

# Treasure hunt

Mark Allen



CoSADIE Project

with thanks to Mike Fitzpatick

# Breaking down science questions

- Find a place to start
- Understand what information already exists
- Identify step by step process

# Tools at your disposal

- Be resourceful!
- TOPCAT, Aladin, VizieR, and many other VO tools have rich set of capabilities
- Many ways of doing the same thing!

# The Rules

- 5 questions
- ~10 minutes per question
- Answer revealed after each question
- Scoring:
  - 1 point if you have an answer
  - 2 points if you have the 'right' answer

*\* Prizes \**

# Question 1.

- What VO service provides images from the UKIRT Infrared Deep Sky Survey (UKIDSS) ?



- UKIDSS DR8 SIAP Service
- e.g. <ivo://wfau.roe.ac.uk/ukidssdr8-siap>
- found via TOPCAT SIA query, or 'All VO' in Aladin

# SIA services in TOPCAT

The image shows a screenshot of the TOPCAT software interface. The main window is titled "Simple Image Access (SIA) Query". It displays a list of available SIA services from a registry. The registry URL is "http://registry.astronipd.org/astroipd-registry/services/RegistryQuery2.R". The search criteria are set to "UKIDS". The search results table lists 8 services, all provided by the Institute for Astronomy at the University of Edinburgh. The "SIA Parameters" section at the bottom includes fields for "SIA URL", "Object Name", "RA" (set to 22000), "Dec" (set to 22000), "Angular Size" (set to 0), and "Image Format" (set to "image/Fits"). A "Submit Query" button is visible at the bottom right of the main window.

Available SIA Services

Registry: <http://registry.astronipd.org/astroipd-registry/services/RegistryQuery2.R>

Keywords: UKIDS

Match Fields:  Object Name  Title  Subject  ID  Publisher  Description

Accept Resource Lists

#	Item Name	Title	Subject	Identifier	Publisher	Format
1	UKIDS 0K1 SIA	UKIDS 0K1 SIA Service	UKIDS 0K1 SIA Images	http://reflex.rse.ac.uk/ukids0k1-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
2	UKIDS 0K2 SIA	UKIDS 0K2 SIA Service	UKIDS 0K2 SIA Images	http://reflex.rse.ac.uk/ukids0k2-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
3	UKIDS 0K3 SIA	UKIDS 0K3 SIA Service	UKIDS 0K3 SIA Images	http://reflex.rse.ac.uk/ukids0k3-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
4	UKIDS 0K4 SIA	UKIDS 0K4 SIA Service	UKIDS 0K4 SIA Images	http://reflex.rse.ac.uk/ukids0k4-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
5	UKIDS 0K5 SIA	UKIDS 0K5 SIA Service	UKIDS 0K5 SIA Images	http://reflex.rse.ac.uk/ukids0k5-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
6	UKIDS 0K6 SIA	UKIDS 0K6 SIA Service	UKIDS 0K6 SIA Images	http://reflex.rse.ac.uk/ukids0k6-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
7	UKIDS 0K7 SIA	UKIDS 0K7 SIA Service	UKIDS 0K7 SIA Images	http://reflex.rse.ac.uk/ukids0k7-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark
8	UKIDS 0K8 SIA	UKIDS 0K8 SIA Service	UKIDS 0K8 SIA Images	http://reflex.rse.ac.uk/ukids0k8-sia	IPAC, Institute for Astronomy, University of Edinburgh	Mark

SIA Parameters

SIA URL: \_\_\_\_\_

Object Name: \_\_\_\_\_

RA: \_\_\_\_\_  (22000)  Accept Sky Positions

Dec: \_\_\_\_\_  (22000)

Angular Size: 0  (0)

Image Format: image/Fits



# Image servers in Aladin

**Server status report**

**UKIDSS**

Description : The UKIRT DR7 Infrared Deep Sky Survey  
Type : Image  
More info : <http://www.ukides.org/>  
Origin : WFAO, Institute for Astronomy, University of Edinburgh  
Status :  
Identifier : UKIDSS

UKIDSS is the next generation near-infrared sky survey, the successor to 2MASS. UKIDSS began in May 2005 and will survey 7500 square degrees of the Northern sky, extending over both high and low Galactic latitudes, in JHK to K=18.3. This depth is three magnitudes deeper than 2MASS. UKIDSS will be the true near-infrared counterpart to the Sloan survey, and will produce as well a panoramic clear atlas of the Galactic plane. In fact UKIDSS is made up of five surveys and includes two deep extra-Galactic elements, one covering 35 square degrees to K=21, and the other reaching K=23 over 0.77 square degrees.

GAIA record:  
IA UKIDSS

[More info...](#) [Close](#)

**Server list**

Check/uncheck the servers concerned by the ALL VO discovery mode

Select all Unselect all Filter:  Go

**Image servers**

- 1)  The Aladin image server (COS/Strasbourg) - OSS/MAM...
- 2)  The UKIRT DR7 Infrared Deep Sky Survey
- 3)  SDSS DR7 Images
- 4)  Multimission Archive at STScI (MAST)
- 5)  Hubble Legacy Archive Footprint Data (HLA)
- 6)  Canadian Astronomical Data Center (CADAC)
- 7)  Hubble press release images
- 8)  VO-Paris Southern Atlas (VOPSAT)
- 9)  Generic SIA query
- 10)  The XMM-Newton Science Archive InterOperability System
- 11)  The ISO Data Archive InterOperability System
- 12)  The Integral Science Data Archive InterOperability System
- 13)  SkyView Virtual Observatory
- 14)  SuperCOSMOS Sky Surveys SSS SIAP Cutout Service
- 15)  UKIDSS DR1 SIAP Service
- 16)  UKIDSS DR2 SIAP Service
- 17)  The Extended IRAS Galaxy Atlas
- 18)  Spitzer First Look Survey (FLS) -- NDAO ELAS N1 -- R
- 19)  Spitzer First Look Survey (FLS) -- NDAO Extragalactic -- R
- 20)  The IRAS Galaxy Atlas
- 21)  The Spitzer Wide-area Infrared Extragalactic Survey
- 22)  Coma Legacy Survey SIAP
- 23)  SIA Service for ROSAT Archive
- 24)  NCSA Astronomy Digital Image Library Simple Image Access
- 25)  The Surface Photometry Catalogue of the ESO-Uppsala Gala...
- 26)  Cosmic Evolution Survey with HST
- 27)  The Mid-Infrared Galaxy Atlas
- 28)  Spitzer First Look Survey (FLS) -- Ancillary MA Data

[SUBMIT](#) [Close](#)

# Question 2.

- How many 2MASS point sources are in the following image?
- [http://cdsweb.u-strasbg.fr/~allen/SDSS\\_i.fits](http://cdsweb.u-strasbg.fr/~allen/SDSS_i.fits)
- (same as: <http://bit.ly/XnknlZ> )
- Bonus: What galaxy is it?



