

# On-line information in astronomy

From networking  
to  
a virtual observatory

# Why keeping data in astronomy?

- Long term observation of variable natural phenomena
- Major scientific objectives:
  - Variability, evolution, statistics
  - Observations at different wavelengths, with different techniques

⇒ *the physical phenomena at work*

# Large projects

- Large ground- and space-based observatories
  - Large surveys
- ⇒ Optimize the scientific return of ‘big science’ by increasing usage

in general 1 year proprietary period

journals: 3 years but abstracts and TOC free

# A few figures: catalogues (1)

- Hipparcos (2<sup>nd</sup> cent. BC), Almagest (2<sup>nd</sup> AD)
- mid-19th, early 20<sup>th</sup>: the first very large catalogues
  - Bonner Durchmusterung (1859-1862)  
325 000 objects
  - Southern Durchmusterung (1886,...)  
135 000 objects
  - Cape Photographic Durchmusterung  
(1895-1900)  
455 000 objects

## A few figures: catalogues (2)

- HIPPARCOS  
100 000 stars, better positions
- Guide Star Catalogue (GSC)  
1992: 20 000 000 \*; 2001: 456 000 000\*
- USNO A1, A2  
500 000 000 stars

# The very large surveys

- Sloan Digital Sky Survey  
100 000 000 objects, 5 colors,  $\pi$  sr,  $z \sim 5$
- DENIS, 2MASS infrared  
3 colors, 100 000 000 objects

Catalogues and surveys



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



ISAAC

VLT

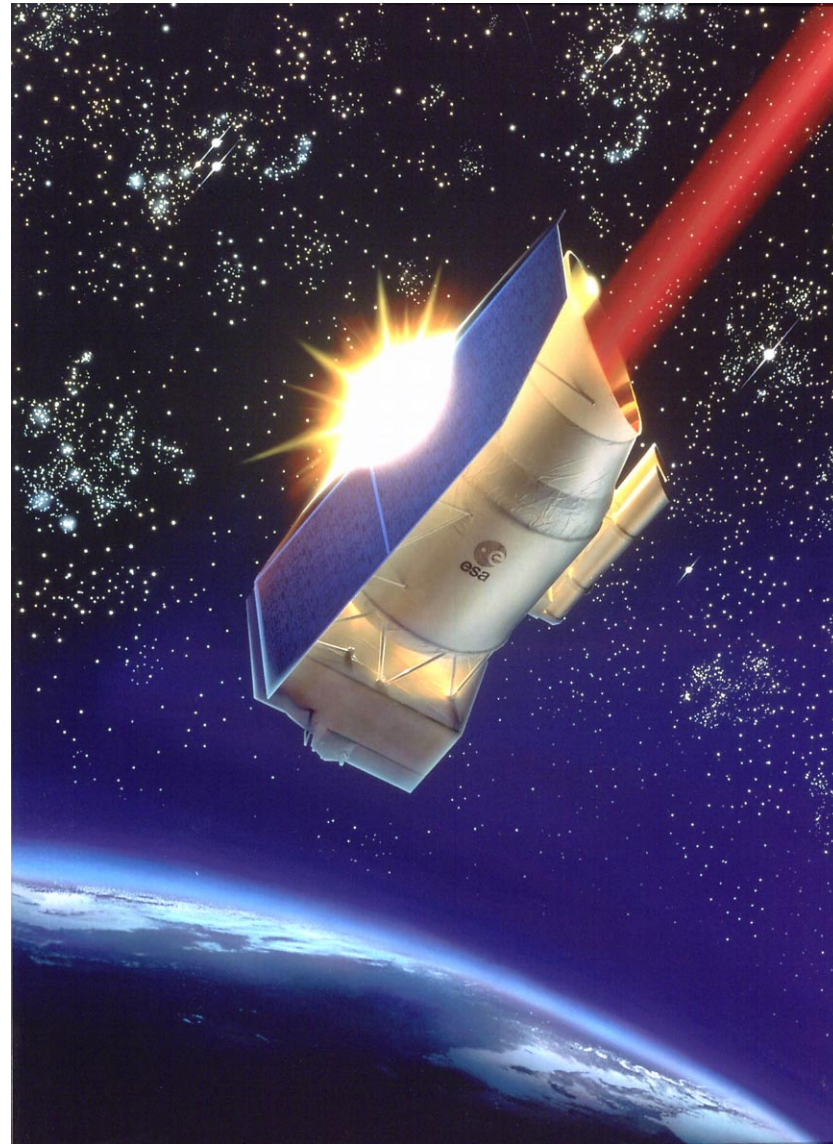


ISO

0.6m telescope

In a cryostat!

4 instruments





# An increasingly complex problem

- Volume and complexity increase
- Distributed, heterogeneous information

Observations, results published in journals, compilations, software, models, ...

- Re-use data

⇒ data ⊕ documentation

# A major technical revolution

- Increased capacity to store and manage information
- Irruption of the WWW
  - Information easily accessible
  - Data/documentation integration
  - Navigation between distributed, heterogeneous information

# Useful and appealing tools

## But

- Careful work on contents and functionalities remains mandatory
- Information validation is critical producers and users!
- Maintenance of services and links

# New constraints

- On Agencies
  - Data conservation, diffusion versus instrumentation, operations
- On the scientific community
  - Give a sufficient priority in projects, evaluation and prospective
  - Resources needed (scientists, engineers)
- On projects
  - Available and usable data
  - selection, organisation, « project memory »

# Networking of information in astronomy

- A small discipline
- Few commercial constraints
- A long term partnership to define exchange standards

# Networking of astronomical information



## **Observations**

Ground- and space-based observatories

Surveys

## **Results**

Publications in electronic journals

# The actors

- Data producers
  - Know instruments and methods
  - ⇒ preserve ‘usable’ data and project memory
- Disciplinary centers
  - Data and information in a given domain
- Journals
  - Results
- Data Centers



# Centre de Données astronomiques de Strasbourg

- Created in 1972
  - Electronic data
  - Expertise about data
  - International role
  - Objective: tools for science

*Collect, homogenize, preserve, distribute  
astronomical information for the usage of the  
whole astronomy community*







## Centre de Données astronomiques de Strasbourg

- Value-added, reference services
- Selected, validated, homogenized information
  - from publications
  - reference catalogues
  - images **+ links**
- Standards and tools



# The CDS hub (1)



## Astronomical objects

identification, bibliography,  
data, measurements



## Information Federator

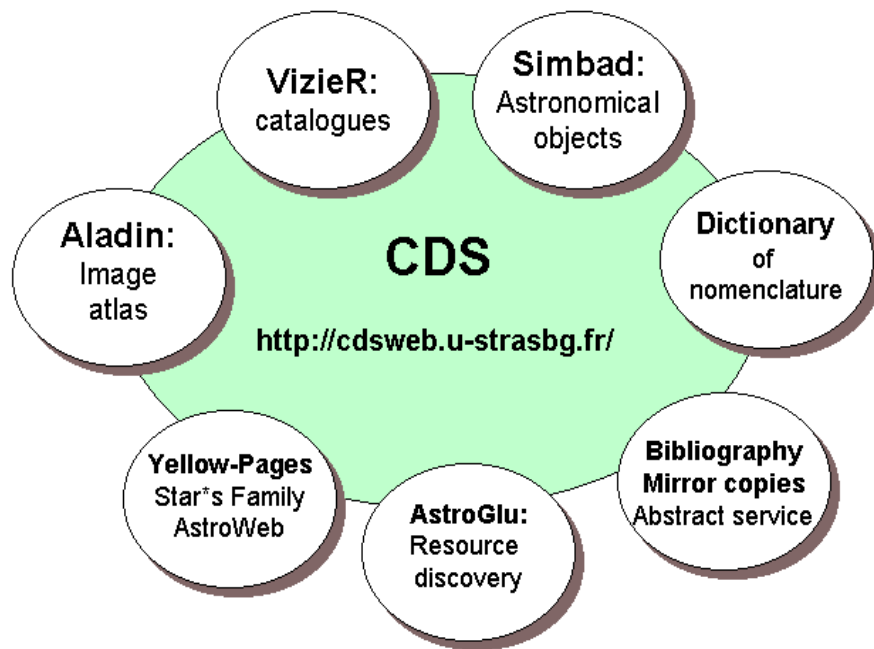
catalogues, published tables  
observation logs, surveys



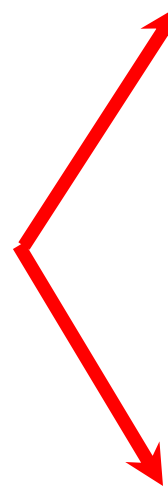
## Information Integrator

images, databases, catalogues,  
surveys, archives, *user data*

# The CDS hub (2)



**Observations**



**Results**

# Query types

- Search by position

*What is known in a region of the sky  
with links to distributed information*

- Search by criteria, e.g.

