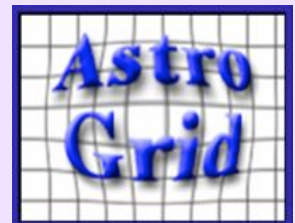


The Virtual Observatory

and Data Mining



- What *is* the VO ?
- Is it *ready* ?
- What's it got to do with *Amateur Astronomy* ?





The Virtual Observatory

The VO vision

The VO vision

- web all docs in the world inside your PC

The VO vision

- web all docs in the world inside your PC
- VO all databases in the world inside your PC

The VO vision

- web all docs in the world inside your PC
 - VO all databases in the world inside your PC
-
- Most astronomy data are already on line
 - So is that all we need ?

Two Problems

- Tower of Babel

- too many different web pages, formats, keywords, table column names, access methods, passwords etc etc
- standardise !!!!

- Data Deluge

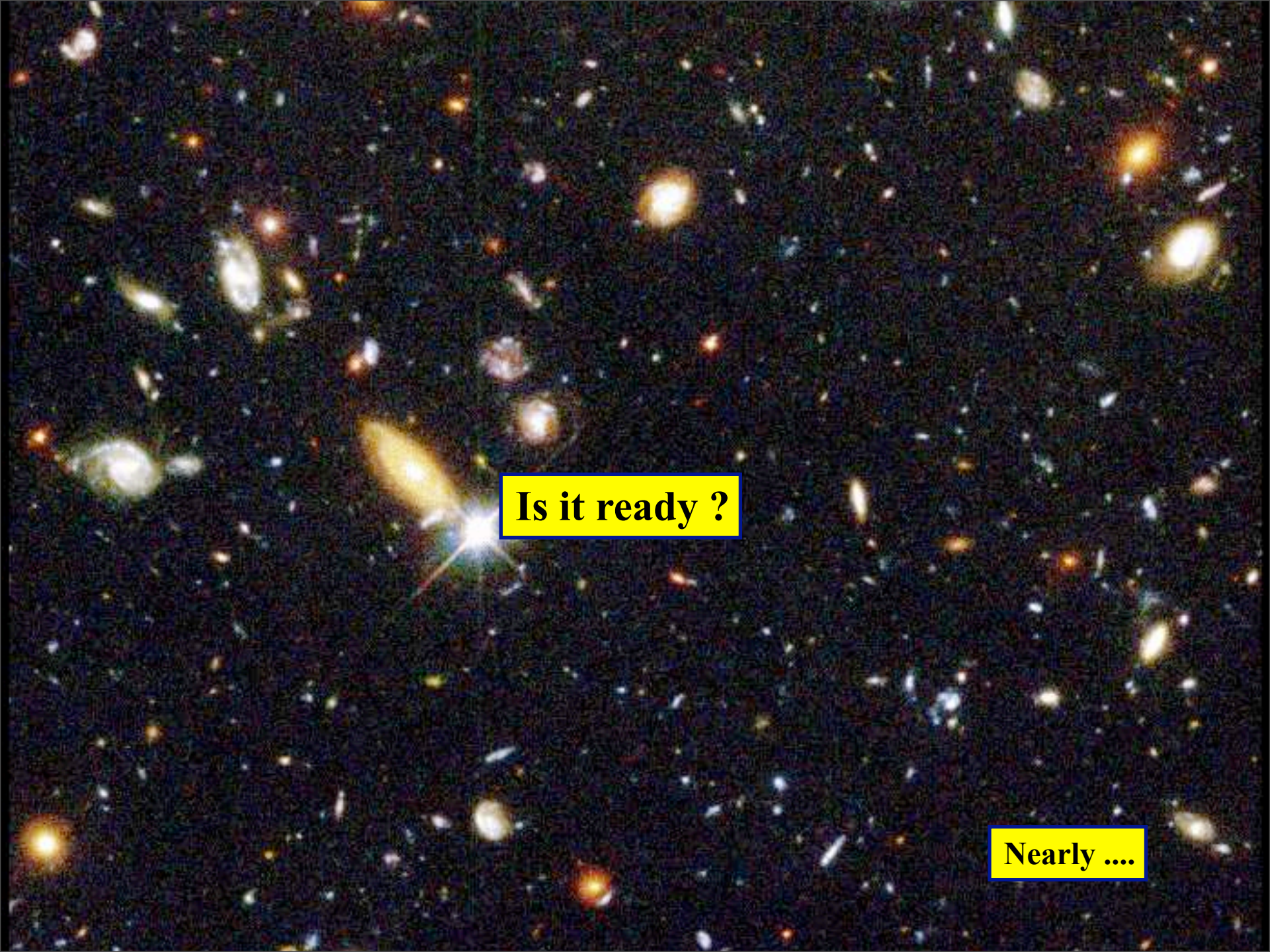
- some modern datasets VAST
- cannot "download and hack"
- need online data *search and analysis services*

So ...we need ...

- ~~heads knocked together~~ *international standards*
- *data services* that follow the rules
- *yellow pages* for data (Registry)
- *VO software* that understands this stuff



Is it ready ?



Is it ready ?

Nearly

Whats done ?

- Thousands of datasets
- Yellow pages
- Lots of techy stuff
- Several good software tools
- Two key popular tools
 - Google Sky and World Wide Telescope

Whats done ?

most of them work...