- 94
- M101 (also known as NGC 5457, UGC 8981, The Pinwheel, IRAS 14013+5435, ...)



# Question 3.

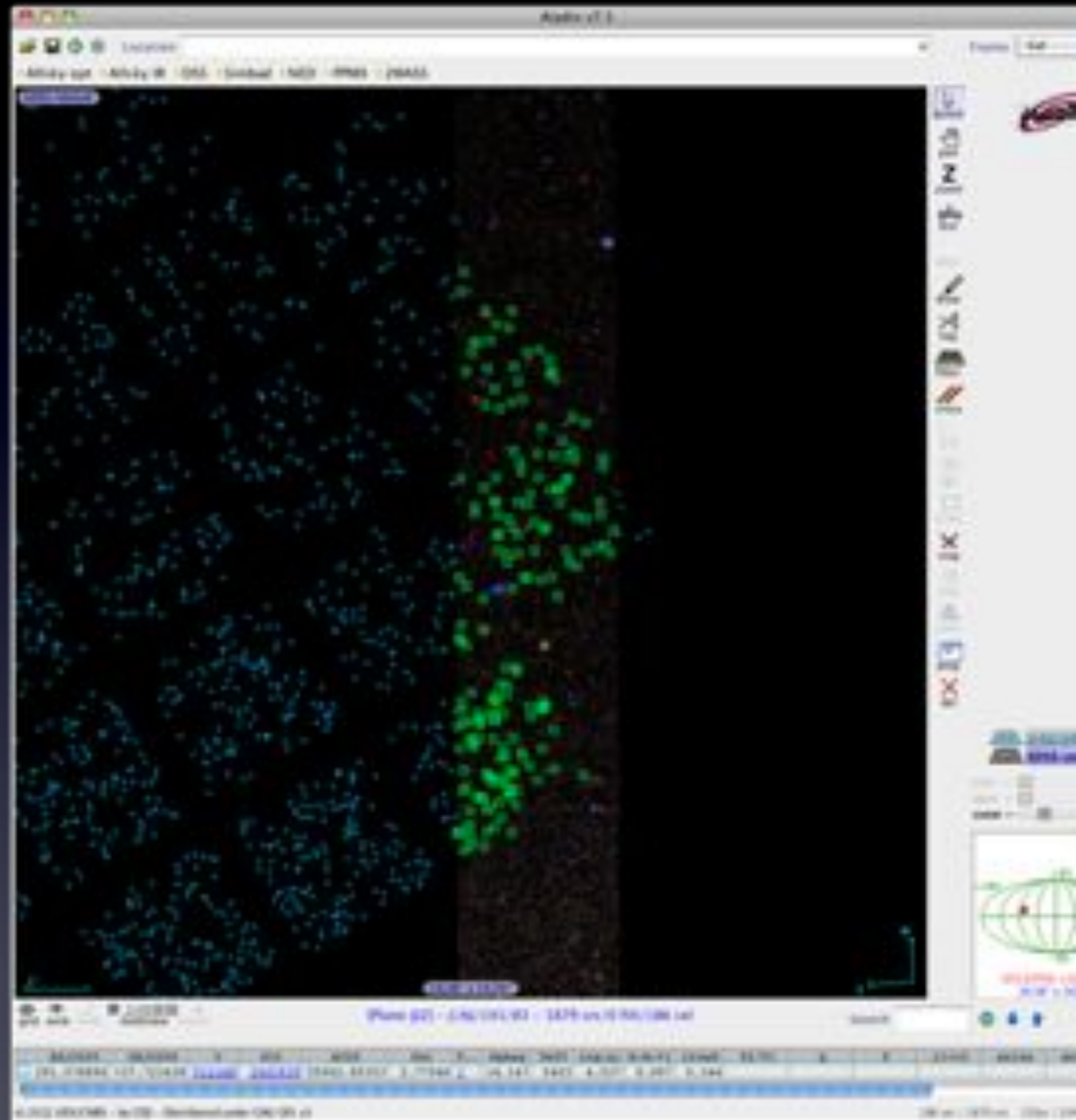
- How many Eclipsing Binaries in the Kepler mission first data release fall within the sky area covered by the Sloan Digital Sky Survey?