- gamma ray burst seen in 1999
- published lists of objects from Chandra

# Early interoperability tools

- **FITS** - description of images, spectra
  - common tools to deal with observations from any telescope
  - maintained by an IAU WG
- NED and SIMBAD name resolvers

Access to observatory archives: by position

Object name >  
position:  
Using SIMBAD

The screenshot shows a Netscape browser window titled "The CFHT Archive - Netscape". The address bar shows the URL "http://cadwww.dao.nrc.ca/cfht/". The page header includes "The Canadian Astronomy Data Centre (CADC)" and "NRC-CNRC". The main heading is "CFHT Archive Query". Below this, the text "SIMBAD coordinates for beta Pic : 05 47 17.0, -51 03 59.4" is circled in red. There are buttons for "Request Marked Datasets", "Reset", "MarkAll", and "UnMarkAll". A table of search results is displayed with columns: Mark, Exp.No., Preview, Target Name, RA (J2000), DEC (J2000), and Gal.La. The table contains five rows of data, all with "TEST" in the Preview column and "N/A" in the Target Name column. Below the table, it says "A total of 5 records were retrieved". At the bottom, there is a footer with "wdbi 1.5.1\_03 - 16-May-1999" and a link to "Send comments to cadc@hia.nrc.ca".

Mark	Exp.No.	Preview	Target Name	RA (J2000)	DEC (J2000)	Gal.La
<input type="checkbox"/>	<a href="#">240614</a>	N/A	TEST	05 47 19.02	-51 04 08.9	-30.
<input type="checkbox"/>	<a href="#">240613</a>	N/A	TEST	05 47 19.52	-51 04 09.9	-30.
<input type="checkbox"/>	<a href="#">240612</a>	N/A	TEST	05 47 19.52	-51 04 09.9	-30.
<input type="checkbox"/>	<a href="#">240611</a>	N/A	TEST	05 47 19.02	-51 04 09.9	-30.
<input type="checkbox"/>	<a href="#">240610</a>	N/A	TEST	05 47 19.12	-51 04 09.9	-30.

# Networking

## The astronomy bibliographic network

### Links between

- electronic journals (common keyword schema)
- the ADS bibliographic database
- on-line services (SIMBAD, NED)
- archival data

***bibcode***      e.g. 1999A&A...351.1003G

## References in an on-line article

- links to ADS
- quality check

The screenshot shows a Netscape browser window titled "Chemical Evolution of SBNGs, References - Netscape". The address bar shows the URL: "/ApJ/journal/issues/ApJL/v481n2/5722/refs.html". The main content area is titled "REFERENCES" and contains a list of 30 references. Each reference includes the authors, year, journal, volume, and page number, followed by a link to the full article and a link to the article on NASA ADS. The references are as follows:

- Baldwin, J. A., Phillips, M. M., & Terlevich, R. 1981, PASP, 93, 5 (BPT) [First citation in article](#) | [NASA ADS](#)
- Comte, G., Augarde, R., Chalabaev, A., Kunth, D., & Maehara, H. 1994, A&A, 285, 1 [First citation in article](#) | [NASA ADS](#)
- Considère, S., Contini, T., & Davoust, E. 1997, in preparation [First citation in article](#)
- Contini, T. 1996, Ph.D. thesis, Univ. Paul Sabatier, Toulouse, France [First citation in article](#)
- Coziol, R. 1996a, A&A, 309, 345 [First citation in article](#) | [NASA ADS](#)
- . 1996b, in Young Galaxies and QSO Absorbers, ed. S. M. Viegas, R. Gruewald, R. R. de Carvalho (San Francisco: ASP), 63 [First citation in article](#)
- Coziol, R., Demers, S., Bameoud, R., & Peña, M. 1997, AJ, in press [First citation in article](#)
- Coziol, R., Demers, S., Peña, M., & Bameoud, R. 1994, AJ, 108, 405 [First citation in article](#) | [NASA ADS](#)
- Garnett, D. R., & Shields, G. A. 1987, ApJ, 197, 593 [First citation in article](#)
- Greenawalt, B., & Walterbos, R. A. M. 1996, preprint [First citation in article](#)
- Ho, L., Filippenko, A. V., & Sargent, W. L. W. 1993, ApJ, 417, 63 [First citation in article](#) | [NASA ADS](#)
- Jablonka, P., Martin, P., & Arimoto, N. 1996, preprint [First citation in article](#)
- Kauffmann, G., Charlot, S., & White S. D. M. 1996, preprint [First citation in article](#)
- Keel, W. C., Kennicutt, R. C. Jr., Hummel, E., & van der Hulst, J. M. 1985, AJ, 90, 708 [First citation in article](#) | [NASA ADS](#)
- Kennicutt, R. C., Jr. 1983, ApJ, 272, 54 [First citation in article](#) | [NASA ADS](#)
- Page, B. E. J., Edmunds, M. G., Blackwell, D. E., Chun, M. S., & Smith, G. 1979, MNRAS, 189, 95 [First citation in article](#) | [NASA ADS](#)
- Peña, M., Ruiz, M. T., & Maza, J. 1991, A&AS, 251, 417 [First citation in article](#)
- Oey, M. S., & Kennicutt, R. C., Jr. 1993, ApJ, 411, 1370 [First citation in article](#)
- Skullman, E. D., Kennicutt, R. C., Jr., & Hodge, P. W. 1989, ApJ, 347, 875 [First citation in article](#) | [NASA ADS](#)
- Struck-Marcell, C. 1981, MNRAS, 197, 487 [First citation in article](#) | [NASA ADS](#)
- Terlevich, R., Melnick, J., Masegosa, J., Moles, M., & Copetti, M. V. F. 1991, A&AS, 91, 285 [First citation in article](#) | [NASA ADS](#)
- Tinsley, B. M., & Larson, R. B. 1979, MNRAS, 186, 503 [First citation in article](#) | [NASA ADS](#)
- van den Bergh, S., Abraham, R., Ellis, R., Tanvir, N. Santiago, B., & Glazebrook, K. 1996, preprint [First citation in article](#)
- Veilleux, S., & Osterbrock, D. E. 1987, ApJS, 63, 295 (VO) [First citation in article](#) | [NASA ADS](#)
- Véron, P., Gonçalves, A. C., & Véron-Cetty, M.-P. 1996, preprint [First citation in article](#)
- Zaritsky, D., Kennicutt, R. C., & Huchra, J. P. 1994, ApJ, 420, 87 (ZKH) [First citation in article](#) | [NASA ADS](#)

Next: [FIGURES](#)  
Previous: [ACKNOWLEDGMENTS](#)



## ADS

- Abstracts
- Scanned articles
- Links to original on-line paper
- Links to other, distributed information e.g. original observations
- Also-read articles

2000ApJ...544..895G - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Shop Stop

[ADS Astronomy Abstract Service](#)

- [Find Similar Abstracts](#)
- [Electronic Refereed Journal Article](#)
- [Full Refereed Journal Article](#)
- [On-line Data](#)
- [References in the article](#)
- [Citations to the Article \(3\)](#)
- [SIMBAD Objects](#)
- [Also-Read Articles](#)
- [Translate Abstract](#)