- Thousands of datasets
- Yellow pages
- Lots of techy stuff
- Several good software tools
- Two key popular tools
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Whats done ?

- Thousands of datasets
- Yellow pages
- Lots of techy stuff
- Several good software tools
- Two key popular tools
 - Google Sky and World Wide Telescope

most of them work...

WWT meshes with the pro stuff



Browse the Sky

Microsoft WorldWide Telescope

Explore | Guided Tours | Search | Community | Telescope | View | Settings

Collections > 1 of 2

My Collections | Constellations | Solar System (Sk... | All-Sky Surveys | Spitzer Studies | Chandra Studies | Hubble Studies | Astrophotography | Radio Studies | NOAO Studies



Look At: Sky | Imagery: Digitized Sky Survey (Optical... | Image Crossfade: [Slider] | Context Search Filter: All | 1 of 44

Orion Nebula | Orion Nebula | Orion Nebula | Barnard 30 | Barnard 30 | Abell 520 | Abell 520 | Messier 42

RA: 05h35m13s
Dec: -03:16:53

start | Microsoft WorldWide ... | 2:05 PM

Pro tools



The screenshot shows a browser window titled "AstroGrid : Home". The address bar contains "AstroGrid : Home". The page features a navigation menu with links for HOME, INSTALL, HELP, and SUPPORT. A search box is located in the top right corner. The main heading is "Welcome to AstroGrid". Below this, there is a paragraph of text describing AstroGrid as the doorway to the Virtual Observatory (VO), followed by a paragraph about software availability and a link to "previous releases". A "GETTING STARTED" box contains instructions on how to use the site, including links to "about the Virtual Observatory", "about the AstroGrid Desktop suite", "Install area", and "Help area". At the bottom, there are sections for "Acknowledging AstroGrid" and "Licensing and Copyright".

AstroGrid : Home

AstroGrid : Home

AstroGrid

search

HOME INSTALL HELP SUPPORT

Welcome to AstroGrid

 AstroGrid is the doorway to the Virtual Observatory (VO). We provide a suite of desktop applications to enable astronomers to explore and bookmark resources from around the world, find data, store and share files in VOSpace, query databases, plot and manipulate tables, cross-match catalogues, and build and run scripts to automate sequences of tasks. Tools from other Euro-VO projects inter-operate with AstroGrid software, so you can also view and analyse images and spectra located in the VO.

These web pages hold our software for downloading, as well as links to other people's software. They also provide the help documentation, and other support material such as FAQs and the Helpdesk ticket system.

Our new software (V2008.1) is released on April 1st 2008. Previous releases will still be available for some time : see [previous releases](#).

GETTING STARTED

Read a little [about the Virtual Observatory](#)
Read a little [about the AstroGrid Desktop suite](#).
Go to the [Install area](#) and download the software.
Have a look at the documentation in the [Help area](#).
Start trying it out !

Acknowledging AstroGrid. If you make use of the AstroGrid system or tools, we would be grateful if you could acknowledge this use in any resulting publications. You could use these words: *'This research has made use of data obtained using, or software provided by, the UK's AstroGrid Virtual Observatory Project, which is funded by the Science & Technology Facilities Council and through the EU's Framework 6 programme.'* Use of any data discovered or accessed through AstroGrid should of course be mentioned as noted by the data providers.

Licensing and Copyright. AstroGrid software is released under the [Academic Free License](#). The copyright on the text used in these web pages is owned by the contributing authors. Copyright on images used are assumed to be with the indicated or implied source as appropriate.

Done

- Get tools at www.astrogrid.org
- Also has links to tools from France, Spain, US, India etc

Browse Yellow Pages

VO Explorer - catalogue searches

Contents of catalogue searches - 11 resources

Filter result: []

Flag...	Title	Capability	Valida...	Date
	IRAS Point Source Catalog, Version 2.0			2008-12-24
	XMM-Newton Serendipitous Source Catalog (2XMMI Version)			2008-12-24
	ROSAT All-Sky Survey: Faint Sources			2008-12-24
	Fermi LAT Bright Source List			2009-02-17
	SDSS Data Release 5 (DR5)			2009-08-12
	UKIDSS DR3			2009-06-05
	SuperCOSMOS Science Archive (SSA)			2009-02-16
	UKIDSS DR1			2009-11-03
	USNO-B1 Catalogue			2007-04-11
	2MASS All-Sky Extended Source Catalog			2008-04-07
	2MASS All-Sky Point Source Catalog			2008-04-07

Information Table Metadata XML

IRAS Point Source Catalog, Version 2.0

Short Name IRASPSC IVOA-ID ivo://nasa.heasarc/iraspvc
Resource Type CatalogService Created 2008-12-24

Content Type catalog Subject survey source Level research

The IRAS Point Source Catalog, Version 2.0, is a catalog of some 250,000 well-confirmed infrared point sources observed by the Infrared Astronomical Satellite (IRAS), i.e., sources with angular extents less than approximately 0.5, 0.5, 1.0, and 2.0 arcminutes in the in-scan direction at 60, and 100 microns (um), respectively. Positions, flux densities, uncertainties, associations with known astronomical objects and various cautionary flags are given for each object in the catalog. Away from confused regions of the sky, the survey is complete to about 0.4, 0.5, 0.6, and 1.0 Janskies (Jy) at 12, 25, 60, and 100 microns, respectively. Typical position uncertainties are about 6 arcseconds in the in-scan direction and about 8 to 16 arcseconds in the cross-scan direction. [Further Information...](#)

