallMagErr
hPetroMag hPetroMagErr hPsfMag hPsfMagErr hSerMag2D hSerMag2DErr
hAperMag3 hAperMag3Err hAperMag4 hAperMag4Err hAperMag6 hAperMag6Err
hGausig hEll hPA hErrBits hDeblend hClass
Done

... towards single point access ...

- Create a system that recognises:
  - data comes from many sources: thus data interoperability
  - applications are needed to work on data
- ... so Requires
  - a system built upon agreed interoperability standards
- ... and this Exploits
  - wider IT developments: Grid and WebServices
    - power of XML/ SOAP/ REST etc
  - access to high speed networks
    - but note: backbones > 10 Gb/s, desktops ~1Gb/s
  - reduced costs of h/w: all data now on spinning disks

IVOA: Stds Enabling Interoperability

- The International Virtual Observatory Alliance http://www.ivoa.net
- A global partnership
  - Projects represent global astronomy data providers
  - IVOA a forum for interoperability standards
  - VO projects build on these standards
  - Global reach

IVOA Standard Areas
http://www.ivoa.net

- Standard vocabulary (semantics)
- Standard data model (encoding format)
- Standard query language (DB queries)
- Standard access services for retrieving catalog records or image cutouts.
- Standard mechanisms for interacting with storage systems (VOSpace)
- Standard authentication/ authorisation mechanisms

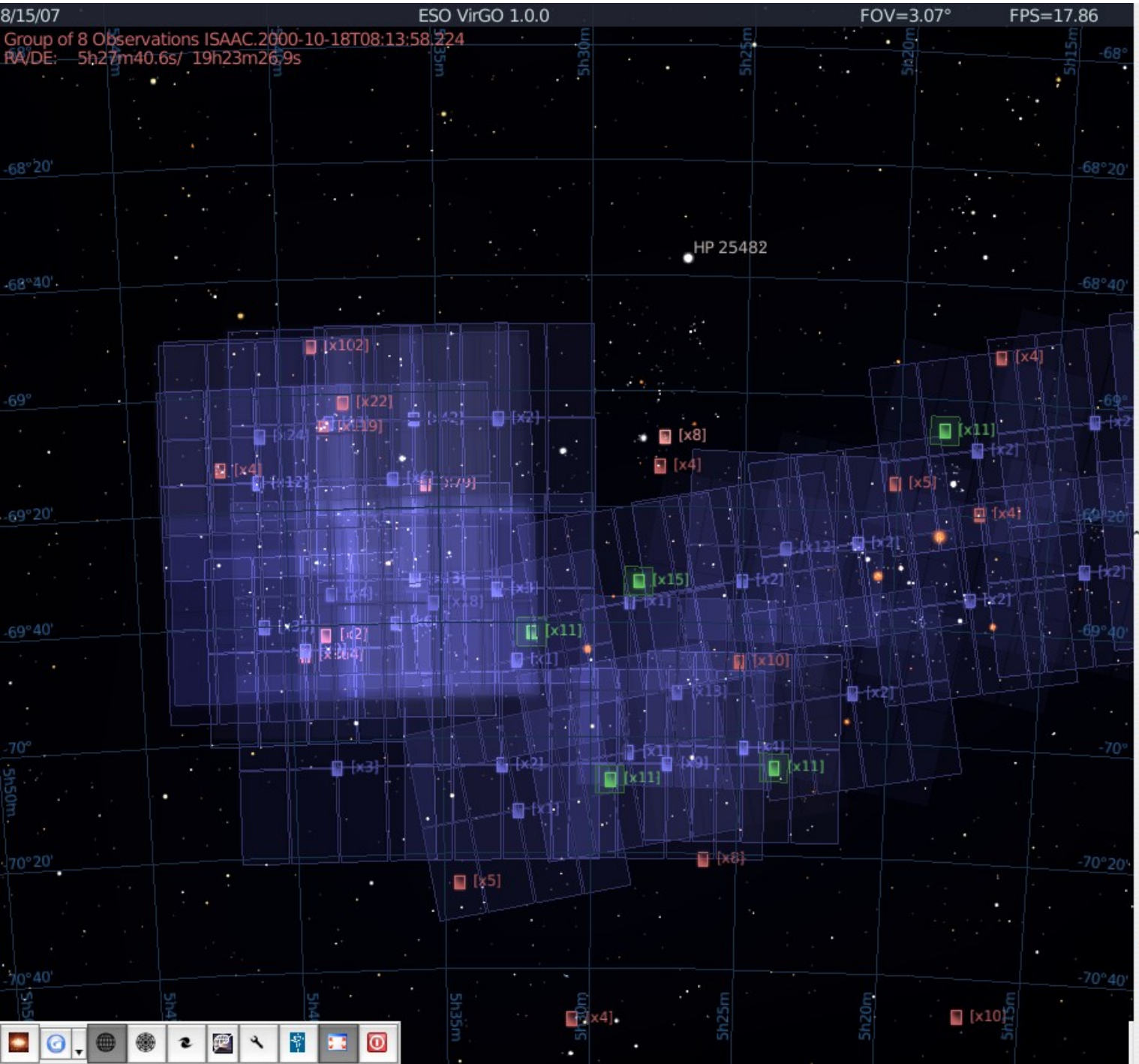
Virtual Observatories are built on these standards ...

The Wider VO Picture: another talk!

- AstroGrid is the UK VO project
- AstroGrid is one of the major partners in the Euro-VO and leads the Euro-VO Technology Centre
  - http://www.euro-vo.org
- In the USA, the National Virtual Observatory (NVO), provides a VO system
  - http://www.us-vo.org

As for Observatories, there is not a 'single' Virtual Observatory, rather a small number of regional VO systems, with implementations being built conforming to VO standards – some are better than others!

Integration with ESO Virgo browser



List Browser

View: All Selected

Select: All, None Selected: Show Preview, Hide Preview

Date	revie	ExpTime	Instrument	Bandpass
2001-02-28		10	ISAAC	H
2006-10-31		20	ISAAC	NB#1....
2001-02-28		10	ISAAC	Ks
2001-02-28		10	ISAAC	H
2006-11-01		30	ISAAC	NB#2....
1999-10-27		30	ISAAC	J
2006-10-31		60	ISAAC	NB#2....
2000-10-08		10	ISAAC	Ks
2000-10-17		0.104	ISAAC	L
2006-10-31		60	ISAAC	NB#2

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 / -69d8'15.9"**
Band: **L**
Data set [image/fits: 1024x1024]
Transmission Curve [VOTable]

View Selector

Type: All

Processing: All

Date: 1995-01-1 2007-08-15

Exp Time: 0.000 1.000

Custom:

- VLT
  - ISAAC
- 2.2m
  - WFI
- NTT
  - SOFI

Target Selection

Simbad: 30Dor Found! Search

RA: 5h 38m 40.12s

Dec: -69° 6' 37.40"

Go!

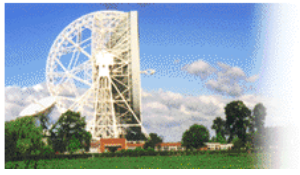
Sho... ESO Scienc... Vis... Fil... Tar...

The VO is already in use, some refs ...

- *Using VO tools to investigate distant radio starburst hosting obscured AGN in the HDF(N) region,* Richards et al., A&A, 472, 805 (2007)
- *Albus 1: a very bright White Dwarf candidate*, Caballero & Solano, ApJ, 665, L151 (2007)
- *Flare productivity of newly-emerged paired and isolated solar active regions,* Dalla, Fletcher, & Walton A&A, 468, 1103 (2007)
- *Radio-loud Narrow-Line Type 1 Quasars,* Komossa et al., AJ, 132, 531 (2006)
- *Luminous AGB stars in nearby galaxies. A study using VO tools,* Tsalmantza et al., A&A, 447, 89 (2006)

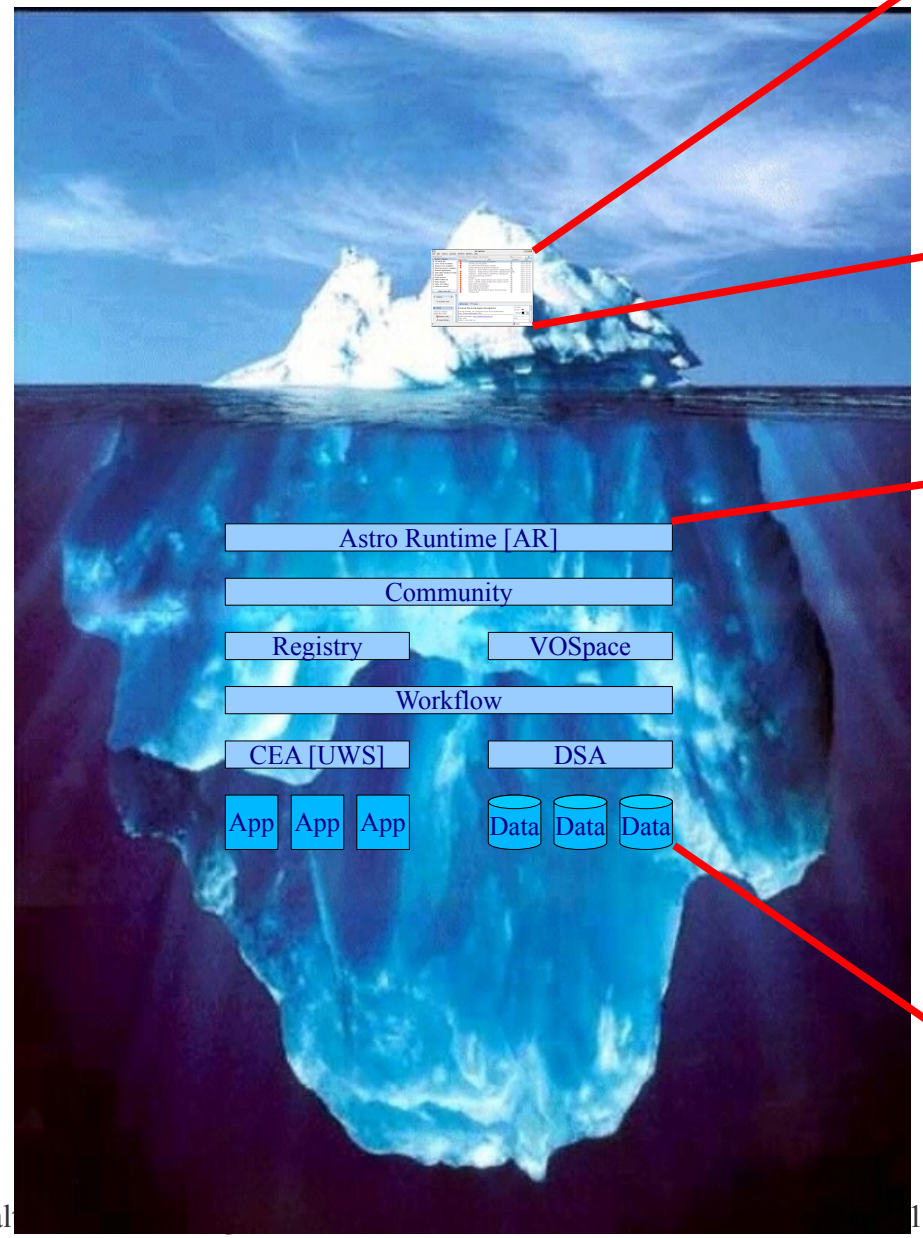
AstroGrid: UK's Virtual Observatory

- Improve the quality, ease, speed and cost effectiveness of on-line astronomy
- Make comparison and integration of data seamless
- Distributed development project
  - PS in Cambridge, PM in Leicester

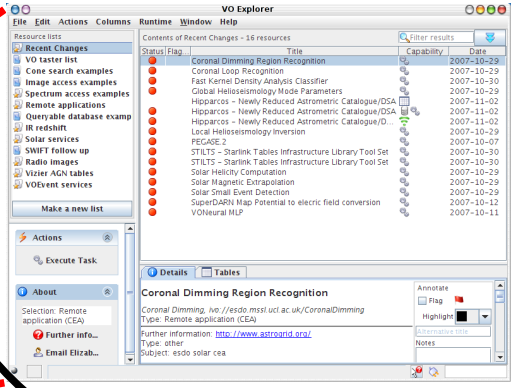


Jodrell Bank Observatory

...Tip of the Iceberg



Today's talk



Astro Runtime [AR]

Community

Registry

VOSpace

Workflow

CEA [UWS]

