Enabling a robust VOSpace based on iRODS

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Observatoire astronomique de Strasbourg
CDS

Plan

- Context
  - The CDS
  - Data and data centres in the astronomical community
  - The Virtual Observatory (VO) and its technical challenge
  - Some VO standards (..., VOSpace)
- VOSpace and iRODS
- Illustrations
- Conclusion

The CDS

- **Centre de Données astronomiques de Strasbourg (since 1971)**
  - **Team of astronomers, engineers and librarians**
  - **Main services**
    - VizieR is a catalogue (**>7 000**) access service, large catalogues can have more than **10^9** entries
    - Simbad provides basic data, cross-identifications, bibliography and measurements for (**> 4 300 000**) astronomical objects outside the solar system
    - Aladin, a sky altlas with interoperability capabilities
  - **Services are widely used by the community (average of ~250 000 hits per day)**
- **Main French partner of the Virtual Observatory project**

Astronomical data

- ***Observation*** **: "detection of a signal, carried out by someone at a particular point and a particular time, with a certain instrument for a particular purpose",** ***Carlos Jaschek, "Data in Astronomy", 1989***
  - **signal : radio, image, spectrum, ...**
  - **someone : NASA, ESO, ESA, universities and institutes, ...**
  - **particular point : northern/southern hemisphere, ...**
  - **particular time : epoch (J2000, B1950, ...)**
  - **instrument : telescopes (optical, radio), satellites, interferometers, etc.**
  - **purpose : cartography, magnitude, distance from Earth, chemical composition, etc.**

Astronomical data (2)

- **From raw data to publications**
  - **The observations**
    - Raw data
    - Observation registries
    - Calibrations and auxiliary data
  - **Reduced data**
    - Catalogues (physical units) (example : VizieR on line service)
    - Databases
  - **Publications**
    - Papers
    - Documentation, “grey substance” literature, etc.

Data centres

- Management of data of spatial missions and ground observatories
  - Data are mainly where the expertise is
  - Massive data processing
  - ...
- Cooperation is a “tradition” and is easy
- Small community
- Go further with the concept of Virtual Observatory

To the Virtual Observatory

- **Access to the digitised sky, using archived and interconnected observations (especially large surveys of the whole sky, observed at different wavelength)**
  - **Inventory of the data available at the international scale**
    - Coherent set of archives, surveys, services, and reference dictionaries
    - Standardized data access modes, Interoperability
- **Scientific challenges**
  - **Understand the structures of the Universe at a large scale**
  - **Formation and evolution of our Galaxy (and others...)**
  - **Rare object discovery (black matter, extrasolar planets…)**
- **Educative and cultural dimension, outreach**

IVOA

- *International Virtual Observatory Alliance*, started in 2000
- Consortium of national and transnational Virtual Observatories
- Different Working/Interest groups
  - Semantics, Grid and Web Services, Data Model, Data Access Layer, VO Query Language, Applications, Theory, …
- 2 meetings / year, active mailing lists, …
- Standardisation work
  - Notes, Working drafts, Proposed recommendations, …
  - ~like W3C

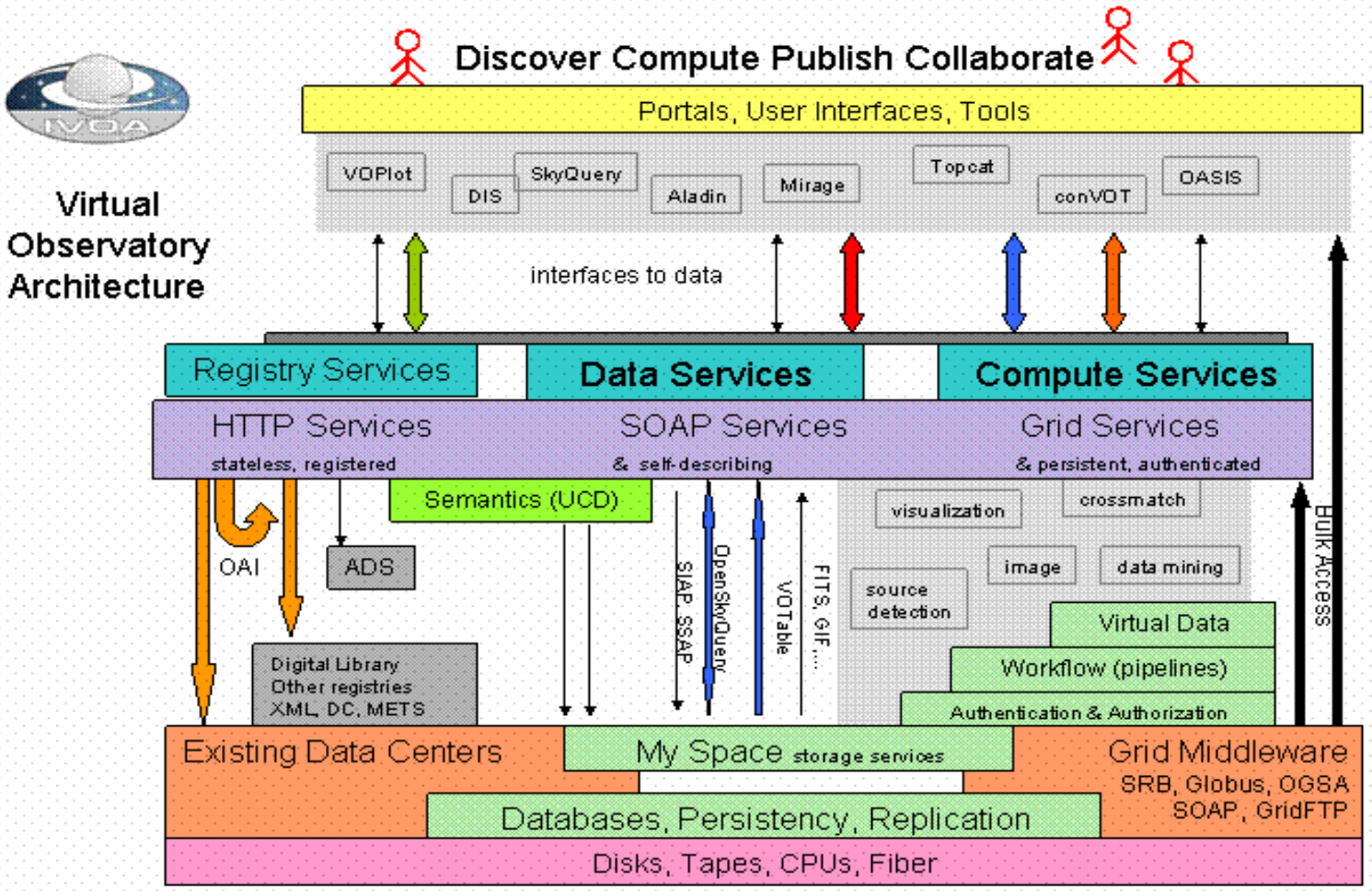
IVOA (2)


Aus-VO
EURO VO
Astro Grid
China-VO
VO-i
CVO
RVO
SVO
NVO
NATIONAL VIRTUAL OBSERVATORY
IVOA
VObs.it
ArVO
Armenian Virtual Observatory
JVO
JAPANESE VIRTUAL OBSERVATORY
HVO
Hungarian Virtual Observatory
GERMAN ASTROPHYSICAL
GAVO
VIRTUAL OBSERVATORY
France

VO technical challenge

- Long time storage of petabytes of data
  - Mostly archives
  - High availability (used in interactive services, cross-matching between data, etc.)
  - Easy to find
  - ...
- Interoperability between astronomical services
- Computation power
  - Needed for simulations, ...
  - Local clusters not sufficient, use of grids like EGEE

VO Architecture



Some IVOA results

- **VO Registry**
  - **Interfaces to publish, query, and harvest**
  - **Allows people to publish to a registry by filling a Web form in a Web portal**
  - **Not unique and centralized, each registry harvests each other to know the new dataset and services added to other VO-registries**
  - **Compliant with digital library standards (Open Archive Initiative) for metadata harvesting and metadata schema**
  - **Contains VO resources identfied by a universal identifier, starting with ivo://**
- **In the future, a VO registry may also accept queries in different languages**