Source Reference 1988IRASP.C.....0J
Relationships service-for [NASA/GSFC Exploration of the Universe Division](#)

Waveband Coverage infrared
Spatial Coverage All-Sky

Annotate
 Flag
Highlight
Alternative title
Notes
Tags

Selection: CatalogService
 Further Info
 Email Curator

Browse Yellow Pages

The image shows a screenshot of the VO Explorer application interface. The main window is titled "VO Explorer - catalogue searches" and displays a table of 11 resources. The first resource is "IRAS Point Source Catalog, Version 2.0" with a date of "2008-12-24".

Flag...	Title	Capability	Valida...	Date
	IRAS Point Source Catalog, Version 2.0			2008-12-24
	XMM-N			
	ROSAT			
	Fermi L			
	SDSS D			
	UKIDSS			
	SuperC			
	UKIDSS			
	USNO-1			
	2MASS			
	2MASS			

Overlaid on the main window is a "VO Explorer - New Smartlist" dialog box. It shows a search named "ROSAT image search" with the following conditions:

- Service capability is Image
- Waveband is X-ray
- Title contains ROSAT

The dialog also displays the generated query text: `((capability = Image) AND (waveband = X-ray)) AND (title = ROSAT)`. At the bottom, it indicates "Matches 10 of 9220 resources" and has "Update" and "Cancel" buttons.

The background interface includes a sidebar with "Resource Lists" and "Examples", a "New Smart List" button, and an "Actions" panel with options like "Query", "Multi Query", and "Web interface".

Search data services

The screenshot displays the 'Astroscope - 103 Cat. Object Services' web interface. The search parameters are as follows:

- Search for:** Cat. Objects, Images, Spectra, Timed Data
- At:** Position (RA,Dec) or Object Name: 19.271249,-73.446993
- Search Radius (degs/arcsecs):** 5.100000
- Units:** Degrees, Sexagesimal

The search results are displayed as a radial diagram with 'Cat. Objects' at the center. The results include:

- Far Ultraviolet Explorer (FUSE) - 216 results
- Long-term photometry of - 4 results
- ANS UV Catalogue of Point - 3 results
- Hipparcos Input Catalogue, - 234 results
- The FUSE Observation Log - 216 results
- Atlas of warm AGN and - 1 results
- Far-UV Point Sources - 438 results
- 2MASS-selected Flat Galaxy -band - 52 results
- 2MASS-selected Flat Galaxy - 24 results
- BeppoSAX WFC Observation Log - 11 results
- The APM Bright Galaxy - 3 results
- CGRO/BATSE Earth Occultation - 4 results
- HEAO 1 A4 X-ray - 3 results
- ATNF Pulsar Catalog - 28 results
- Ephemerids of eclipsing - 3 results
- Search Results

The interface also features a 'Process' section with actions like View, Download, Multi Query, and Send tables to Aladin/Topcat, and an 'About' section.

Pipe results to other apps

TOPCAT(1): Table Browser

Table Browser for 1: [nph-catsearch?CAT=fp_psc&RA=355.0&DEC=0.0&SR=0.1](#)

	ra	dec	err_maj	err_min	err_ang	designation	j_m
1	355.06	-0.01215	0.06	0.06	90	23401429-0000437	14.877
2	354.923	-0.052709	0.13	0.11	1	23394151-0003097	14.773
3	355.076	-0.063874	0.35	0.24	4	23401820-0003499	16.912
4	354.936	-0.067378	0.14	0.12	1	23394461-0004025	15.42
5	355.077	-0.05786	0.5	0.42	80	23401840-0003282	16.584
6	355.028	-0.036228	0.07	0.07	90	23400675-0002104	15.493
7	355.022	-0.028082	0.21	0.19	79	23400527-0001410	16.776
8	354.931	-0.020214	0.24	0.24	11	23394355-0001127	16.798
9	355.003	-0.039334	0.19	0.17	7	23400066-0002216	16.639
10	355.073	-0.065699	0.24	0.14	1	23401750-0003565	16.566
11	354.906	-0.016004	0.28	0.25	9	23393748-0000576	16.397
12	354.939	-0.078006	0.13	0.11	0	23394540-0004408	12.15
13	354.935	-0.056206	0.13	0.11	1	23394435-0003223	13.596

Pipe results to other apps

TOPCAT(1): Table Browser

Scatter Plot

Table Browser for 1: nph-
ra de

1	355.06	
2	354.923	
3	355.076	
4	354.936	
5	355.077	
6	355.028	
7	355.022	
8	354.931	
9	355.003	
10	355.073	
11	354.906	
12	354.939	
13	354.935	

1500
1000
500
0
-500

j_snr

11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5

j_m

Main

Data

Table: 1: nph-catsearch?CAT=fp_psc&RA=355.

