

# THE US NATIONAL VIRTUAL OBSERVATORY

## The Virtual Observatory: Retrospective and Prospectus



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# US NRC Decadal Survey, 2000

The NVO will provide a "virtual sky" based on the enormous data sets being created now and the even larger ones proposed for the future. It will enable a new mode of research for professional astronomers and will provide to the public an unparalleled opportunity for education and discovery.



# Virtual Observatories of the Future (June 2000, Pasadena)



# IVOA



# IVOA Standards

Category	Name	Status
<i>Applications</i>	Simple Application Messaging Protocol (SAMP)	REC
<i>Data Access</i>	Simple Cone Search (SCS)	REC
	Simple Image Access Protocol (SIAP)	PR
	Simple Line Access Protocol (SLAP)	PR
	Simple Spectrum Access Protocol (SSAP)	REC
	Table Access Protocol (TAP)	PR
<i>Data Models</i>	Space-Time Coordinates (STC)	REC
	Astronomical Dataset Characterization	REC
	Spectral Lines Data Model	PR
	Spectral Data Model	REC
<i>Grid &amp; Web Services</i>	Single Sign-On/Authentication (SSO)	REC
	VOSpace	REC
	Credential Delegation Protocol	PR
	Universal Worker Service (UWS)	PR
	Support Interfaces	WD
	Web Service Basic Profile	WD
<i>Registries</i>	Identifiers	REC
	Registry Interface	PR
	Resource Metadata	REC
	VOResource	REC
	VODataService	PR
<i>Semantics</i>	Unified Content Descriptors (UCDs)	REC
	Maintenance of UCD Words	REC
	UCD1+ Controlled Vocabulary	REC
	Vocabularies in the Virtual Observatory	REC
<i>VOEvent</i>	Sky Event Reporting Metadata	REC
<i>Query Language</i>	Astronomical Data Query Language (ADQL)	REC
	SkyNode Interface	WD
<i>VOTable</i>	VOTable Format Specification	REC

*Nature*, 10 Sept 2009



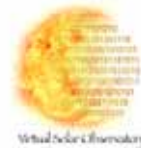
# Nature, 10 Sept 2009

Some communities have been quite open to sharing, and their repositories are bulging with data. Physicists, mathematicians and computer scientists use <http://arXiv.org>, operated by Cornell University in Ithaca, New York; the International Council for Science's World Data System holds data for fields such as geophysics and biodiversity; and molecular biologists use the Protein Data Bank, GenBank and dozens of other sites. The astronomy community has the International Virtual Observatory Alliance, geoscientists and environmental researchers have Germany's Publishing Network for Geoscientific & Environmental Data (PANGAEA), and the Dryad repository recently launched in North Carolina for ecology and evolution research." (Nelson 2009)



# VOs in Other Sciences

## The National Solar Observatory Component of the Virtual Solar Observatory



The Virtual Solar Observatory (VSO) is a software system linking together distributed archives of solar data into a unified whole, along with data search and analysis tools. The links on this page are to documents describing the concept in more detail.

**VIRTUAL HELIOSPHERIC OBSERVATORY**

HOME DATA QUERY MORE SERVICES CONTACT TOOLS NEWS SPASE-QL

**LATEST NEWS**

- ACE, Geotail, IMP8, and WIND Propagated Data Added
- Ulysses (OSCAR) Polar Heights Data Added

**LATEST DATA UPDATES**

- 9 Sep 2009: ACE magnetic field and plasma data shifted to Earth bow shock nose (1-min) (11 files)
- 9 Sep 2009: Geotail magnetic field and plasma data shifted to Earth bow shock nose (1-min) (12 files)
- 9 Sep 2009: IMP8 magnetic field and plasma data shifted to Earth bow shock nose (1-min) (7 files)
- 9 Sep 2009: STEREO-A IMPACT MAG (844 files)
- 9 Sep 2009: STEREO-B IMPACT MAG (843 files)

**NCAR Virtual Solar Terrestrial Observatory**

Home Data Communities About Us Login

## Welcome to the Virtual Solar Terrestrial Observatory

The Virtual Solar Terrestrial Observatory (VSTO) is a unified semantic environment serving data from diverse data archives in the fields of solar, solar-terrestrial, and space physics (SSTSP), currently:

- Upper atmosphere data from the **CEDAR** (Coupling, Energetics and Dynamics of Regions) archive
- Solar corona data from the **MLSO** (Mauna Loa Solar Observatory) archive

**OCEAN OBSERVATORIES INITIATIVE**

Home » Programs & Partnerships » Ocean Observing » Ocean Observatories Initiative (OOI)