**hint:** Data Release catalogue by Prsa+, 2011

**hint:** Use the All-Sky image of SDSS

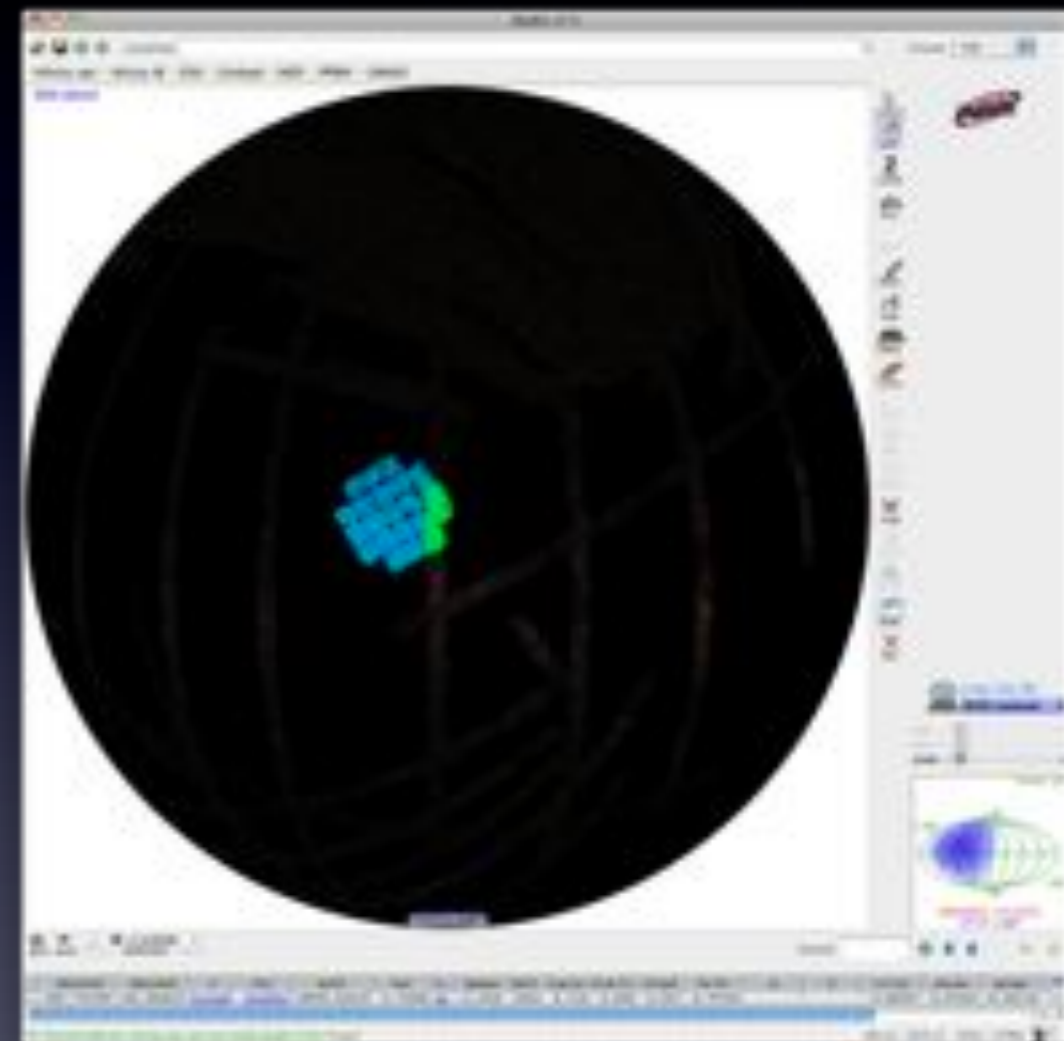
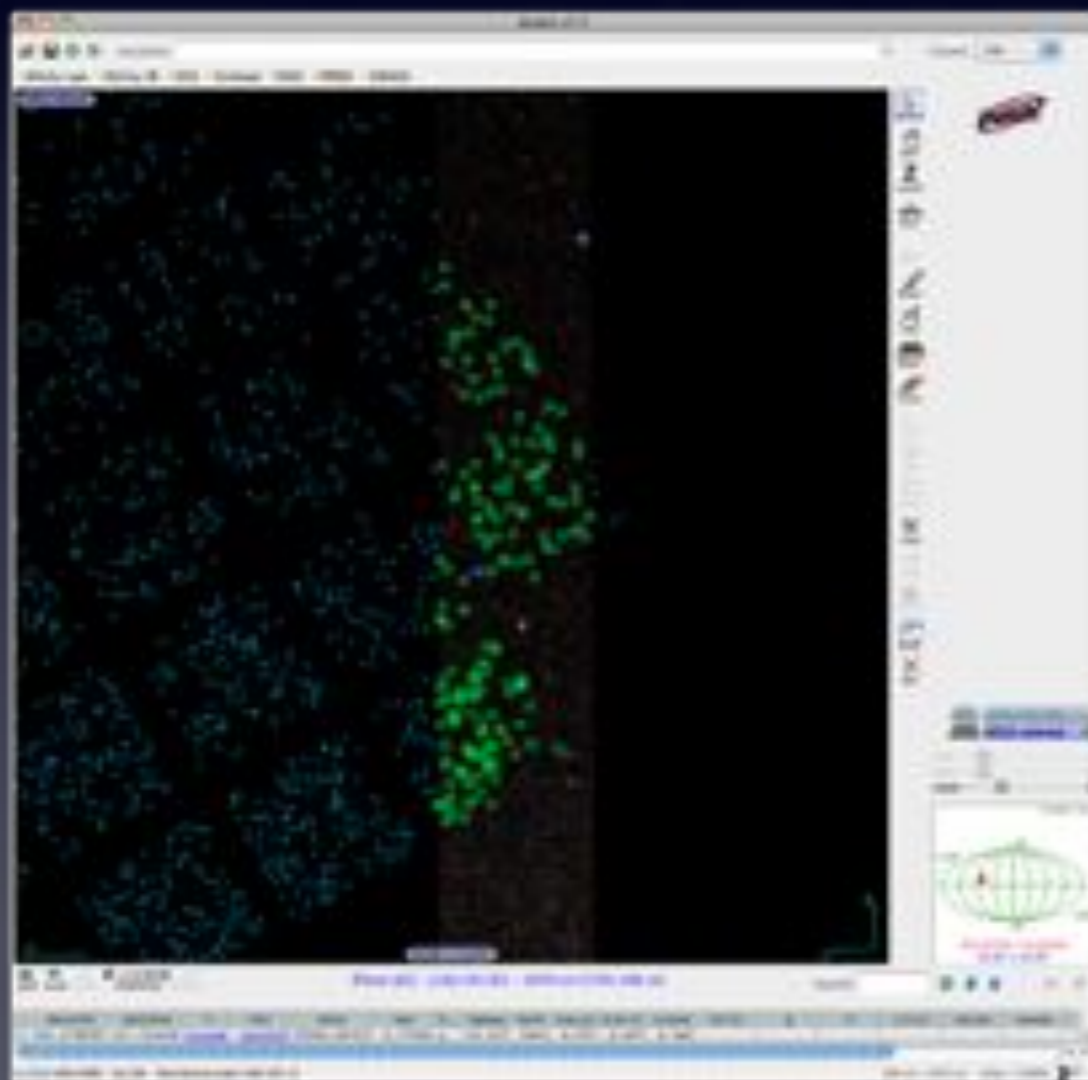


