# IVOA Newsletter - December 2017



**IVOA Newsletter Editors:** Deborah Baines, Bruce Berriman, Jamie Anne Budynkiewicz, Theresa Dower, Giulia Iafrate, Simon O'Toole, Li Shanshan, Yihan Tao.

**The International Virtual Observatory Alliance (IVOA) was formed in June 2002 with a mission to facilitate the international coordination and collaboration necessary for the development and deployment of the tools, systems and organizational structures necessary to enable the international utilization of astronomical archives as an integrated and interoperating virtual observatory. The IVOA now comprises 20 VO programs from Argentina, Armenia, Australia, Brazil, Canada, Chile, China, Europe, France, Germany, Hungary, India, Italy, Japan, Russia, South Africa, Spain, Ukraine, the United Kingdom, and the United States and an inter-governmental organization (ESA). Membership is open to other national and international programs according to the IVOA Guidelines for Participation. You can read more about the IVOA and what we do at http://ivoa.net/about/.**

**What is the VO?**
The Virtual Observatory (VO) aims to provide a research environment that will open up new possibilities for scientific research based on data discovery, efficient data access, and interoperability. The vision is of global astronomy archives connected via the VO to form a multiwavelength digital sky that can be searched, visualized, and analyzed in new and innovative ways. VO projects worldwide working toward this vision are already providing science capabilities with new tools and services. This newsletter, aimed at astronomers, highlights VO tools and technologies for doing astronomy research, recent papers, and upcoming events.

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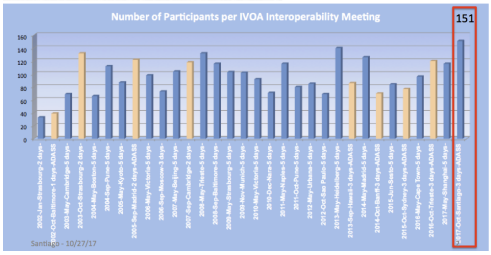
## IVOA NEWS

**The Greatest Attendance so far**




### The Santiago de Chile IVOA meeting

Pepi Fabbiano, Mark Allen and Janet Evans

The October IVOA Interoperability meeting took place in Santiago, Chile, 27-29 October 2017. This was a short meeting, following the Santiago ADASS meeting, but enjoyed the greatest attendance so far, a record 151 attended, including a large cohort from Chile and other South American countries. This attendance highlights the increasing importance and presence of the VO and IVOA standards in astrophysical software.

Although short, this meeting benefited from prior discussion during the ADASS meeting. It was characterized by high quality professional discourse and very good presentations. The Time Domain priority area was a focus, reflecting the increasing importance of survey and multi-messenger observations. Although no new standards were approved in this session, after the record 10 approved in the Spring Shanghai meeting, significant advances were achieved in the improvement of core IVOA standards, with updates to documents in the areas of Provenance, VODML, Grid and Web Services, DAL standards revisit, and Registry Interfaces.

IVOA related activity included an interest in large data management and knowledge discovery, fostered by the IVOA KDD interest group, which sponsored a bird of a feather session in the ADASS meeting. The IVOA community is also responding to the needs of the astrophysical community at large, as evidenced by discussions and developments in notebooks, computing near the data, and focus on validation and monitoring of VO services.

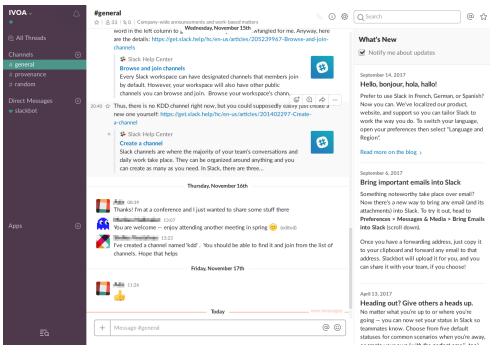
The overall theme from both ADASS and IVOA meetings was that the VO is everywhere!

Thanks are due to the ChileVO organizing team, led by Dr. Mauricio Solar that made this meeting both enjoyable and productive.

More information: http://www.adass.cl/#ivoa

**IVOA Slack workspace**

During the IVOA Interop meeting in Santiago, Dave Morris launched a Slack workspace, https://ivoa.slack.com, as an additional means for collaboration in the IVOA, writing: *"This is an experiment to see if Slack is a useful tool for IVOA members to communicate. To get it started, please invite your colleagues to join. If you are a member of a working group, please feel free to create a channel for it."* IVOA on Slack is slowly getting traction, as there are already channels for GWS, KDD, Provenance, Registry, Time domain, Time series, VOEvent and general discussions.




