

15/12/2006



CDS and the VO

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Outline of the talk

- Introduction
- The main CDS services:



- The Virtual Observatory and the CDS
- Practical demos using Aladin

CDS - over 30 years of history

- **1972**: creation of the **Centre de Données Stellaires**.
 - Electronic data
 - Expertise on data
 - International center
 - Goal: research
- **1983**: extension to galaxies and other non-stellar bodies:
Centre de Données astronomiques de Strasbourg

Collect, homogenize, distribute, preserve astronomical information for the whole community.

CDS - over 30 years of history

- **1993/94**: **WWW starts**
- **2001**: CDS participates in Virtual Observatory projects
- **CDS today**:
 - Collaboration INSU/ULP (Institut National des Sciences de l'Univers; Université Louis Pasteur)
 - ~25 staff members in Strasbourg team + a few other ones in France:
 - 'documentalists'
 - astronomers
 - software developers
 - Many collaborations (national and international)
 - Several 10⁴ hits/day on our services

A data center (1)

- **Why care about data preservation in astronomy?**
 - Instruments are more and more powerful, why keep « old » less accurate data?
- **Mandatory mission to preserve data**:
 - variable phenomena require observations over a time range: changes in luminosity, positions, with possibly very long periods (centuries)
 - statistics
 - re-use of data: saves time and money (VO: archive=telescope)

A data center (2)

- **Multi-wavelength astronomy**
 - better analysis of physical processes, usage of data by non-specialists
- **Large surveys**
 - complexity and volumes are growing
- **WWW**
 - direct access to distributed data

A data center (3)

- What data in astronomy?
 - compilation databases (SIMBAD/NED)
 - observations (reference images, surveys, ground or space-based observation archives)
 - spectras
 - catalogues (observation, compilation)
 - bibliography (journals, ADS, preprints)
 - yellow pages, softwares
 - personal data
- Exponential growth of data volumes

Data volumes

- 1801, Uranographia: 17,200 stars;
- 1924-1936, HD: 272,150 stars;
- 1989, IRAS: 500,000 sources;
- 1997, Tycho: 1,000,000 sources;
- 1997, USNO-A1 488,006,860 sources;
- 2003, USNO-B1 1,045,913,669 sources.
- > 5000 new bibliographic references/year
- 4-500 new catalogues/ year (including electronic publications of journal tables)
- modern sky surveys: several Tb of images

Data storage

1975 – Punch card



1974 – hard drive 400kb



1980 - magnetic tapes



CDrom 700Mb



2006 - HD 500Gb



A data center (4)

- A data center is not only a data warehouse
- A validation work is needed
- Data must come with quality metadata describing
 - their nature
 - their origin
 - the processing history
 - quality
 - ...

Activities of CDS (1)

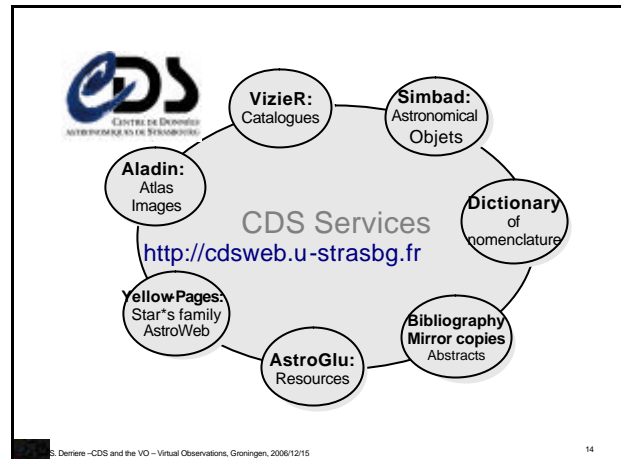
- Reference services with high value-added for the astronomical community
- Technology watch, R&D / pluridisciplinary actions
- Evolution of the services
 - daily work on contents (+5000 bib. refs, +500 catalogues/year) and features
 - contents validation
 - operational constraints on services

Activities of CDS (2)




- Selective collect and distribution of astronomical data (tables, logs, surveys, publications, reference images):
 - value added to raw data through evaluation and comparisons ;
 - distribute results to the community;
 - do research on these data.

Activities of CDS (3)

- Develop databases and access interfaces
- Mirror copies (journals, bibliography)
- Support for users (*question@simbad*)
- Knowledge diffusion
- Participation in projects
- Virtual Observatory
 - evolution of reference services
 - standards and tools
 - national action (OV-France)



The main CDS services

-  **Astronomical Objects**
identifications, bibliography, measurements
-  **Catalogue service**
catalogues, published tables, observation logs, surveys
-  **Information integration**
images, databases, catalogues, archives, personal data



Identifiers, basic data, bibliography and measures from:

- published literature
- selected catalogues

Dictionary of nomenclature (collab. GEPI)
Systematic cross-identification

Contents (updated daily) from:

- Bibliography (90 journals, collaborations Obs. Paris, IAP, ...)
- Catalogues (multi-wavelength coverage, major projects) – in collaboration with experts
- Collab. from OMP, GRAAL, ...