**Title:** STIS Coronagraphic Imaging of the Herbig AE Star: HD 163296

**Authors:** [Grady, C. A.](#); [Dewine, David](#); [Woodgate, B.](#); [Kimble, R.](#); [Bruhweiler, F. C.](#); [Boggess, A.](#); [Linsky, J. L.](#); [Plait, Philip](#); [Clampin, M.](#); [Kalas, P.](#)

**Affiliation:** AA(NOAO/STIS, Goddard Space Flight Center, Code 681, Greenbelt, MD 20771), AB(NOAO/STIS, Goddard Space Flight Center, Code 681, Greenbelt, MD 20771), AC(Laboratory for Astronomy and Solar Physics, Code 681, NASA/GSFC, Greenbelt, MD 20771), AD(Laboratory for Astronomy and Solar Physics, Code 681, NASA/GSFC, Greenbelt, MD 20771), AE(Institute for Astrophysics and Computational Sciences, Catholic University of America, Washington, DC 20064), AF(Institute for Astrophysics and Computational Sciences, Catholic University of America, Washington, DC 20064), AG(JILA, University of Colorado and NIST, Boulder, CO 80309-0440), AH(Advanced Computer Concepts, Inc., Potomac, MD 20854), AI(Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218), AJ(Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218)

**Journal:** The Astrophysical Journal, Volume 544, Issue 2, pp. 895-902. ([ApJ Homepage](#))

**Publication Date:** 12/2000

**Origin:** UCP

**ApJ Keywords:** Stars: Circumstellar Matter, Stars: Planetary Systems, stars: individual (HD 163296), Stars: Pre-Main-Sequence

Document: Done

# HST archive

*From observation  
To publication*

ADS Data Links - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape

[ADS Abstract Service](#)

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Links for 2000ApJ...544..895G

[HST Proposal IDs](#)  
[HST Proposal Id: 7565](#)

[HST Proposal IDs](#)  
[HST Proposal Id: 8042](#)

[HST Proposal IDs](#)  
[HST Proposal Id: 8419](#)

[HST Proposal IDs](#)  
[HST Proposal Id: 8474](#)

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[Astronomy Abstract Service](#)    [HELP](#)

HST Proposal 7565 - Netscape

File Edit View Go Communicator Help

COMPARISON OF PROTOPLANETARY DISKS  
HST Proposal 7565

Bruce Woodgate  
NASA Goddard Space Flight Center

Cycle: 7  
Category: YOUNG STARS AND CIRCUMSTELLAR MATERIAL  
Proposal type: GTO/STIS  
Status: completed

Information from [PRESTO](#):  
[about this proposal](#)  
[about other proposals by this PI](#)

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**Abstract**

We will search for planets and disk structures around nearby bright stars, comparing an example of a solar type and a hotter star, each with a main sequence and a pre-main sequence star, using broad band coronagraphic imaging using the STIS CCD. Multiple roll angles will be used to minimize systematic errors and image artefacts. Parallel observations with NICMOS and WF/PC2 will be taken for distant galaxy studies.

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**ADS links**

Papers related to proposal id:

1. [STIS Coronagraphic Imaging of the herbige Ae Star: HD 163296 -- GRADY,C.A. et al, 2000ApJ...544..895G](#)

Search for relevant abstracts using the [ADS Abstract Service](#)

Author's name:

Search on proposal abstract    Return



A&A on line

*From publication  
to SIMBAD  
and more*

On the X-ray fast-time variability of Sco X-2 (GX 349+2) - Netscape

File Edit View Go Communicator Help

Bookmarks Location: icles/aa/abs/2001/17/aah2493/aah2493.html What's Related

A&A 370, 479-487 (2001)  
DOI: 10.1051/0004-6361:20010216

## On the X-ray fast-time variability of [Sco X-2 \(GX 349+2\)](#)

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(Received 11 October 2000 / Accepted 2 February 2001)

**Abstract**  
We have analysed archived Ginga data on the Z source [Sco X-2 \(GX 349+2\)](#). We present the first detailed investigation of its X-ray fast-time variability as a function of position in the Z track. During the two-day observation over the period 5-7 March 1989, the source was in the so-called flaring branch, and the lower part of the so-called normal branch. We found broad peaked noise with a centroid frequency and width of ~4.7 Hz and ~6-12 Hz respectively. The peaked noise was strongest in the lower flaring branch, with a maximum fractional rms amplitude of ~3%. We conclude that it is not a manifestation of atoll source high frequency noise, as had been suggested, and compare it with the power spectral features seen in other Z sources. We find that the peaked noise is markedly different to the quasi-periodic oscillations found in the normal and flaring branches of [Sco X-1](#); however it bears some resemblance to that seen in the flaring branch of [Cyg X-2](#) at low overall intensities.

**Key words:** accretion, accretion disks -- stars: binaries: close -- stars: individual: [Sco X-2](#); [GX 349+2](#) -- stars: neutron -- X-rays: stars

Offprint request: P. M. O'Neill, [p.m.oneill@adfa.edu.au](mailto:p.m.oneill@adfa.edu.au)

[SIMBAD Objects](#)

Document: Done

# Simbad

## Information

### About the object

**Simbad Query Result**

Object query : **simbad search Sco X-2**  
 ==> Your identifier (Sco X-2) is translated to : **X SCO X-2**

Available data: [Basic data](#) [Identifiers](#) [Plot & image tools](#) [Bibliography](#) [measurements](#) [External archives](#)

**Basic data : V\* V1101 Sco -- Low Mass X-ray Binary**

ICRS 2000.0 coordinates **17 05 44.5 -36 25 22 D** ~  
 FK5 2000/2000 coordinates **17 05 44.5 -36 25 22**  
 FK4 1950/1950 coordinates **17 02 22.9 -36 21 20**

B magn, V magn, Peculiarities **20.1, 18.6**  
 Spectral type ?

**Identifiers (15):**

<a href="#">V* V1101 Sco</a>	<a href="#">X Sco X-2</a>	<a href="#">3A 1702-363</a>
<a href="#">EXO 1703-364</a>	<a href="#">GPS 1702-363</a>	<a href="#">GX 349+02</a>
<a href="#">H 1655-36</a>	<a href="#">H 1702-363</a>	<a href="#">LH 1702-363</a>
<a href="#">JH 1702-363</a>	<a href="#">LFXS J170544.6-362527</a>	<a href="#">ZS 1702-363</a>
<a href="#">3U 1702-36</a>	<a href="#">4U 1702-36</a>	<a href="#">XB 1702-363</a>

**Plots and image tools:**

Query and Plot around  
 radius  arc min.

[Aladin Previewer](#) [Aladin Java Applet](#)

Links  
To high energy  
observations in  
HEASARC,  
To Catalogues

**Simbad Query Result - Netscape**

File Edit View Go Communicator Help

Location: [trasbg.fr/cgi-bin/bibobj?2001A%26A...370..4790&Sco+X-2](http://trasbg.fr/cgi-bin/bibobj?2001A%26A...370..4790&Sco+X-2)

**Identifiers (15):**

<a href="#">V* V1101 Sco</a>	<a href="#">X Sco X-2</a>	<a href="#">3A 1702-363</a>
<a href="#">EXO 1703-364</a>	<a href="#">GPS 1702-363</a>	<a href="#">GX 349+02</a>
<a href="#">H 1655-36</a>	<a href="#">H 1702-363</a>	<a href="#">1H 1702-363</a>
<a href="#">1M 1702-363</a>	<a href="#">1RXS J170544.6-362527</a>	<a href="#">2S 1702-363</a>
<a href="#">3U 1702-36</a>	<a href="#">4U 1702-36</a>	<a href="#">XB 1702-363</a>

**Plots and image tools:**

[Aladin Previewer](#) [Aladin Java Applet](#)

Query and Plot around

radius  arc min.