Some IVOA results (2)

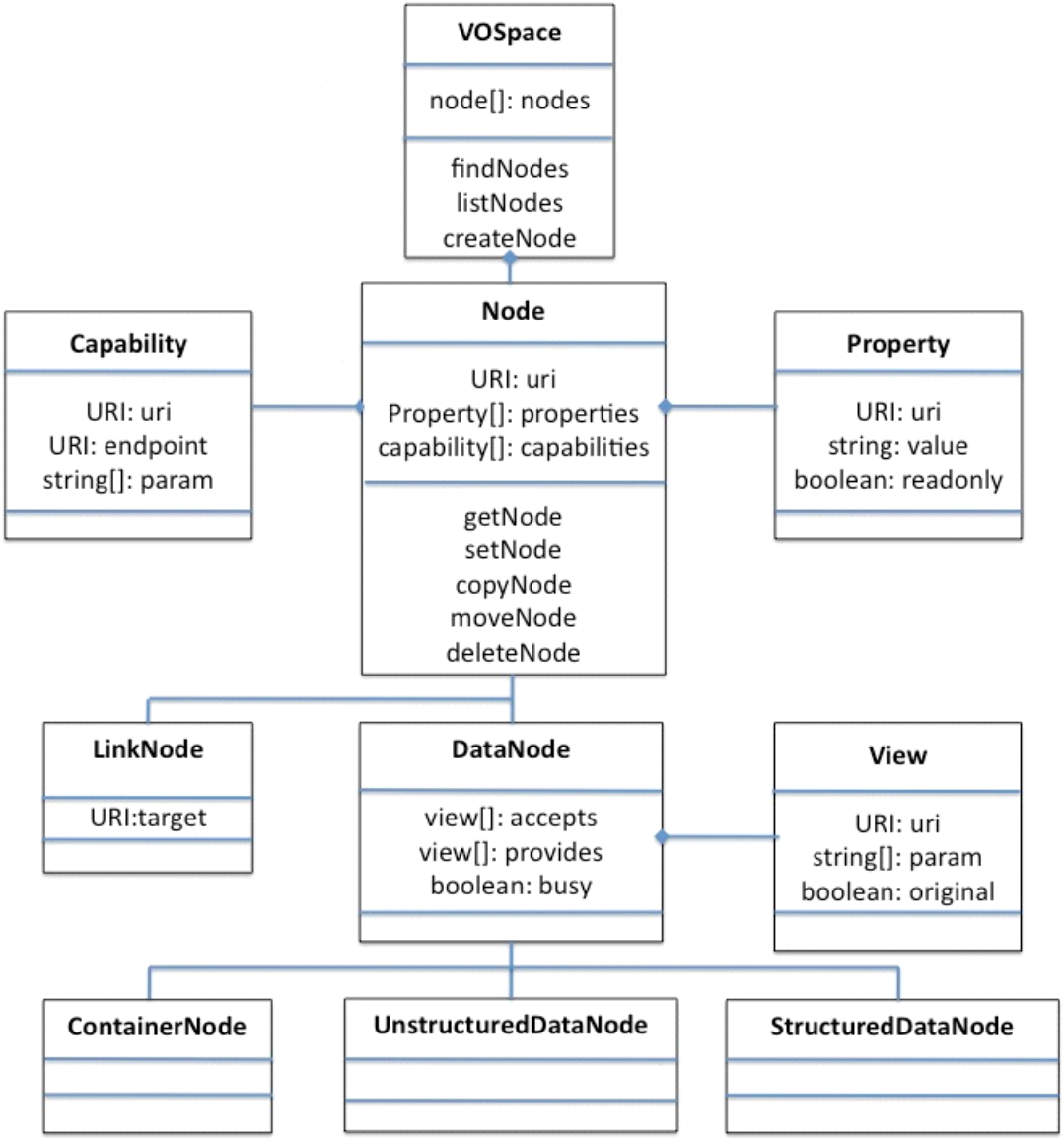
- **The UCDs (Unified Content Descriptors)**
  - **A standardized vocabulary used to describe astronomical quantities and related concepts (in VizieR 1500 UCDs are enough for 100000 columns)**
    - **"phot.mag;em.IR.K" means a photometric magnitude in infra red between 2 and 3 microns**
  - **No formal representation structure, with syntax and semantics, describing the relationships and dependencies between the words, and it is not possible to perform automated reasoning on UCDs**
- **Definition of ontologies...**

...	
src.ellipticity	Source ellipticity
src.impactParam	Impact parameter
src.morph	Morphology structure
src.morph.param	Morphological parameter
src.orbital	Orbital parameters
src.orbital.eccentricity	Orbit eccentricity
src.orbital.inclination	Orbit inclination
...	

Some IVOA results (3)

- **VOSpace is the IVOA interface to distributed storage. It specifies how VO agents and applications can use network attached data stores to persist and exchange data in a standard way. A VOSpace web service is an access point for a distributed storage network. Through this access point, a client can:**
  - **add or delete data objects**
  - **manipulate metadata for the data objects**
  - **obtain URIs through which the content of the data objects can be accessed**
- ***VOSpace does not define how the data is stored or transferred, only the control messages to gain access.*** **Thus, the VOSpace interface can readily be added to an existing storage system.**