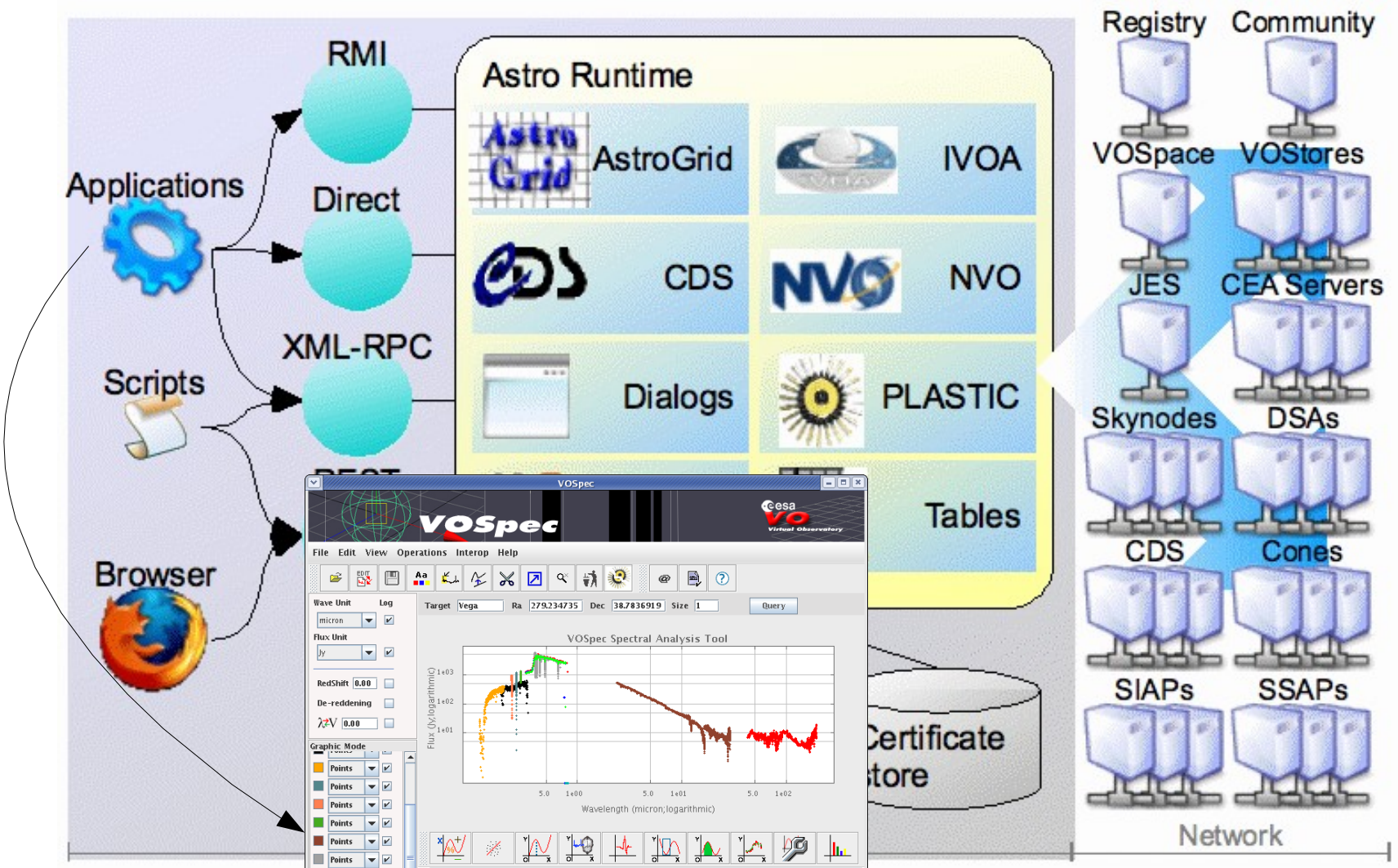
DSA

App App App

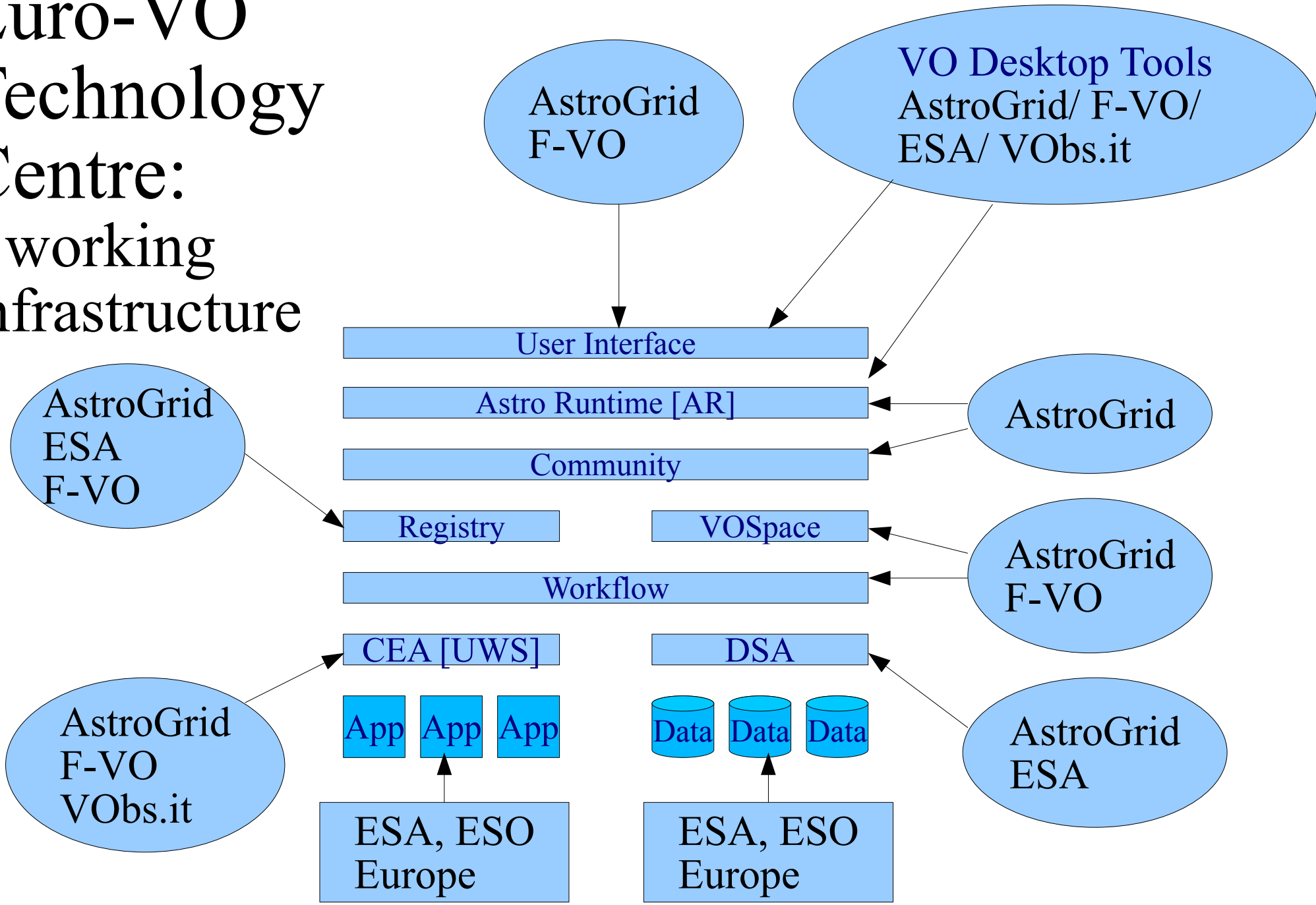
Data Data Data

Astro-Run Time: VO accessibility

this middleware means that each new mission doesn't have to re-invent the wheel



Euro-VO Technology Centre:
a working infrastructure



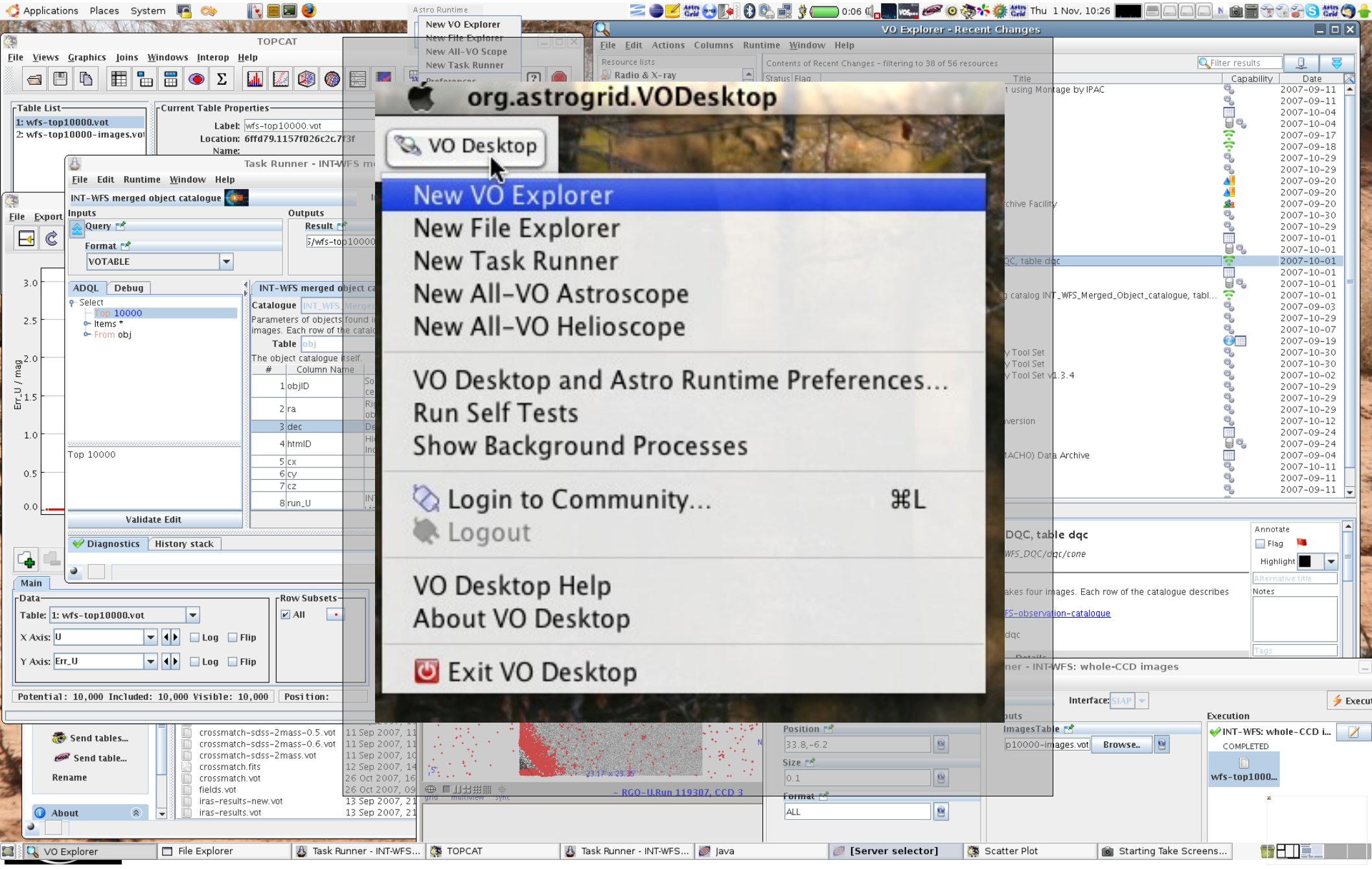
AstroGrid

VODesktop Suite

2008.2 Release

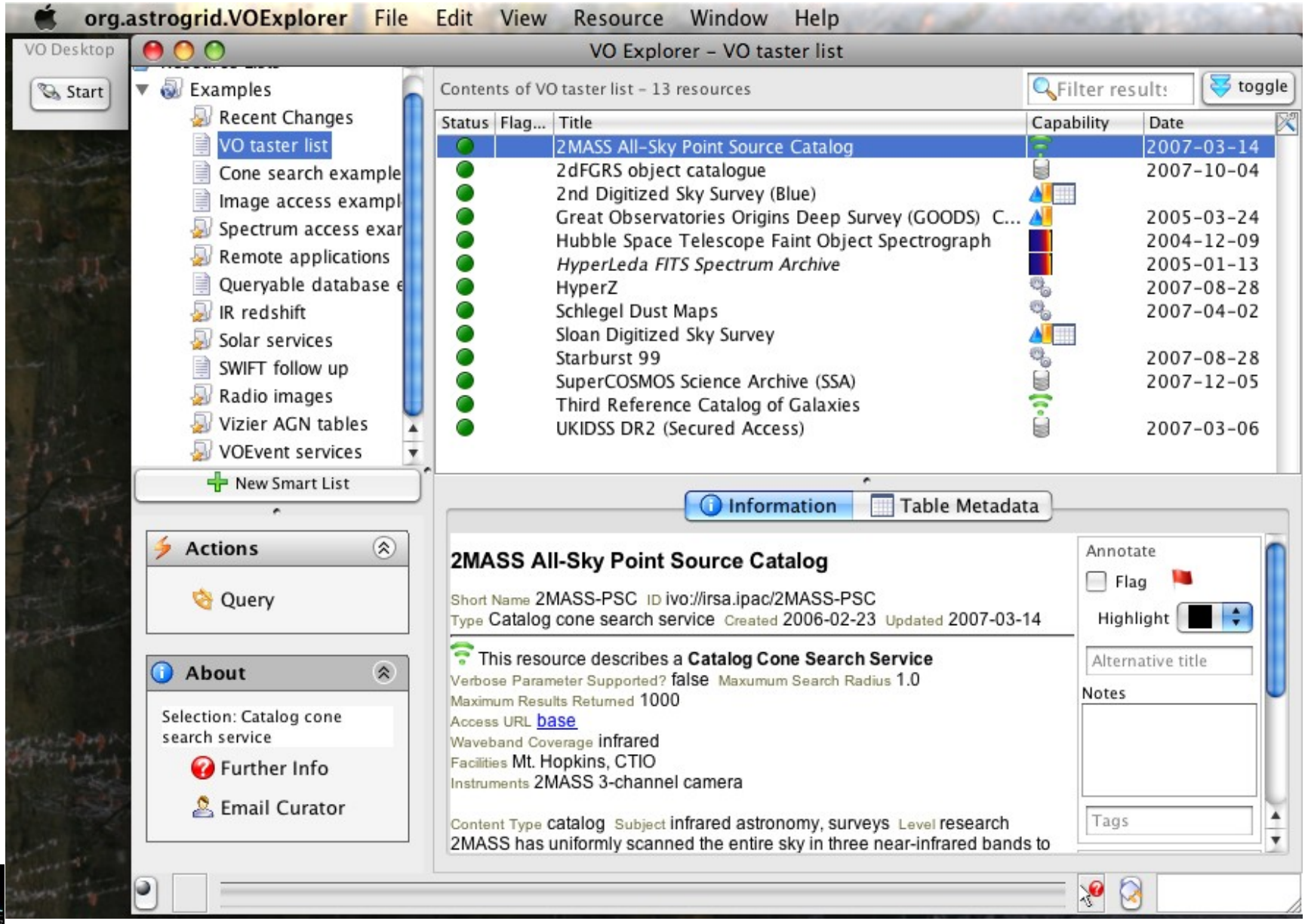
http://www.astrogrid.org

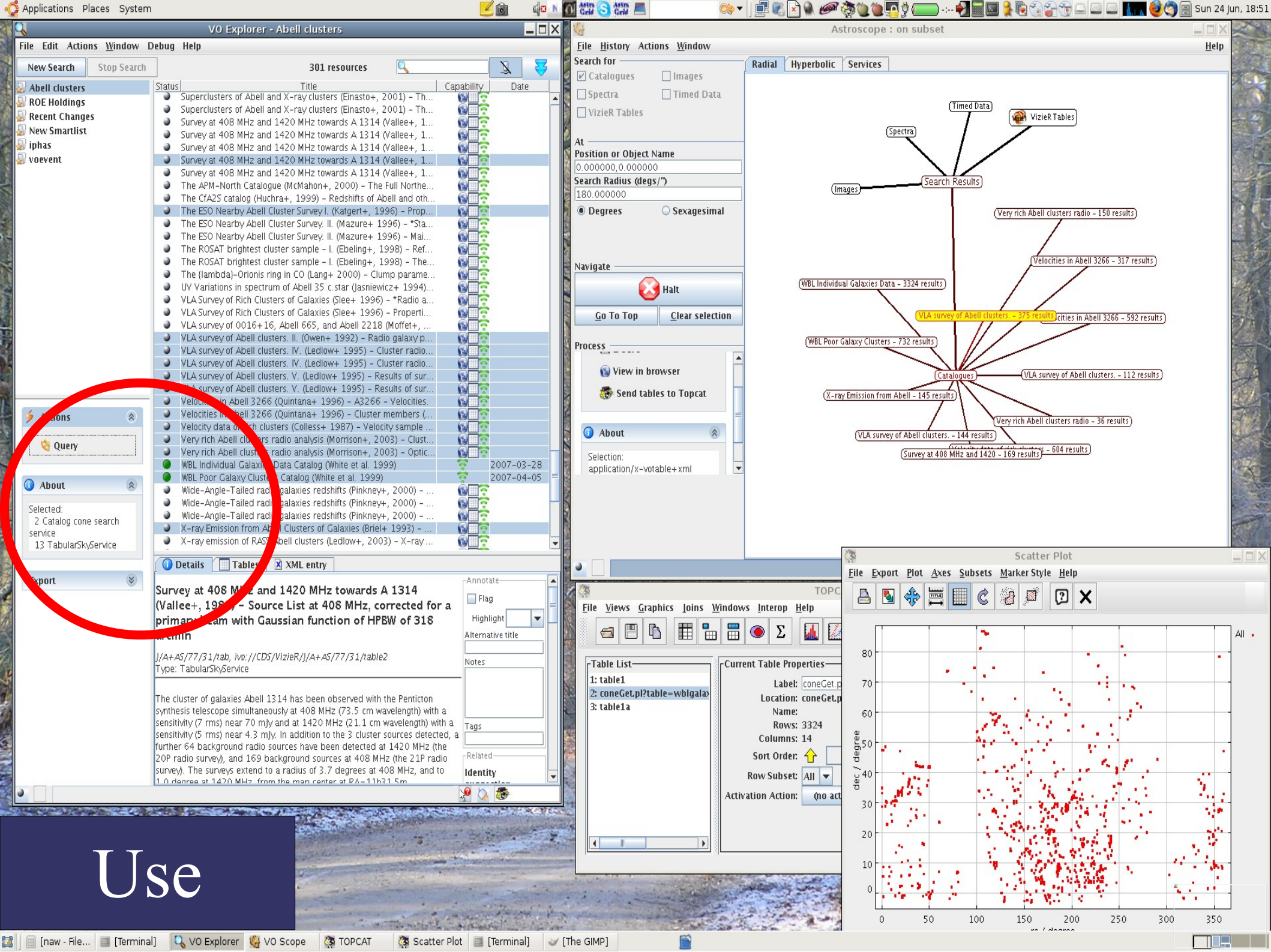
VODesktop: new from Apr 2008



VOExplorer

Part of VODesktop: Search, Filter, View, Use Data




Applications Places System
Sun 24 Jun, 18:51
VO Explorer - Abell clusters
File Edit Actions Window Debug Help
New Search
Stop Search
301 resources
Abell clusters
ROE Holdings
Recent Changes
New Smartlist
iphas
voevent
Status
Title
Capability
Date
Query
About
Selected:
2 Catalog cone search service
13 TabularSkyService
Details
Tables
XML entry
Survey at 408 MHz and 1420 MHz towards A 1314 (Vallee+, 198
Source List at 408 MHz, corrected for a primary beam with Gaussian function of HPBW of 318
arcmin
Type: TabularSkyService
The cluster of galaxies Abell 1314 has been observed with the Penticton synthesis telescope simultaneously at 408 MHz (73.5 cm wavelength) with a sensitivity (7 rms) near 70 mJy and at 1420 MHz (21.1 cm wavelength) with a sensitivity (5 rms) near 4.3 mJy. In addition to the 3 cluster sources detected, a further 64 background radio sources have been detected at 1420 MHz (the 20P radio survey), and 169 background sources at 408 MHz (the 21P radio survey). The surveys extend to a radius of 3.7 degrees at 408 MHz, and to