**References: 128 from 1983 to 2001**

display  from  to

**External archives :**

- Archive data at [HEASARC - High-Energy Astrophysics Science Archive Research Center](#)
- Catalogue information from [VizieR](#) :  
[V\\* V1101 Sco](#)

[Return to SIMBAD query form](#)

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# Lessons learnt (1)

- *De facto* standard
- Bottom-up approach: Cooperation between all the actors + snowball effect  
Journals, ADS, data centers, archive centers
- Easy-to-build link  
but contents / validation are fundamental

## Lessons learnt (2)

- Standard discussed long before Internet, because two data bases needed to exchange bibliographic information
- Bibcode is better adapted to ‘classical’ publication in journals, human readable
- Gateway to other bibliographical standards (e.g. DOI): correspondance table

# Data federation

## Tabular data in astronomy

A common description for tabular data

- Reference catalogues
- Published tables
- Large surveys
- Catalogues of observations in archives

***ReadMe***

*physical organization*      ⇔      *contents*



# ReadMe

For published tables:  
check of data homogeneity before publication

sent by authors and checked or prepared by editorial office

**I/221** The Magellanic Catalogue of Stars - MACS (Tucholke+ 1996)

The Magellanic Catalogue of Stars - MACS  
Tucholke H.-J., de Boer K.S., Seitter W.C.  
<Astron. Astrophys. Suppl. Ser., 119, 91-98 (1996)>  
<The Messenger 81, 20 (1995)>  
[=1996A&AS..119...91T](#) =[1995Msngr..81...20D](#)

**ADC\_Keywords:** Magellanic Clouds ; Positional data

**Description:**  
The Magellanic Catalogue of Stars (MACS) is based on scans of ESO Schmidt plates and contains about 244,000 stars covering large areas around the LMC and the SMC. The limiting magnitude is B<16.5m and the positional accuracy is better than 0.5" for 99% of the stars. The stars of this catalogue were screened interactively to ascertain that they are undisturbed by close neighbours.

**File Summary:**

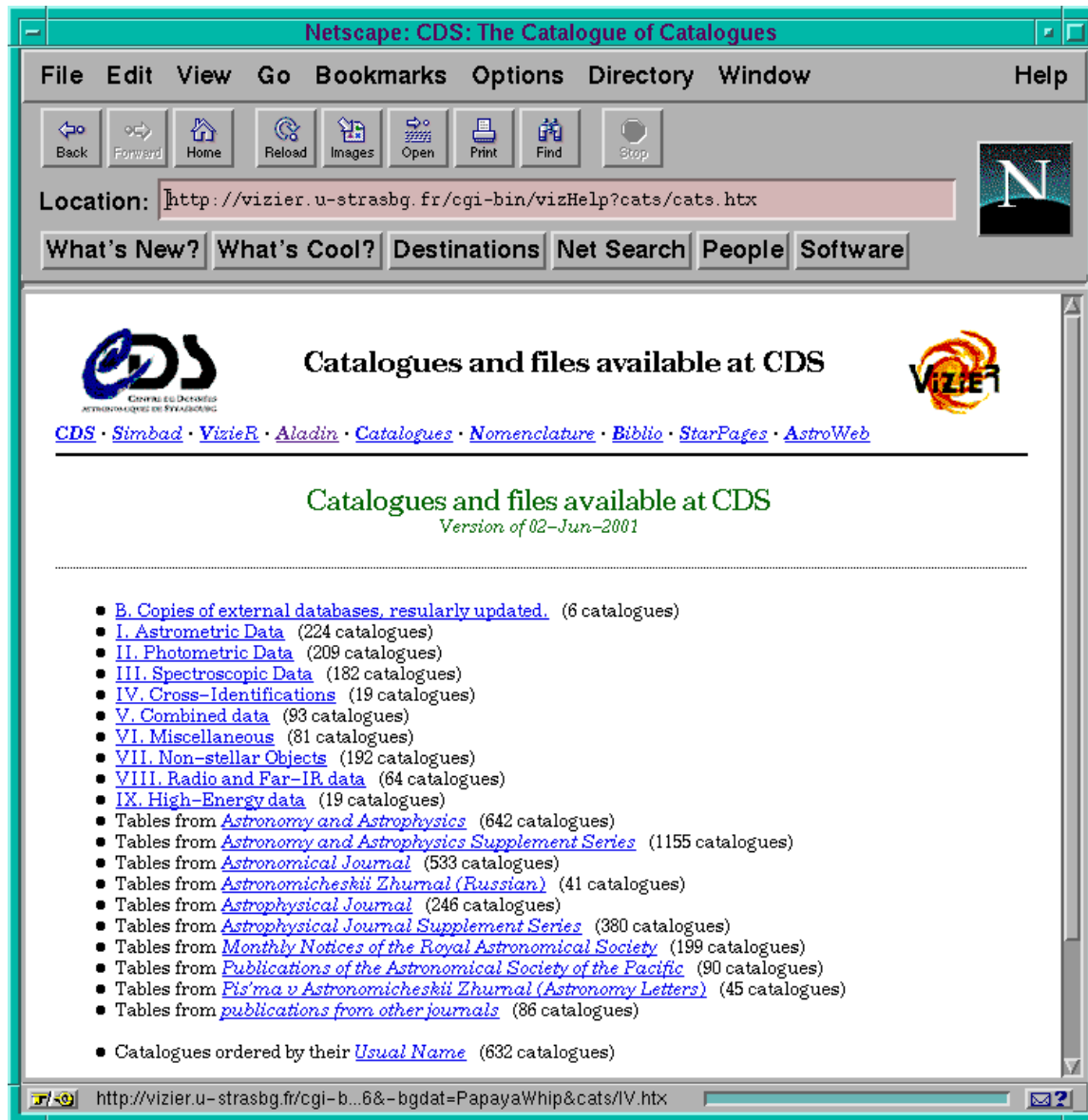
FileName	Lrecl	Records	Explanations
* ReadMe	80	.	This file
* <a href="#">lmc.dat</a>	52	175779	The Large Magellanic Cloud
* <a href="#">smc.dat</a>	52	67782	The Small Magellanic Cloud

**Byte-by-byte Description of file:** [lmc.dat](#) [smc.dat](#)

Bytes	Format	Units	Label	Explanations
1- 12	A12	---	MACS	Designation
14- 15	I2	<a href="#">h</a>	RAh	Right Ascension J2000 , Epoch 1989.0 (hours)
17- 18	I2	<a href="#">min</a>	RAm	Right Ascension J2000 (minutes)
20- 25	F6.3	<a href="#">s</a>	RA s	Right Ascension J2000 (seconds)
27	A1	---	DE-	Declination J2000 (sign)
28- 29	I2	<a href="#">deg</a>	DEd	Declination J2000 , Epoch 1989.0 (degrees)
31- 32	I2	<a href="#">arcmin</a>	DEm	Declination J2000 (minutes)
34- 38	F5.2	<a href="#">arcsec</a>	DEs	Declination J2000 (seconds)
40	I1	---	Npos	Number of positions used



Tables published  
in articles are  
usable data!



**CDS**  
CENTRE DE DONNÉES  
ASTRONOMIQUES DE STRASBOURG

**Catalogues and files available at CDS**

[CDS](#) · [Simbad](#) · [VizieR](#) · [Aladin](#) · [Catalogues](#) · [Nomenclature](#) · [Biblio](#) · [StarPages](#) · [AstroWeb](#)

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**Catalogues and files available at CDS**  
Version of 02-Jun-2001