- 185 - 193
- depends on SDSS version

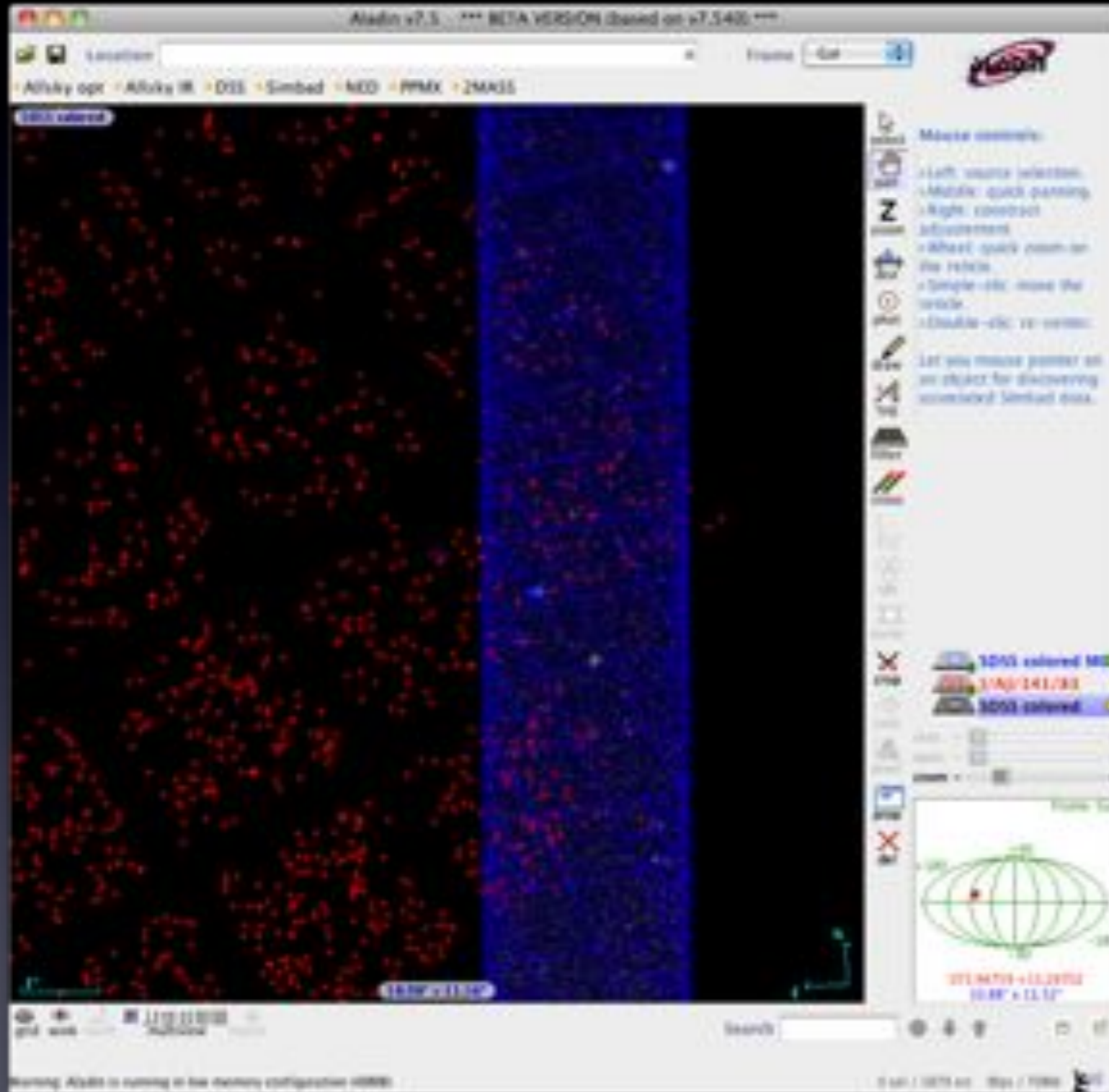




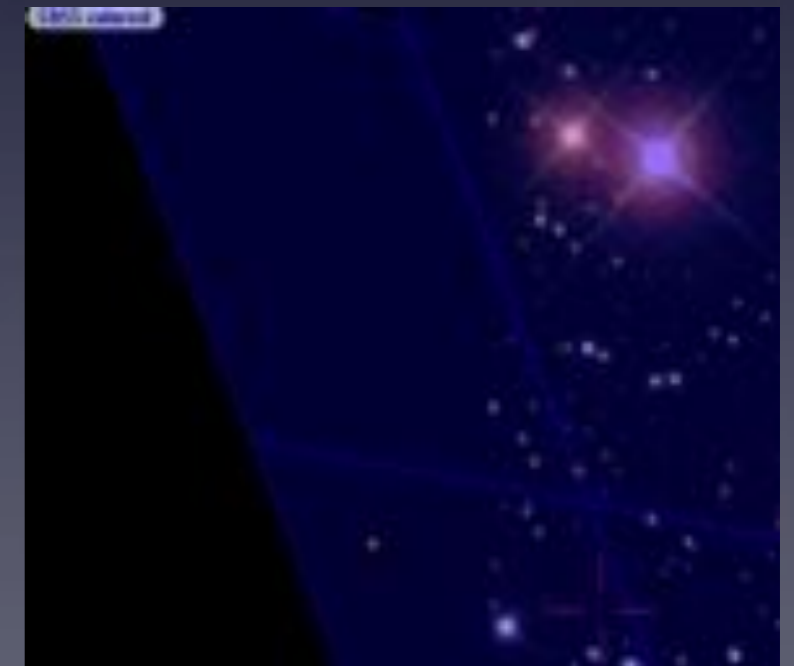
Catalogue compared to SDSS All sky (galactic coords helps selection)



also by using MOC



but be careful of resolution!



# Question 4.

- How many Bautz-Morgan type II Abell clusters are within 10 degrees of the south equatorial pole?

(not including intermediate types)

## Hint:

Use: Rich Clusters of Galaxies (Abell et al. 1989)  
[Astrophys. J. Suppl. Ser. 70, 1 (1989)]

or/ the Abell catalogue from HEASARC



- 12
- Identify a version of the Abell catalog of galaxy clusters, that has Bautz-Morgan types listed
  - HEASARC Abell catalog via TOPCAT cone search
  - Vizier VII/110A (Abell et al 1989)
- Query and filter the catalog on coordinates DEC<-80, and BMtype
- Or include spatial constraint in initial query

VizieR

http://vizier.u-strasbg.fr/viz-bin/VizieR-4

Portal | Contact | VizieR | About | X-Match | Other | Help

### VizieR Result Page

Send to VizieR

Show the input form  
Show annotation information

The 2 columns in *color* are computed by VizieR, and are *not part of the original data*.