X Axis: j_m Log

Y Axis: j_snr Log

Row Subsets

All

Potential: 55 Included: 55 Visible: 20 Position: (12.34, 1

Pipe results to other apps

TOPCAT(1): Table Browser

Scatter Plot

Table Browser for 1: nph-

	ra	de
1	355.06	
2	354.923	
3	355.076	
4	354.936	
5	355.077	
6	355.028	
7	355.022	
8	354.931	
9	355.003	
10	355.073	
11	354.906	
12	354.939	
13	354.935	

Aladin v6.0

Location ICRS Pixel 1.842 full

rass3bb.fits

1° 8.965° x 8.286° 10° x 10°

Data

Table: 1: nph-catsearch?CAT

X Axis: j_m

Y Axis: j_snr

Potential: 55 Included: 55

grid multiview match

(c)1999-2009 UdS/CNRS - Centre de Donnees astronomiques de Strasbourg

0 sel / 0 src 1Mb

Pipe results to other apps

The image displays a workflow for processing astronomical data. On the left, the TOPCAT(1) Table Browser shows a table with 13 rows of data. The 5th row is highlighted, showing RA 355.077. In the center, a Scatter Plot window shows a plot of j_snr (Y-axis, -500 to 1500) versus j_m (X-axis, 11.5 to 12.5). The 5th data point from the table is plotted at approximately (11.5, 1000). On the right, the Aladin v6.0 interface shows a sky map of the region $8.965^\circ \times 8.286^\circ$. A red crosshair marks the position of the 5th source. The Aladin interface includes a toolbar with various tools like select, pan, zoom, and a zoom level of 2x. A small inset window shows a zoomed-in view of the source.

ra	de
1 355.06	
2 354.923	
3 355.076	
4 354.936	
5 355.077	
6 355.028	
7 355.022	
8 354.931	
9 355.003	
10 355.073	
11 354.906	
12 354.939	
13 354.935	

Table Browser for 1: nph-
ra de
1 355.06
2 354.923
3 355.076
4 354.936
5 355.077
6 355.028
7 355.022
8 354.931
9 355.003
10 355.073
11 354.906
12 354.939
13 354.935

Scatter Plot
1500
1000
500
0
-500
 j_snr
11.5 12.0 12.5
 j_m

Aladin v6.0
Location ICRS Pixel 1.842 full
rass3bb.fits
select
pan
zoom
dist
draw
tag
text
filter
cross
rgb
assoc
cont
mqls
pixel
prop
del
Zoom 2x
10" x 10"
8.965° x 8.286°
1"
N
E
Search
grid multiview match
(c)1999-2009 UdS/CNRS - Centre de Donnees astronomiques de Strasbourg
0 sel / 0 src 1Mb