SIMBAD = Set of Identifications, Measurements and Bibliography for Astronomical Data.

Queries	Discussion history	Information
by identifier	Presentations	Regulations
by coordinates	Main functionalities	Acknowledgment
by reference code	History history	
by list of IDs	User's guide	
by object		
by email		
Simbad mirror at CDS		

Statistics
Simbad contains today (20-Nov-2005):
3,493,740 objects
9,243,276 identifiers
154,845 bibliographical references
4,654,798 citations of objects in papers

Content	Statistics
The SIMBAD astronomical database provides basic data, cross-identifications and bibliography for astronomical objects outside the solar system.	Simbad contains today (20-Nov-2005):
SIMBAD can be queried by object name, coordinates, other criteria (filters), and lists of objects.	3,237,779 objects
Links to some other on-line services are also provided.	8,597,362 identifiers
	145,825 bibliographical references
	4,102,164 citations of objects in papers

SIMBAD3 Web Interface

... and Submit

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Result...

Data

Identifiers

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Result...

Links to images, graphs

Bibliographic references

Measurements

Links to external archives and VizieR catalogues

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SIMBAD

- The identifiers syntax is controlled by the dictionary of nomenclature
- Associated service : Name Resolver
 - returns coordinates for an identifier
 - used in many applications
- There are links between SIMBAD, the bibliographic services (ADS, with bibcodes), VizieR, Aladin...

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SIMBAD database :

List of objects for reference code: 2004CoSka...34...45S

Abstracts from ADS

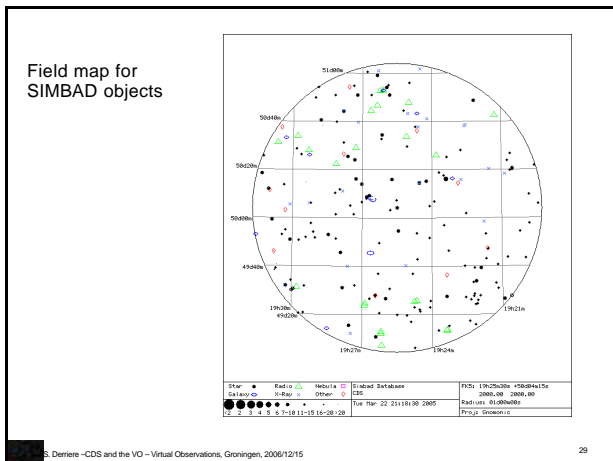
Total number of objects found: 40

Currently displayed are the first identifier in SIMBAD and the object type.

By clicking on the [ID: CAT] anchor, you get the information from the nomenclature dictionary for the corresponding identifier.

By clicking on the identifier #refID, you get the basic data and all the identifiers from SIMBAD.

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Vizier Detailed Page
http://vizier.cds.nl/vizier/objects/124092553.html

Name	Value	Display
_RAJ2000	19 20 29.723 3.67	Right ascension (J2000) RAJ2000=19 20 29.723 3.67; proper motion: RA proper motion (mas/yr) [measured by Vizier], and part of the original data
_DECJ2000	+30 08 18.93 3.47	Declination (J2000) DECJ2000=30 08 18.93 3.47; proper motion: Dec proper motion (mas/yr) [measured by Vizier], and part of the original data
_RAICR2000	283.434403 3.47	Right ascension (ICR2000) RAICR2000=283.434403 3.47; proper motion: RA proper motion (mas/yr) [measured by Vizier], and part of the original data
_DECICR2000	+49.318 3.47	Declination (ICR2000) DECICR2000=49.318 3.47; proper motion: Dec proper motion (mas/yr) [measured by Vizier], and part of the original data
_RAJ1950	193.74 3.47	Right ascension (J1950) RAJ1950=193.74 3.47; proper motion: RA proper motion (mas/yr) [measured by Vizier], and part of the original data
_DECJ1950	+30.37 3.47	Declination (J1950) DECJ1950=30.37 3.47; proper motion: Dec proper motion (mas/yr) [measured by Vizier], and part of the original data
_RA	193.74	Right ascension (J2000) RA=193.74; proper motion: RA proper motion (mas/yr) [measured by Vizier], and part of the original data
_DEC	30.081893	Declination (J2000) DEC=30.081893; proper motion: Dec proper motion (mas/yr) [measured by Vizier], and part of the original data
_RAICR	283.434403	Right ascension (ICR2000) RAICR=283.434403 3.47; proper motion: RA proper motion (mas/yr) [measured by Vizier], and part of the original data
_DECICR	49.318	Declination (ICR2000) DECICR=49.318 3.47; proper motion: Dec proper motion (mas/yr) [measured by Vizier], and part of the original data
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SIMBAD4