VOSpace schema



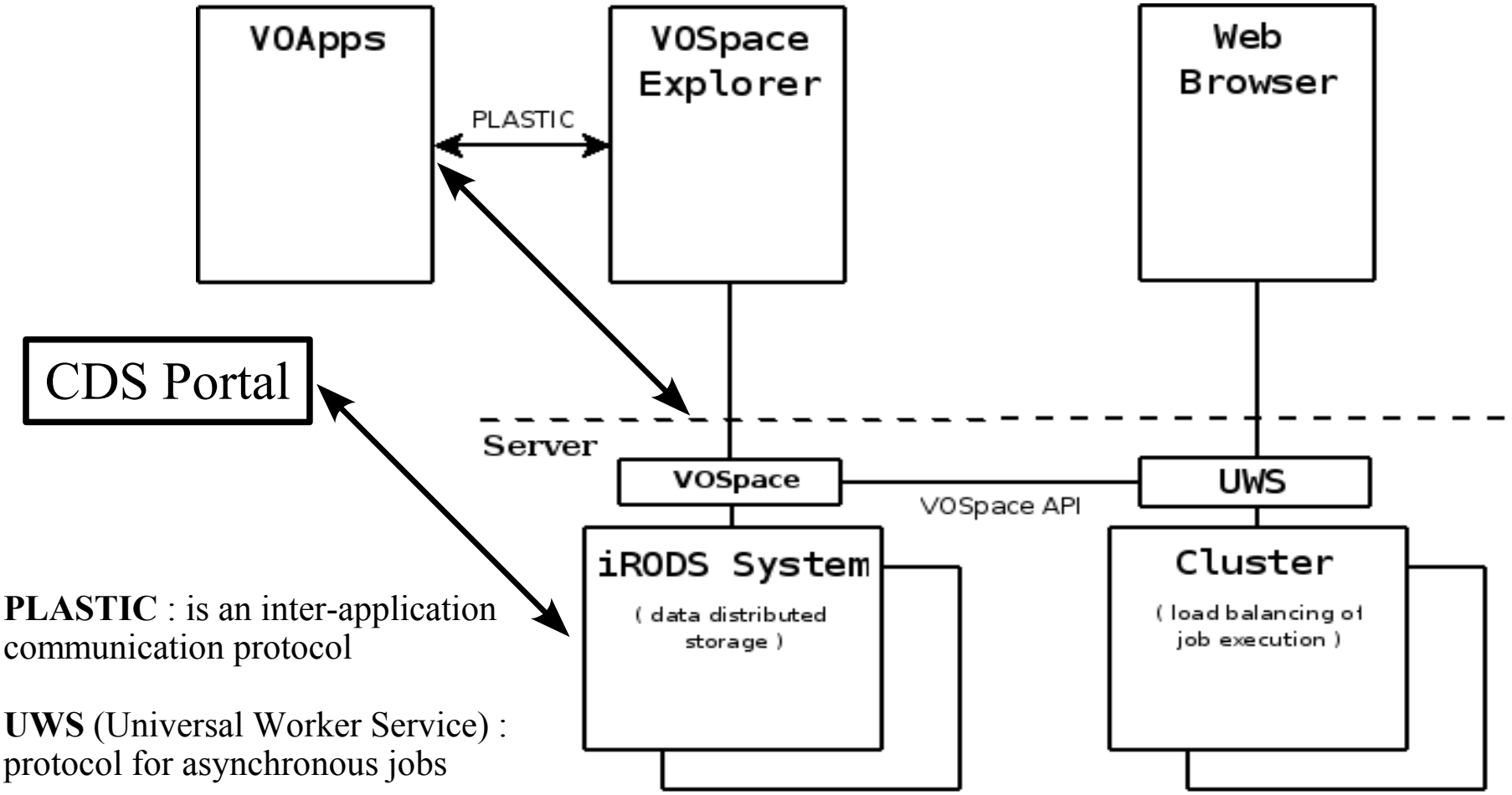
VOSpace and iRODS

- First step : experiment iRODS
  - Development of an Aladin (a sky atlas which is also a VO portal) plugin giving an access to the iRODS implementation through Jargon
- Second step
  - Implemention of the VOSpace interface over iRODS
  - Use of iRODS in the new CDS portal
- Third step : creation of VOSpace client tools
  - A VOSpace Explorer
  - A VOSpace file chooser
- Last step : release for real life (VOSpace and CDS portal)

VOSpace and iRODS (2)

- Use of different iRODS versions
  - iRODS 1.0 for the first prototype, iRODS 1.1 for the second and iRODS 2.0.1 for the final release
  - Jargon API from 1.* to 2.*
- VOSpace
  - Web Service : Axis2 & Tomcat
- iRODS at CDS : 2 quad core servers with 12 TB for the production release → small configuration to evaluate the production needs (not easy to fix “à priori”)

VOSpace-iRODS architecture



PLASTIC : is an inter-application communication protocol

UWS (Universal Worker Service) : protocol for asynchronous jobs

VOApps : Aladin, Topcat, VizIvo, VOSpec, etc.

Illustration

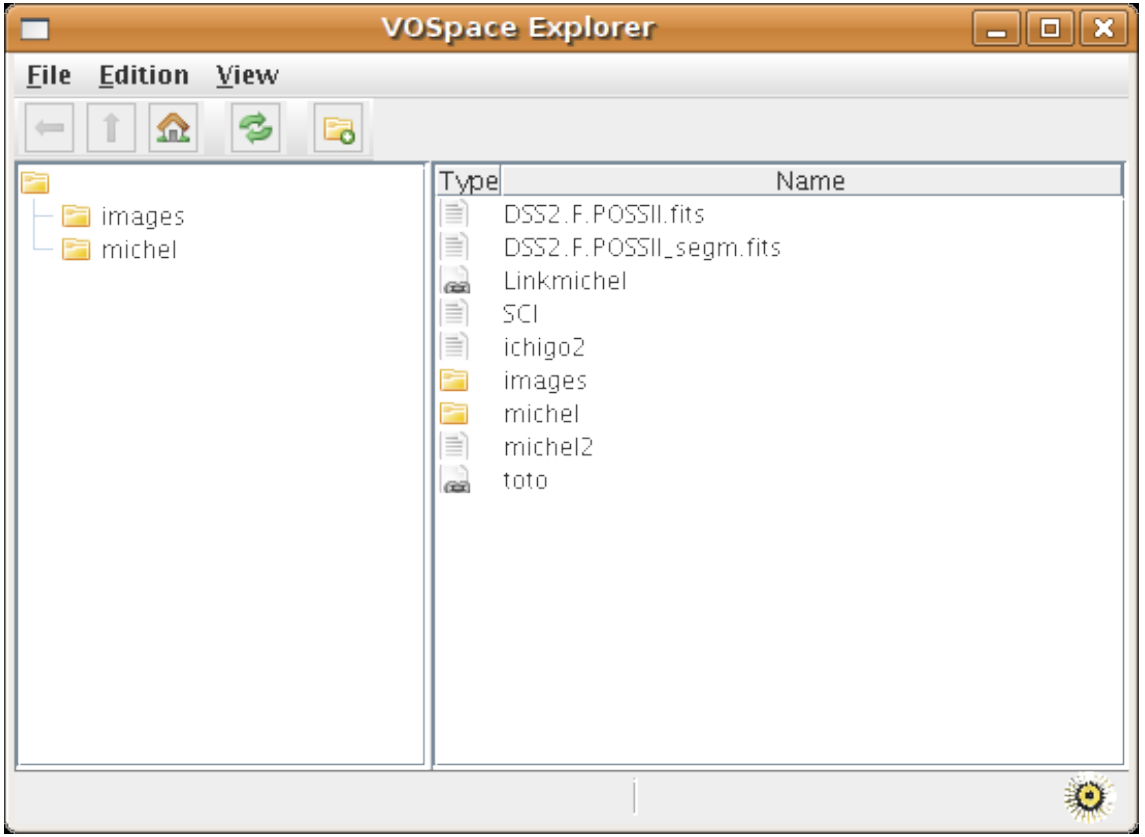
VOSpace tools

iRODS provides a robust storage system
in back of VOSpace

Developed by Cyril Pestel during the Euro VOTECH project
(ending in June 2009)