**VII118A table4** [Rich Clusters of Galaxies \(Abell+ 1989\)](#) [Available](#) 

[Full annotation](#) [Supplementary southern clusters \(1174 rows\)](#)

File	RAJ2000	DEC2000	ACORN	RAB1950	DEB1950	EMtype	Count	m10	Rich Index	RAJerr	DECerr	
	h:m:s	d:m:s	mag	mag	mag					h:m:s	d:m:s	
1	03 35.9	-85 27	289	03 45.5	-85 47.0		8	17.1	0	5	03 35.9	-85 27
2	15 44.3	-85 27	785	15 30.8	-85 17.0		13	17.2	0	5	15 44.3	-85 27
3	21 27.5	-85 01	928	21 16.6	-85 14.0		4	17.1	0	5	21 27.5	-85 01
4	22 23.8	-84 49	1039	22 13.9	-85 04.0		5	17.3	0	5	22 23.8	-84 49
5	22 49.9	-84 08	1081	22 43.9	-84 24.0		42	16.8	0.0723	5	22 49.9	-84 08
6	00 13.9	-84 04	21	00 14.1	-84 21.0		8	16.0	0	4	00 13.9	-84 04
7	16 03.4	-83 11	788	15 52.9	-83 03.0		24	17.6	0	5	16 03.4	-83 11
8	19 12.6	-82 23	809	19 02.0	-82 28.0		29	17.8	0	5	19 12.6	-82 23
9	01 55.3	-81 23	211	01 56.3	-81 38.0		0	16.8	0	5	01 55.3	-81 23
10	00 19.7	-80 49	30	00 17.7	-81 06.0		3	16.8	0	5	00 19.7	-80 49

Available Visualizations:  
\*Click the results with the VizieR utility

giving the VizieR Service

VizieR

http://vizier.u-strasbg.fr/viz-bin/VizieR-4

Portal | Contact | VizieR | About | X-Match | Other | Help

### VizieR Result Page

Send to VizieR

Show the input form  
Show annotation information

The 2 columns in *color* are computed by VizieR, and are *not part of the original data*.

**VII118A table4** [Rich Clusters of Galaxies \(Abell+ 1989\)](#) [Available](#) 

[Full annotation](#) [Southern "Abell Catalog" \(1364 rows\)](#)

File	RAJ2000	DEC2000	ACORN	RAB1950	DEB1950	EMtype	Count	m10	Rich Index	RAJerr	DECerr	
	h:m:s	d:m:s	mag	mag	mag					h:m:s	d:m:s	
1	04 10.7	-88 43	3299	04 37.7	-88 31.0		39	18.0	0	5	04 10.7	-88 43
2	04 59.5	-86 42	3333	05 16.0	-86 46.0		32	19.4	0	6	04 59.5	-86 42

giving the VizieR Service

© UDS/ONAS  
Contact

## VizieR Result Page

Send to VOtools



- Show the target firm
- Show constant information

The 2 columns in *color* are computed by VizieR, and are *not part of the original data*.

**VII110A/abell** [Rich Clusters of Galaxies \(Abell+ 1989\)](#)

Rich Clusters



*First annotation* Southern "Abell Catalog" (1364 rows)

File	RAJ2000	DEJ2000	ACORAB1950	DEB1950	BMtype	Count	ml9	Rich Dclass	RA_jrv	DE_jrv	
	lons	lats	lons	lats			mag		lons	lats	
1	04 10.7	-88 45	3292	04 57.7	-88 51E		39 18.0	0	5	04 10.7	-88 45
2	04 59.5	-86 42	3333	05 16.0	-86 46E		32 19.4	0	6	04 59.5	-86 42

**VII110A/abell** [Rich Clusters of Galaxies \(Abell+ 1989\)](#)

Rich Clusters



*First annotation* Supplementary southern clusters (1174 rows)

File	RAJ2000	DEJ2000	RAB1950	DEB1950	BMtype	Count	ml9	Rich Dclass	RA_jrv	DE_jrv	ACOS		
	lons	lats	lons	lats			mag		lons	lats			
1	03 55.9	-85 37	03 45.5	-85 47E			8 17.1	0	5	03 55.9	-85 37	389	
2	15 44.5	-85 27	15 30.8	-85 17E			13 17.2	0	5	15 44.5	-85 27	785	
2	21 27.5	-85 01	21 16.6	-85 14E			4 17.1	0	5	21 27.5	-85 01	924	
4	22 23.8	-84 49	22 15.9	-85 04E			5 17.3	0	5	22 23.8	-84 49	1009	
5	22 49.9	-84 08	22 43.9	-84 24E			-62 16.8	0.0723	0	5	22 49.9	-84 08	1061
6	00 15.9	-84 04	00 14.1	-84 21E			-8 16.0	0	4	00 15.9	-84 04	21	
7	16 03.4	-83 11	15 52.9	-83 03E			24 17.6	0	5	16 03.4	-83 11	788	
8	19 12.6	-82 23	19 02.0	-82 28E			29 17.8	0	5	19 12.6	-82 23	809	
9	01 55.3	-81 23	01 56.3	-81 38E			0 16.8	0	5	01 55.3	-81 23	211	
10	00 19.7	-80 49	00 17.7	-81 06E			-20 16.8	0	5	00 19.7	-80 49	30	

Cone Search

Available Cone Services

Registry: [http://registry.astronid.org/astronid-registry/services/RegistryQueryE\\_0](http://registry.astronid.org/astronid-registry/services/RegistryQueryE_0)

Keywords:

