Interoperability between Publications, Reference Data and Visualisation Tools

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CDS Centre de données astronomique de Strasbourg



since 1972...

- Collect useful data on objects in electronic form
- Improve them by critical evaluation and combination
- Distribute the results to the international community
- Conduct research using the data

Astronomy

- Publishing and Reference services must evolve because science is constantly changing
- Era of big surveys (but also detailed individual studies)
- Multi-wavelength astronomy, Time Domain astronomy, multi-messenger astronomy coming

Interconnected science

- Involves 'Big Data', Data Mining, VO
 - using multiple instruments/telescopes
 - combining data from multiple sources
- more Open and collaborative
 - using tools and services that fit the purpose
 - distributed teams/collaborations/projects

CDS services



Astronomical Objects : IDs, bibliography, measurements







Catalogue Service : Catalogues, published tables, observation logs, surveys, associated data

Visualisation and integration : images, catalogues, archives, VO portal, All-sky capabilities

X-Match : Catalogue cross-match

Reference data centre

- Qualified information = Scientific Value
 - Peer reviewed
 - Critically evaluated, professionally curated
- Science-driven to maintain relevance and quality
- Reliant on maintaining trust and support of community: Journals, Authors, Archives, Data Centres, Observatories

Making information useable

- Add value by homogeneous description of heterogeneous data
- Standardisation
 - Formats, conventions, protocols
- Metadata
 - Encodes a level of 'meaning' to the data
- Interoperability • Connections - literature, archives, tools

CDS Portal

2

Portal My data Help

Target: ngc 4039 GO J2000 position for ngc 4039: 12 01 53.7 -18 53 08



Diect identifiers, measurements and bibliography for noc 4039	
Object type: Galaxy in Pair of Galaxies	
 Morphological type: Sc 	

- More SIMBAD data for ngc 4039
- 1049 bibliographic references
- 360 objects within 2'
- Display map around ngc 4039
- Display SimPlay interactive map around ngc 4039 Related objects in bibliography:



• Display region in Aladin (Web Start)

Aladin image	s					
Survey	Band	λ (µm)	Size	Epoch	Resolution	Download
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Login Preferences Register

Display grayscale image



Catalogues for ngc 4039

- <u>10 catalogues with 'ngc 4039' keyword</u>
 <u>179 catalogues around ngc 4039:</u>

Vi	Vizier catalogues								
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2	l/297 Query	NOMAD Catalog (Zacharias+ 2005) [ReadMe]	53	optical,IR	89				
	J/ApJS/1… Query	Chandra ACIS survey in 383 nearby galaxies. I. (Liu, 2011) [ReadMe]	52	X-ray	64				



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Vizier



Catalogues, published tables, observation logs, surveys, associated data

Heterogeneous tables described by standardised metadata

Multiple interfaces: Vizier web page, Aladin interface, CDS Portal, direct URL queries, Topcat interface, DS9, VO TAP, VO Cone Search

Simplified query interface



Description - Browsing modes - Large catalogues & Surveys - VO compatibility - VizieR mirrors - Help/Documentations - Notes

Advanced query interface

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Browsing modes: Designation, Acronyms, Favorites, Dates, Image, spectra, Kohonen Or list the large surveys

Tools related to VizieR

- new <u>Photometry viewer</u>: Plot photometry (sed) including all VizieR
- <u>TAP VizieR</u> : query VizieR using ADQL (a SQL extension dedicated for astronomy)
- CDS cross-match service : fast cross-identification between any 2 tables, including VizieR catalogues, SIMBAD

Query interface for single table

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TOPCAT

- Direct Vizier access
- Protocols
- Metadata
- TAP: SQL like queries
- Interoperability



Interoperability - SAMP





17

Broadcast

Photometry in catalogues

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http://vizier.u-strasbg.fr/vizier/sed/

VizieR Photometry viewer



Aladin



Aladin - recent developments

- Benefits of hierarchical representation of large image surveys and catalogues
- Coverage maps open up new possibilities for manipulating surveys and catalogues
 - powerful for scientific selection/queries
 - new interactions between images, cubes and catalogues

It's really all about how you describe regions on the sky, and how you can manipulate and work with them



Vea

Delphinus

Eauuleus

Altai

Aquila



Deneb

Vega

Cepheus

Constellations - beautiful but difficult to compute with

Regions in spherical coordinates good for boxes and circles

Complex region polygons provide accurate representation (non unique) but also cumbersome

Healpix tessellation of the sky



Each tile represented by an integer in a hierarchical scheme



HiPS: Hierarchical Progressive Surveys

- -Multi-resolution HEALPix data structure for
 - •Images
 - Catalogues
 - •3-dimensional data cubes
- -Conserves scientific data properties alongside visualisation considerations
- -Implemented for ~250 data sets and growing
- -New levels of interoperability



Use an archive as a survey

 HiPS of the WFPC2 HST archive images (filter by filter)



Survey/image outlines

• MOC: Multi-Order Coverage maps





- Comparing coverage of 100s of large data sets
- Intersection/union/complement trivial
- Catalogue coverage
 1000s (Vizier)



Queries based on coverage and catalogues
 e.g. Veron quasars in HST, XMM and SDSS images

Hierarchical views of Catalogues

- Same idea: *HiPS Catalogue*. Important when dealing with/visualizing 10⁶, 10⁷, 10⁸ + catalogues
- Allows zooming into large or deep catalogue
- Hierarchy can be defined in different ways brightness, parallax, local density
- e.g. SIMBAD progressive Survey (hierarchy based on size of object and number of citations)



HiPS catalogue capabilities just getting started

- current capability : beneficial for visualization
- being investigated for use in managing/ analysing very large catalogues (e.g. Gaia)
- imagine multiple Gaia catalogues organised by different hierarchies

Summary

- Reference services:
 - quality, integrity and relevance
- Interoperability support many access modes, promote standardisation
- HiPS and MOC: Hierarchical approach to big data and interoperability
 - Lots of innovation going on!

thanks