**Ocean Observatories Initiative (OOI)**

- Registration Open for OOI Science Workshop, Nov. 11-12, Ballimore, MD
- NSF, OL Sign Cooperative Agreement

Ocean Observing Home | Previous Page





# VOs in Unexpected Places

Fors q'ille estoit plus estendue.  
 Qu'asse mais ne nauoir veue.  
 Celle saue q' li bien seoit.  
 S'ades q' grant lie me faisoit.  
 De regarder le lieu plaiant.  
 De leaue d'eez: reluplant.  
 Mon vis ratereschy: saue.  
 Si by tout conuert et paue.  
 Le fen' de leaue de grauelle.  
 La prarie grande et belle.  
 Jusquan pie de leaue l'aitoit.  
 C'ere et serre belle estoit.  
 La matinee et actremme.  
 Lors men alay parmi la proie.  
 Contreual leaue elbanoit.  
 Tout le riante coltoient.



Et omat lamat veit le iardin.  
 Quant ieus vint von auat ale.  
 Si dy vint dective steit: k  
 F'ndes d'ung mur hali bataille.  
 Doutraut. Schors: entaille.  
 A mautes rudes p'traiturees.  
 Les ymages et les figures.  
 A y moult volentes rennes.  
 Si dy comptexay et d'eez.  
 De ces ymages la semblance.  
 Si com moy d'it en remebrae.




Et d'ne lamat deit les ymages.  
 Au milieu du mur by harne.  
 Plome de corou: z Satapie.  
 Il rec estoit et moult p'ueste.  
 Bien sembloit estre f'ceeste.  
 Et remplie de grande rage.  
 Et stoit par seblat cest ymage.  
 Si n'estoit pas bien atournee.  
 A me sembloit estre forcee.  
 K'ehgme auoit et freonee.  
 Le vis et k nes recourte.  
 Moult laide estoit: eforalle.  
 Et si estoit encor liee.  
 H'ideulomet d'unc touaille.  
 Vne aule ymages dault' taile.  
 A fenestre by delez sy.  
 Son nom deilus la teste sy.



Et est villempe.  
 Appellee estoit villempe.  
 Vne ymage q' felome.

# Hubble Legacy Archive: VO Inside



## Hubble Legacy Archive

abell 1414 [Search](#) [Reset](#) [Help advanced search](#)  
Examples: M101, 14 09 12.6 +14 20 56.7 r=0.2d, more...  
 Requires Firefox, Safari, IE7, or compatible browser.

**Position list:**    
**File upload:**      
List delimiter:  List format:

**Position:** RA:  Dec:  radius:  degrees

**Selection:** Instruments:  All  ACS  ACSGrism  WFC2  WFC2-PC  STIS  FOS  GRS

**Data Product:**

Proposal ID:  Spectral elements:  Moving targets only:

[Image preferences](#)

[Inventory](#) [Images](#) [Footprints](#) [Cart, 0 kB](#) [Grism Spectra \(ST-ECF\)](#) [Help](#)

abell 7656 RA = 134.953054 Dec = 27.980694 r = 0.2 [12:59:48.733 +27:58:50.53]

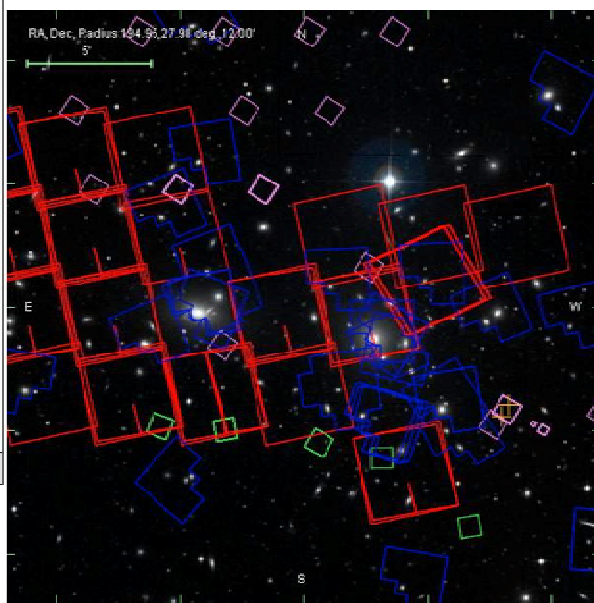
Instrument	#Footprints
<input checked="" type="checkbox"/> ACS	78
<input checked="" type="checkbox"/> ACSGrism	0
<input type="checkbox"/> WFPC2-PC	0
<input checked="" type="checkbox"/> WFPC2	129
<input checked="" type="checkbox"/> STIS	47
<input checked="" type="checkbox"/> NICMOS	118
<input checked="" type="checkbox"/> NICMOS-Grism	2
<input checked="" type="checkbox"/> FOS	0
<input checked="" type="checkbox"/> GRS	0