Match Fields:  Short Name  Title  Subjects  ID  Publisher  Description

Accept Resource Lists

Short Name	Title	Subjects
ABELL2047	Abell Clusters Measured Redshifts Catalog	Cluster of Galaxies
Abell	Abell Clusters	Cluster of Galaxies
1/A+A/218/143	IRV of Abell 151 galaxies (Fronst+, 1991)	Clusters_of_galaxies, Velocities
1/A+A/278/179	X-ray Emission from Abell Clusters of Galaxies (Brid+ 1993)	Clusters_of_galaxies
1/A+A/363/440	RR photometry of Abell 2104 (Liang+, 2000)	Clusters_of_galaxies, Photometry, Redshifts
1/A+A/377/428	Abell 970 galaxies radial velocities (Gode+, 2001)	Clusters_of_galaxies, Velocities
1/A+A/382/160	RR photometry in Abell 1849 (Qui+, 2002)	Clusters_of_galaxies, Galaxies, Redshifts
1/A+A/384/183	Multiphase galaxies in Abell 1357 and Coma (Ignatiev+Parshin+, 2002)	Photometry narrow-band, Clusters_of_galaxies, Velocities
1/A+A/393/419	Catalogue of galaxies towards Abell 496 (Dunne+, 2002)	Clusters_of_galaxies
1/A+A/394/195	Spectroscopy of Abell 212 and Abell 213 (Dierich+, 2002)	Clusters_of_galaxies, Photometry, Galaxies, Galaxies spectra

AccessURL: <http://heasarc.gsfc.nasa.gov/cgi-bin/vocone/coneGet...>

Cone Parameters

Cone URL: <http://heasarc.gsfc.nasa.gov/cgi-bin/vocone/coneGet.pl?table=abell>

Object Name:

RA:

Dec:

Radius:

TOPCAT: Table Browser

Table Browser for E: Abell-100

name	ra	dec	count	inttype	redshift	rich	dist	vmag	search_offset	
52	ABELL2727	1,85	-80,	18	0-0	0,	1	6	17,3	479,89655
55	ABELL1225	151,7	-80,35	22	0-0	0,	0	5	17,1	521,14975
56	ABELL7905	259,	-80,2	18	0-0	0,	0	5	17,	528,92504
57	ABELL585	22,20	-80,88	-14	0-0	0,	0	5	18,8	528,90897
58	ABELL285	14,50	-80,	9	0-0	0,	0	5	18,8	540,85722
63	ABELL1615	225,72	-80,55	19	0-0	0,	0	5	17,	566,87084
64	ABELL2457	19,19	-80,25	87	0-0	0,	0	5	17,2	585,89001
65	ABELL10145	226,05	-80,27	18	0-0	0,0481	0	3	18,0	589,90894
6	ABELL129	52,64	-86,72	10	0	0,	0	5	17,2	59,98214
9	ABELL111	74,87	-84,7	12	0	0,	0	6	17,1	199,38516
16	ABELL1495	57,97	-85,41	9	0	0,	0	5	17,1	247,97516
17	ABELL2451	216,23	-85,43	12	0	0,	0	5	17,	255,81814
22	ABELL140	221,48	-85,22	-4	0	0,	0	5	17,1	300,3152
25	ABELL10096	215,95	-84,8	5	0	0,	0	5	17,1	302,37408
28	ABELL1613	242,47	-84,37	-12	0	0,2131	0	5	18,4	302,81248
30	ABELL11	2,97	-84,26	-6	0	0,	0	4	18,1	302,83765
37	ABELL185	201,95	-83,16	14	0	0,	0	5	17,	409,31913
44	ABELL1091	189,11	-82,39	19	0	0,	0	5	17,1	454,36417
54	ABELL113	24,43	-82,38	8	0	0,	0	5	18,4	527,87434
58	ABELL105	4,63	-80,82	-10	0	0,	0	5	18,4	537,8582
4	ABELL761	124,54	-87,4	14	0-0	0,	1	5	17,8	169,89311
5	ABELL591	219,1	-86,92	79	0-0	0,	2	5	17,1	194,82805
6	ABELL1650	181,78	-86,8	82	0-0	0,	0	5	17,2	182,10770
7	ABELL1621	242,25	-86,8	55	0-0	0,	1	5	17,2	182,10770
13	ABELL7815	257,42	-85,8	8	0-0	0,	0	5	18,8	246,12991
15	ABELL4805	66,22	-85,8	19	0-0	0,	0	5	17,0	251,91414



# Question 5.

- How many galaxies in the Third Reference Catalog of Bright Galaxies (RC3) have counterparts in the 13th edition Veron & Veron (2010) catalogue of AGN and quasars?

**hint:** you don't need to download the catalogues

*Try CDS X-Match service*

<http://cdsxmatch.u-strasbg.fr/xmatch>



- 392 (with 4" match radius)
- ~1000 (with 1' match radius)

Match Tables

Match Criteria

Algorithm: Sky

Max Error: 4.0 arcsec

Table 1

Table: 11: VO\_218\_vv10

RA column: RAJ2000 degrees

Dec column: DEJ2000 degrees

Table 2

Table: 21: VO\_055\_rc3

RA column: RAJ2000 degrees

Dec column: DEJ2000 degrees

Output Rows

Match Selection: Best match, symmetric

Join Type: 1 and 2

Eliminating multiple row references...

Elapsed time for match: 1 seconds

Match succeeded

Go Stop

Cone Search

Available Cone Services

Registry: [http://registry.astrogrid.org/astrogrid-registry/services/RegistryQueryv1\\_0](http://registry.astrogrid.org/astrogrid-registry/services/RegistryQueryv1_0)

Keywords: RC3

Match Fields:  Short Name  Title  Subjects  ID  Publisher  Description

Accept Resource Lists

Cancel Query Submit Query

Short Name	Title	Subjects	Identifier	Publisher
118y/106/2128	RC3 corrections and additions (Conew+ 1994)	Galaxies	ivo://CDS.VizieR/118y/106/2128	CDS
RC3	Third Reference Catalog of Bright Galaxies	Galaxy	ivo://nasa.ferriarc/rc3	NASA/CSDE/HEASARC
VO/155	Third Reference Cat. of Bright Galaxies (RC3) (de Vaucouleurs+ 1991)	Galaxies	ivo://CDS.VizieR/VO/155	CDS
	RC3: Third Reference Catalog of Bright Galaxies (LEDAS)	LEDAS, rc3	ivo://uk.ac.le.star.impledas/ledas/ledas/rc3	LEDAS, University of Le...