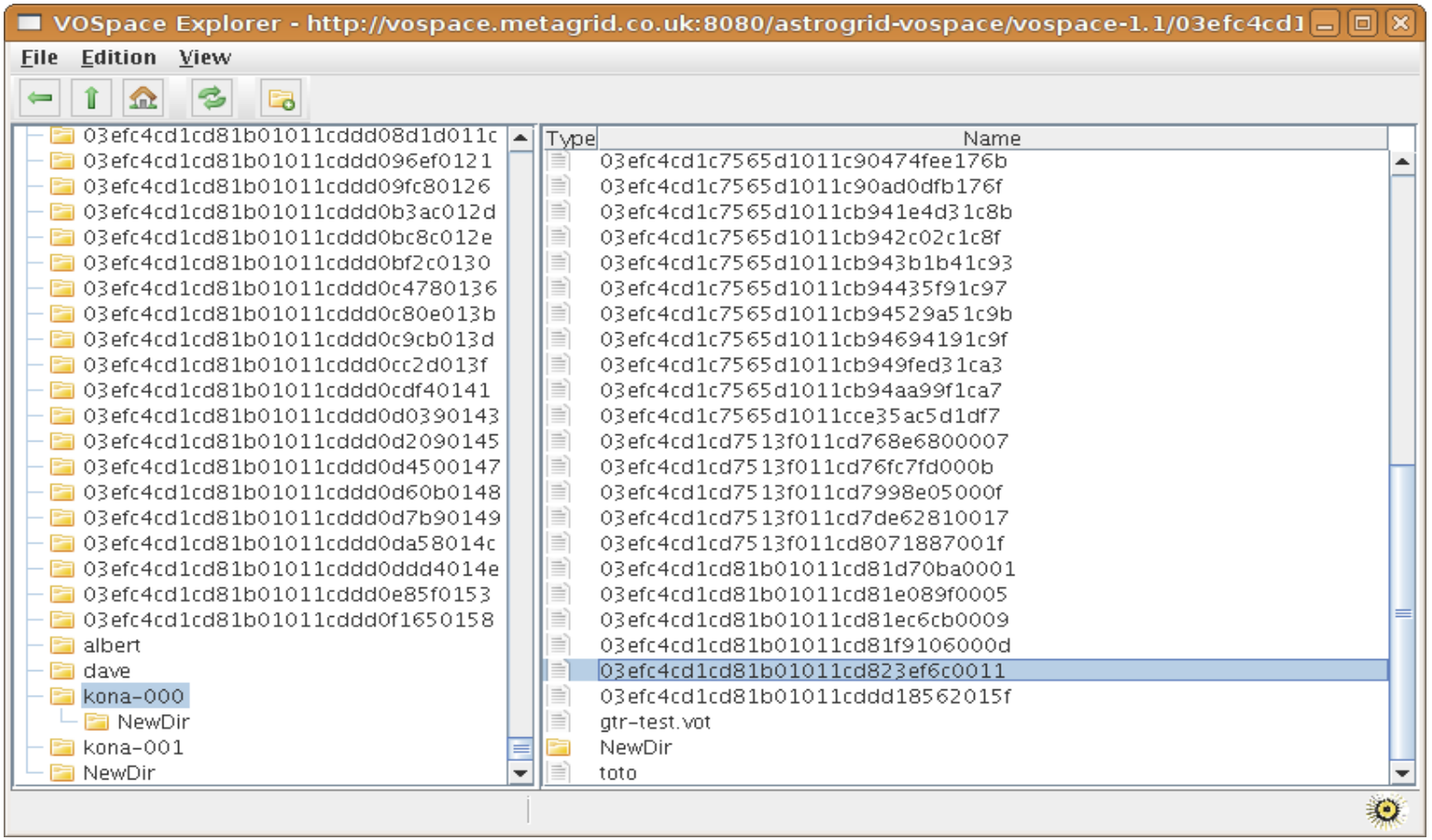
VOSpace Explorer

- Development of a VOSpace Explorer in Java
- If a VO tool supports drag and drop it is possible to interact through this way with the explorer
- PLASTIC has been added



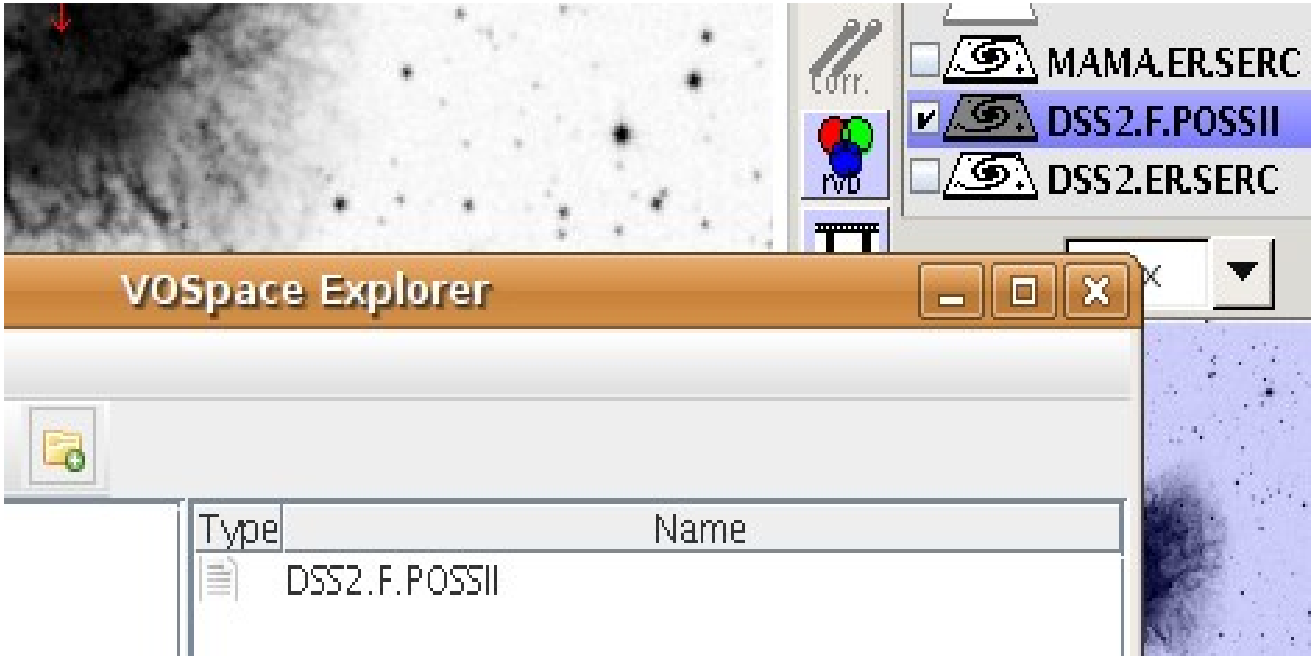
VOSpace Explorer (2)

- **Access to other VOSpace, (ex. : Astrogrid's VOSpace, Dave Morris)**

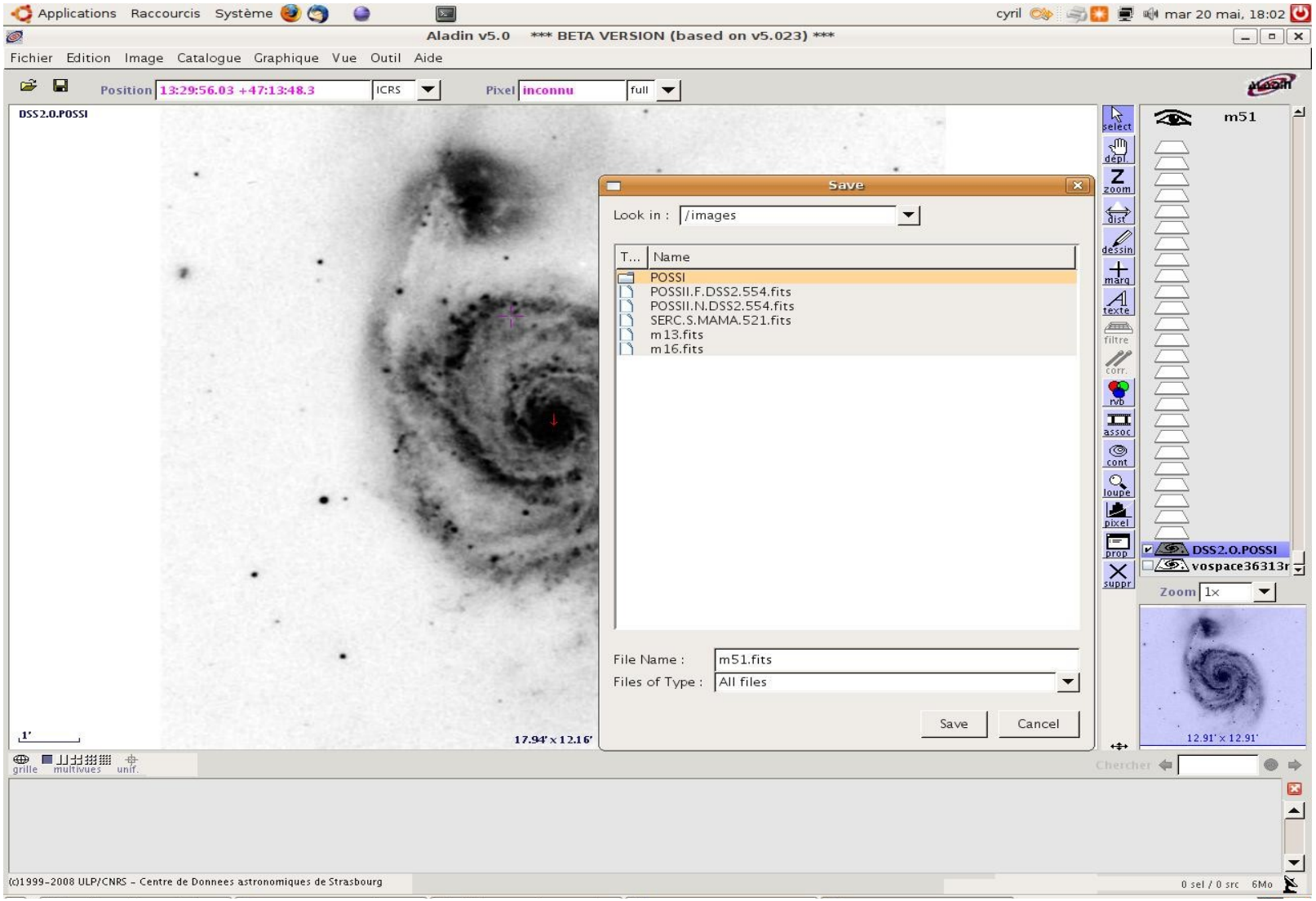


VOSpace Explorer (3)