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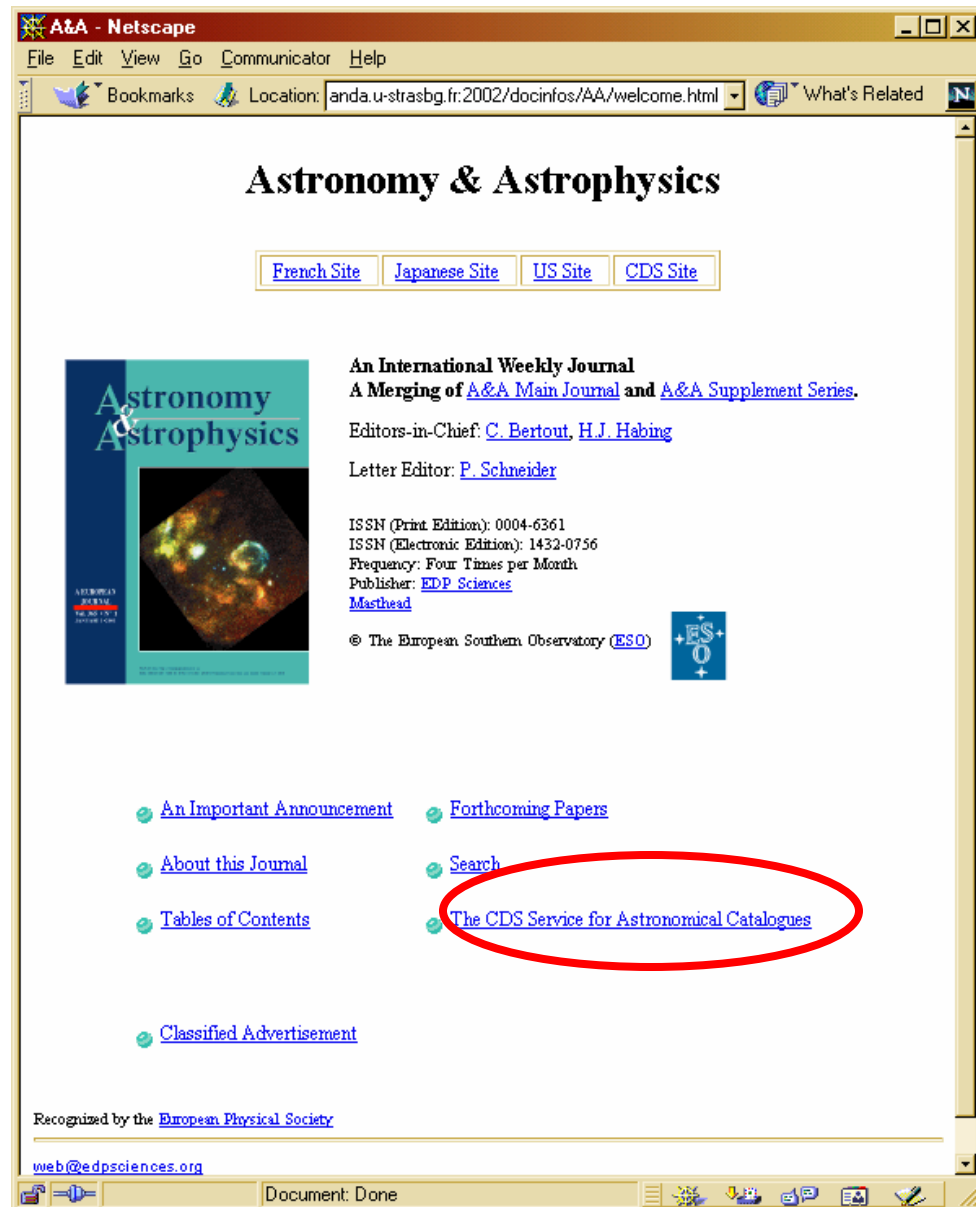
- [B. Copies of external databases, regularly updated.](#) (6 catalogues)
- [I. Astrometric Data](#) (224 catalogues)
- [II. Photometric Data](#) (209 catalogues)
- [III. Spectroscopic Data](#) (182 catalogues)
- [IV. Cross-Identifications](#) (19 catalogues)
- [V. Combined data](#) (93 catalogues)
- [VI. Miscellaneous](#) (81 catalogues)
- [VII. Non-stellar Objects](#) (192 catalogues)
- [VIII. Radio and Far-IR data](#) (64 catalogues)
- [IX. High-Energy data](#) (19 catalogues)
- Tables from [Astronomy and Astrophysics](#) (642 catalogues)
- Tables from [Astronomy and Astrophysics Supplement Series](#) (1155 catalogues)
- Tables from [Astronomical Journal](#) (533 catalogues)
- Tables from [Astronomicheskii Zhurnal \(Russian\)](#) (41 catalogues)
- Tables from [Astrophysical Journal](#) (246 catalogues)
- Tables from [Astrophysical Journal Supplement Series](#) (380 catalogues)
- Tables from [Monthly Notices of the Royal Astronomical Society](#) (199 catalogues)
- Tables from [Publications of the Astronomical Society of the Pacific](#) (90 catalogues)
- Tables from [Pis'ma v Astronomicheskii Zhurnal \(Astronomy Letters\)](#) (45 catalogues)
- Tables from [publications from other journals](#) (86 catalogues)

• Catalogues ordered by their [Usual Name](#) (632 catalogues)

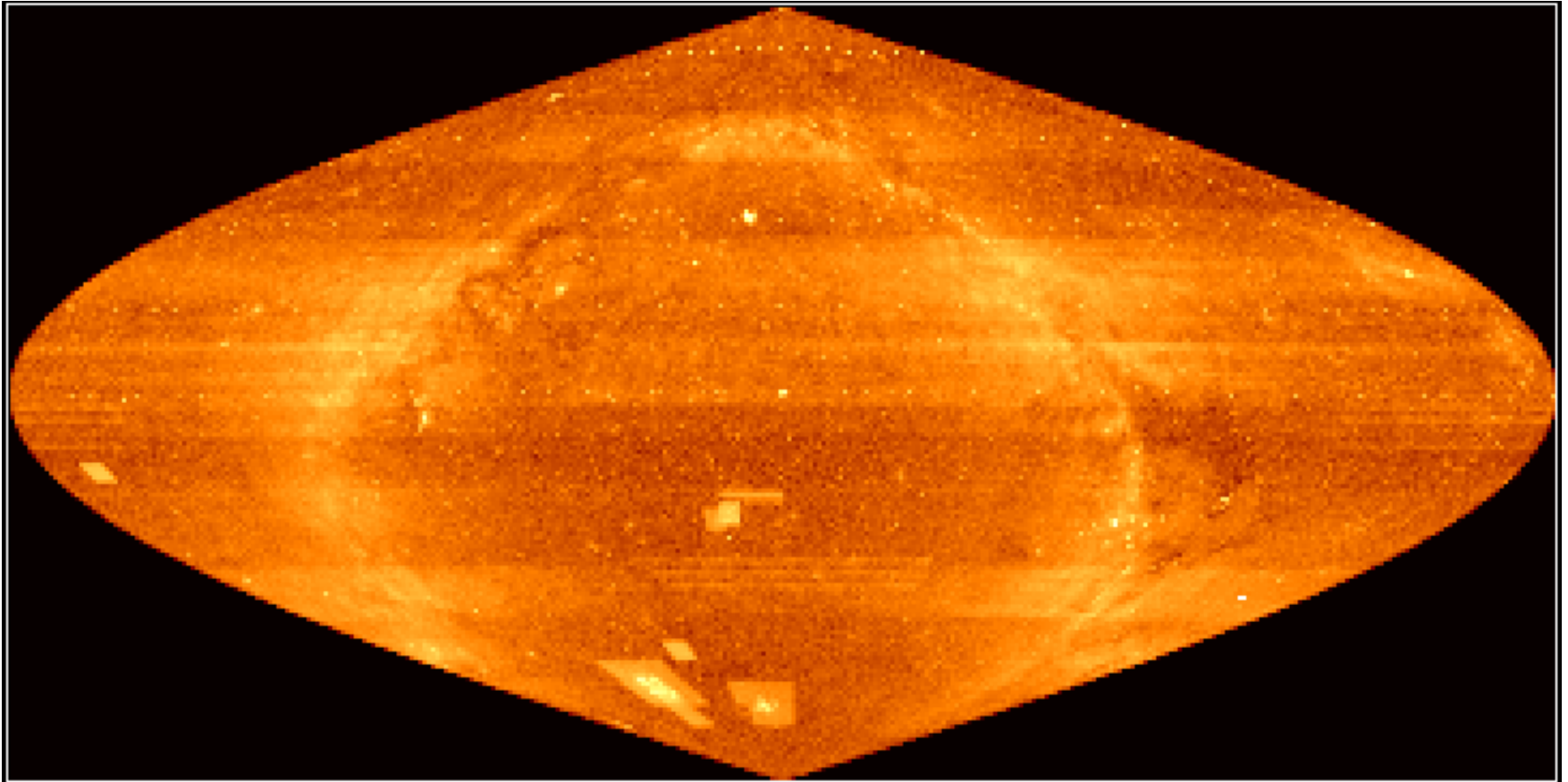
http://vizier.u-strasbg.fr/cgi-bin/vizHelp?cats/cats.htx