AccessURL: <http://heasarc.gsfc.nasa.gov/cgi-bin/vo/cone/coneGet.pl>

Description:

Version:

Cone Parameters

Cone URL: <http://heasarc.gsfc.nasa.gov/cgi-bin/vo/cone/coneGet.pl?table=rc3&>

Object Name:

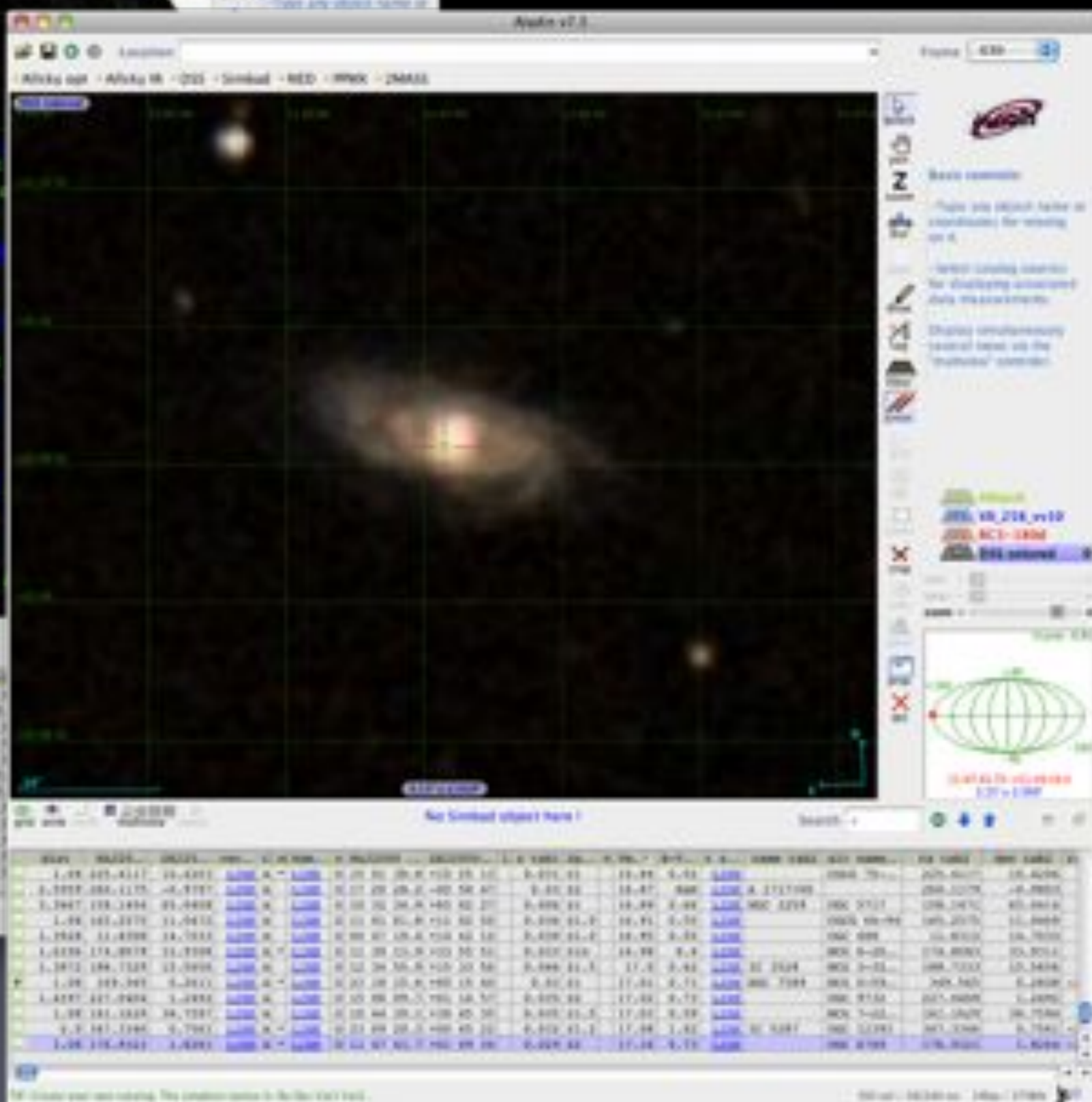
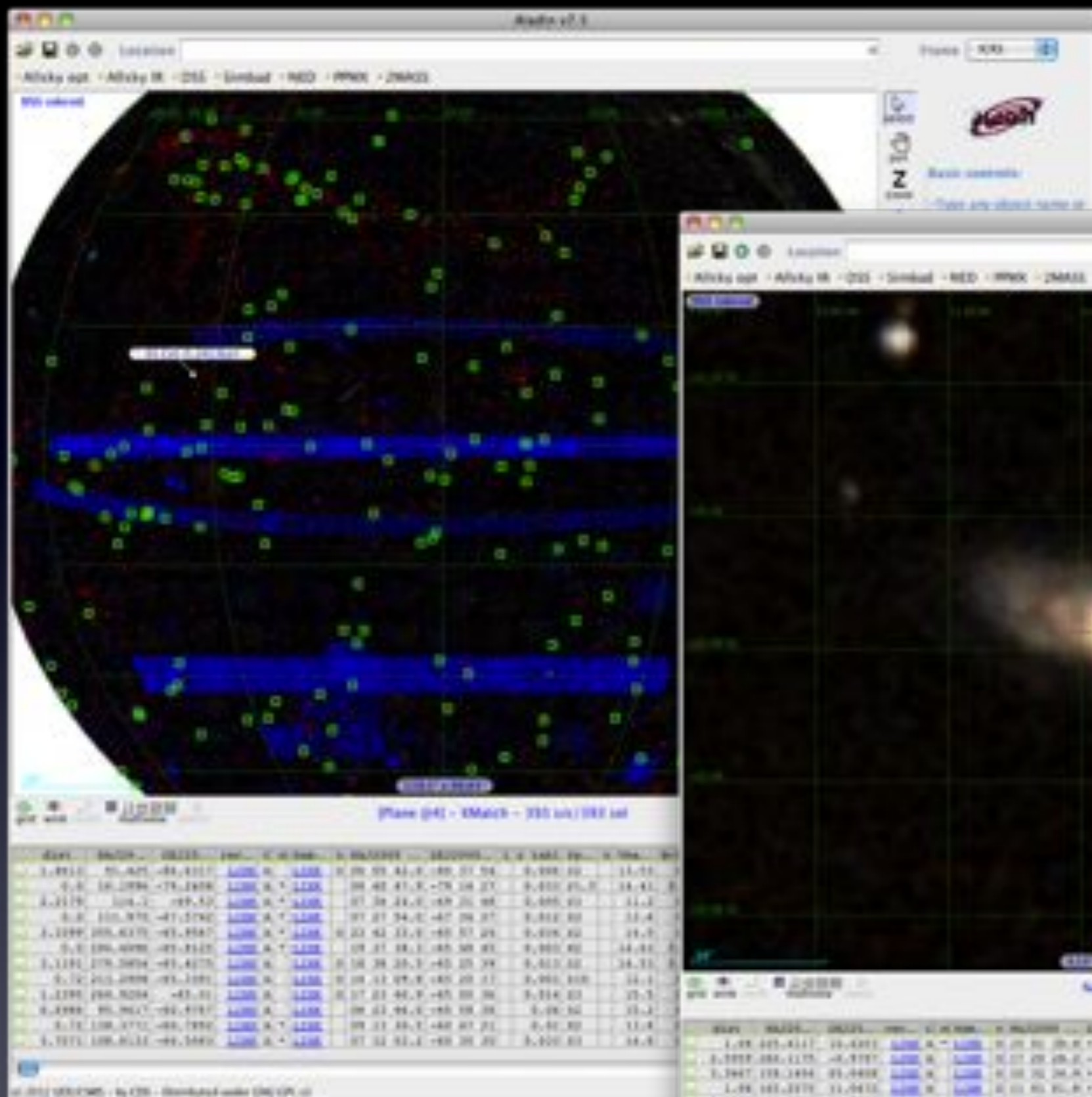
RA: 0 degrees (2000)