Annotate
Flag
Highlight
Alternative title
Notes
Tags
Related
Identity
Astroscope : on subset
File History Actions Window Help
Search for
Catalogues
Images
Spectra
Timed Data
VizieR Tables
At
Position or Object Name
0.000000,0.000000
Search Radius (degs/')
180.000000
Degrees
Sexagesimal
Navigate
Halt
Go To Top
Clear selection
Process
View in browser
Send tables to Topcat
About
Selection:
application/x-votable+xml
Radial
Hyperbolic
Services
Search Results
Very rich Abell clusters radio - 150 results
Velocities in Abell 3266 - 317 results
WBL Individual Galaxies Data - 3324 results
VLA survey of Abell clusters. - 375 results
WBL Poor Galaxy Clusters - 732 results
Catalogues
VLA survey of Abell clusters. - 112 results
X-ray Emission from Abell - 145 results
Very rich Abell clusters radio - 36 results
VLA survey of Abell clusters. - 144 results
Survey at 408 MHz and 1420 - 169 results
TOPCAT
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Current Table Properties
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Columns: 14
Sort Order:
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Activation Action:
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File Export Plot Axes Subsets Marker Style Help
All
dec / degree
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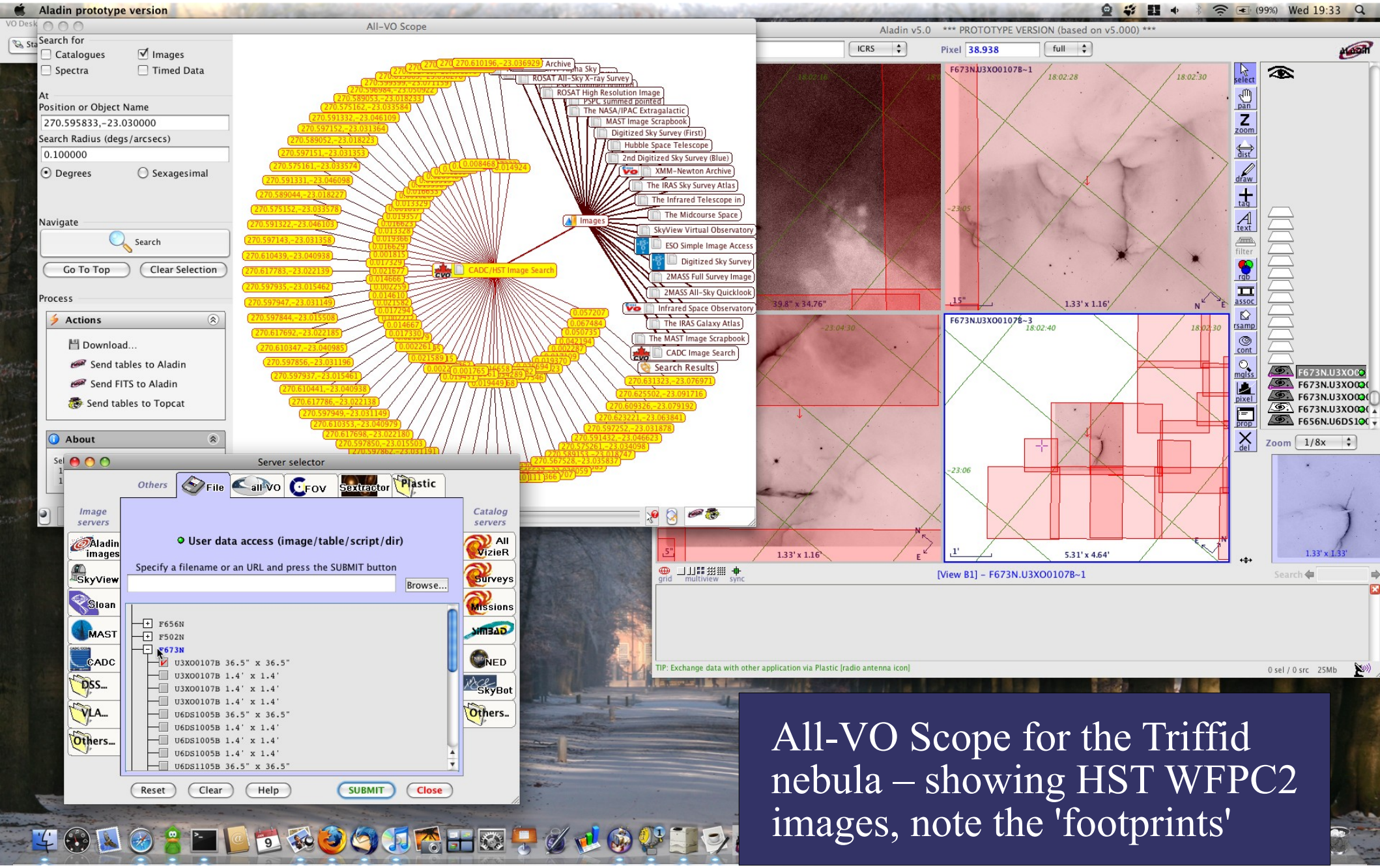
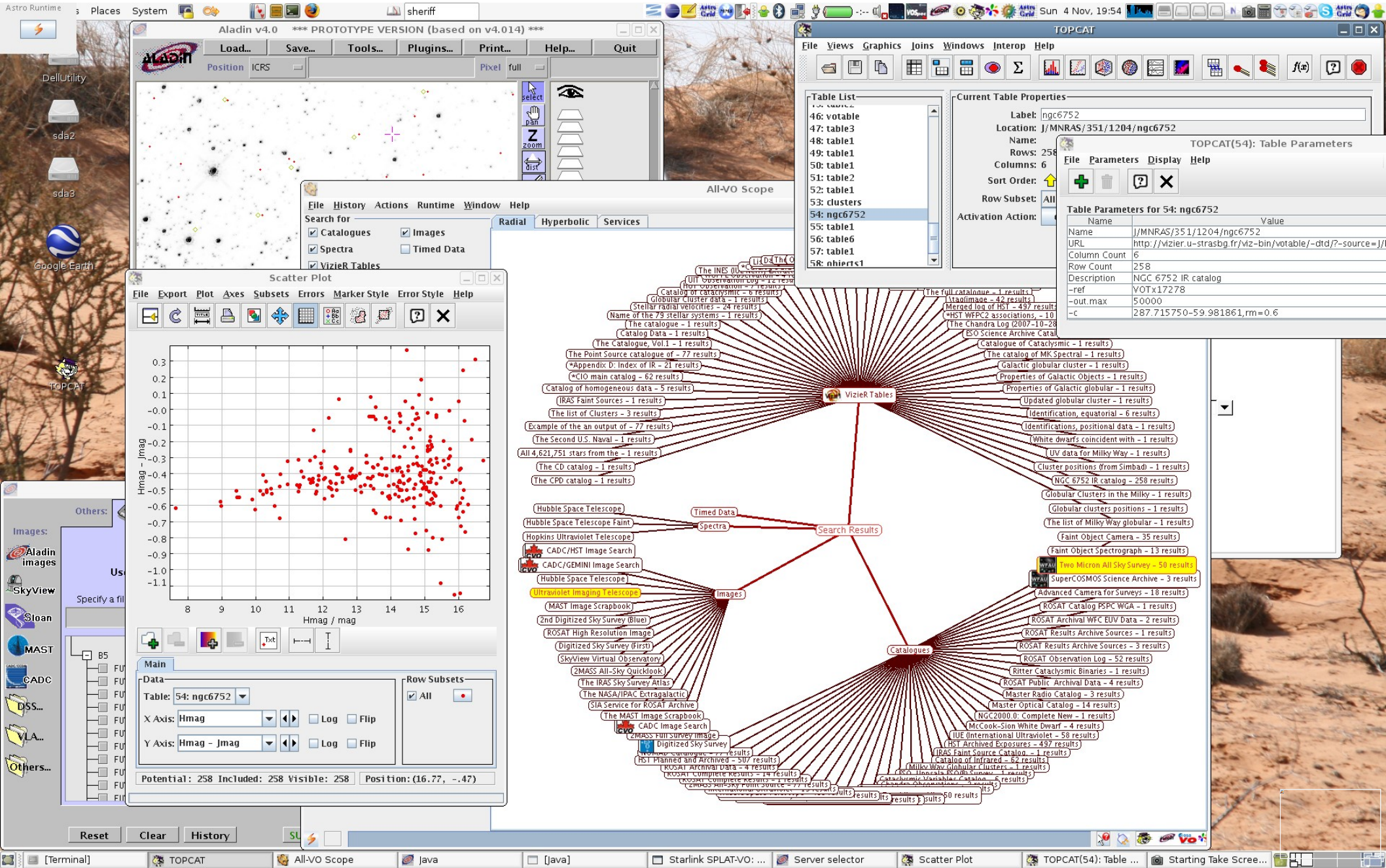
VO Explorer
VO Scope
TOPCAT
Scatter Plot
[Terminal]
[The GIMP]
Use

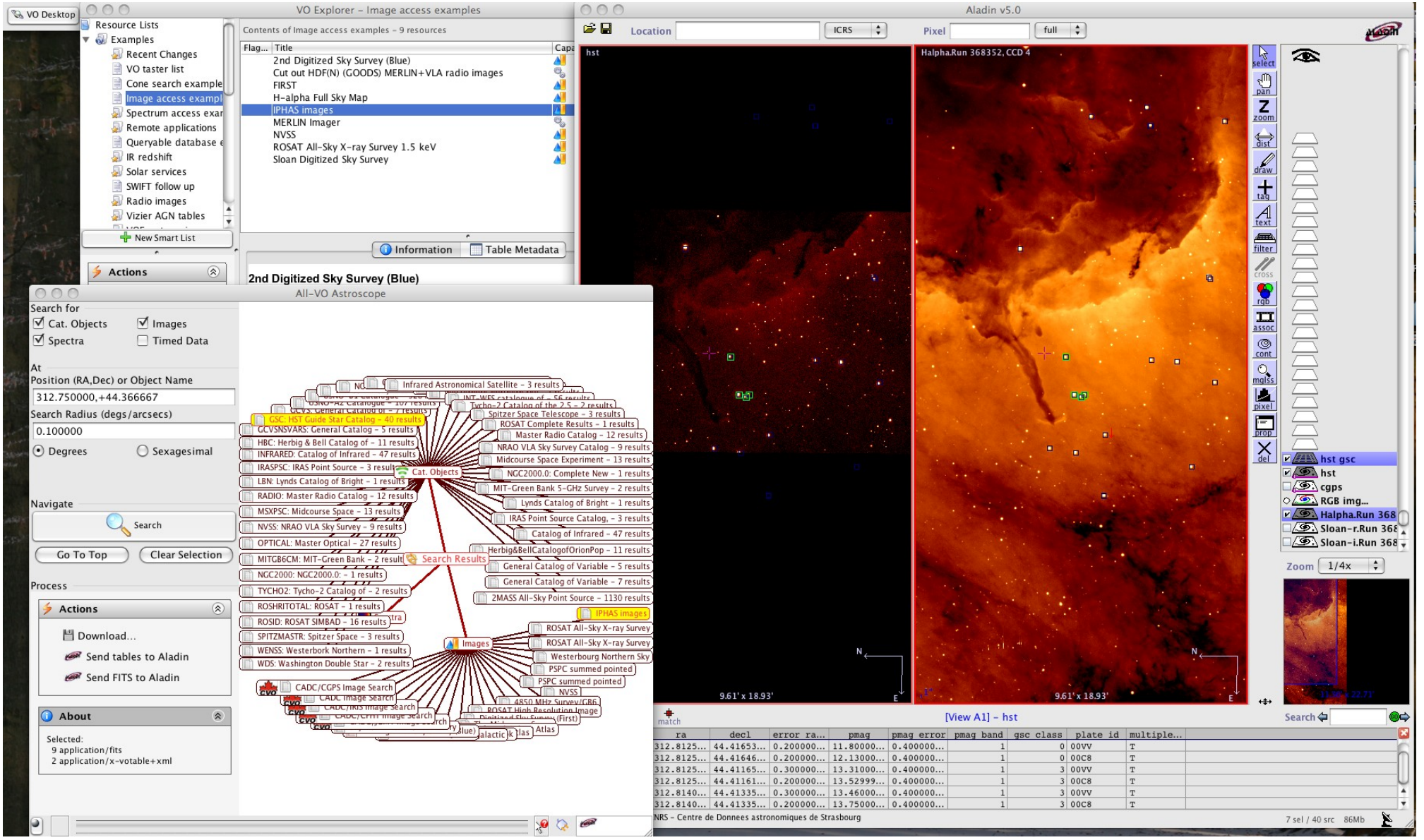


All-VO Scope for the Triffid nebula – showing HST WFPC2 images, note the 'footprints'