- Released december 2006
- Complete rewrite: Java + PostgreSQL
- Advanced output options and formats (VOTable)
- Query on any parameter (e.g. redshift>5)
- Easy to query by list of targets
- Improved script queries

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Identifiers: 124092553

Coordinates: RA: DEC: PM: PM2: PA: RA2: DEC2: PM2: PA2

Object type: Normal (street astronomical)

Submit Clear

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Output format: HTML

Max. Fields: maximum (5000)

Full identifier:

RA:

DEC:

PM:

PM2:

PA:

RA2:

DEC2:

PM2:

PA2:

Name:

Aliases:

Aliases V:

Name:

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214.386166	-57.767818	16.926	15.777	99.999	0.09	0.19	9.99	17.067	15.508	99.999
214.535889	-57.767764	16.458	15.562	99.999	0.07	0.17	9.99	16.496	15.457	99.999
214.401036	-57.767685	14.974	14.391	99.999	0.04	0.11	9.99	15.021	14.549	99.999
214.569711	-57.767623	17.971	15.777	99.999	0.18	0.19	9.99	17.394	15.553	99.999
214.149915	-57.767576	16.975	99.999	99.999	0.10	9.99	9.99	16.840	99.999	99.999
214.550993	-57.767487	16.801	15.716	99.999	0.09	0.18	9.99	16.605	15.682	99.999
214.557370	-57.767406	99.999	16.526	13.594	9.99	0.27	0.22	99.999	15.948	12.905
214.404212	-57.767370	15.848	14.973	99.999	0.05	0.13	9.99	15.654	15.197	99.999
214.296113	-57.767262	15.161	13.266	99.999	0.04	0.09	9.99	15.055	13.271	99.999
214.238914	-57.767254	15.362	14.061	99.999	0.04	0.10	9.99	14.916	14.106	99.999
214.286765	-57.767228	15.694	13.984	99.999	0.05	0.09	9.99	15.784	14.019	99.999
214.595510	-57.767131	17.716	16.170	99.999	0.15	0.23	9.99	17.274	16.150	99.999
214.466317	-57.767040	15.975	13.680	12.253	0.06	0.09	0.12	15.998	13.686	12.836
214.503014	-57.767008	17.436	99.999	99.999	0.13	9.99	9.99	17.548	99.999	99.999
214.483010	-57.766971	99.999	16.015	99.999	9.99	0.21	9.99	99.999	16.370	99.999
214.470701	-57.766933	16.031	13.917	12.708	0.06	0.09	0.14	16.025	13.909	13.395
214.382021	-57.766657	18.085	99.999	99.999	0.19	9.99	9.99	19.044	99.999	99.999
214.261368	-57.766621	17.167	15.994	99.999	0.11	0.20	9.99	17.209	16.246	99.999
214.611797	-57.766361	17.103	15.149	99.999	0.10	0.14	9.99	16.741	14.812	99.999
214.267771	-57.766321	17.388	15.712	99.999	0.13	0.18	9.99	16.713	15.023	99.999
214.532974	-57.766214	16.379	14.323	13.036	0.06	0.11	0.16	16.099	14.255	13.102
214.565229	-57.766304	17.249	15.955	99.999	0.11	0.20	9.99	17.213	17.242	99.999
214.256734	-57.766279	16.855	14.660	13.244	0.07	0.12	0.18	16.426	14.683	12.860
214.499574	-57.766278	17.009	14.856	13.533	0.10	0.13	0.22	16.628	14.731	13.337
214.597738	-57.766200	17.174	99.999	99.999	0.11	9.99	9.99	16.903	99.999	99.999
214.216793	-57.766161	15.516	14.837	99.999	0.05	0.12	9.99	15.496	14.697	99.999
214.142976	-57.766060	99.999	15.804	99.999	9.999	0.19	9.99	99.999	15.705	99.999
214.278051	-57.766037	16.967	15.725	99.999	0.10	0.18	9.99	17.014	16.130	99.999
214.598047	-57.765921	15.941	13.637	12.239	0.06	0.09	0.12	15.850	13.620	12.295
214.426628	-57.765900	99.999	16.214	13.928	9.99	0.23	0.27	99.999	16.593	13.955
214.410201	-57.765870	15.641	14.798	99.999	0.05	0.12	9.99	15.604	14.415	99.999
214.517390	-57.765862	99.999	16.320	99.999	9.99	0.24	9.99	99.999	18.163	99.999
214.463607	-57.765814	17.931	15.866	99.999	0.17	0.19	9.99	17.819	15.194	99.999
214.554082	-57.765761	15.537	12.979	11.402	0.05	0.08	0.09	15.540	12.948	11.385
214.474225	-57.765746	18.131	99.999	99.999	0.20	9.99	9.99	18.831	99.999	99.999