Dec: 0 degrees (2000)

Radius: 160 degrees

Accept Sky Point

OK



### Choose tables to cross-match

X

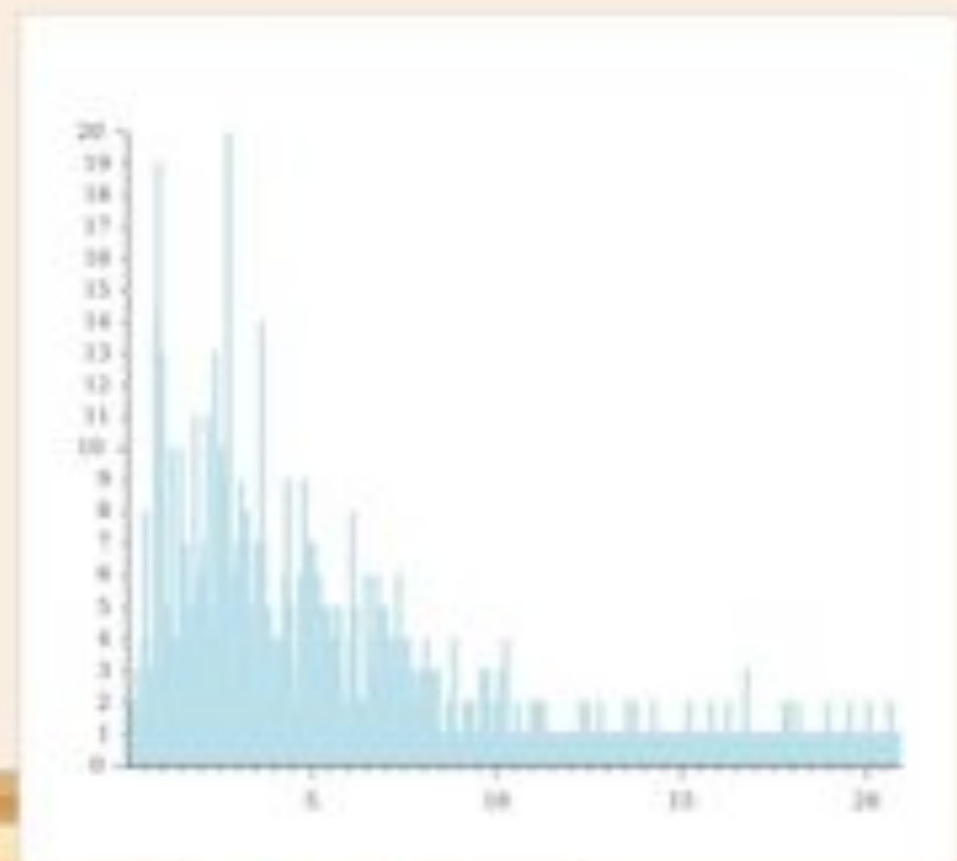
[VizieR](#) [SIMBAD](#) [My stars](#)

[Third Reference Cat. of Bright Galaxies \(RC3\) \(de Vaucouleurs et al. 1991\)](#)

  
 23,011 rows

[Quasars and Active Galactic Nuclei \(13th Ed.\) \(Veron et al. 2010\)](#)

  
 168,940 rows



### Visualize and manage your cross-match jobs

List of X-match jobs


Table 1	Table 2	Options	Begin	Status	
VII/155/rc3	VII/258/vv10	fixed radius	06/02/2013 at 9:54	completed	<input type="button" value="Get result"/> <input type="checkbox"/>
VII/155/rc3	VII/258/vv10	fixed radius	06/02/2013 at 9:53	completed	<input type="button" value="Get result"/> <input type="checkbox"/>

For the selected job(s):

### Choose tables to cross-match

X

[View R](#) | [SIMBAD](#) | [My stars](#)

[Third Reference Cat. of Bright Galaxies \(RC3\) \(de Vaucouleurs+ 1991\)](#) 

23,011 rows

[Quasars and Active Galactic Nuclei \(13th Ed.\) \(Veron+ 2010\)](#) 




168,940 rows

[Show options](#)

**Begin the X-Match**

### Visualize and manage your cross-match jobs

List of X-match jobs

Table 1	Table 2	Options	Begin	Status	Actions
VII/155/rc3	VII/258/vv10	fixed radius 	06/02/2013 at 9:54	completed 	<a href="#">Get result</a> <input type="checkbox"/>
VII/155/rc3	VII/258/vv10	fixed radius 	06/02/2013 at 9:53	completed	<input type="checkbox"/>

Job executed in 1s  
 < 1s to correlate  
 < 1s to generate file  
 Result: 1,000 rows (178 kB)

[Cancel](#)