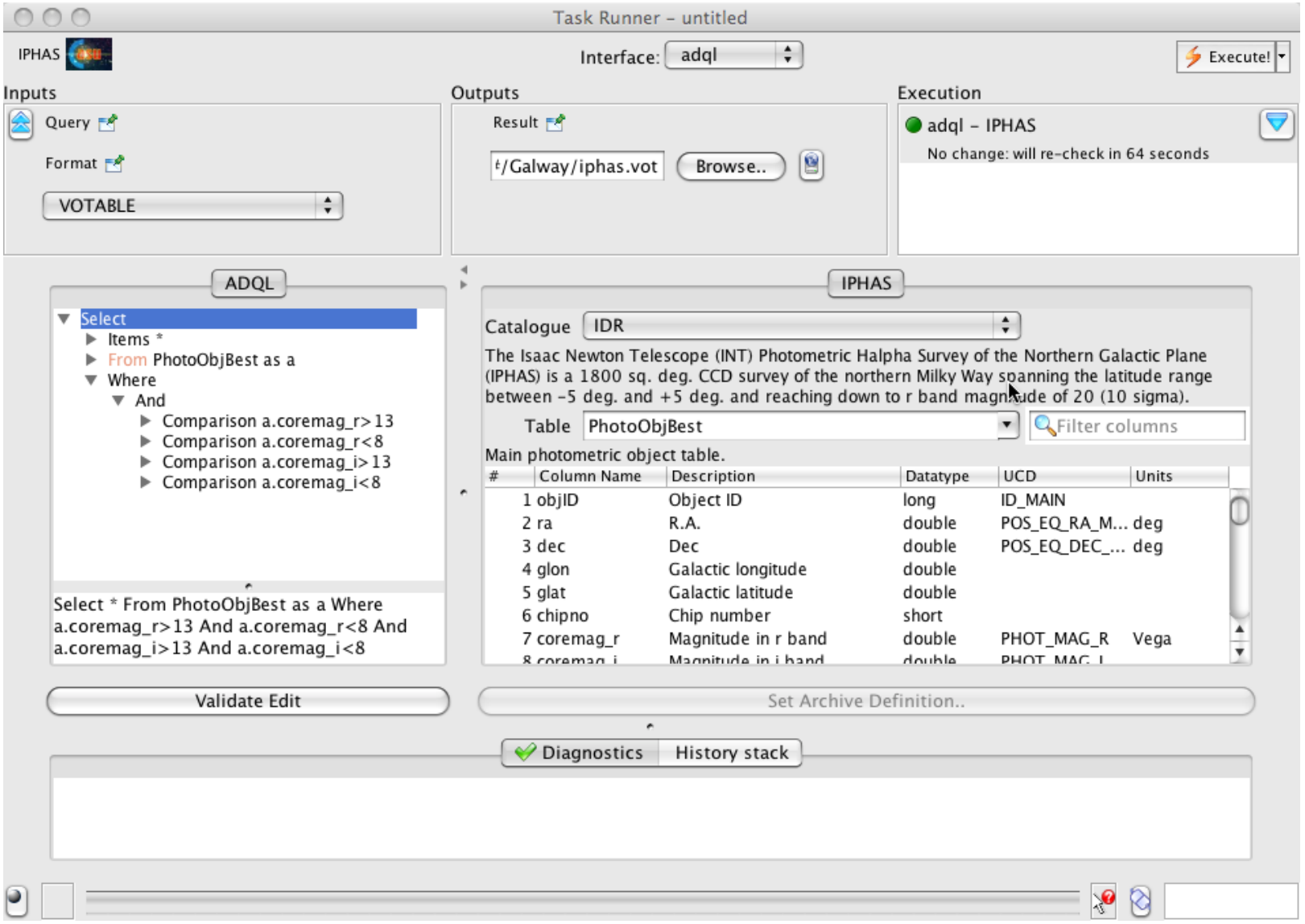
VODesktop: All VO-Scope



VOExplorer Image Access: IC5070

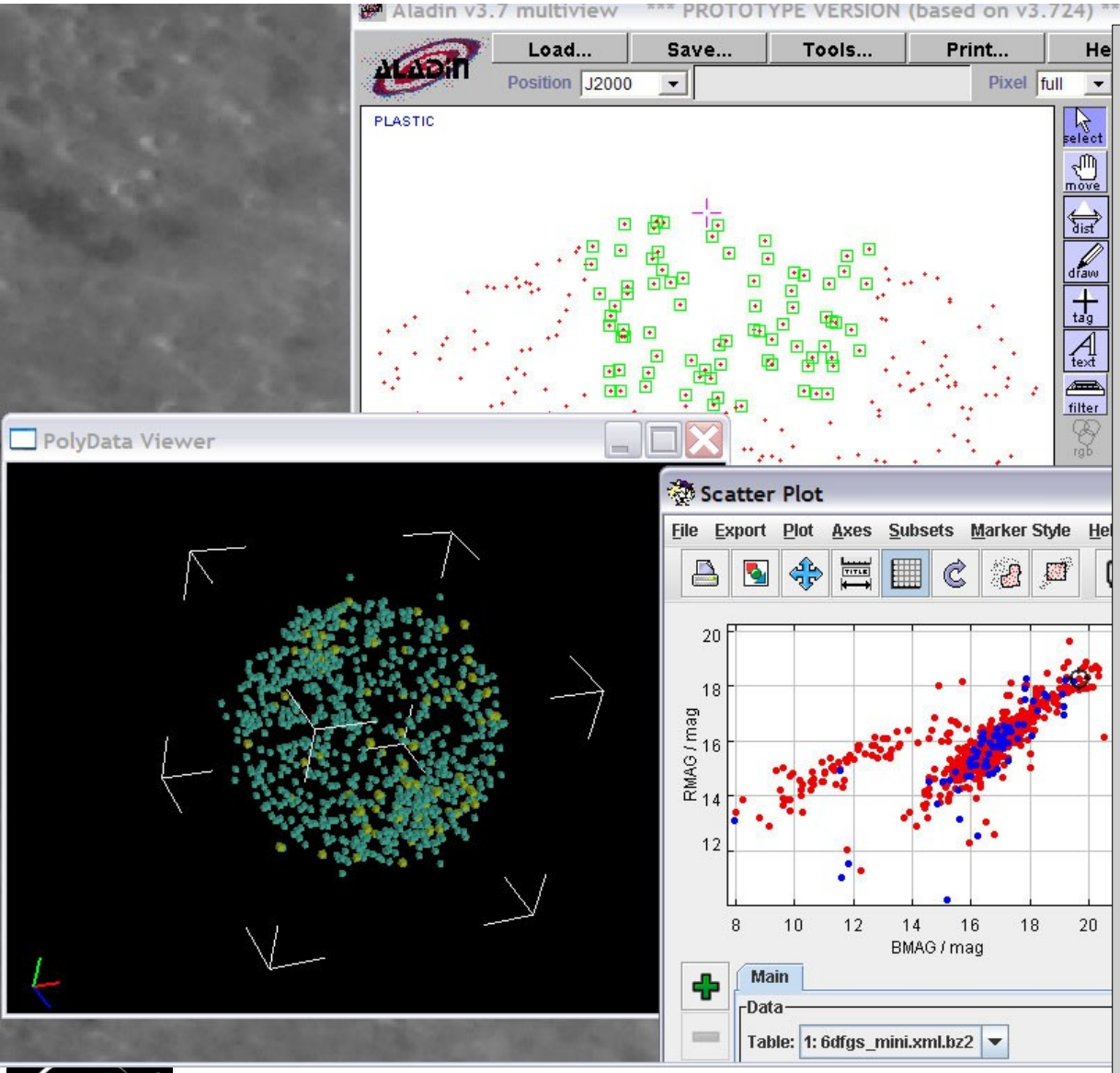


Catalogue Access: Example - IPHAS



Plastic – VO tools on the desktop

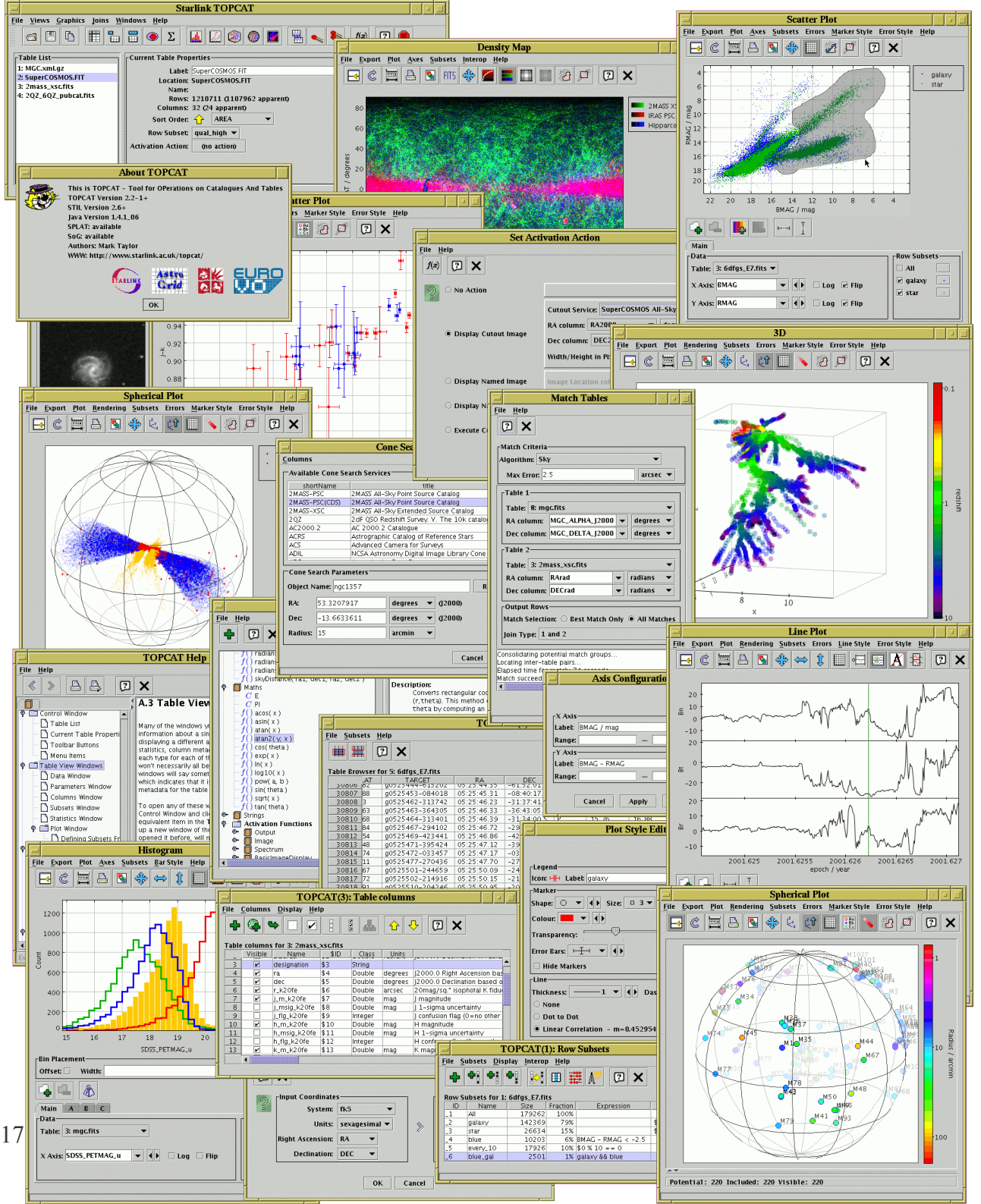
http://plastic.sourceforge.net



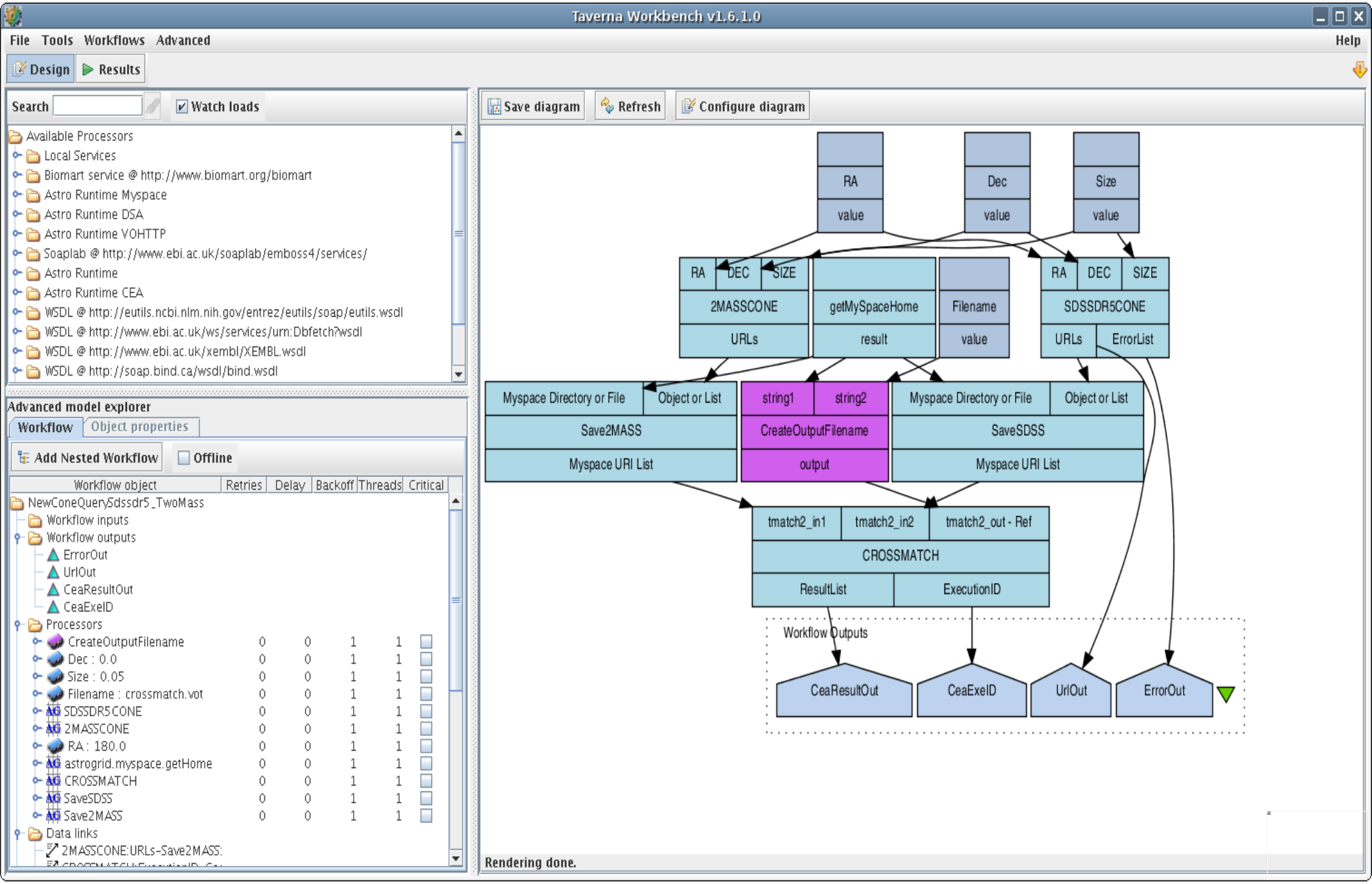
- Enables applications to 'talk' to each other
  - select sources in one application and these will show up in another application
- Communication protocol for client side VO tools
- Easy to adopt and extend
- Wide buy-in – tools from UK, France, USA, etc
- Developed mainly by AstroGrid

Desktop Tools: Topcat

- Developed by Mark Taylor
- AstroGrid funded
- Interoperates with VODesktop via PLASTC protocol



Workflows: AstroGrid-Taverna

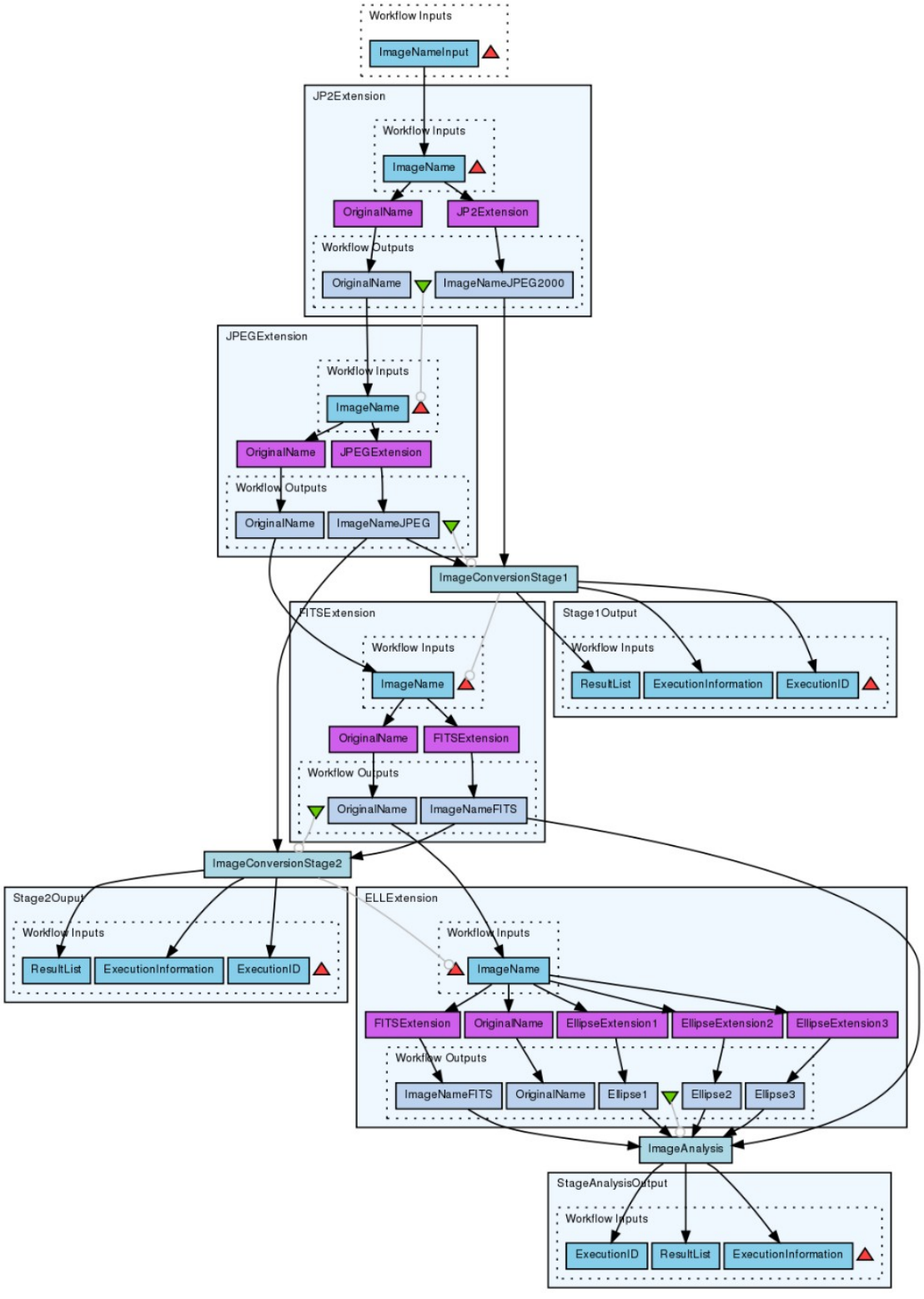


Running a workflow: via Astro-Taverna

This shows the applications configured in the 'AstroGrid' applications environment, the applications physically located on a server at the IoA, orchestrated in a workflow.

The results, in this case a catalogue, are stored in the VOSpace and thus available to the remote user.

Note: this workflow is actually running astronomy applications to process medical imaging data.