- **PLASTIC use between Aladin and the VOSpace Explorer**

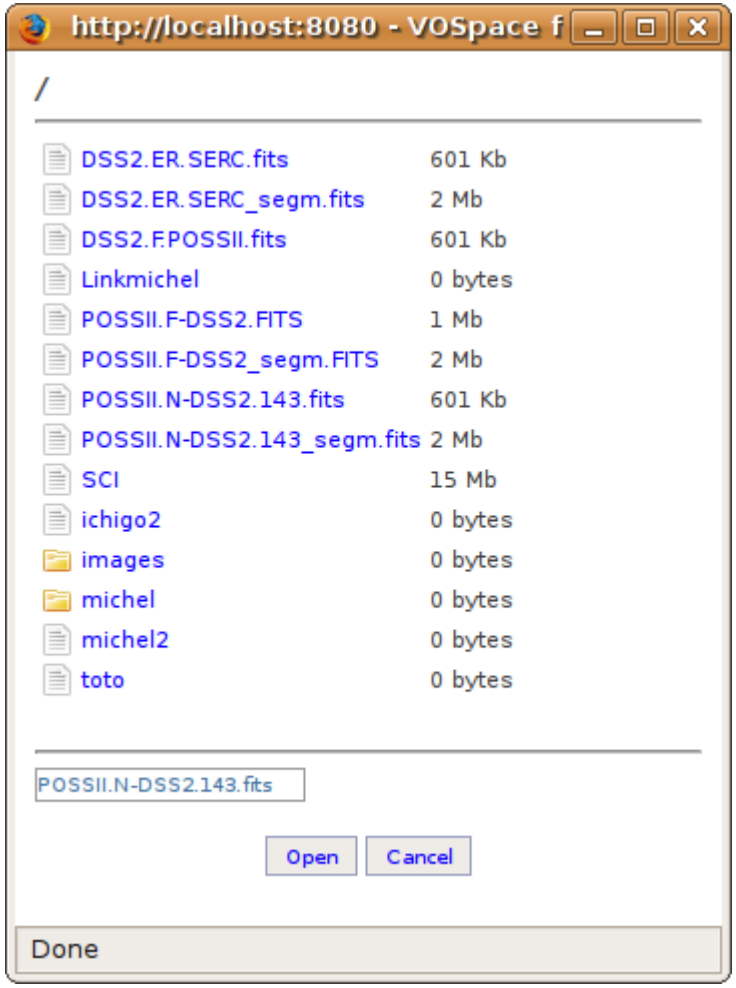


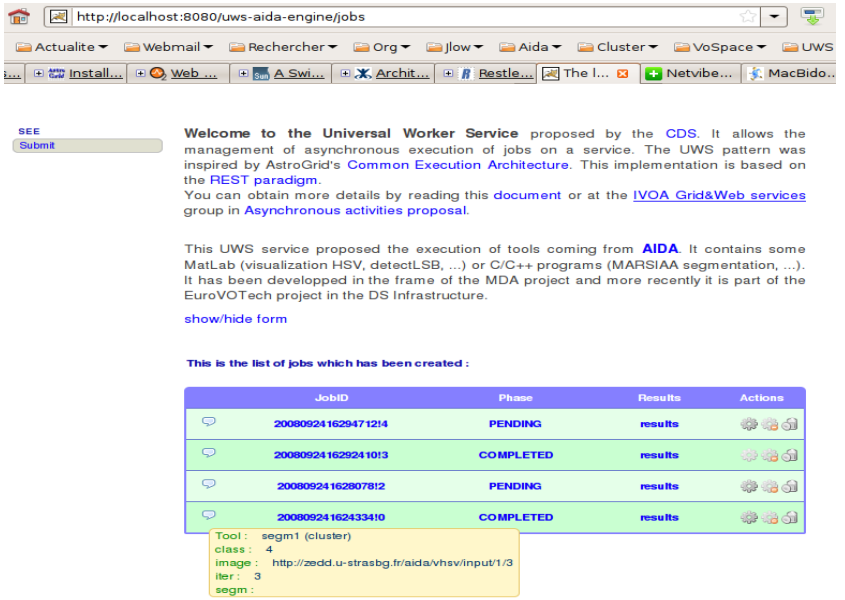
File chooser used in Aladin



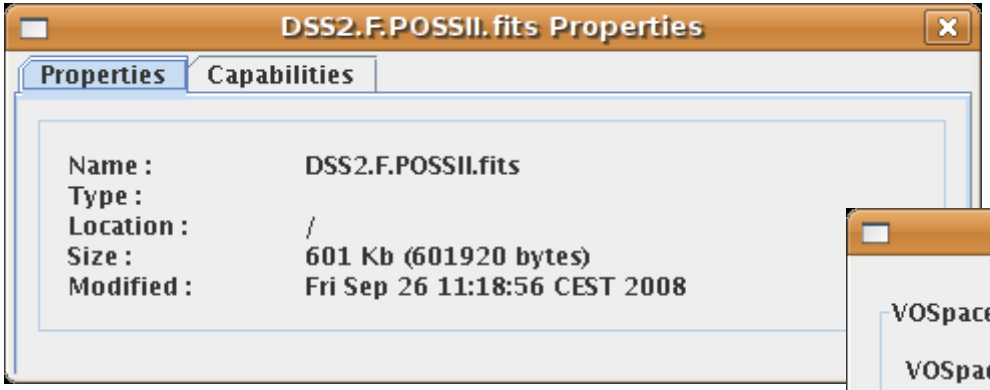
FileChooser as a servlet

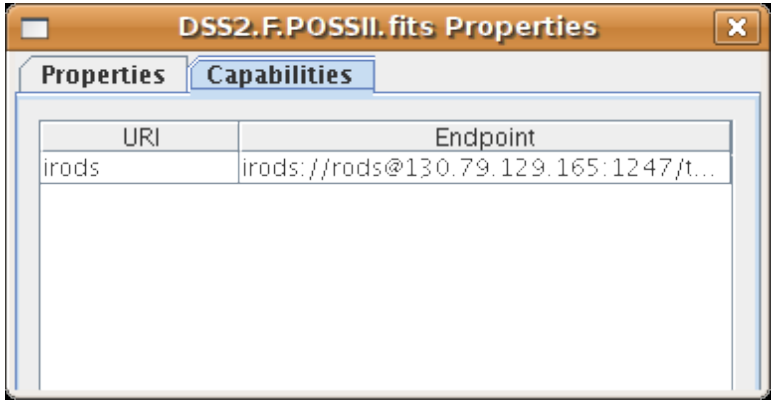
- Used in CDS UWS (Universal Worker Service) framework





Properties, capabilities, security





TLS : with password ok, with certificate soon

Illustration (2)

CDS Portal

iRODS is used to store the user data generated during a session

Developed by Pascal Wassong during the EuroVO AIDA project (ending in June 2010)

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http://cdsportal.u-strasbg.fr/portal.html#m27

Simbad VizieR Aladin Catalogs Dictionary Biblio Tutorials Developers

CDS Portal

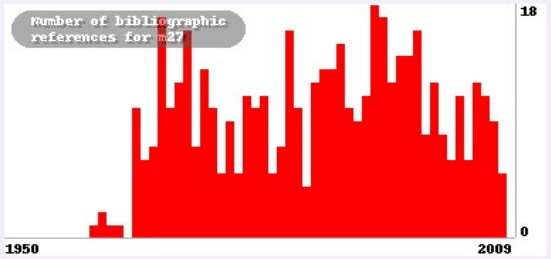
Portal My data Login Register Preferences

Target: m27 GO

J2000 position for m27: 19 59 36.340 +22 43 16.09

Object identifiers, measurements and bibliography for m27

- Object type: Planetary Nebula
- Spectral type: DA
- More SIMBAD data for m27
- 475 bibliographic references
- 14 objects within 2'
- Display map around m27



Images for m27

- Display region in Aladin (Web Start)