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~30,000 queries/day

- Over 5000 catalogues (1cat = n tables)
- Metadata: calibrated and homogenized
- Standardized description (ReadMe).
- Partnership with journals (A&A since 1993).
- Same interface to access large surveys (USNO, GSC, DENIS, 2MASS, UCAC, ...).
- Many mirrors (USA, India, China, Japan, ...).

```

Fichier  Edition  Affichage  After à  Marque-pages  Outils  Aide
-----
V/89      Ages, Metallicity, Galactic Orbit of F stars (Barnacke 1995)
-----
Catalogue of ages, metallicity, orbital elements and other parameters
for nearby F stars
Barnacke V.A., Shvachko Yu.G.
Mail: Inf. CDS 87, 13 (1995)
-----
1993BICGS...47...1B
-----
ADC:Keywords: Stars, F-type ; Stars, age ; Abundance, [Fe/H] ;
Space velocities ;

Description:
Stellar magnitudes, metallicity, effective temperatures, surface
gravities, distances, and tangential velocities are calculated for
3488 F stars with homogeneous data on orbit geometry and proper
motion, and placed within 80 pc from the Sun. Components of space
velocity, eccentricities of galactic orbits, perigalactic and
apogalactic distances, and maximal resonances from galactic arms
are presented for 1787 stars. Isochrone ages are determined for 3485
slightly evolved stars proceeding from Revised Yale isochrones.

File Summary:
-----
File name      Level  Records  Explanations
-----
+ README      00          - This file+
+ catalog     142       3488  The catalogue
+ desc       01         117  ASCII description
+ paper.tex   03         154  LaTeX explanation

Byte-by-byte Description of file: catalog
-----
Byte Format  Units  Label  Explanations
-----
1-  6  16  ---  M0      [1:3908]M- M0 number of the star
7  21  ---  K_M0    [1:2385] Component or duplicate indicator
9- 14  29.3  B04     [2:17]r   Temperature index, corrected for blanketing
and luminosity effects (see paper)
15- 20  29.3  B04     [2:17]g   Colour excess, index of metallicity
22- 27  29.3  B04     [2:17]c   Colour excess, index of luminosity
-----
Terminal
-----

```

Each catalogue has a ReadMe file: simple ascii description of contents

Description VizieR provides access to the world's largest library of published astronomical catalogues and data tables available on-line, organized in a well-documented database. Query tools allow the user to select tables of data tables and to extract and format records according to their needs. Specific tools have been added for exploring access to very large catalogues such as [SDSS](#), [Gaia](#), [Gaia DR2](#), or the [2MASS](#) [10000000](#).

Access to VizieR is available in French, English, German, Italian, Japanese, Korean, Spanish, and Chinese.

File services VizieR is available in French, English, German, Italian, Japanese, Korean, Spanish, and Chinese.

Help VizieR is available in French, English, German, Italian, Japanese, Korean, Spanish, and Chinese.

Documentation [Documentation](#), [User's Manual](#), [FAQ](#), [List of available catalogues](#)

Metadata [VizieR Catalogues in HTML](#), [VizieR Catalogues in XML](#)

Acknowledgement If the access to catalogues with VizieR was helpful for your research work, the following acknowledgment would be appreciated: "The research has made use of the VizieR catalogue access tool, CDS, Strasbourg, France."

The centre is supported by [European Observations](#).

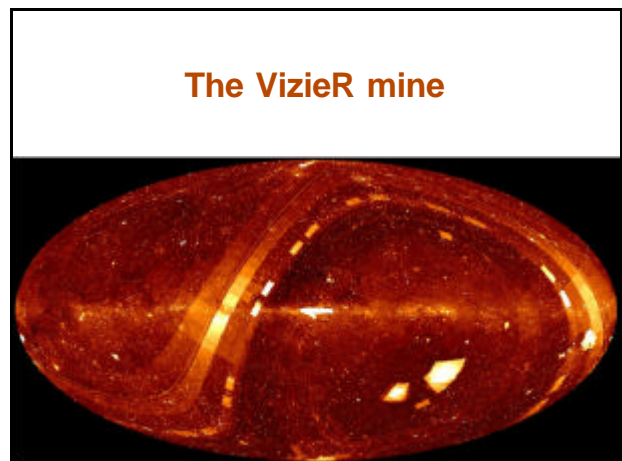
- 1994 : 680 catalogues - 3Gb
- 2004 : 4000 catalogues - (210 Gb, up to 1 billion sources for USNOB1.0)