... and Scripts

- access all the AstroGrid VO functionality from the command line – connecting via AstroGrid's 'Astro-Runtime'
- use python, perl, C++, etc

siapsearch.py - /data/AstroGrid/ACR-Examples/Python-Scripts/siapsearch.py

File Edit Format Run Options Windows Help

```
#!/usr/bin/python
"""
Query a SIAP service and returns a list of images which are loaded into Aladin

Usage:
    python siapsearch.py sdss 180.0 0.0
    python siapsearch.py iphas 312.75 44.37
    python siapsearch.py 2mass 312.75 44.37
"""

import sys
from math import cos, radians
import time
from astrogrid import acr
from astrogrid import Applications, DSA, MySpace, SiapSearch

while not acr._connected:
        print 'Connecting to AR...'
        time.sleep(10)

ssiap = {'sdss': 'ivo://sdss.jhu/services/SIAPDR6-images',
         'iphas': 'ivo://uk.ac.cam.ast/IPHAS/images/SIAP',
         '2mass': 'ivo://irsa.ipac/2MASS-QL'}

s = sys.argv[1]
ra, dec = sys.argv[2:4]
siap = SiapSearch(ssiap[s])
res = siap.execute(ra, dec, 0.5 )

try:
        acr.plastic.broadcast(res)
except:
        print 'Failed to send table to Aladin.'
```

Ln: 34 Col: 0

Coming Up ... some usage examples

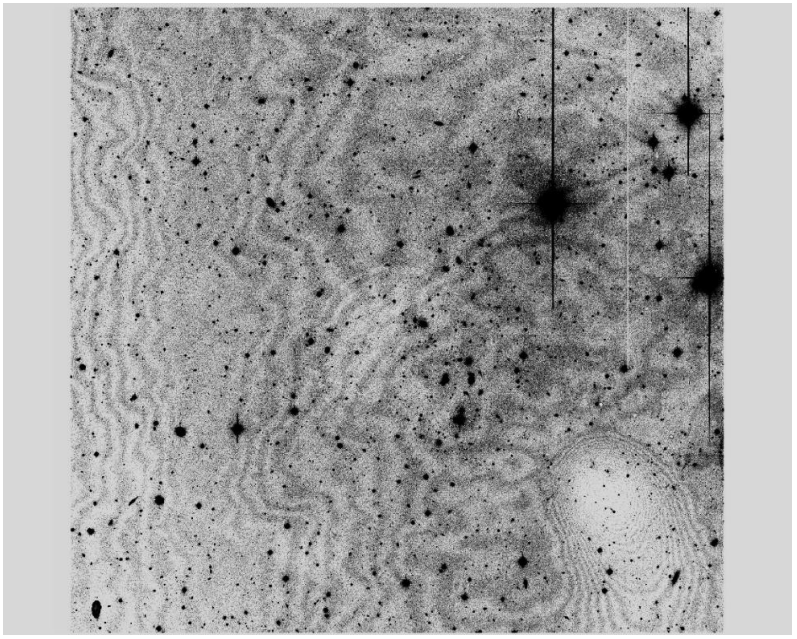
- Single Object: 3C295, X-ray binaries, Jets in YSOs
  - demonstrates use of visual tools, including AstroScope
  - radio, x-ray, optical data comparison
  - direct access to Vizier tables
- Statistical Studies: investigating Galactic structure
  - Field of Streams
  - large data access example

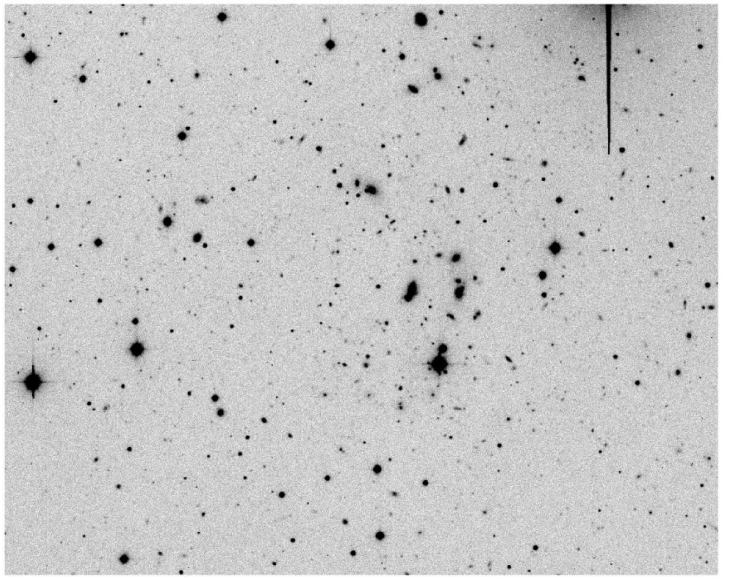
Example Large Scale Survey: the IPHAS Survey of the Galactic Plane

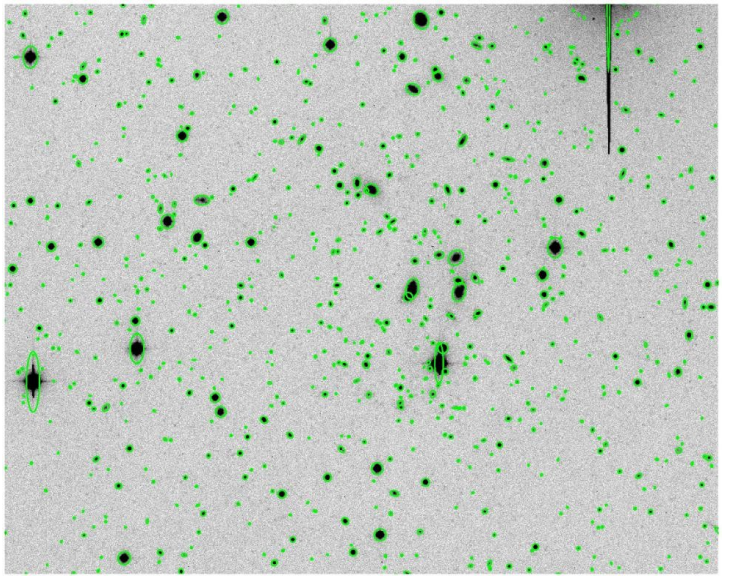
- IPHAS: H-alpha Survey of the Northern Galactic Plane (PI: Janet Drew: Herts, UK)
- Key Goals: Large scale Milky Way structure and study of early and late type populations (preferentially selected via H-alpha emission line properties)
- All data reduced at CASU (IoA, Cambridge)
- VO access work partly implemented through the May 2006 AG Tools Call programme - http://www.astrogrid.org/calls

Survey Products

- Photometric catalogue ~200 million objects
- Detection of ~50000 Hα-emitting objects

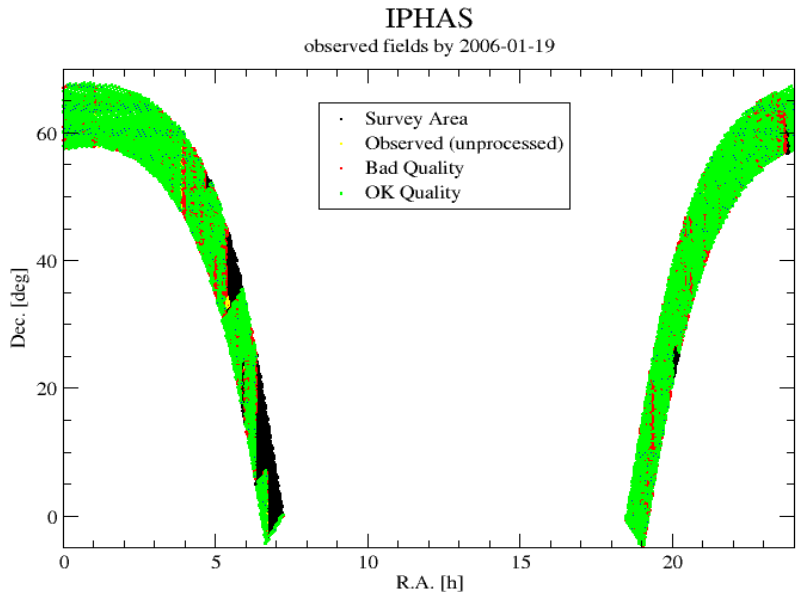


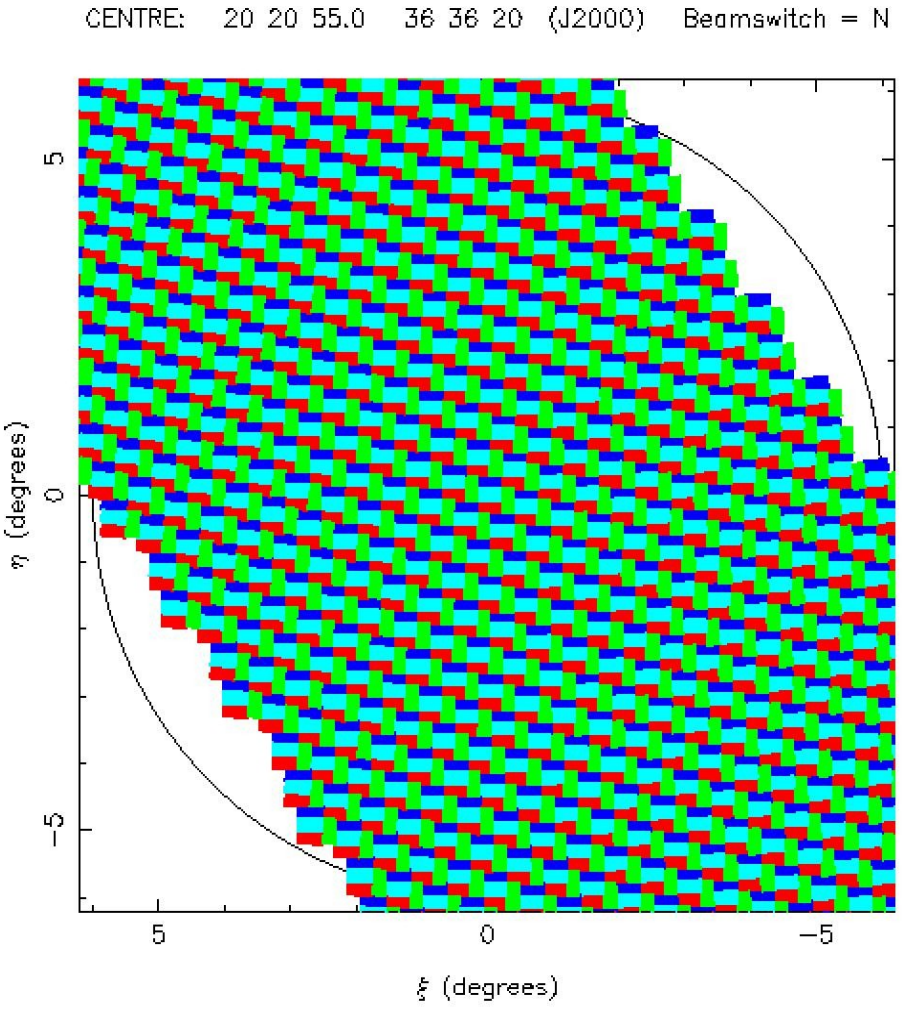




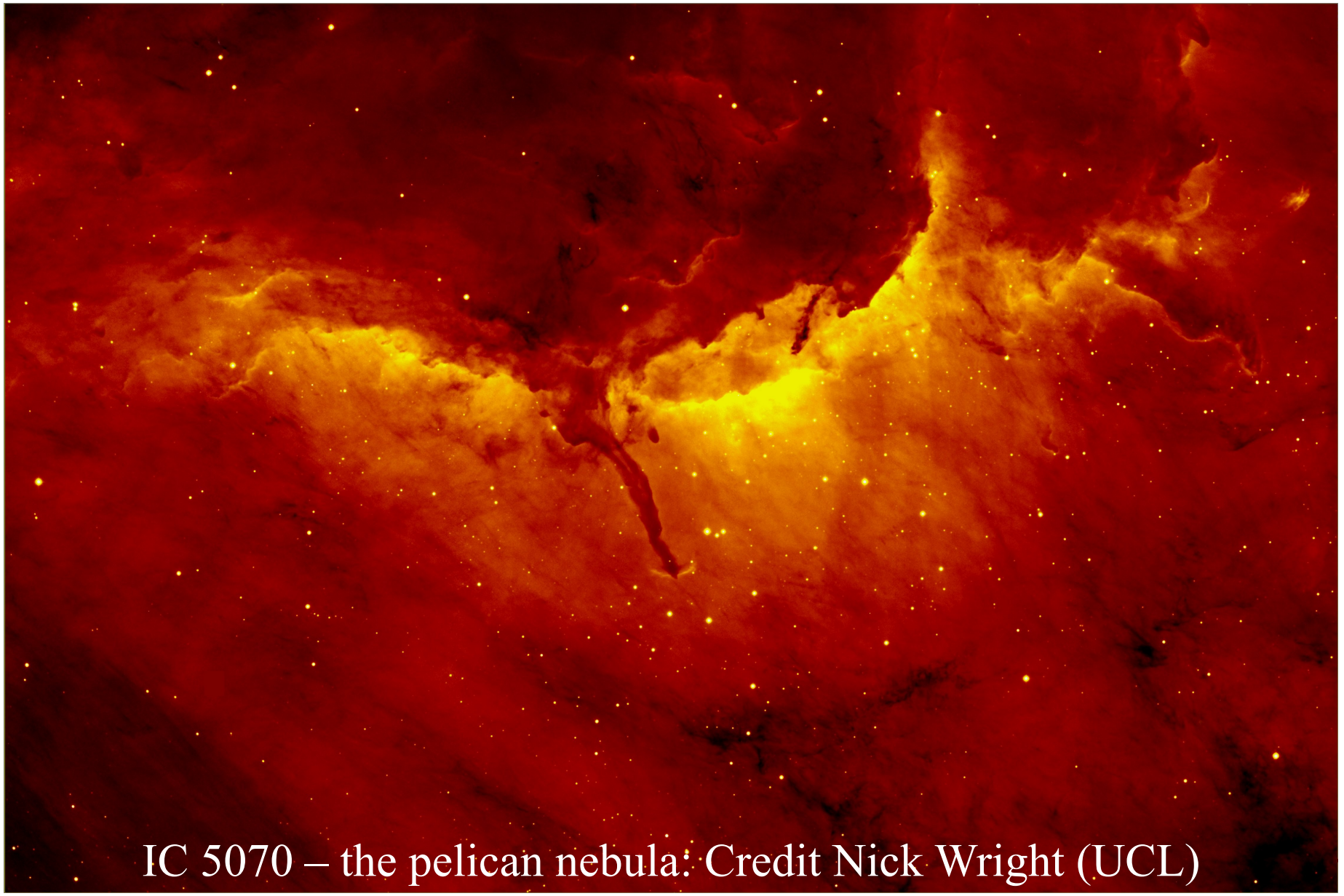
IPHAS Survey

- 7635 Pointings ~2000 sq deg
- x 2 (overlap, 5'x5' offset)
- thus 15270 Pointing in total
- r, Ha, and i
- ~30 GB/night of data = > 1TB total