Aladin images

Survey	Band	Wavelength (µm)	Size	Epoch	Resolution	Download
2MASS	K	2.16	8.5' x 17.0'	1999-11-04	0.9" / pixel	FITS
2MASS	H	1.65	8.5' x 17.0'	1999-11-04	0.9" / pixel	FITS
2MASS	J	1.24	8.5' x 17.0'	1999-11-04	0.9" / pixel	FITS
POSSII	F	0.65	12.9' x 12.9'	1992-09-19	1.0" / pixel	FITS JPEG
POSSII	F	0.65	12.9' x 12.9'	1996-07-11	1.0" / pixel	FITS JPEG
POSSII	J	0.49	12.9' x 12.9'	1990-07-24	1.0" / pixel	FITS JPEG
POSSII	N	0.83	12.9' x 12.9'	1992-07-22	1.0" / pixel	FITS JPEG
POSSII	N	0.83	12.9' x 12.9'	1995-07-19	1.0" / pixel	FITS JPEG
POSSII	N	0.83	12.9' x 12.9'	1994-06-15	1.0" / pixel	FITS JPEG
POSSI	O	0.64	12.9' x 12.9'	1951-07-13	1.0" / pixel	FITS JPEG
POSSII	J	0.49	13.0' x 13.0'	1990-07-26	1.0" / pixel	FITS JPEG
POSSII	J	0.49	13.0' x 13.0'	1988-06-14	1.0" / pixel	FITS JPEG
POSSI	E	0.40	14.1' x 14.1'	1951-07-13	1.6" / pixel	FITS JPEG

Display grayscale image

Catalogues for m27

- 0 catalogues with 'm27' keyword

Terminé

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http://cdsportal.u-strasbg.fr/portal.html#m27

Google

POSSII	N	0.83	12.9' x 12.9'	1992-07-22	1.0" / pixel	FITS JPEG
POSSII	N	0.83	12.9' x 12.9'	1995-07-19	1.0" / pixel	FITS JPEG
POSSII	N	0.83	12.9' x 12.9'	1994-06-15	1.0" / pixel	FITS JPEG
POSSI	O	0.64	12.9' x 12.9'	1951-07-13	1.0" / pixel	FITS JPEG
POSSII	J	0.49	13.0' x 13.0'	1990-07-26	1.0" / pixel	FITS JPEG
POSSII	J	0.49	13.0' x 13.0'	1988-06-14	1.0" / pixel	FITS JPEG
POSSI	E	0.40	14.1' x 14.1'	1951-07-13	1.6" / pixel	FITS JPEG

Display grayscale image

Catalogues for m27

- 0 catalogues with 'm27' keyword
- 73 catalogues around m27

Vizier catalogues

	Name	Description	Local density	Wavelength	Popularity	Coverage map
☆	I/297 Query	NOMAD Catalog (Zacharias+ 2005) [ReadMe]	53	optical,IR	85	
★	I/284 Query	The USNO-B1.0 Catalog (Monet+ 2003) [ReadMe]	51	optical	92	
☆	I/305 Query	The Guide Star Catalog, Version 2.3.2 (GSC2.3) (STScI, 2006) [ReadMe]	49	optical	85	
☆	I/304 Query	Carlsberg Meridian Catalog 14 (CMC14) (CMC, 2006) [ReadMe]	36	optical	78	
☆	II/246 Query	2MASS All-Sky Catalog of Point Sources (Cutri+ 2003) [ReadMe]	34	IR	100	
☆	I/267 Query	The APM-North Catalogue (McMahon+, 2000) [ReadMe]	20	optical	79	
☆	J/A+A/469/1221 Query	Sydney observatory Galactic survey (SOGS) (Fresneau+, 2007) [ReadMe]	16	optical	69	
★	IX/10A Query	ROSAT All-Sky Bright Source Catalogue (1RXS) (Voges+ 1999) [ReadMe]	11	X-ray	89	
☆	VI/110 Query	Final Merged Log of IUE Observations (NASA-ESA, 2000) [ReadMe]	10	UV	70	
☆	B/hst Query	HST Archived Exposures Catalog (STScI, 2007) [ReadMe]	10	optical	76	