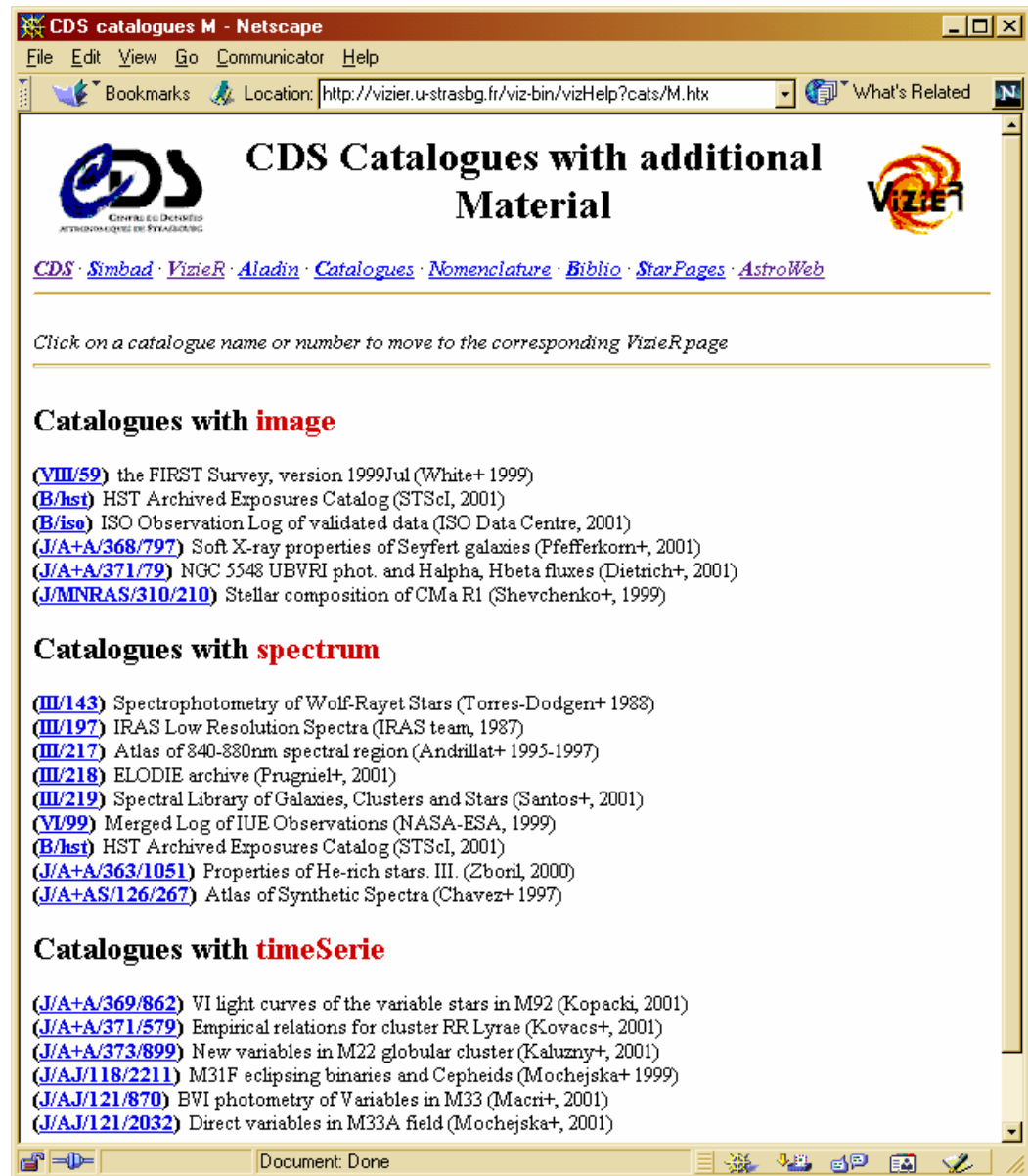
# Narrow collaboration between CDS and journals



# The 'tabular' data mine





Links to observational data (images, spectra, time series), often distributed in observatory archives



CDS catalogues M - Netscape

File Edit View Go Communicator Help

Bookmarks Location: <http://vizier.u-strasbg.fr/viz-bin/vizHelp?cats/M.htx> What's Related

 **CDS Catalogues with additional Material** 

[CDS](#) · [Simbad](#) · [VizieR](#) · [Aladin](#) · [Catalogues](#) · [Nomenclature](#) · [Biblio](#) · [StarPages](#) · [AstroWeb](#)

Click on a catalogue name or number to move to the corresponding VizieR page

**Catalogues with image**

- [\(VIII/59\)](#) the FIRST Survey, version 1999Jul (White+ 1999)
- [\(B/hst\)](#) HST Archived Exposures Catalog (STScI, 2001)
- [\(B/iso\)](#) ISO Observation Log of validated data (ISO Data Centre, 2001)
- [\(J/A+A/368/797\)](#) Soft X-ray properties of Seyfert galaxies (Pfefferkorn+, 2001)
- [\(J/A+A/371/79\)](#) NGC 5548 UBVRi phot. and Halpha, Hbeta fluxes (Dietrich+, 2001)
- [\(J/MNRAS/310/210\)](#) Stellar composition of CMA R1 (Shevchenko+, 1999)

**Catalogues with spectrum**

- [\(III/143\)](#) Spectrophotometry of Wolf-Rayet Stars (Torres-Dodgen+ 1988)
- [\(III/197\)](#) IRAS Low Resolution Spectra (IRAS team, 1987)
- [\(III/217\)](#) Atlas of 840-880nm spectral region (Andrillat+ 1995-1997)
- [\(III/218\)](#) ELODIE archive (Prugniel+, 2001)
- [\(III/219\)](#) Spectral Library of Galaxies, Clusters and Stars (Santos+, 2001)
- [\(VI/99\)](#) Merged Log of IUE Observations (NASA-ESA, 1999)
- [\(B/hst\)](#) HST Archived Exposures Catalog (STScI, 2001)
- [\(J/A+A/363/1051\)](#) Properties of He-rich stars. III. (Zboril, 2000)
- [\(J/A+AS/126/267\)](#) Atlas of Synthetic Spectra (Chavez+ 1997)

**Catalogues with timeSerie**

- [\(J/A+A/369/862\)](#) VI light curves of the variable stars in M92 (Kopacki, 2001)
- [\(J/A+A/371/579\)](#) Empirical relations for cluster RR Lyrae (Kovacs+, 2001)
- [\(J/A+A/373/899\)](#) New variables in M22 globular cluster (Kaluzny+, 2001)
- [\(J/A/J/118/2211\)](#) M31F eclipsing binaries and Cepheids (Mochejska+ 1999)
- [\(J/AJ/121/870\)](#) BVI photometry of Variables in M33 (Macri+, 2001)
- [\(J/AJ/121/2032\)](#) Direct variables in M33A field (Mochejska+, 2001)