VizieR

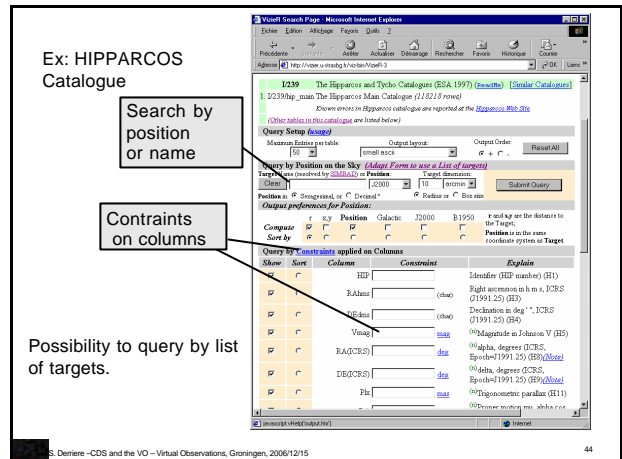
- Catalogues from:
 - electronic publication of journal's tables
 - digitized photographic plates
 - digital surveys
 - observations, archive logs
- Catalogues can come with additional material (spectra, images, time series, ...), or external links

Many ways to use VizieR

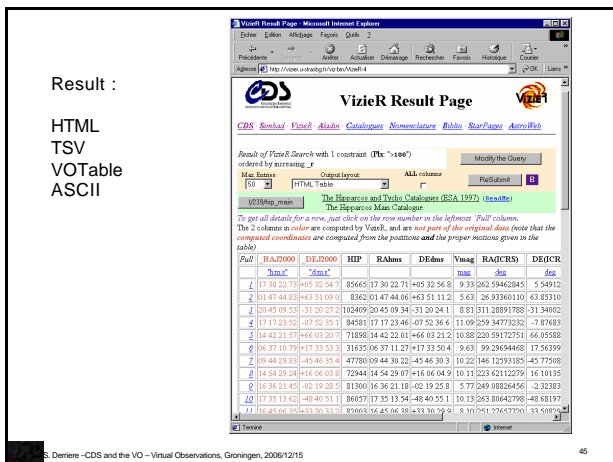
- Catalogue discovery (find new relevant catalogues)
 - search by keywords, author, topic, mission, UCD (i.e. columns content)
 - constraint on sky coverage
- Catalogue(s) query
 - FTP download
 - Position query (cone, box)
 - Contrain parameters
 - List
- Batch mode: cdsclient package (Dev. corner)



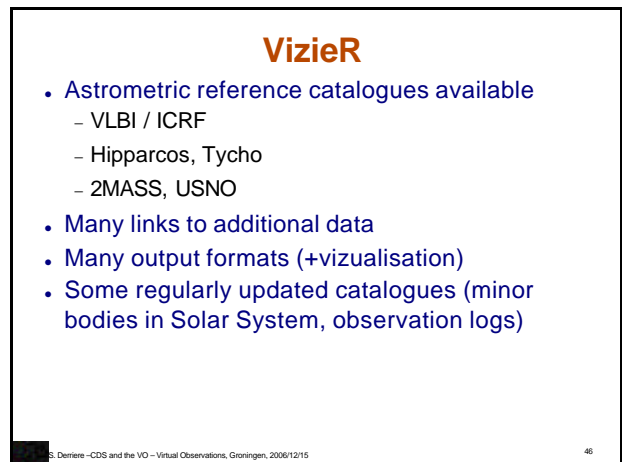
The VizieR mine



Possibility to query by list of targets.