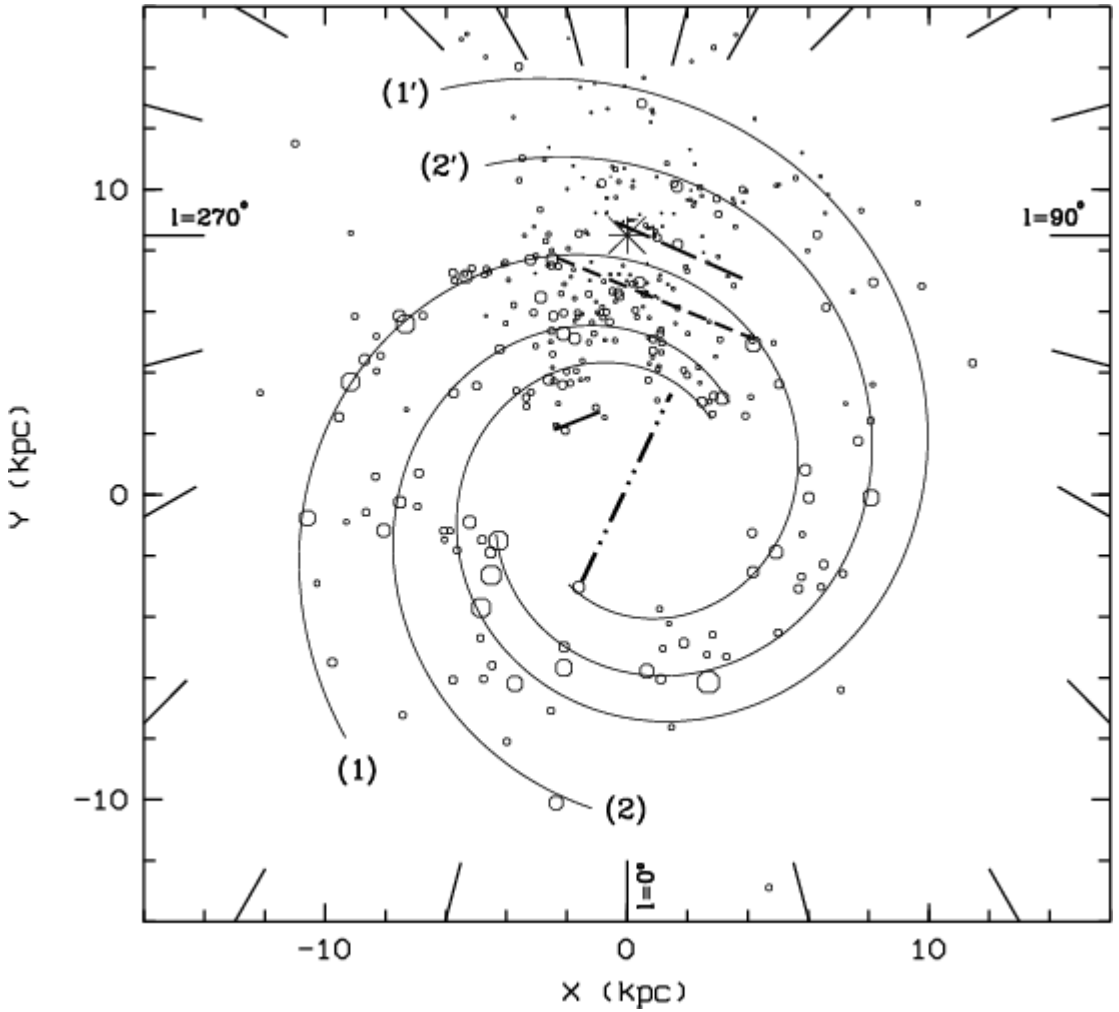
IPHAS: Images



IC 5070 – the pelican nebula: Credit Nick Wright (UCL)

Models for Galactic Structure

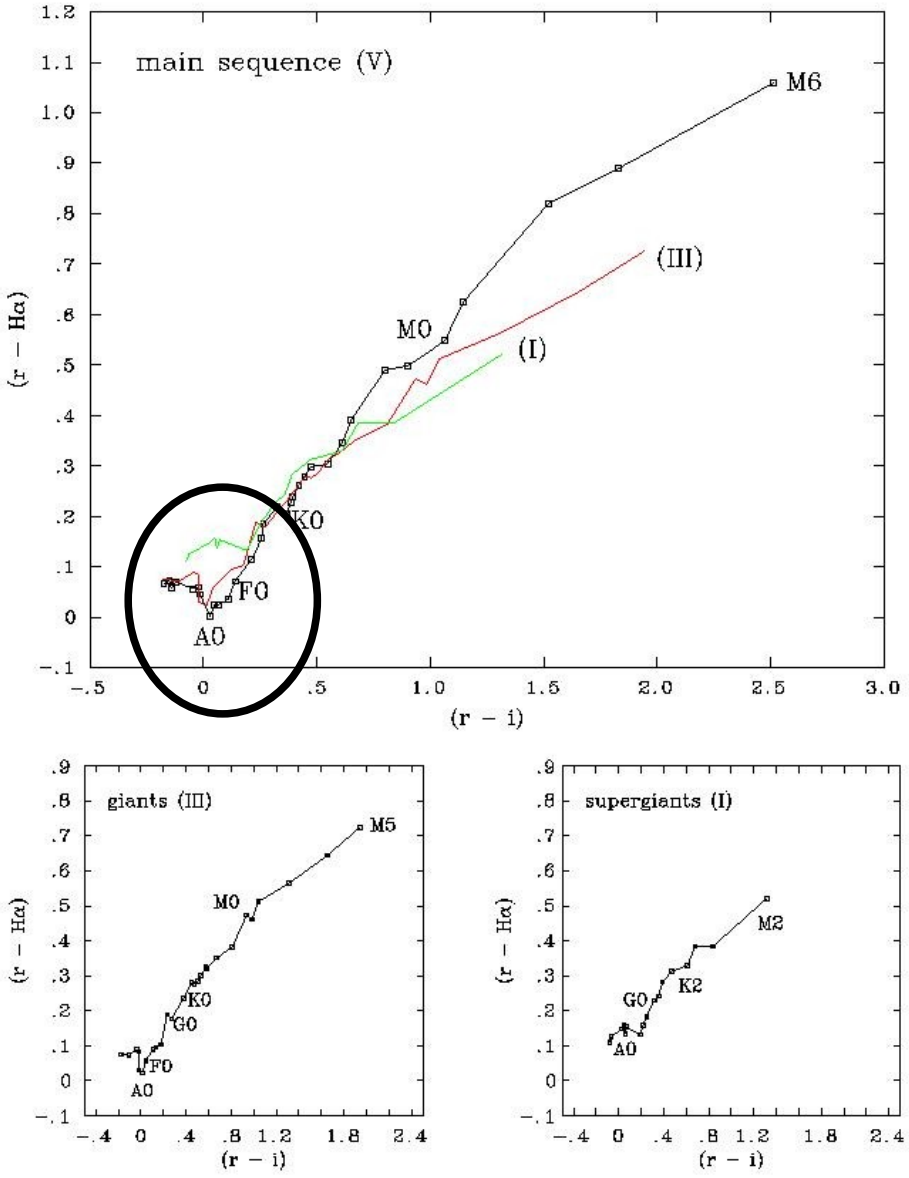
- Young populations good tracers of galactic structure
- e.g. Russeil (2003) study based on positions of star forming complexes (from HI, HII, CO observations)
- IPHAS – find the tracers which map the structure ...



Russeil 4-arm model - 1) Sagittarius-Carina, 2) Scutum-Crux, 1') Norma-Cygnus, 2') Perseus arms – sun marked by X

Structure: use of the IPHAS survey

- IPHAS is deep enough to sample most of the plane
  - r~20 = unreddened A0 dwarfs at 20kpc
- A0V reddening line → a population of easily-modelled 'standard candles'
- Find early type (A, B stars) from their position in the colour-colour plane



Pickles 1998 stellar library

IPHAS Initial Data Release

- IDR: photometric catalogue of about 200 million unique objects, coupled with associated image data covering about 1600 square degrees in three passbands
- Access to the primary data products:
  - uses AstroGrid / VO interfaces
  - traditional web access +
  - access via AstroGrid VO Desktop opens up the full range of analysis options
- The IDR represents the largest dataset published primarily through VO interfaces to date

IPHAS Initial Data Release — Cambridge Astronomy Survey Unit - Mozilla Firefox

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IPHAS Initial Data Relea...

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IPHAS INITIAL DATA RELEASE

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  - Data Products
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  - Data Flow
  - Known Problems
  - Help and Feedback
  - Publications
  - Credits
  - Source Nomenclature
- Astronomical Data Centre

NEWS

Cone Search Portal
Dec 03, 2007

IPHAS Initial Data Release Available
Dec 03, 2007

AAT Data Archive Online
Jun 07, 2007

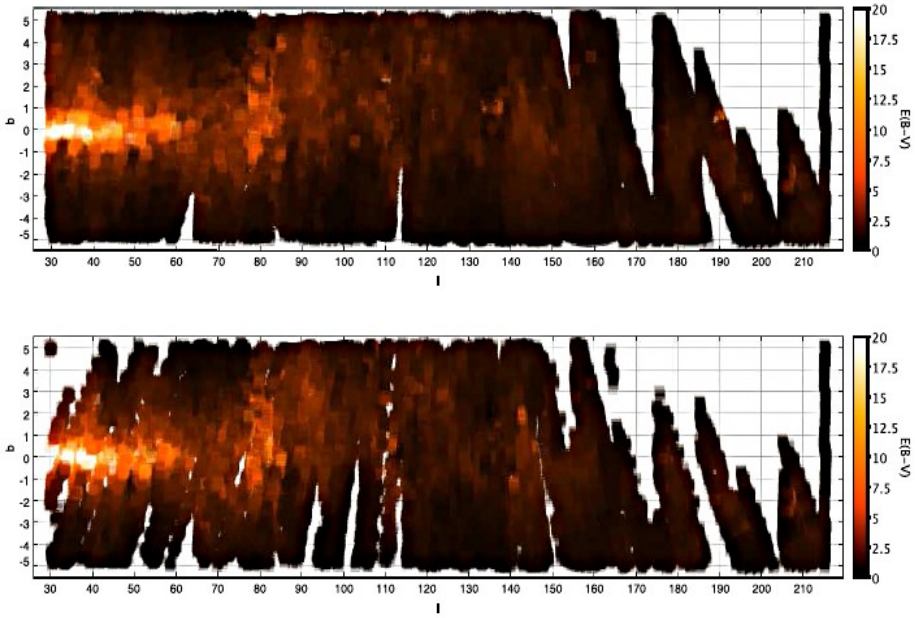
VIRCAM Data Reduction Pipeline Manual
Dec 11, 2006

VIRCAM Dark and Flat

The INT Photometric Hα Survey of the Northern Galactic Plane (IPHAS, Drew et al. 2005 -- see www.iphas.org for general information) is mapping the northern Galactic Plane in the latitude range |b|<5 deg in the Hα, r' and i' bands using the Wide Field Camera on the 2.5-m INT telescope at La Palma to a depth of r'=20 (10σ). The Initial Data Release (IDR) is the first major public data release, providing access to images and catalogs through Astrogrid.

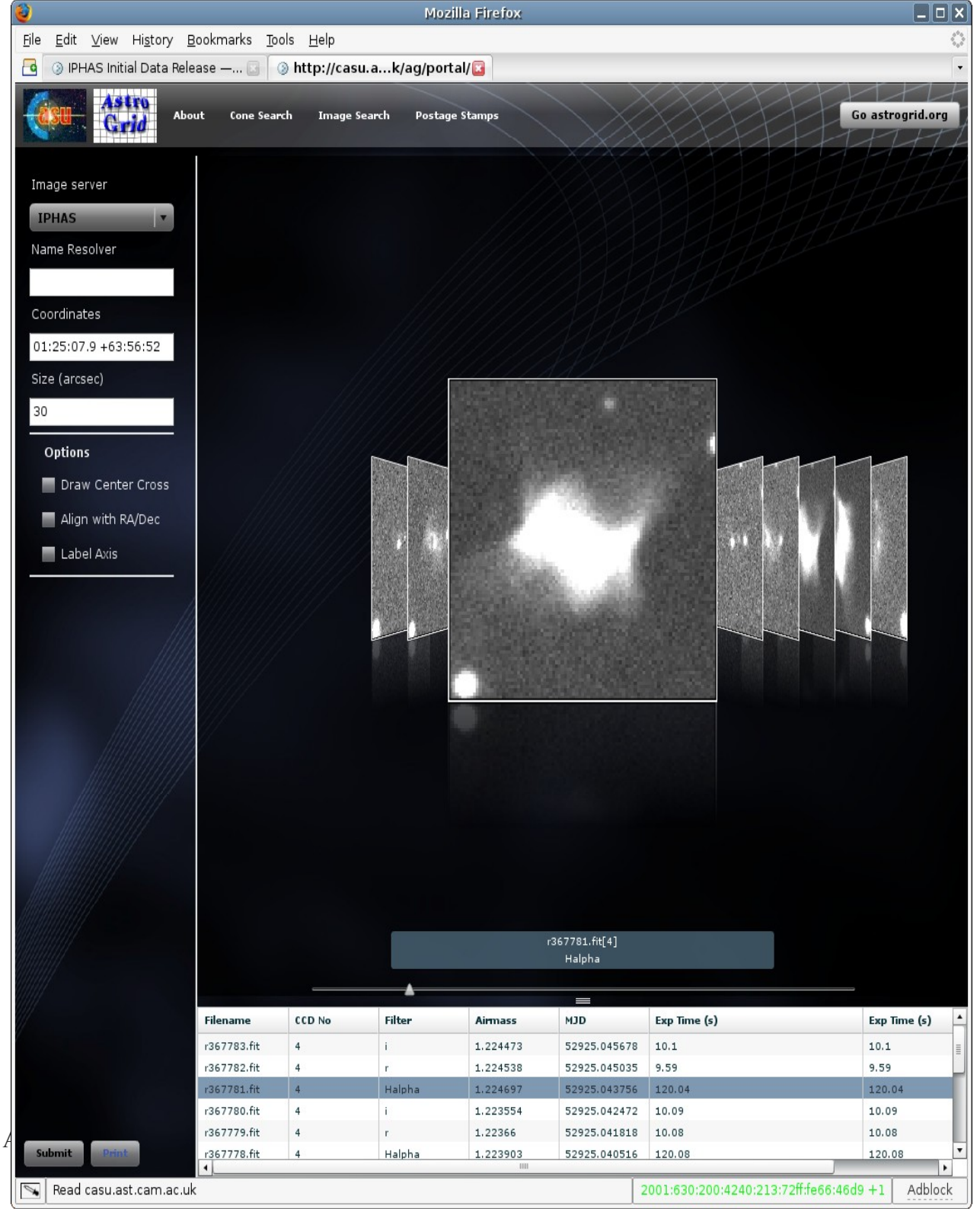
IDR Cone Search Interface

The IDR (Gonzalez-Solares et al. 2008) contains the data obtained between September 2003 and December 2005 during a total of 212 nights. Between these dates, approximately 60 percent of the total survey area was covered in terms of final survey quality.



IPHAS Initial Data Release sky coverage in galactic coordinates (degrees). The top figure displays the coverage of

Done 2001:630:200:4240:213:72ff:fe66:46d9 +1 Adblock


Mozilla Firefox
File Edit View History Bookmarks Tools Help
IPHAS Initial Data Release —...
http://casu.a...k/ag/portal/
About
Cone Search
Image Search
Postage Stamps
Go astrogrid.org
Image server
IPHAS
Name Resolver
Coordinates
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Size (arcsec)
30
Options
Draw Center Cross
Align with RA/Dec
Label Axis
Submit
Print
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CCD No
Filter
Airmass
MJD
Exp Time (s)
Exp Time (s)
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r367782.fit 4 r 1.224538 52925.045035 9.59 9.59
r367781.fit 4 Halpha 1.224697 52925.043756 120.04 120.04
r367780.fit 4 i 1.223554 52925.042472 10.09 10.09
r367779.fit 4 r 1.22366 52925.041818 10.08 10.08
r367778.fit 4 Halpha 1.223903 52925.040516 120.08 120.08
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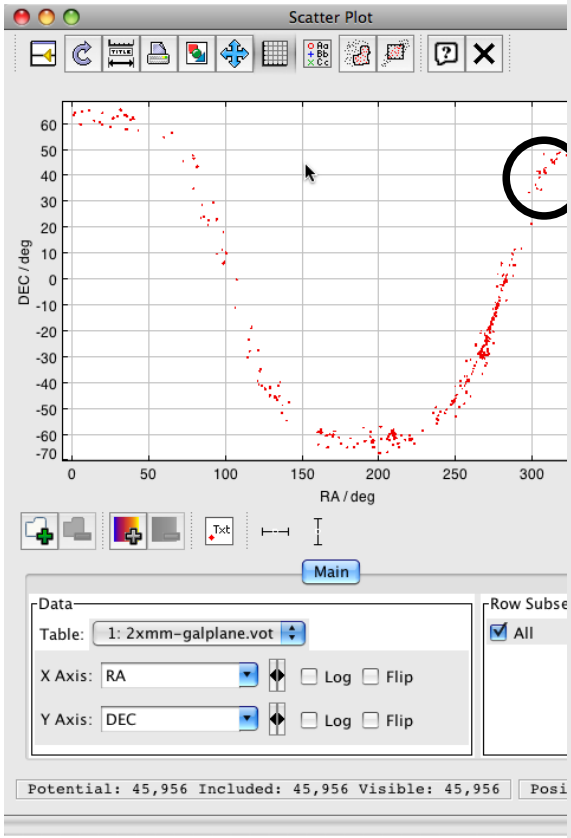
Finding a