**DSS Image:**  On  Off

**Data Product:**  
 Exposure (Level 1)  
 Combined (Level 2)  
 Best Available  
 Contributed HLSP  
 Mosaic (Level 3)

To Zoom, go to Advanced Search and enter a smaller value for Radius (smallest value 0.01 degrees)

Click [here](#) for NVO STC Web Services



RA, Dec, Radius 134.952790 deg, 13.00'

# Marketing



# NVO Website



**Need help? Not sure how to start?**

[» Getting Started with NVO](#)



Collect all data at a given position.

[» DataScope](#)



Count matches between catalog entries and given positions.

[» Inventory](#)



Query databases and cross-match object lists

[» Open SkyQuery](#)



Find data collections and catalogs by searching their descriptions.

[» Directory](#)



Integrate data from multiple positions and datasets.

[» VIM](#)



Query the VO from the command line.

[» VO-CLI](#)



Convert text tables to the VOTable format used by VO applications.

[» Table Tools](#)



Do more with NVO.

[» Data Analysis & More](#)

# Google, then...

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10 2  
9 3  
8 4  
7 5  
6


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# VO Service Reliability Problems



National Virtual Observatory



## NVO Portal: DataScope Response



Hosted by:  
HEASARC  
NASA/GSFC

NVO Home
New Query
Help
Contact Us

Data found(426)
No data (5346)
Errors(31)
Waiting(0)
100% complete

Position: MESSIER 045      Resources/hits: 5803/61670      Cache age: 8.991 hours

Summary
Resources
Data Table
No Data
Still Processing
Errors
Help

### Query errors

Short Name	Service Type Title Error	Publisher
2MASS-PSC	Objects/Infrared Astronomy, Surveys 2MASS All-Sky Point Source Catalog java.net.SocketTimeoutException: Read timed out	NASA/IPAC Infrared Science Archive
ADIL	Observations/Radio, Millimeter, Infrared, Optical, UV NCSA Astronomy Digital Image Library Cone Search (Targeted Images) java.net.ConnectException: Connection timed out	NCSA Radio Astronomy Imaging
ADIL	Images/Radio, Millimeter, Infrared, Optical, UV NCSA Astronomy Digital Image Library Simple Image Access java.net.ConnectException: Connection timed out	NCSA Radio Astronomy Imaging
Aladin	Images/Optical, Infrared The ALADIN image server org.xml.sax.SAXParseException: Content is not allowed in prolog.	CDS
CADC/HSTCA	Images/Optical, UV CADCA/HSTCA SIA service java.io.FileNotFoundException: http://www.cadc-coda.hia-ihp.nrc-cnrc.gc.ca/ivoa/HSTCA/siapQuery?POS=56.85,24.116667&SIZE=0.25&requestID=DS1254116231548	Canadian Astronomy Data Centre
DSS1	Images/Optical Digitized Sky Survey 1 java.io.FileNotFoundException: http://nvo-twiki.stsci.edu/gscvo/DSS1.jsp?FORMAT=image/fits&&POS=56.85,24.116667&SIZE=0.2505&requestID=DS1254116231548	Space Telescope Science

# VO-Enabled Research Papers



**EURO FACILITY CENTRE**

The Euro-VO projects: [VOTECH](#) [EuroVO-DCA](#) [EuroVO-AIDA](#)

**Science**

- Software
- Recipes User Manual
- Scientific Workflows
- AIDA Research Initiative
- Scientific Papers**
- Science Advisory Committee
- Acknowledging
- Helpdesk

**Technical**

- Software
- Registries
- Tutorials
- IVOA Standards =>

**Data Centres**

- Overview
- Partners
- Work Packages
- Tutorials

## VO-enabled Scientific Papers

Scientific publications mainly enabled by VO tools or about VO tools and methods.

For conference proceedings and other non-refereed publications, see [here](#)

### REFEREED PUBLICATIONS

**The LAEX and NASA portals for CoRoT public data**  
Solano et al., 2009, A&A, in press, arXiv:0907.3405

**The chemical abundance analysis of normal early A- and late B-type stars**  
Fossati et al., 2009, A&A, 503, 945

**Exo-Dat: An Information System in Support of the CoRoT/Exoplanet Science**  
Deleuil et al., 2009, AJ, 138, 649

**GALEX-SDSS Catalogs for Statistical Studies**  
Budavari et al., 2009, ApJ, 694, 1281

and 30 more...



The VO is:  
Technology enabled...  
*science driven.*