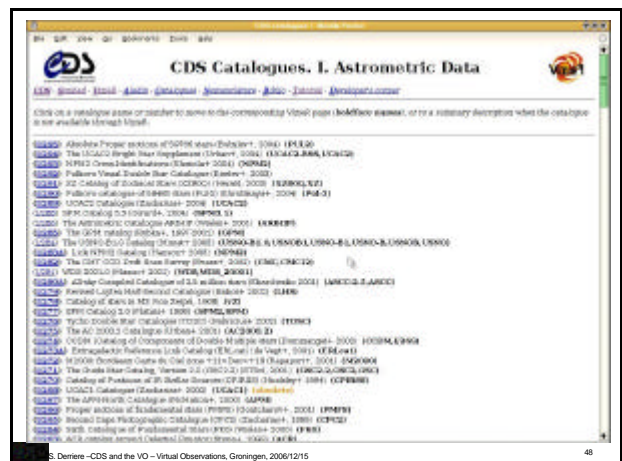


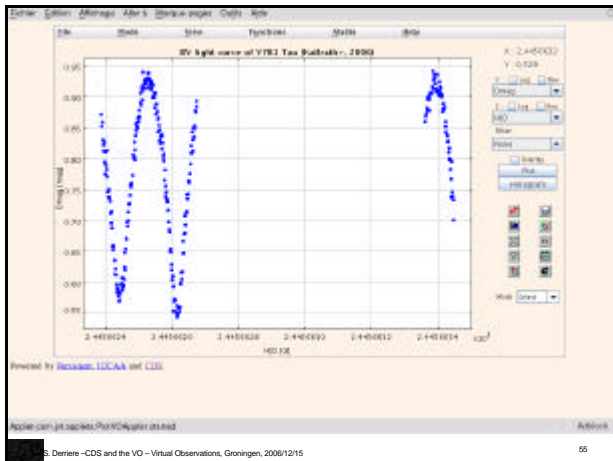
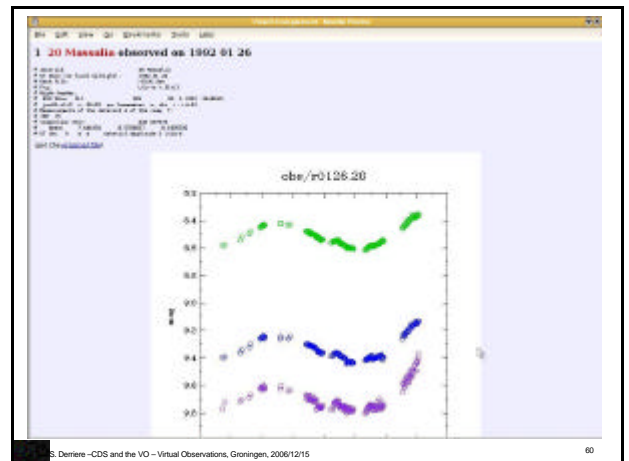
Result :
HTML
CSV
VOTable
ASCII




VizieR

- Astrometric reference catalogues available
 - VLBI / ICRF
 - Hipparcos, Tycho
 - 2MASS, USNO
- Many links to additional data
- Many output formats (+visualisation)
- Some regularly updated catalogues (minor bodies in Solar System, observation logs)




4-5000 queries/day

- Younger than SIMBAD and VizieR: 1997
- Two aspects:
 - image server
 - Java interface (was X-windows at first)
- Three levels of usage:
 - Previewer (very simple)
 - Java Applet in Web page
 - Aladin Standalone : full application
- 2005: Aladin v3.0 – 2007 v4.0



Data integration tool:

- Images in the Strasbourg image server:
 - MAMA, DSS1, DSS2, 2MASS, EROS1, IRAS
- Access to remote services:
 - HST, VLA/FIRST, SuperCOSMOS, Skyview, SDSS, ...
- Access to local data (images, catalogues)
- MANY features:
 - overlay on images: contours, catalogues, NED, SIMBAD, field of view, filters...
 - astrometric calibration, resampling, color composition, blinking, multi-view, scripting, cross-match, diagrams (VOPlot)...

Interactive sky atlas

Integration of local/remote image and catalogue data.

Free !

Many Servers

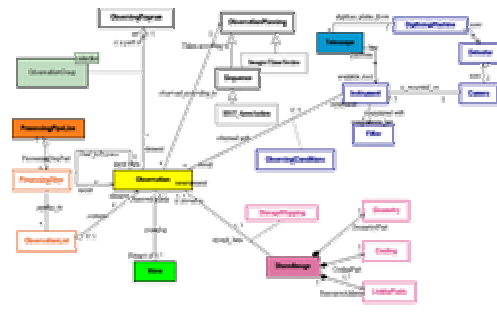
Metadata Tree

Visualisation des champs de vue des images

(1) DM - objectives

- Abstract description of concepts and their relationships:
 - define names and meaning of concepts
 - structure concepts and relations
- Production of the WG:
 - White papers
 - UML Diagrams
 - XML Schemas (serialization)
- DM = conceptual layer of the VO

(1) DM – UML Diagram



(2) WS & GRID

- Communication with/between services:
 - HTTP GET/POST
 - human-service (ex: web form)
 - SOAP (Simple Object Access Protocol)
 - WSDL: self-describing
 - service-service (ex: SESAME Name Resolver)
 - GRID
 - SOAP + authentication, state management, ...