Scatter Plot
DEC / deg
RA / deg
Main
Data
Table: 1: 2xmm-galplane.vot
X Axis: RA
Y Axis: DEC
Log
Flip
Row Subse
All
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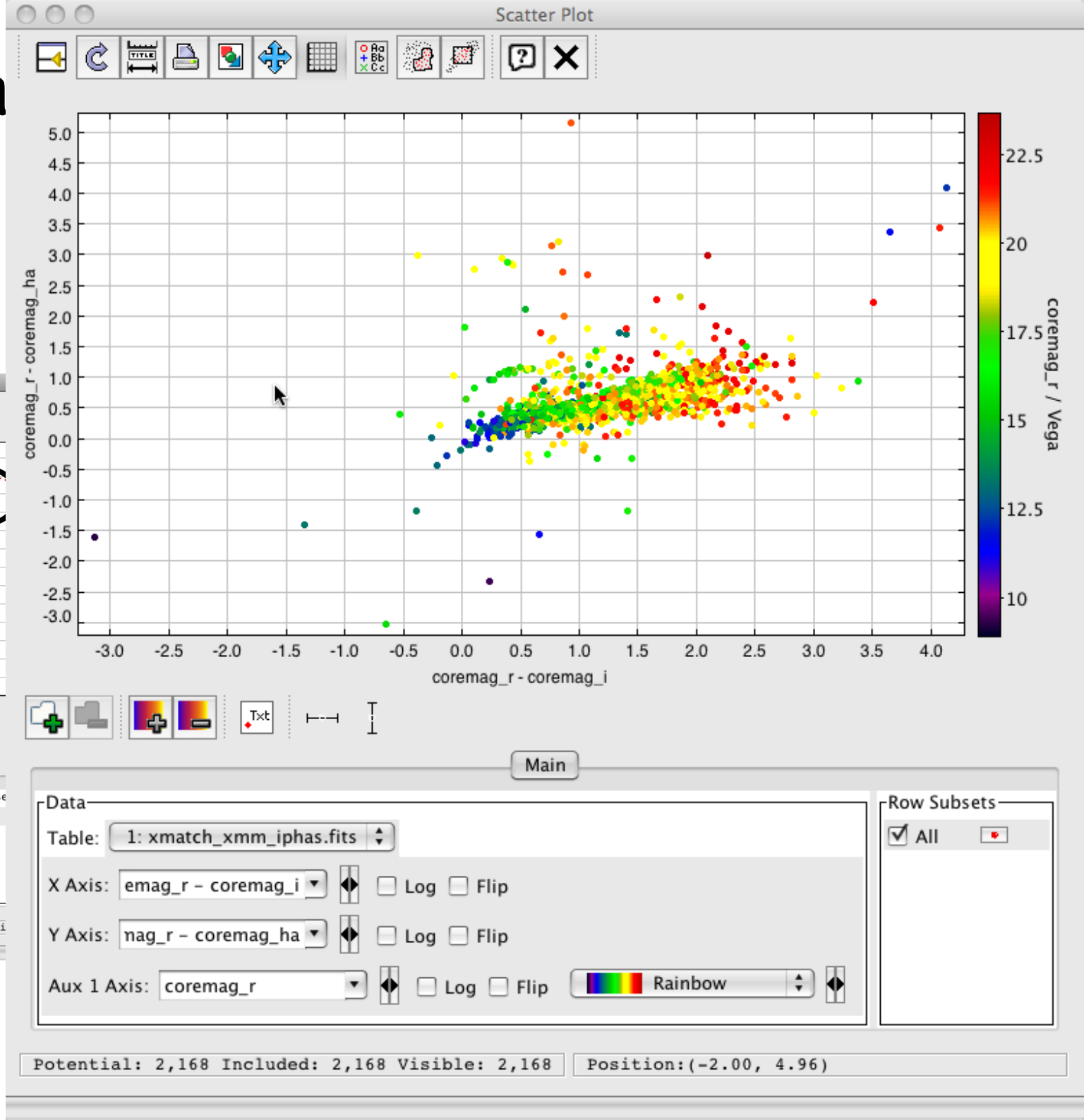
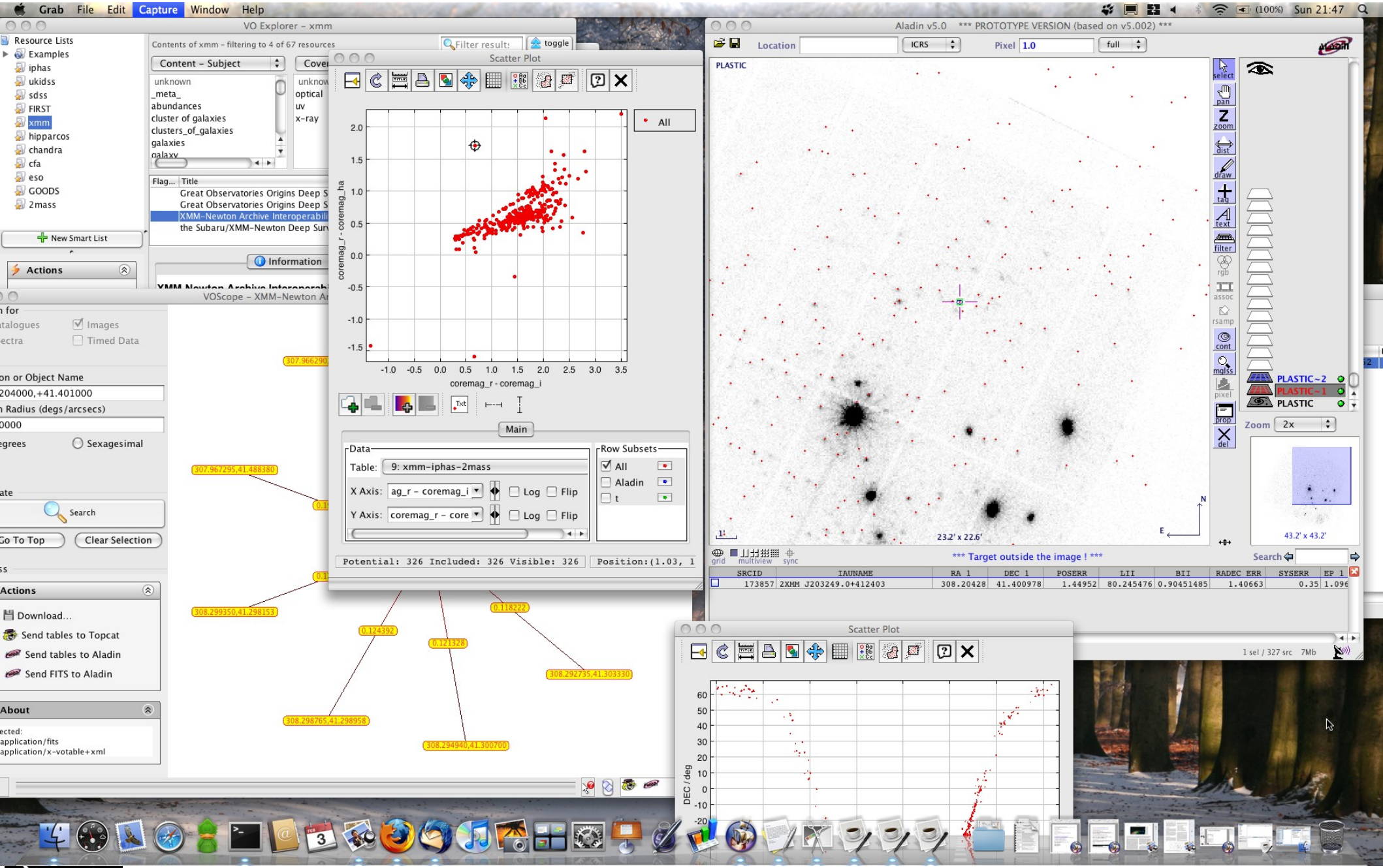
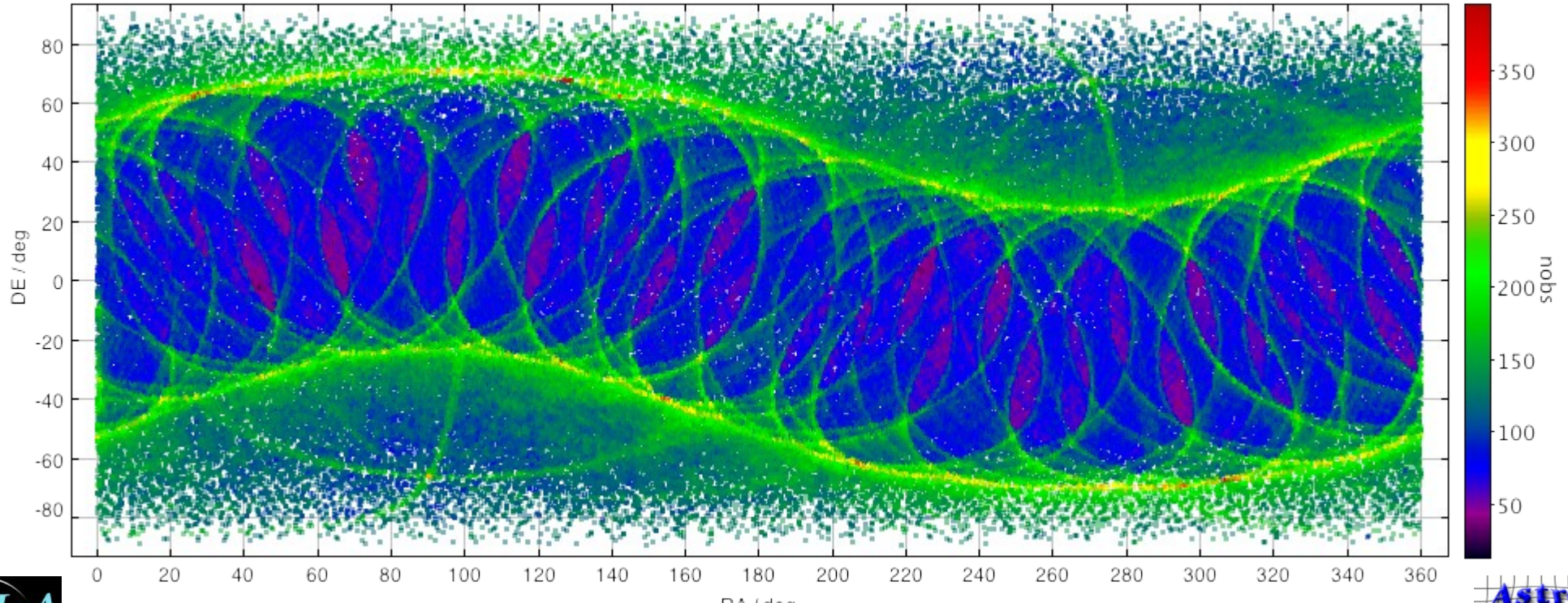

Scatter Plot
coremag_r - coremag_ha
coremag_r - coremag_i
coremag_r / Vega
Main
Data
Table: 1: xmatch_xmm_iphas.fits
X Axis: emag_r - coremag_i
Y Axis: nag_r - coremag_ha
Aux 1 Axis: coremag_r
Log
Flip
Rainbow
Row Subsets
All
Potential: 2,168 Included: 2,168 Visible: 2,168
Position:(-2.00, 4.96)

Finding accreting binaries ...

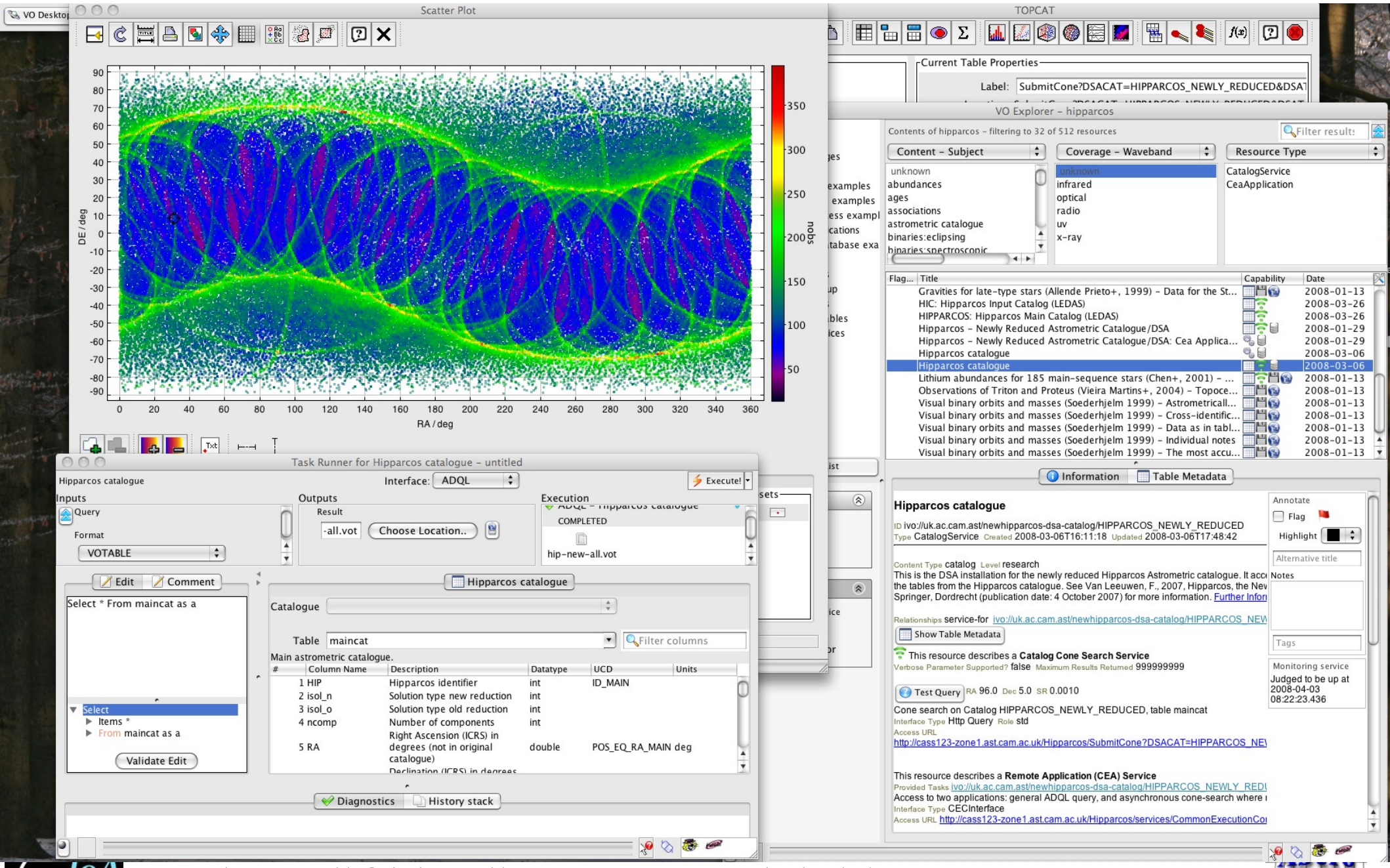


Gaia and the Virtual Observatory

- ESA/ DPAC create the required software infrastructure to process and generate intermediate and final data products
- Scientific & Cost effective delivery of these projects will be facilitated by use of the Euro-VO/AstroGrid Virtual Observatory infrastructure
  - reduces cost of development: no bespoke interfaces