Document: Done

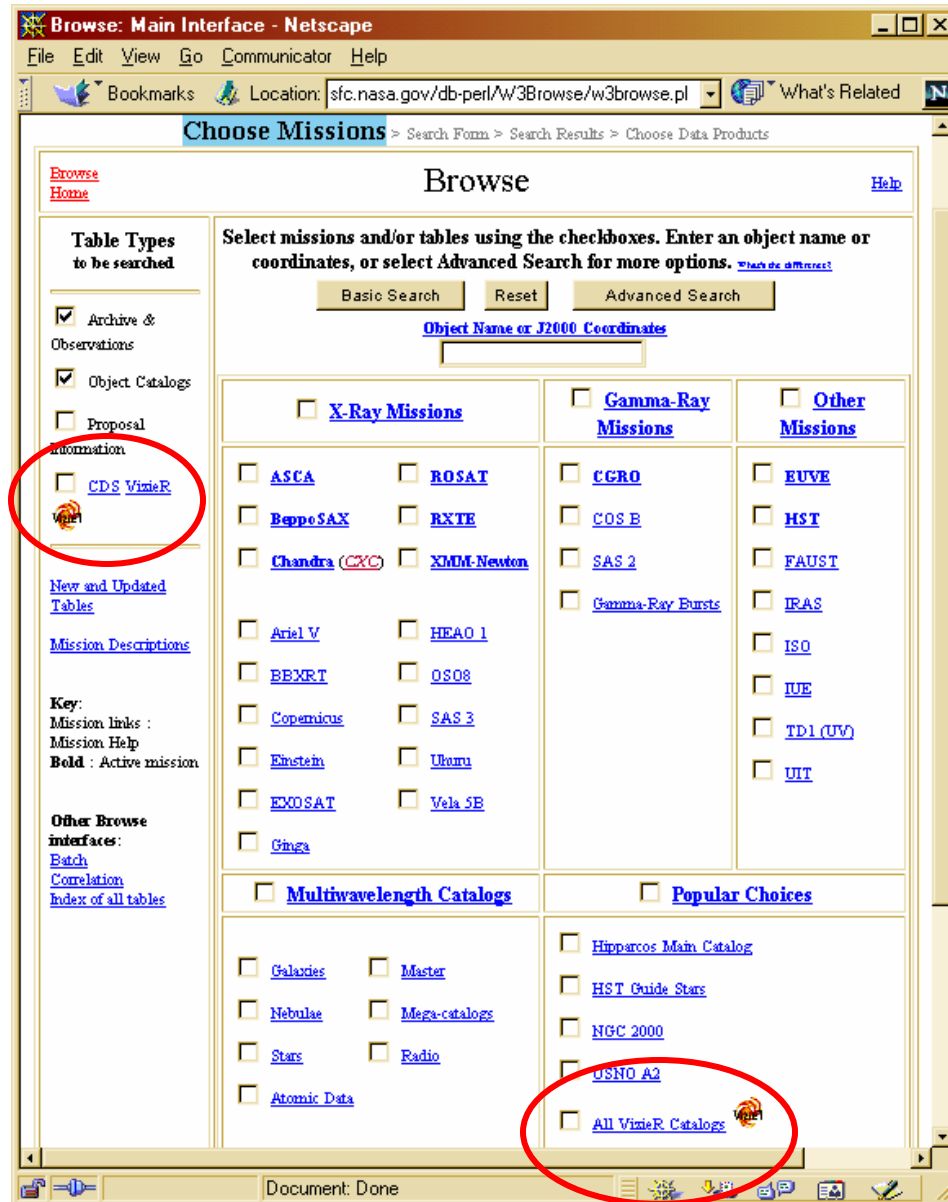


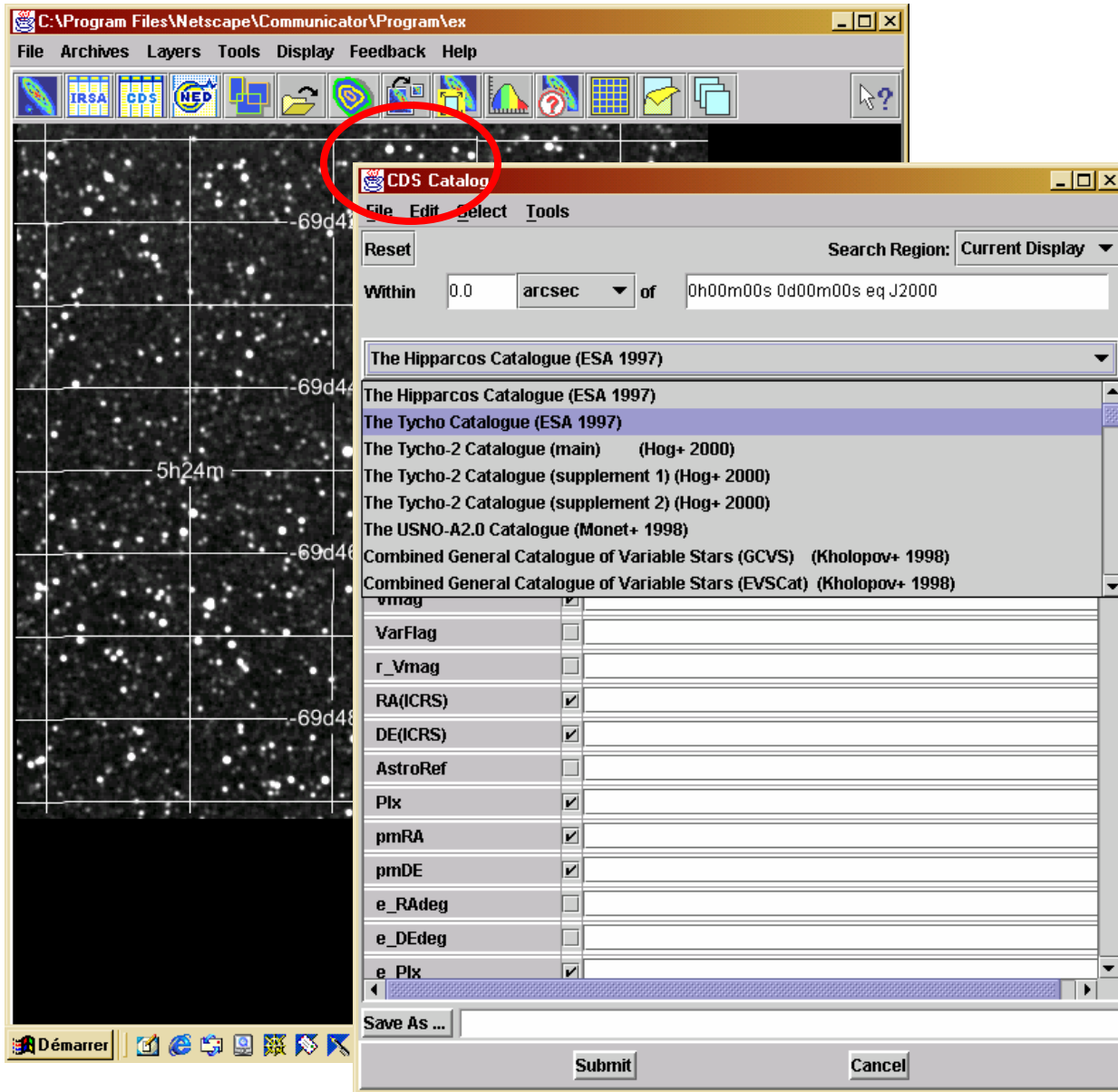
# Towards data integration

- XML
- Questions
  - Minimize the ‘tagging overhead’
  - Management of binary ‘blobs’
  - Assess/distribute information about data quality
  - Unit knowledge/conversion
- *Astrores*, then VOTable

# HEARSARC Browse

*Astrores*  
in action!