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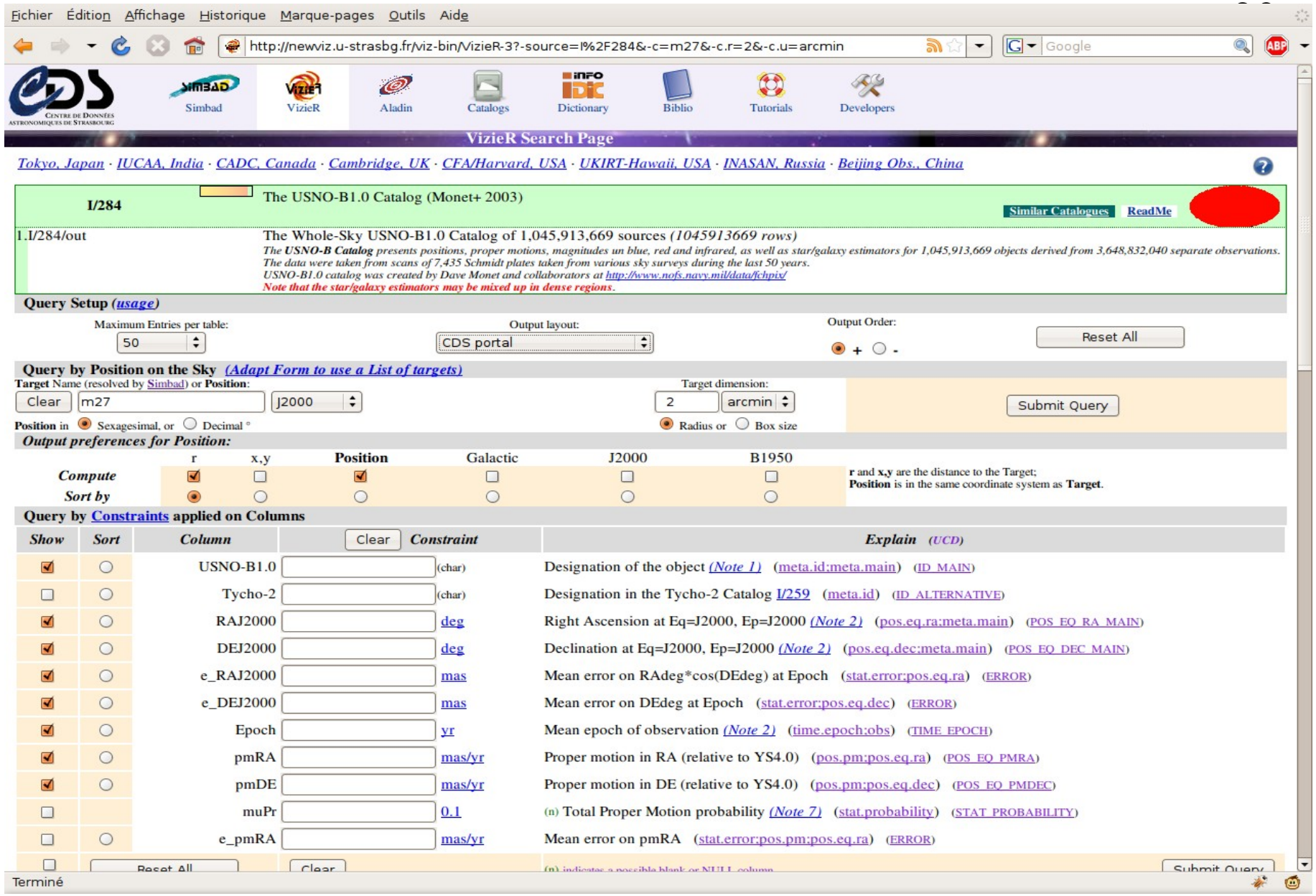
Aucun élément dans la corbeille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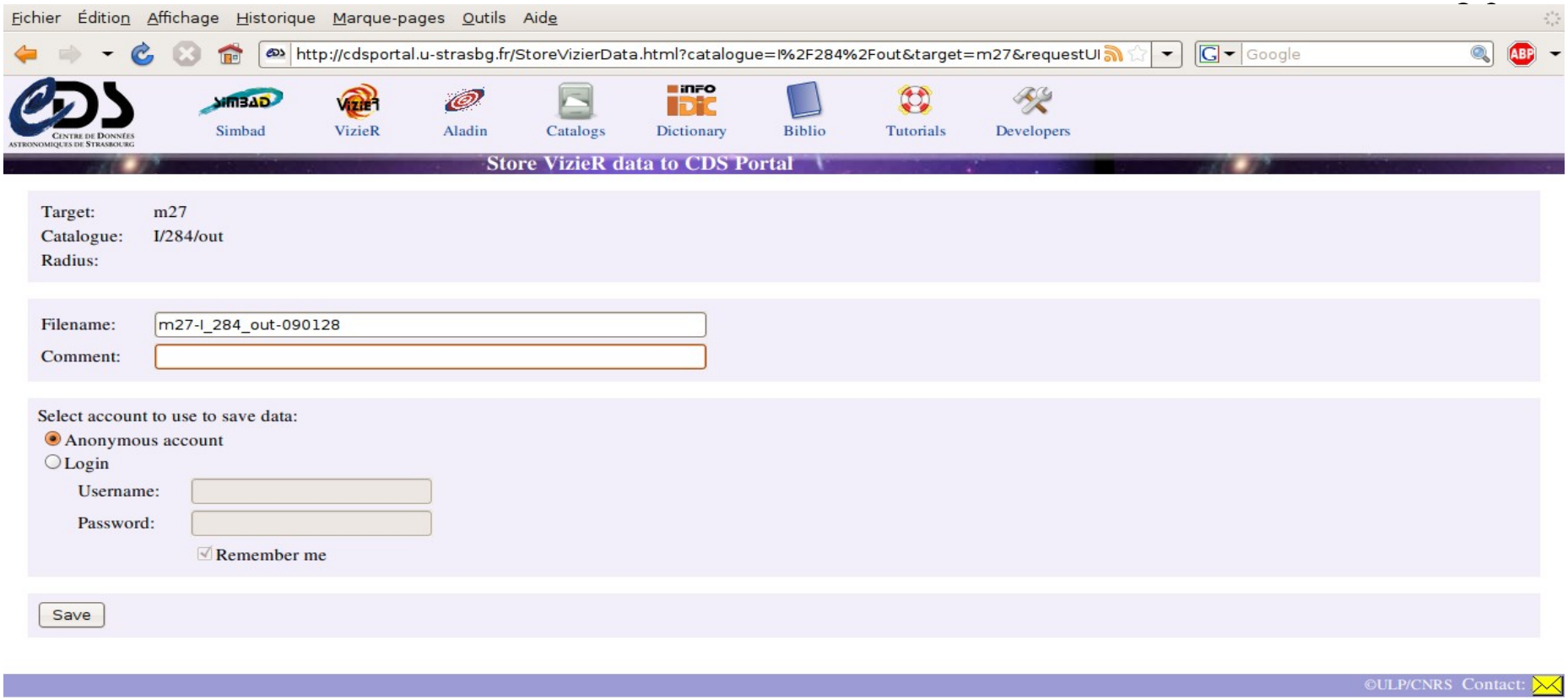
Google
Simbad
VizieR
Aladin
Catalogs
Dictionary
Biblio
Tutorials
Developers
VizieR Search Page
Tokyo, Japan · IUCAA, India · CADC, Canada · Cambridge, UK · CFA/Harvard, USA · UKIRT-Hawaii, USA · INASAN, Russia · Beijing Obs., China
I/284
The USNO-B1.0 Catalog (Monet+ 2003)
Similar Catalogues
ReadMe
1.I/284/out
The Whole-Sky USNO-B1.0 Catalog of 1,045,913,669 sources (1045913669 rows)
The USNO-B Catalog presents positions, proper motions, magnitudes un blue, red and infrared, as well as star/galaxy estimators for 1,045,913,669 objects derived from 3,648,832,040 separate observations.
The data were taken from scans of 7,435 Schmidt plates taken from various sky surveys during the last 50 years.
USNO-B1.0 catalog was created by Dave Monet and collaborators at http://www.nofs.navy.mil/data/fchpix/
Note that the star/galaxy estimators may be mixed up in dense regions.
Query Setup (usage)
Maximum Entries per table:
50
Output layout:
CDS portal
Output Order:
+ -
Reset All
Query by Position on the Sky (Adapt Form to use a List of targets)
Target Name (resolved by Simbad) or Position:
Clear
m27
J2000
Target dimension:
2
arcmin
Position in Sexagesimal, or Decimal °
Radius or Box size
Submit Query
Output preferences for Position:
r
x,y
Position
Galactic
J2000
B1950
Compute
Sort by
r and x,y are the distance to the Target;
Position is in the same coordinate system as Target.
Query by Constraints applied on Columns
Show
Sort
Column
Clear
Constraint
Explain (UCD)
USNO-B1.0 (char) Designation of the object (Note 1) (meta.id;meta.main) (ID_MAIN)
Tycho-2 (char) Designation in the Tycho-2 Catalog I/259 (meta.id) (ID_ALTERNATIVE)
RAJ2000 deg Right Ascension at Eq=J2000, Ep=J2000 (Note 2) (pos.eq.ra;meta.main) (POS_EQ_RA_MAIN)
DEJ2000 deg Declination at Eq=J2000, Ep=J2000 (Note 2) (pos.eq.dec;meta.main) (POS_EQ_DEC_MAIN)
e_RAJ2000 mas Mean error on RAdeg*cos(DEdeg) at Epoch (stat.error;pos.eq.ra) (ERROR)
e_DEJ2000 mas Mean error on DEdeg at Epoch (stat.error;pos.eq.dec) (ERROR)
Epoch yr Mean epoch of observation (Note 2) (time.epoch;obs) (TIME_EPOCH)
pmRA mas/yr Proper motion in RA (relative to YS4.0) (pos.pm;pos.eq.ra) (POS_EQ_PMRA)
pmDE mas/yr Proper motion in DE (relative to YS4.0) (pos.pm;pos.eq.dec) (POS_EQ_PMDEC)
muPr 0.1 (n) Total Proper Motion probability (Note 7) (stat.probability) (STAT_PROBABILITY)
e_pmRA mas/yr Mean error on pmRA (stat.error;pos.pm;pos.eq.ra) (ERROR)
Reset All
Clear
(n) indicates a possible blank or NULL column
Submit Query