Hipparcos via AstroGrid in 4 clicks



Field of Streams

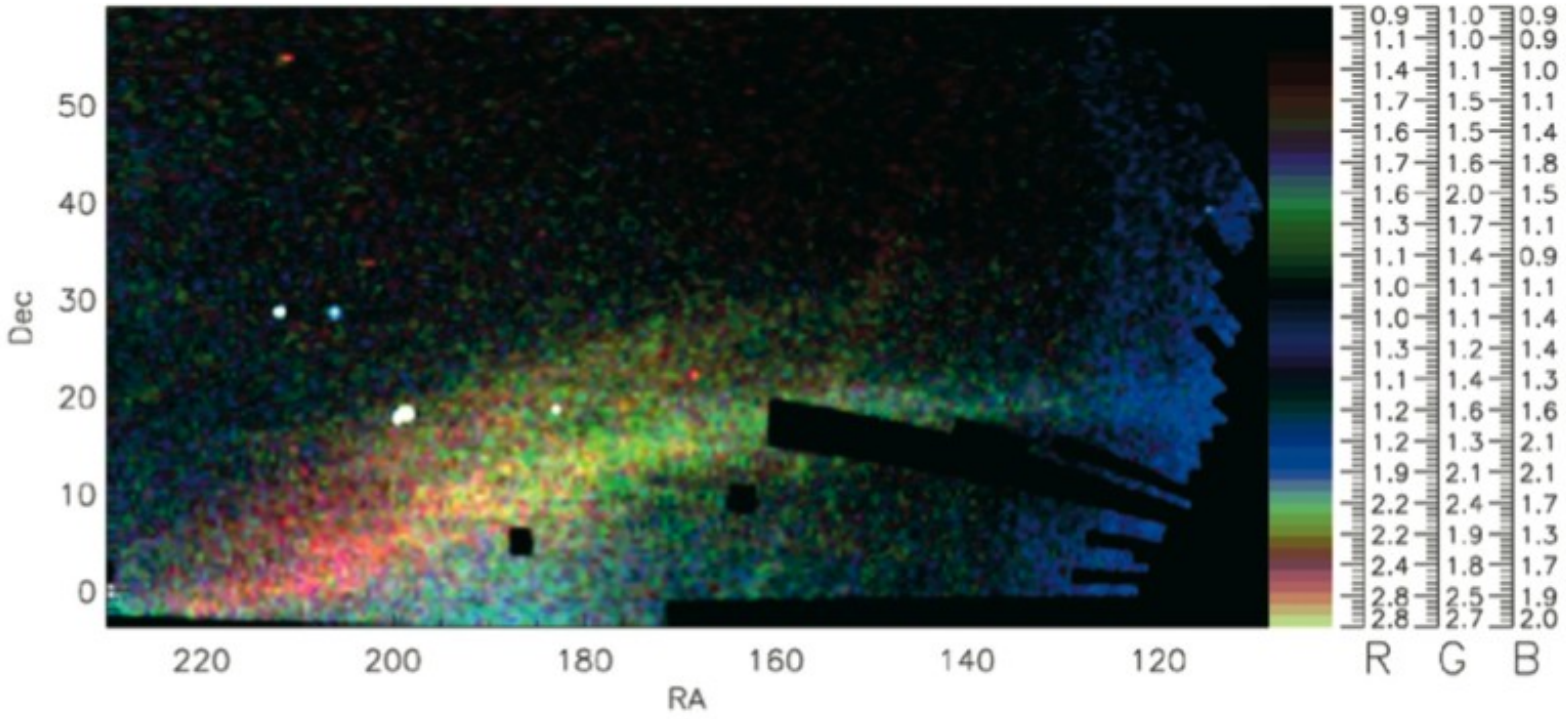
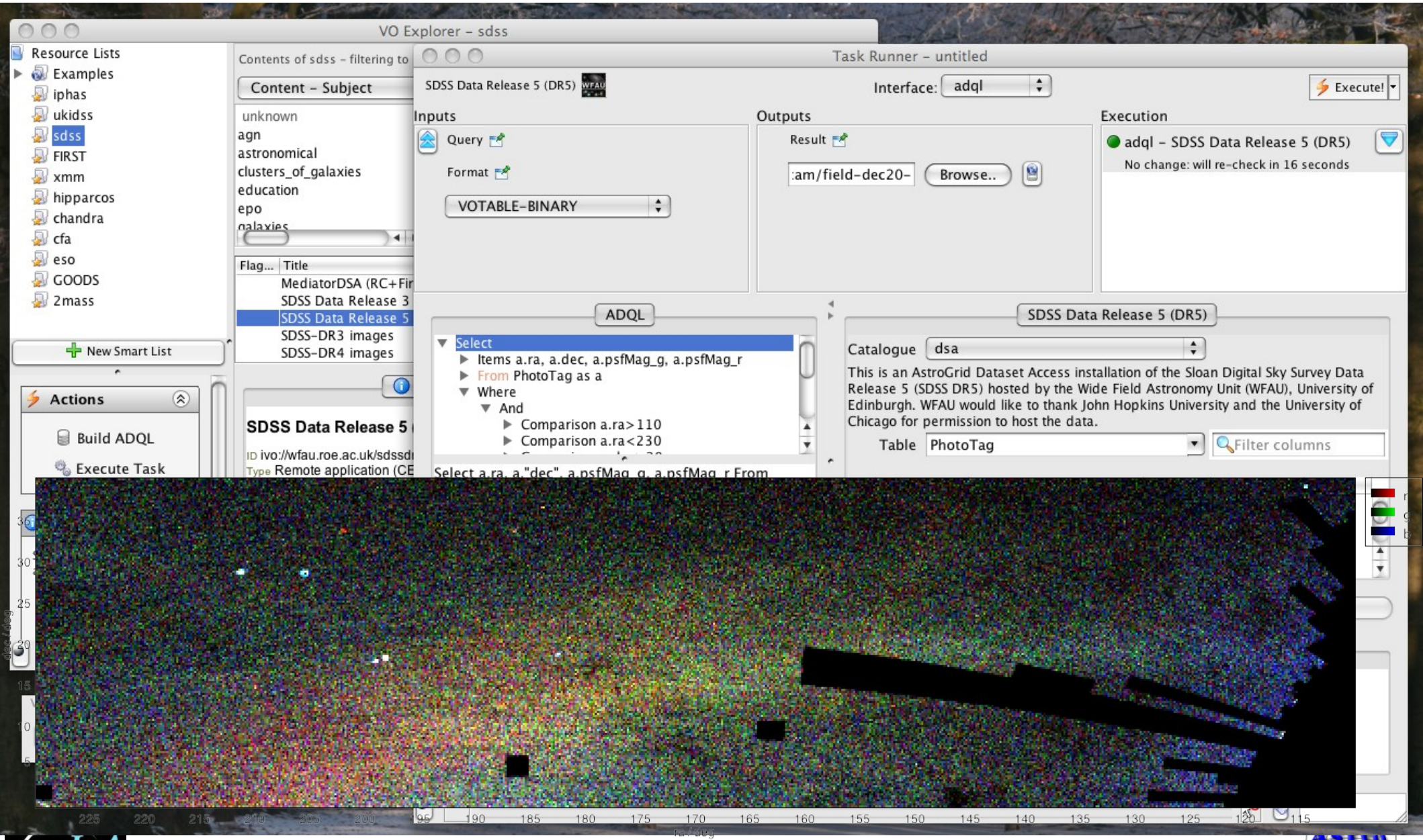


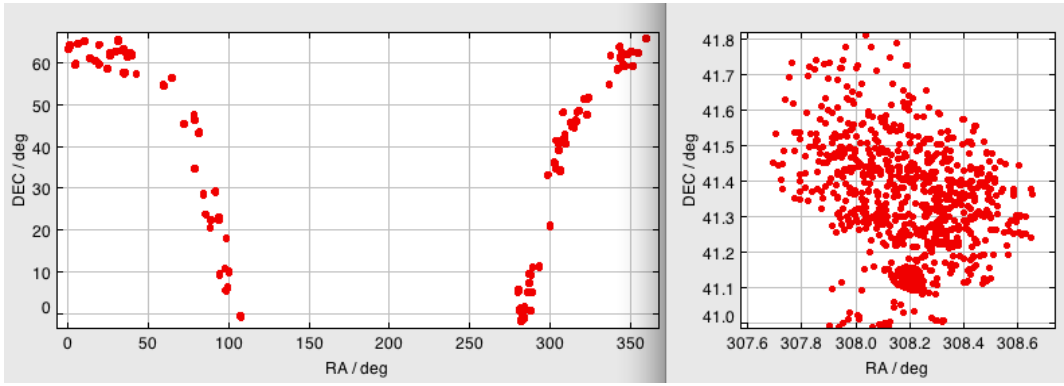
FIG. 1.—Spatial density of SDSS stars with $g - r < 0.4$ around the north Galactic cap in equatorial coordinates, binned 0.°5 × 0.°5. The color plot is an RGB composite with blue for the most nearby stars with $20.0 < r \leq 20.66$, green for stars with $20.66 < r \leq 21.33$, and red for the most distant stars with $21.33 < r \leq 22.0$. Note the bifurcation in the stream starting at $\alpha \approx 180°$. Further structure that is visible includes the Monoceros Ring at $\alpha \approx 120°$ and a new thin stream at $150° \lesssim \alpha \lesssim 160°$ and $0° \lesssim \delta \lesssim 30°$. The color bar shows a palette of 50 representative colors labeled according to the stellar density (in units of 100 stars per square degree) in each of the red, green, and blue components. The displayed density ranges are 102–330 (*red*), 107–304 (*green*), and 98–267 (*blue*).

Your 'Field of Streams' with the VO ...

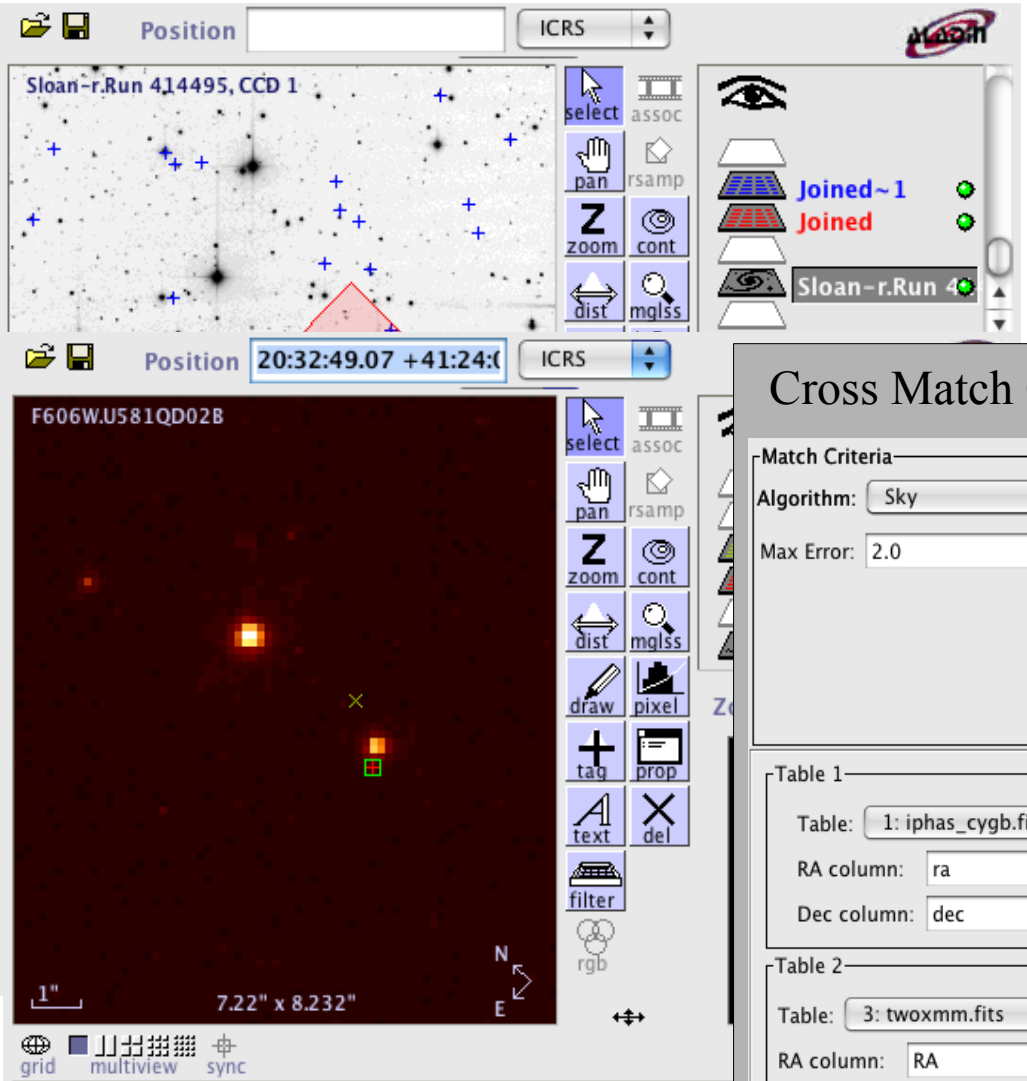


X-Ray Binaries in the Galactic Plane

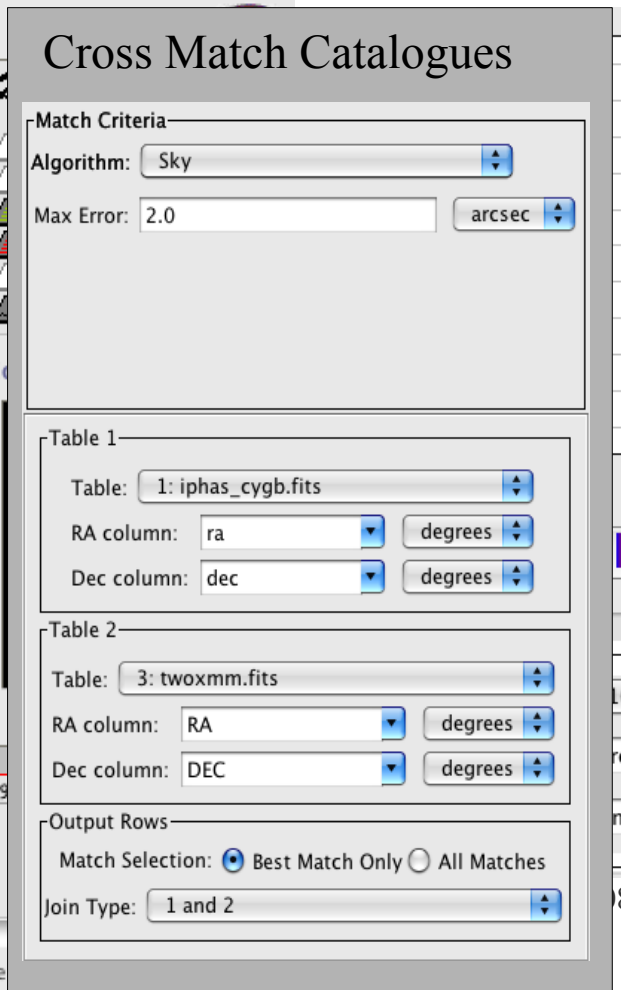
Select data (IPHAS + 2XMM)

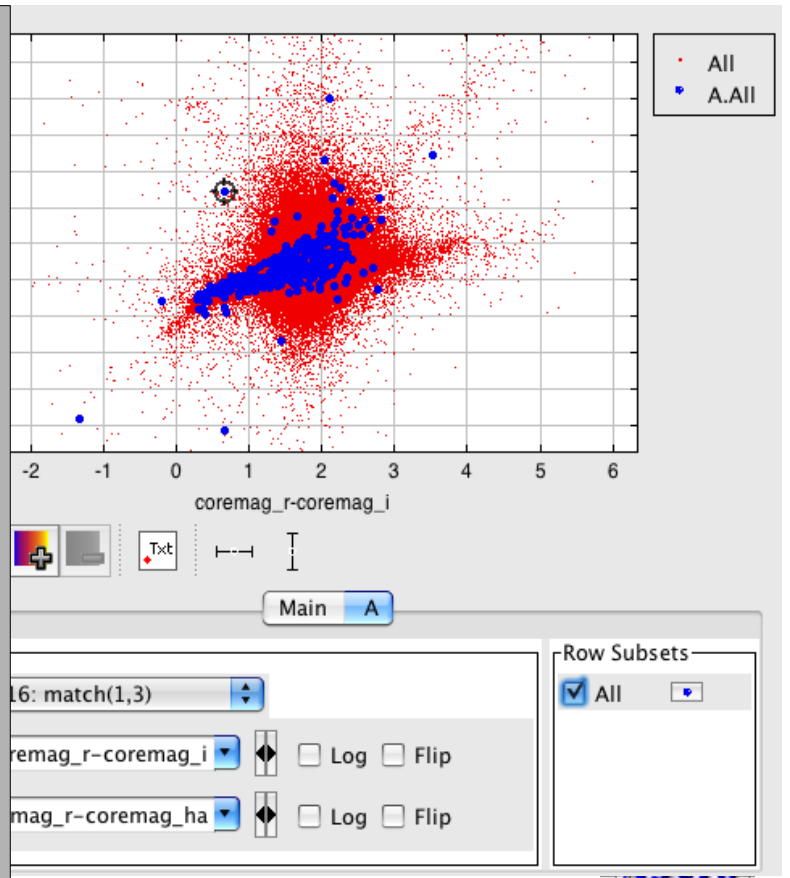


Visualize catalogue and select candidates



Cross Match Catalogues





08

Grid

Documentation
Help
Worked Examples
The software

http://www.astrogrid.org