Do Science

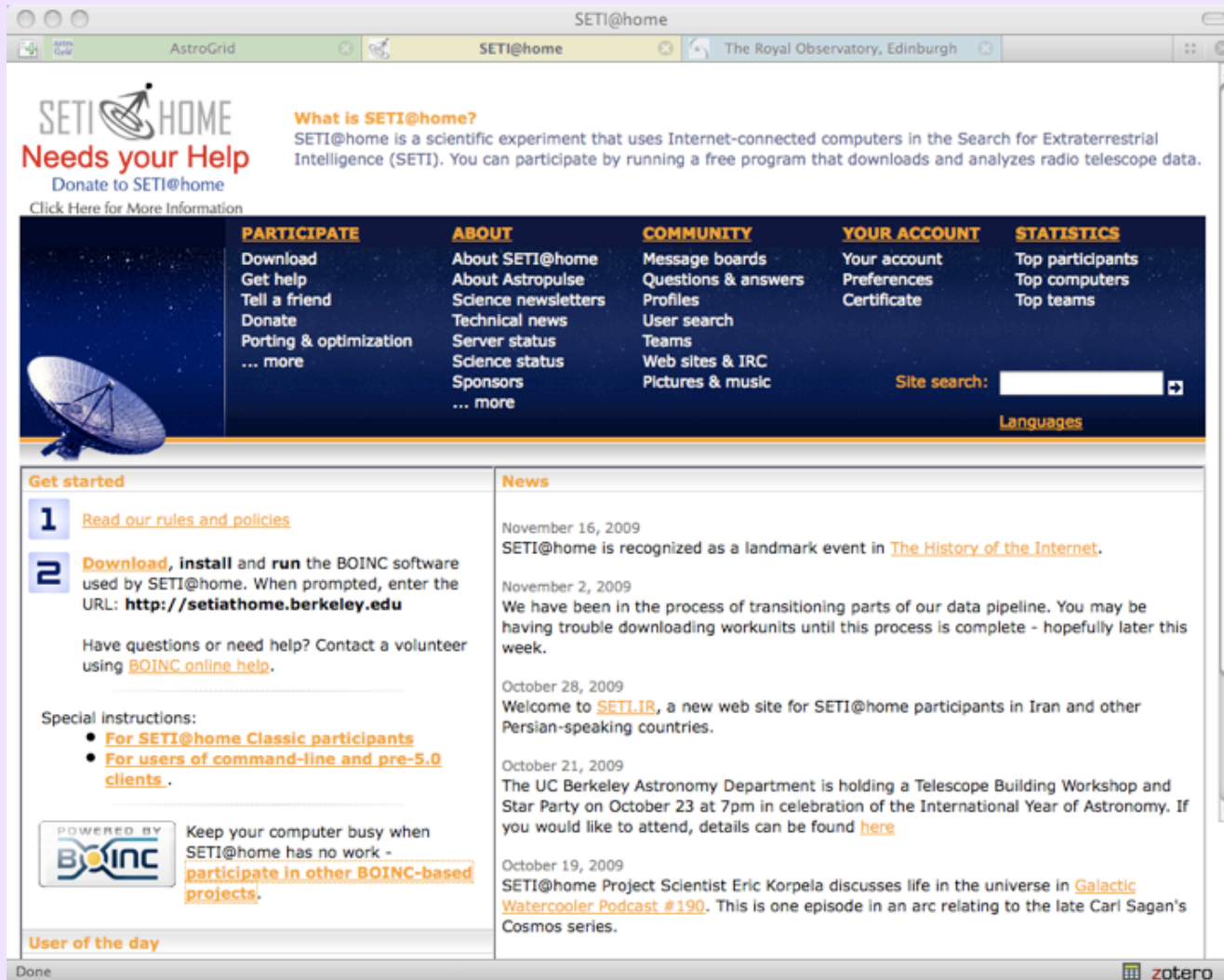


**What's this got to do
with Amateur Astronomy ?**

Three paths

- enjoy the sky
- contribute to the software
- contribute to the science
 - a long tradition for the physical sky
 - why not the virtual sky too ?

Citizen Science : SETI at Home



The screenshot shows the SETI@home website in a browser window. The browser tabs include 'AstroGrid', 'SETI@home', and 'The Royal Observatory, Edinburgh'. The website header features the SETI@home logo and the text 'Needs your Help' with a 'Donate to SETI@home' link and a 'Click Here for More Information' link. Below the header is a navigation menu with five main categories: PARTICIPATE, ABOUT, COMMUNITY, YOUR ACCOUNT, and STATISTICS. Each category has a list of sub-links. A search bar and a 'Languages' link are also present. The main content area is divided into two columns: 'Get started' and 'News'. The 'Get started' column contains a numbered list of steps: 1. Read our rules and policies, and 2. Download, install and run the BOINC software. It also includes a link to 'BOINC online help' and 'Special instructions' for classic participants and command-line clients. A 'POWERED BY BOINC' logo is shown with the text 'Keep your computer busy when SETI@home has no work - participate in other BOINC-based projects.' The 'News' column contains several news items with dates and brief descriptions. The browser status bar at the bottom shows 'Done' and a 'zotero' icon.

SETI@HOME
Needs your Help
Donate to SETI@home
Click Here for More Information

What is SETI@home?
SETI@home is a scientific experiment that uses Internet-connected computers in the Search for Extraterrestrial Intelligence (SETI). You can participate by running a free program that downloads and analyzes radio telescope data.

PARTICIPATE	ABOUT	COMMUNITY	YOUR ACCOUNT	STATISTICS
Download Get help Tell a friend Donate Porting & optimization ... more	About SETI@home About Astropulse Science newsletters Technical news Server status Science status Sponsors ... more	Message boards Questions & answers Profiles User search Teams Web sites & IRC Pictures & music	Your account Preferences Certificate	Top participants Top computers Top teams

Site search:

Languages

Get started

- 1 [Read our rules and policies](#)
- 2 **Download, install and run** the BOINC software used by SETI@home. When prompted, enter the URL: <http://setiathome.berkeley.edu>

Have questions or need help? Contact a volunteer using [BOINC online help](#).

Special instructions:

- [For SETI@home Classic participants](#)
- [For users of command-line and pre-5.0 clients](#)

Keep your computer busy when SETI@home has no work - [participate in other BOINC-based projects](#).

News

November 16, 2009
SETI@home is recognized as a landmark event in [The History of the Internet](#).

November 2, 2009
We have been in the process of transitioning parts of our data pipeline. You may be having trouble downloading workunits until this process is complete - hopefully later this week.

October 28, 2009
Welcome to [SETI.IB](#), a new web site for SETI@home participants in Iran and other Persian-speaking countries.

October 21, 2009
The UC Berkeley Astronomy Department is holding a Telescope Building Workshop and Star Party on October 23 at 7pm in celebration of the International Year of Astronomy. If you would like to attend, details can be found [here](#)

October 19, 2009
SETI@home Project Scientist Eric Korpela discusses life in the universe in [Galactic Watercooler Podcast #190](#). This is one episode in an arc relating to the late Carl Sagan's Cosmos series.

- donate your CPU cycles to hunting for ET
- worthy but passive

Citizen Science : Galaxy Zoo

GALAXY ZOO 2

Home How To Take Part My Galaxies Contact Us Profile Logout

Classify galaxies

Answer the question below using the buttons provided.

Is the galaxy simply smooth and rounded, with no sign of a disk?

Smooth Features or disk Star or artifact

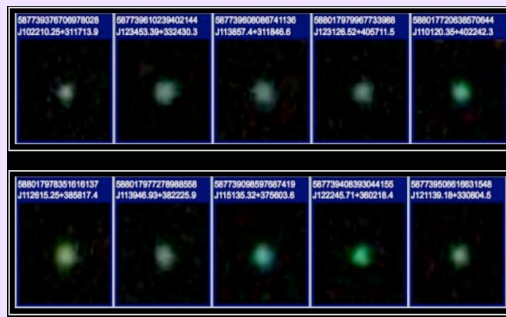
Need help? ?