Terminé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http://cdsportal.u-strasbg.fr/StoreVizierData.html?catalogue=I%2F284%2Fout&target=m27&requestUI
Google
Centre de Données astronomiques de Strasbourg
Simbad
VizieR
Aladin
Catalogs
Dictionary
Biblio
Tutorials
Developers
Store VizieR data to CDS Portal
Target: m27
Catalogue: I/284/out
Radius:
Filename: m27-I_284_out-090128
Comment:
Select account to use to save data:
Anonymous account
Login
Username:
Password:
Remember me
Save
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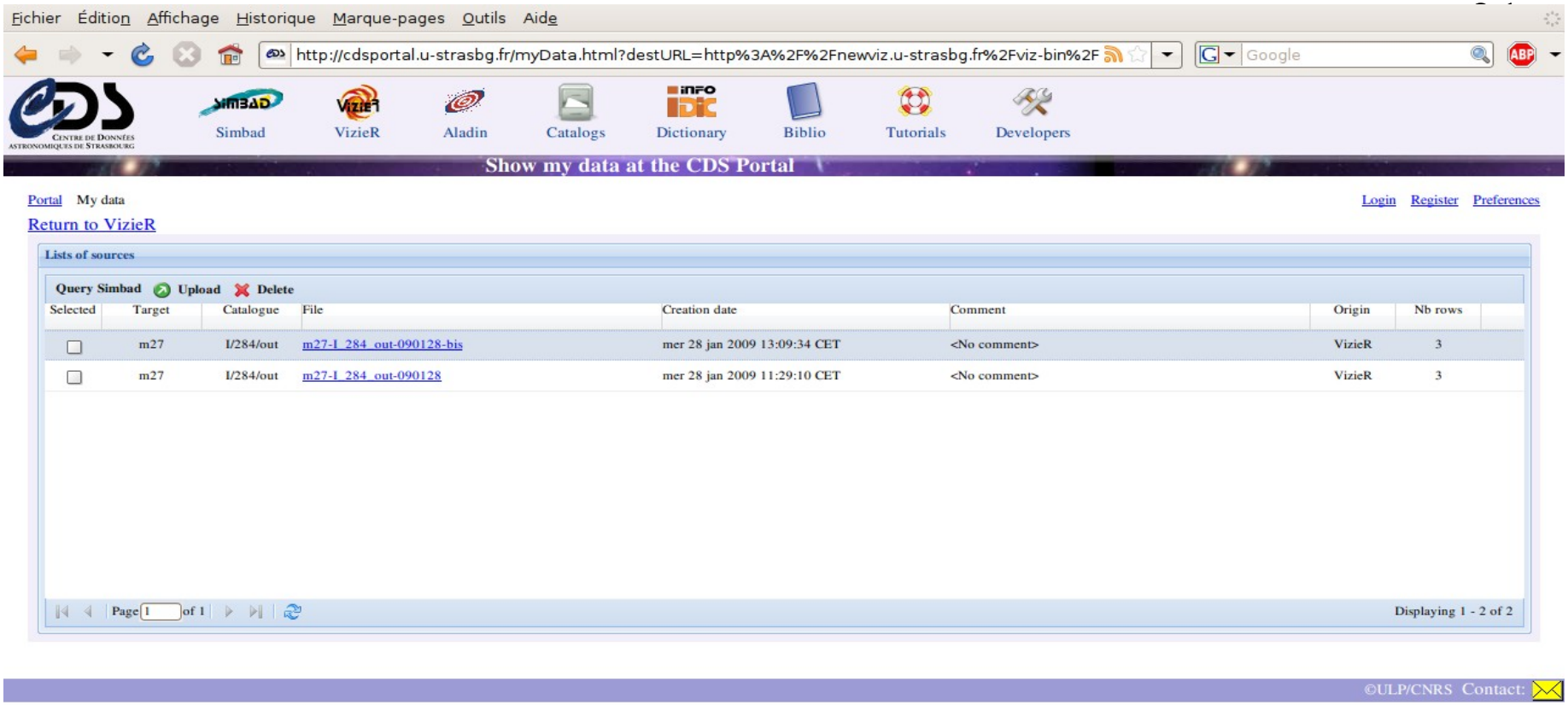
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http://cdsportal.u-strasbg.fr/myData.html?destURL=http%3A%2F%2Fnewviz.u-strasbg.fr%2Fviz-bin%2F
Google
Simbad
VizieR
Aladin
Catalogs
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Developers
Show my data at the CDS Portal
Portal My data
Login Register Preferences
Return to VizieR
Lists of sources
Query Simbad Upload Delete
Selected Target Catalogue File Creation date Comment Origin Nb rows
m27 I/284/out m27-I_284_out-090128-bis mer 28 jan 2009 13:09:34 CET <No comment> VizieR 3
m27 I/284/out m27-I_284_out-090128 mer 28 jan 2009 11:29:10 CET <No comment> VizieR 3
Page 1 of 1
Displaying 1 - 2 of 2
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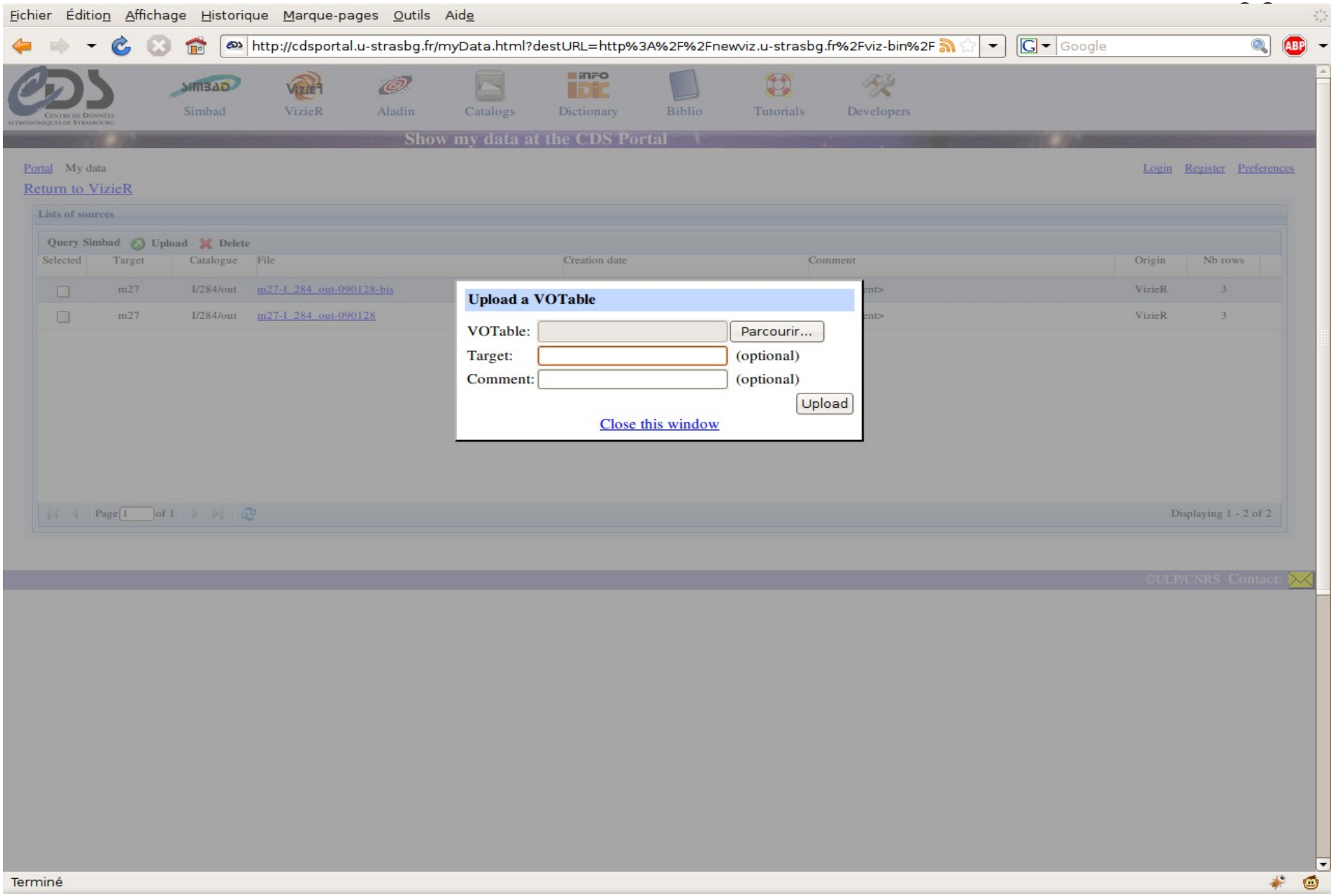
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http://cdsportal.u-strasbg.fr/myData.html?destURL=http%3A%2F%2Fnewviz.u-strasbg.fr%2Fviz-bin%2F
Google
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Show my data at the CDS Portal
Portal My data
Login Register Preferences
Return to VizieR
Lists of sources
Query Simbad Upload Delete
Selected Target Catalogue File Creation date Comment Origin Nb rows
m27 I/284/out m27-I_284_out-090128-bis VizieR 3
m27 I/284/out m27-I_284_out-090128 VizieR 3
Upload a VOTable
VOTable: Parcourir...
Target: (optional)
Comment: (optional)
Upload
Close this window
Page 1 of 1
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Conclusion of this work

- iRODS is easy to implement and seems to be a good solution to ensure the robustness of a VOSpace
- This work was done in the frame of VOTECH project (ending in June 2009), tools are available and maintenance will continue for the tools used at CDS (VOSpace-iRODS framework, VOSpace Explorer, CDS Portal)
- On iRODS Wiki : http://www.irods.org/index.php/VOSpace
- On DICE pages :
  http://www.diceresearch.org/DICE_Site/Uses/Entries/2008/11/5_iRODS_Opens_Virtual_Vistas_for_Astronomy.html
- On IN2P3 Wiki :
  http://indico.in2p3.fr/conferenceOtherViews.py?view=standard&confId=1234
- IVOA wiki : http://www.ivoa.net
- CDS website : http://cds.u-strasbg.fr