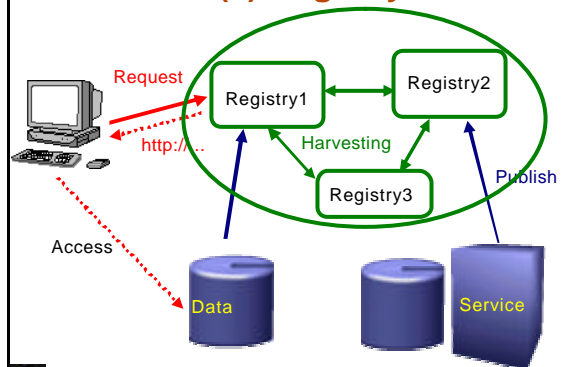
(2) WS & GRID

- Each service chooses its communication mode
- GRID: computing grid – data grid
- Collaboration VO - GRID:
 - transfer programs rather than data
 - data replication
 - authentication, authorization
 - VOspace (personnel storage, computing space). ex: mySpace
 - workflow construction (graph of services)

(3) Registry

- Description of VO Resources (data & services) by metadata
 - XML schema (*curation, coverage*)
 - similar to OAI (*library of Congress*)
 - unique identifier ivo:// for 1 resource
- 3 actions:
 - publish (data or service producer)
 - harvest (exchange between registries)
 - query (astronomers find the resources)

(3) Registry



(4/5) DAL / VOQL

- Data access protocols
- Simple Services:
 - Cone Search – catalogues with positions
 - SIAP – Simple **I**mage Access Protocol
 - SSAP – Simple **S**pectrum Access Protocol: 1D spectra
- OpenSkyQuery et ADQL
 - SQL / XML requests
 - distributed execution plan (SkyNode)

(6) UCD

- UCD = Unified Content Descriptors
- **S**émantic description of contents
- Origin (1997) in Vizier
 - UCD1
- VO reused it for:
 - describing tables (VOTable)
 - registry
 - DAL (Cone Search)
- New scheme: UCD1+

(7) VOTable

- XML format for exchanging tabular data
 - data and metadata in the same file
- Adoption of VOTable 1.0 april 2002; now: VOTable 1.1
- Most used standard in VO! (many tools: VOPlot, Aladin, Mirage, ...)
- Many libraries to read/write VOTable