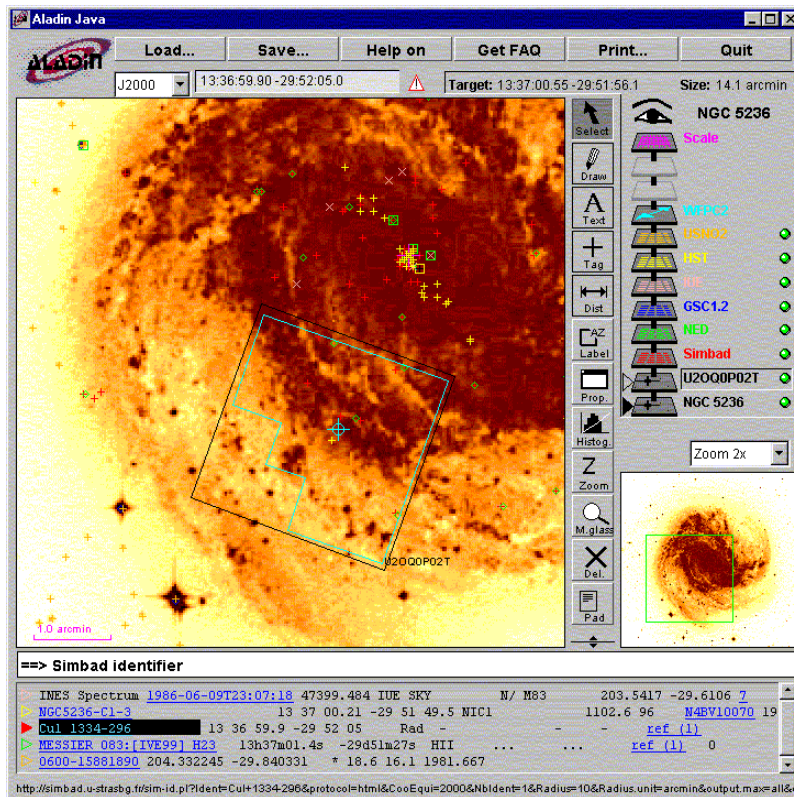


OASIS





# Data integration with

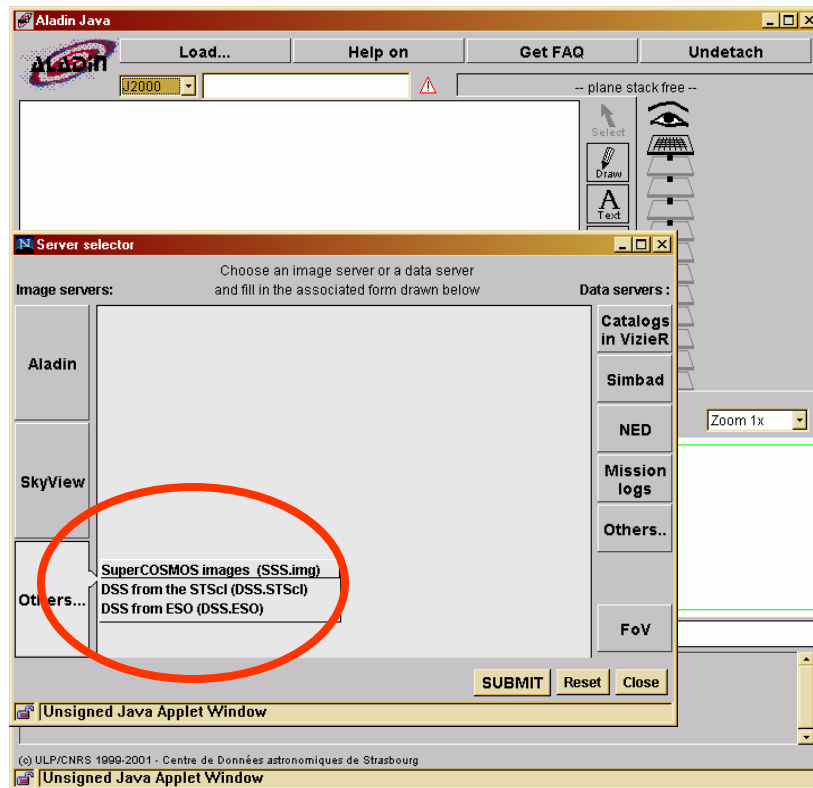


## NGC 5236

- DSS image
- HST observation FOV
- SIMBAD and NED
- GSC, USNO A2
- IUE observations



# ALADIN access to distributed information



- Distributed
  - Image databases
  - Catalogues
- Predefined
  - Supercosmos
  - HEASARC SkyView
- User defined

# The Virtual Observatory

*« an enabling and coordinating entity to foster the development of tools, protocols, and collaborations necessary to realize the full scientific potential of astronomical databases in the coming decade »*

*NVO White Paper, juin 2000*

***Science driven***

# VO components (1)

- Network infrastructure
- GRID (computer AND data GRID)
- High capacity storage
- Management of very large data sets
- Access to distributed information
- Information retrieval tools
- Data Mining
- Statistical tools on very large distributed data sets

# Virtual Observatory projects

- A priority in Europe (OPTICON) and USA (Decadal Survey)
- Several conferences
  - Virtual Observatories of the future (CalTech)
  - Mining the sky (Garching)
  - AstroGRID workshop (Belfast)
- Europe: AVO; USA: NVO; AstroGRID; Australia; Germany; ...

## VO components (2)

- Interoperability
  - Access to data
  - Query result integration
    - ⇒ Exchange standards
    - ⇒ Metadata
- Open question: define rules allowing people to deposit their data in the VO (quality?)

# The project (1)

- EC RTD project  
PI P. Quinn (ESO)  
ESO, ESA, AstroGRID, CDS, Terapix, Jodrell Bank



- Phase A proposal
- Shared cost project

# The project (2)

## Three work areas

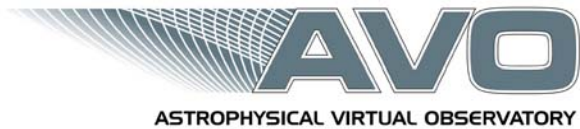
- Science Use Cases and Requirements (ST-ECF)

cf



- Interoperability deployment and demonstration
- Technology needs (AstroGRID)
  - GRID systems
  - Scalable storage and computation
  - Databases





# Interoperability prototype

## Interoperability deployment and demonstration

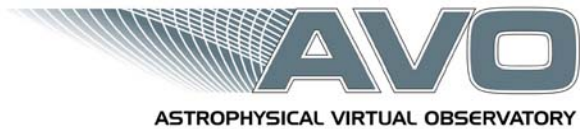
Ground- and space, multiwavelength,  
multitechnique archives



## Tools

VizieR (data federation)/Aladin (data integration)  
cross-id ... ESO/CDS Data Mining Project





# Interoperability prototype

## Products



- Working prototype open for community usage
- Running of science cases for evaluation
  - ⇒ **Science driven: results, feedback !**
- Improvement of federation and integration tools
- Counsel to archives on interoperability implementation
- Standards



# Interoperability WG

## Membership: Data managers

- Study *cost effective tools and standards* for improving access and data exchange to/from data archives and information services (minimal workload)
- Discuss the technical results of the AVO interoperability prototyping
- optical/IR (EC OPTICON), radio (EC RadioNet)
- International partnership beyond EU  
USA, Canada, Australia

# The International VO alliance

Coordination between the projects

- A common roadmap
- First milestone (April 15<sup>th</sup>, 2002)

*VOTable V1.0*

- VO meeting, Garching, June 2002

# Information retrieval

## Where is the data of interest for me?

- Practical Objective
  - Define a minimal and ‘controlled’ set of metadata
  - To be done **with** archive/service managers*
- AstroBrowse/AstroGLU; ISAIA
  - Knowledge/maintenance of query syntax
  - GLU (Générateur de Liens Uniformes)

# The GLU

- GLU: a distributed/mirrored service directory
  - 31 synchronized repositories, 11 countries, 5 providers
- GLU can build queries by adjusting automatically the syntax as required by services (coordinate conversion, splitted fields)
- GLU is a toolkit managing HTML pages with dynamically updated links
  - dealing with mirror sites
  - dealing with keywords describing resources
- Hot topic: GLU vs WSDL/UDDI

## Information retrieval (2)

- Proposal for query syntax  
ASU      Astronomical Server URL
- Proposal for contents description  
UCD      Uniform Content Descriptor
- Data quality  
Avoid illegitimate usage of data

# UCDs

= Uniform Content Descriptor

- Developed in the frame of the ESO/CDS Data Mining project
- Hierarchical knowledge tree (2 000 items)
- Implemented for the 100,000 columns in VizieR (cats, publ. tables, logs, surveys)
- To be tested and extended: access tool



## ✧ AVO/Astrogrid/NVO common collaborations

### ■ VOTable (VOData as generalization?)

- ◆ XML schemas

### ■ Metadata issues

- ◆ Query mechanisms
- ◆ Data service/resource directories
- ◆ Data service/resource capabilities

### ■ Metadata dictionary

### ■ Data models

### ■ Identity, authentication

### ■ Science scenarios

### ■ User interfaces, portals??

## ✧ AVO/Astrogrid/NVO common milestones



# Conclusion

- Astronomy is at the forefront for data diffusion and networking
- The on-line services are everyday tools for scientists
- Building an international virtual observatory is an important endeavour for the coming years
- Partnership is critical
- Discipline standard/tools vs generic ones is a constant debate