Invert galaxy image Add to my favourites

- classify galaxies fed to you by SDSS team
- real science results !



Hanny's Voorwerp



Green Peas

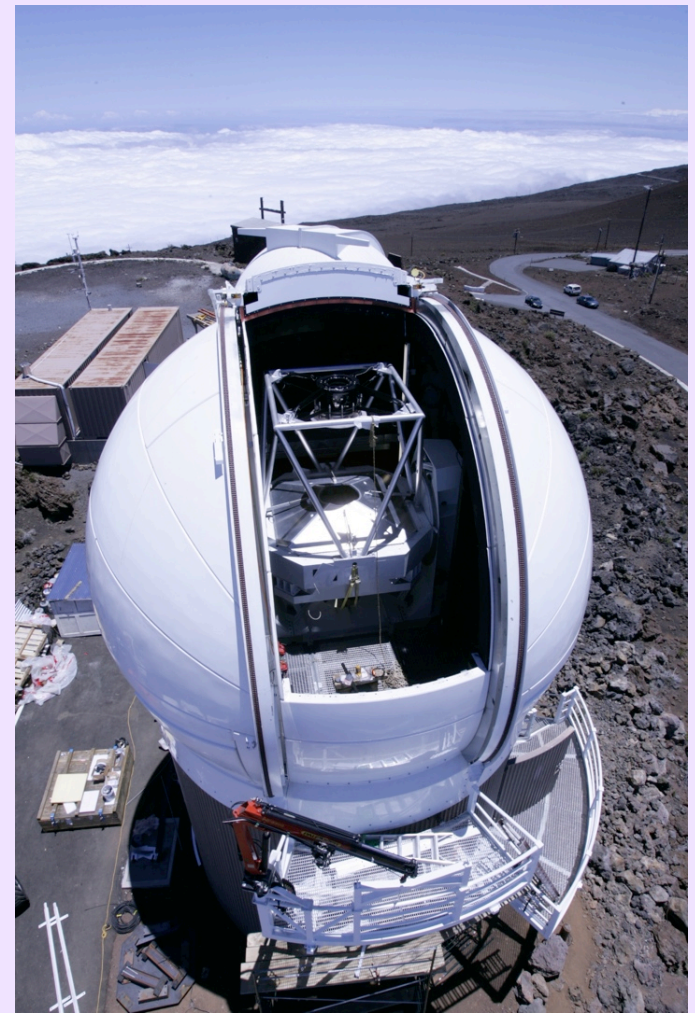
All-Sky Time Machines

SuperWASP

- now
- exoplanets

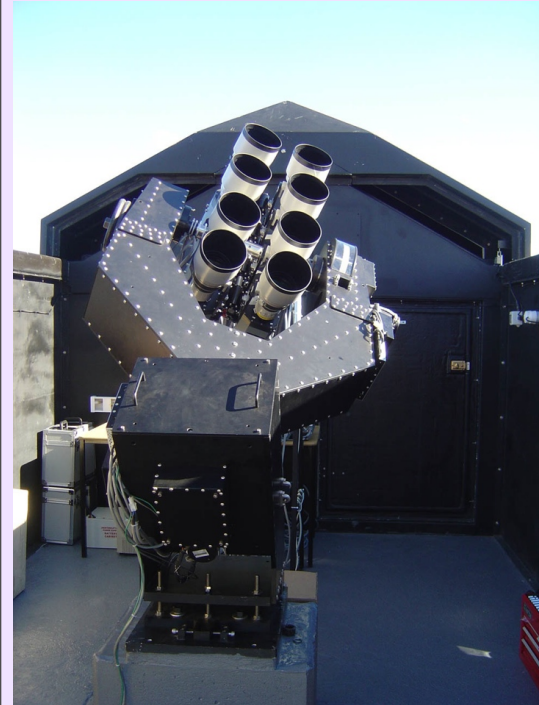
PanSTARRS

- next year
- killer rocks
- supernovae
- black hole flares



LSST

- 2017
- everything

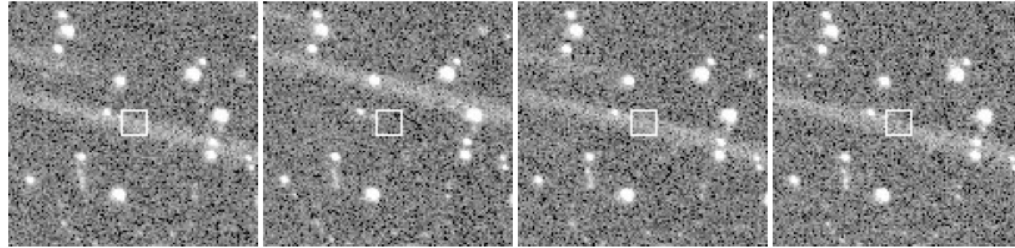


Citizen Science : Transients ?

CRTS (Catalina) Event 6774.