Example of VOTable 1.1:

```
<?xml version="1.0"?>
<VOTABLE version="1.1" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.ivoa.net/xml/VOTable/VOTable/v1.1"
  xmlns:xlink="http://www.w3.org/1999/xlink">
  <RESOURCE name="myFavouriteGalaxies">
    <TABLE name="results">
      <DESCRIPTION>Locations and distances estimates</DESCRIPTION>
      <PARAM name="Telescope" datatype="float" ucd="phys.size.instr.tel"
        unit="m" value="3.0"/>
      <FIELD name="RA" ID="col1" ucd="pos.eq.ra:meta.main" xref="J2000"
        datatype="float" width="6" precision="2" unit="deg"/>
      <FIELD name="DEC" ID="col2" ucd="pos.eq.dec:meta.main" xref="J2000"
        datatype="float" width="6" precision="2" unit="deg"/>
      <FIELD name="Name" ID="col3" ucd="meta.id:meta.main"
        datatype="char" arraysize="8"/>
      <FIELD name="SQL" ID="col4" ucd="acc.veloc.hz" datatype="int"
        width="5" unit="km/s"/>
      <FIELD name="RW1" ID="col5" ucd="stat.uncorr:arc.veloc.hz"
        datatype="int" width="3" unit="km/s"/>
      <FIELD name="R" ID="col6" ucd="phys.distance" datatype="float"
        width="4" precision="1" unit="Mpc">
        <DESCRIPTION>Distance of Galaxy, assuming H=75km/s/Mpc</DESCRIPTION>
      </FIELD>
      <DATA>
        <TABLEDATA>
          <TABLE>
            <TR>
              <TD>10.68</TD><TD>41.27</TD><TD>
                224</TD><TD>297</TD><TD>5</TD><TD>0.7</TD>
            </TR>
            <TR>
              <TD>287.43</TD><TD>63.85</TD><TD>
                6744</TD><TD>8394</TD><TD>64</TD><TD>10.4</TD>
            </TR>
            <TR>
              <TD>223.48</TD><TD>30.66</TD><TD>
                598</TD><TD>1824</TD><TD>34</TD><TD>0.7</TD>
            </TR>
          </TABLEDATA>
        </TABLEDATA>
      </DATA>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

CDS and the VO

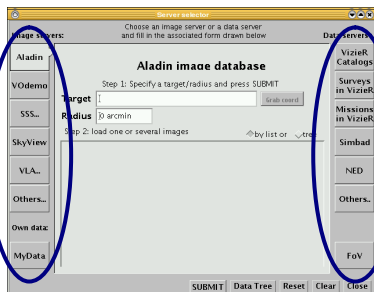
- CDS plays an active role in the VO projects (VO-France, AVO, VOTech, DCA, IVOA, ...)
- CDS is participating to the definition of the VO standards (VOTable, UCD, ...)
- The VO progresses impact on the CDS services

Aladin: a VO portal

- VO access for astronomers:
 - discover available data and services
 - access and query
 - manipulation and analysis
 - publish, disseminate results
- The AVO prototype was an extension of Aladin
- Aladin has integrated several new features developed in VO projects

ex: AVO prototype

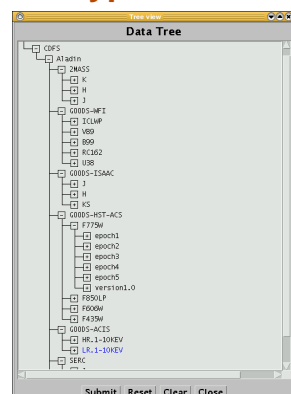
- Data access:



ex: AVO prototype

- Image access

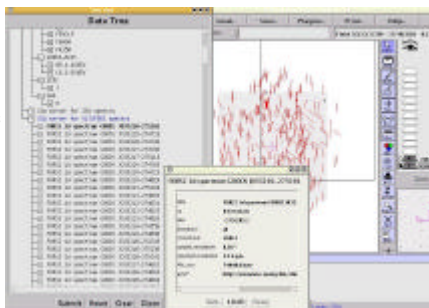
- DAL: SIA
- the Aladin image server returns the metadata of the images
- construction of the 'metadata tree'



ex: AVO prototype

- Spectrum access

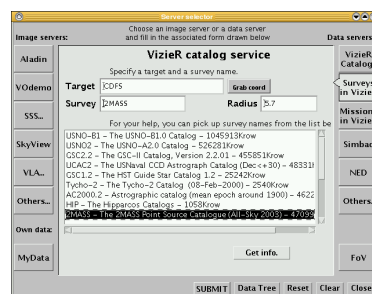
- DAL: SSA
- ex: metadata of the ESO server



ex: AVO prototype

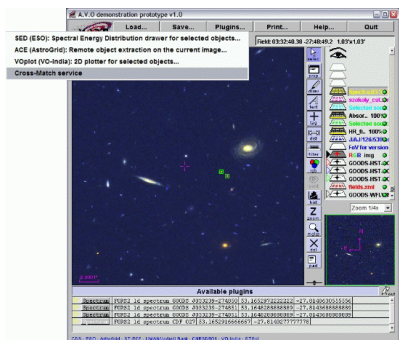
- Catalogue access

- Cone Search
- ex: VizieR



ex: AVO prototype

- Access to services
 - Extractor
 - Cross-match
- Protocols HTTP, WS...
- FITS, VOTable



Recent VO developments

- PLASTIC (VOTech)
 - PLATform for Astronomical Tools Inter Connection
 - Various applications exchange messages through a hub
 - Aladin, TOPCAT, VisIVO, SPLAT, ...
- Instrumental FoVs (VOTech)
- All-VO action in Aladin
 - built from the VO Registry

1. Harvesting from STScI
2. Conversion and filtering into a GLU dic
3. GLU site synchronization
4. New Aladin form managing these VO GLU records...
5. ...to produce general metadata trees
6. ... to choose and manipulate images and catalogs..

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Other VO-related evolutions

- VizieR access:
 - ConeSearch
 - SkyNode
- VOTable and UCDs used everywhere
 - VizieR, SIMBAD, Aladin (filters...)
- Catalogue cross-match in Aladin
- Many things to get your hands on during this afternoon's session !

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<http://cdsweb.u-strasbg.fr/>

question@simbad.u-strasbg.fr

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Links (1)

- CDS web site:
 - <http://cdsweb.u-strasbg.fr>
- SIMBAD:
 - <http://simbad.u-strasbg.fr/>
- VizieR
 - <http://vizier.u-strasbg.fr/>
 - <http://vizier.u-strasbg.fr/viz-bin/VizieR>
- Aladin
 - <http://aladin.u-strasbg.fr/>

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Links (2)

- CDS Tutorials
 - <http://cdsweb.u-strasbg.fr/Tutorial/>
 - <http://aladin.u-strasbg.fr/java/aladin.pdf>
- IVOA
 - <http://www.ivoa.net/>
- Action Spécifique OV-France
 - <http://www.france-ov.org/>

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