Logged in as mlg

New images



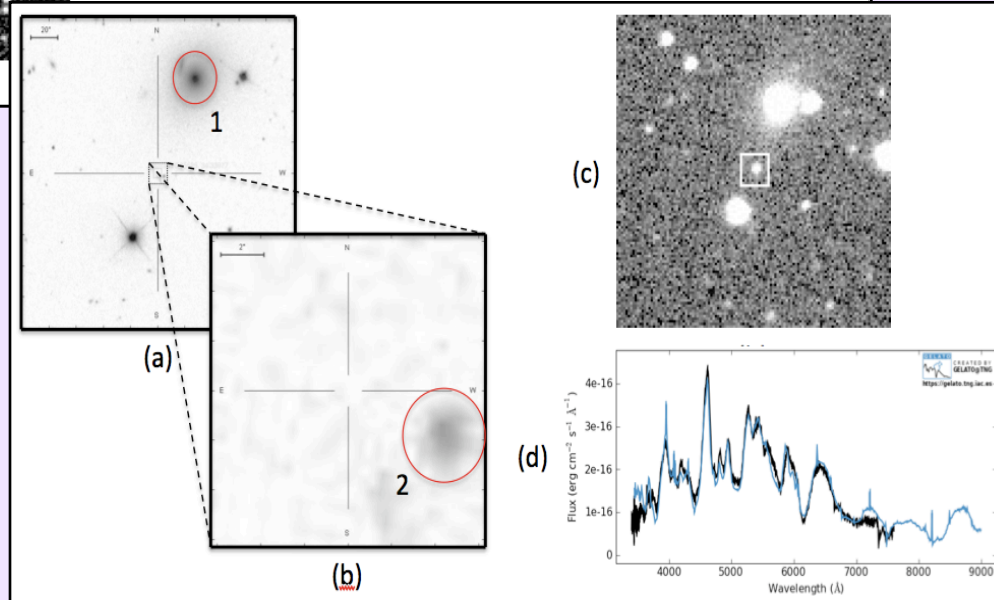
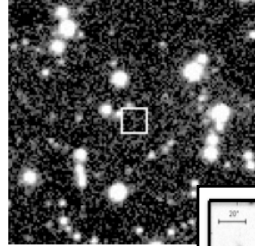
First we would like to understand if the set of images that you see represents a real astronomical object, such as a star getting much brighter, or if it is an artifact or other man-made cause that is nothing to do with what is really happening in the deep sky.

Does this look like a real star field? Is it [Real](#) or is it [Artifact](#)?

Further questions about the nature of the artifact:

- Is there a bright star in the field, or just outside, that may be confusing things? [...more](#)
- Is it an edge? [...more](#)
- Is there a line across the central box? [...more](#)
- Is there a satellite trail across the image? [...more](#)

Reference Image



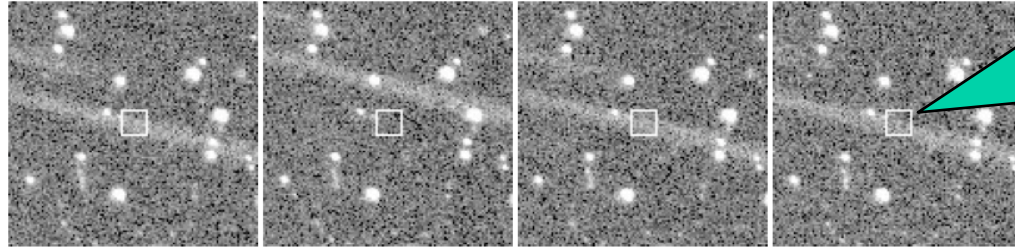
- human check on computer data mining results

Citizen Science : Transients ?

CRTS (Catalina) Event 6774.

Logged in as mij

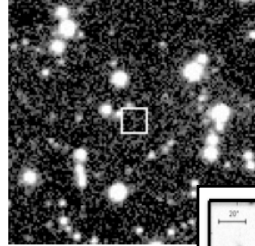
New images



First we would like to understand if the set of images that you see represents a real astronomical object, such as a star getting much brighter, or if it is an artifact or other man-made cause that is nothing to do with what is really happening in the deep sky.

Does this look like a real star field? Is it [Real](#) or is it [Artifact](#)?

Reference Image

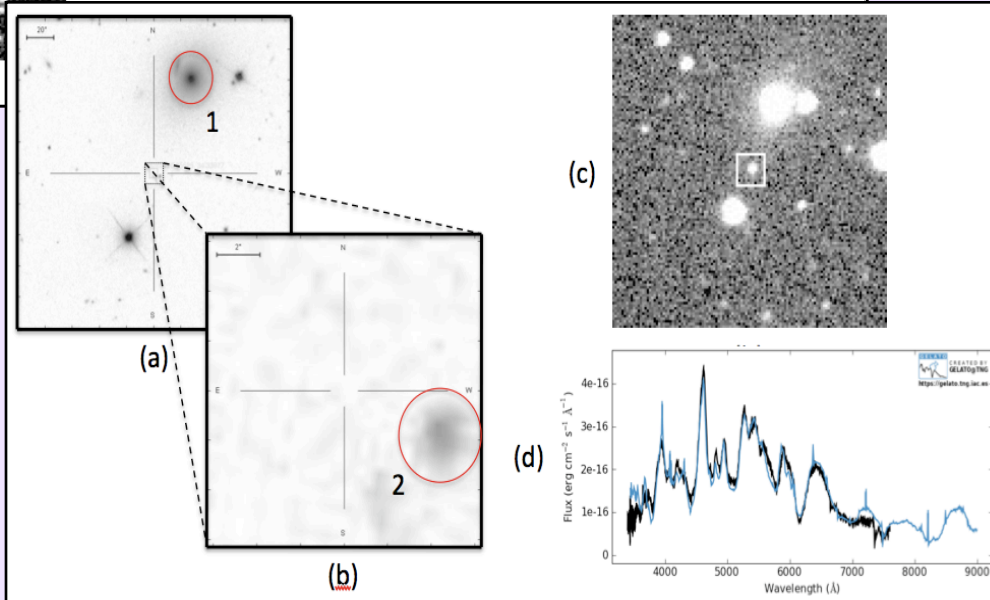


Further questions about the nature of the artifact:

- Is there a bright star in the field, or just outside, that may be confusing things? [...more](#)
- Is it an edge? [...more](#)
- Is there a line across the central box? [...more](#)
- Is there a satellite trail across the image? [...more](#)

Is this thing real ?

- human check on computer data mining results

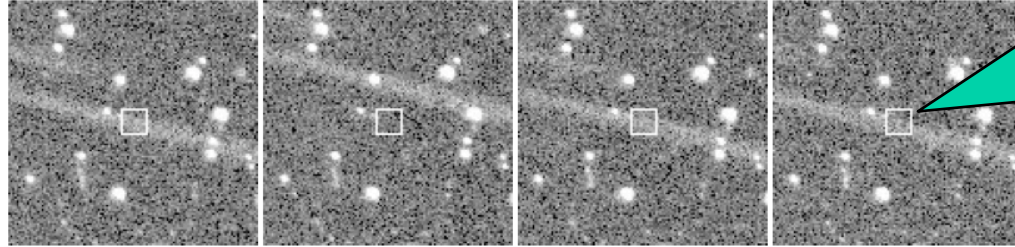


Citizen Science : Transients ?

CRTS (Catalina) Event 6774.

Logged in as mlg

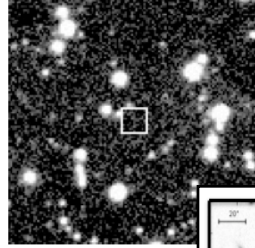
New images



First we would like to understand if the set of images that you see represents a real astronomical object, such as a star getting much brighter, or if it is an artifact or other man-made cause that is nothing to do with what is really happening in the deep sky.

Does this look like a real star field? Is it [Real](#) or is it [Artifact](#)?

Reference Image

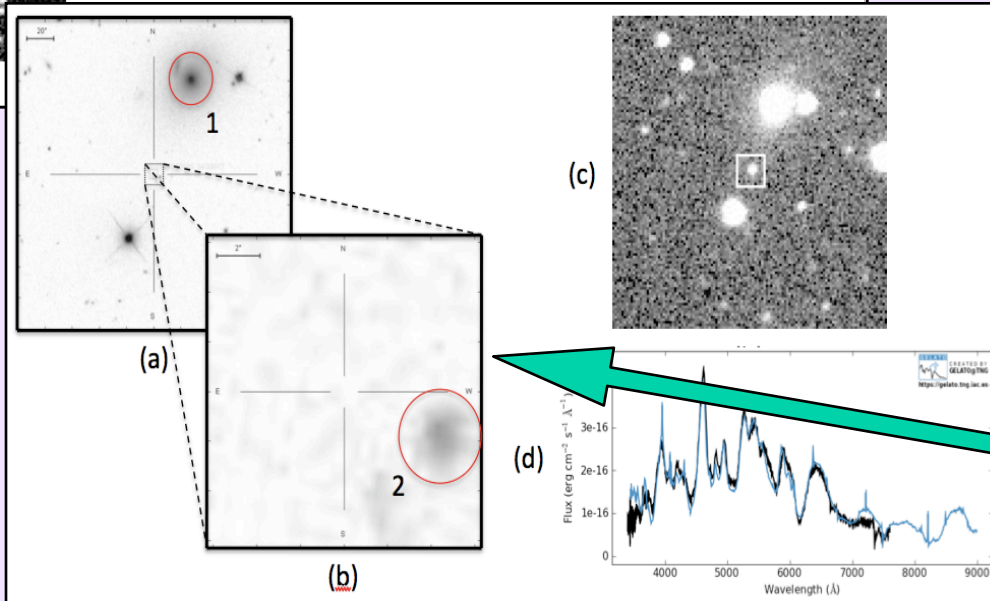


Further questions about the nature of the artifact:

- Is there a bright star in the field, or just outside, that may be confusing things? [...more](#)
- Is it an edge? [...more](#)
- Is there a line across the central box? [...more](#)
- Is there a satellite trail across the image? [...more](#)

Is this thing real ?

- human check on computer data mining results



Does the model look right ?

Taking the initiative

- Citizen Science examples so far are using people as soft computers
- The Pros tell the Ams what to do
- But the whole Virtual Sky is out there waiting for you...
- Surely you can think of something we didn't ?

Taking the initiative

- Citizen Science examples so far are using people as soft computers
- The Pros tell the Ams what to do
- But the whole Virtual Sky is out there waiting for you...
- Surely you can think of something we didn't ?

Over to you

A dense field of stars in various colors (red, orange, yellow, white, blue) with a central yellow box containing the text 'FIN'. The stars are scattered across the frame, with some appearing brighter and larger than others. The background is a mix of dark and light colors, suggesting a rich stellar population.

FIN