With new members needing an invitation to join a Slack workspace, one way to get an invitation is asking somebody active in one of the fields of work listed above, or else Dave Morris as the IVOA Slack workspace administrator.

There exists also a well-functioning IRC gateway, accommodating users who prefer classical software for their on-line communication.


**DAEPO BoF Session at ADASS**

On the recent ADASS conference held in Santiago, Chile, a birds of a feather (BoF) session on Data-driven and VO-enabled Education and Citizen Science was organized by the chair of IVOA Education Interest Group and IAU working group on Data Driven Astronomy Education and Public Outreach (DAEPO), Dr. ChenZhou Cui. In the BoF session, Ms. Janet Evans from the Harvard-Smithsonian Center for Astrophysics, Secretary of the Executive Committee of the IVOA, introduced the Virtual Observatory and the IVOA. The principal developer of the World Wide Telescope (WWT), Mr. Jonathan Fay from Microsoft Research, gave a talk on the history and latest development of WWT. Dr. Chenzhou Cui presented the work of China-VO in DAEPO with examples of a citizen science project called Popular Supernova Project

(PSP) and interactive digital planetarium powered by WWT. Participants shared their experience and discussed how to efficiently leverage the data and VO-tools at hand to design and carry out education activities and citizen science projects.

More information: http://www.adass.cl/#program

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## SCHOOLS AND WORKSHOPS

**Third ASTERICS Virtual Observatory School**

The ASTERICS project held its third VO school at the Centro de Astrobiología (INTA-CSIC), Madrid, on 14-16 November 2017. The goal of the school was twofold: to expose European astronomers and representatives of the ESFRI projects involved in ASTERICS to the variety of VO tools and services available today so that they can use them efficiently for their own research; and to gather requirements and feedback from participants.

During the first two days, VO experts gave hands-on sessions on the usage of VO tools and services using real life examples of scientific applications, which allowed participants to become fully familiar with the VO capabilities on their own laptops. The last day was then dedicated to the participants own science cases, applying what they had learnt earlier in the week.

More information can be found here

**GAVO-ArVO Collaboration Workshop**

Under joint funding by the Armenian Ministry of Education and Science (MES) and the German Bundesministerium für Bildung und Forschung (BMBF), a project on *building a high-performance research environment through German and Armenian Astrophysical Virtual Observatories* (GAVO and ArVO) is being run, led by Joachim Wambsganss (German PI) and Areg Mickaelian (Armenian PI).

The project started with a visit of eight Armenian scientists and students on 23-30 November 2017, to Astronomisches Rechen-Institut – Universität Heidelberg (ARI, Heidelberg, Germany). The workshop introduced VO standards and tools, TAP, ADQL and the activities of GAVO to the Armenian team members. The second part of the Workshop was devoted to the implementation of VO tools on the Digitized First Byurakan Survey (DFBS), the main product of ArVO. The main task is the publication of the DFBS images and spectra through the VO, i.e. creating SIAP and SSAP services for the DFBS. Some scientific use cases were explored and discussed.

The project will continue in 2018, when visits of German

scientists and students to Armenia and more visits of Armenian scientists and students to Germany are planned. In addition, a workshop will be organised in Armenia, the 6th Byurakan International Summer School (6BISS), in September 2018, and will include VO tools training.

**Access more scientific usage tutorials here**

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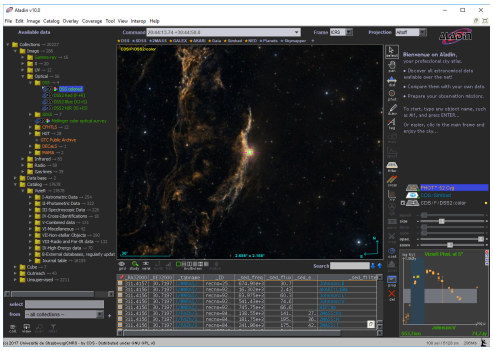
## VO APPLICATIONS AND IMPLEMENTATION HIGHLIGHTS

**Aladin Desktop V10**



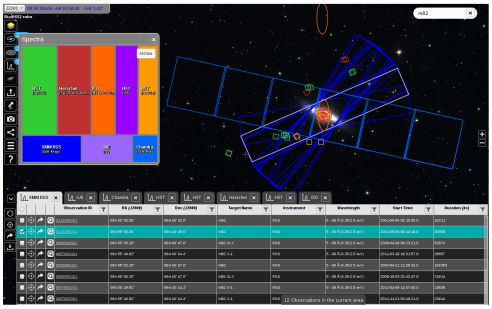
The Centre de Données astronomiques de Strasbourg (CDS) is pleased to announce a major release of Aladin Desktop v10.

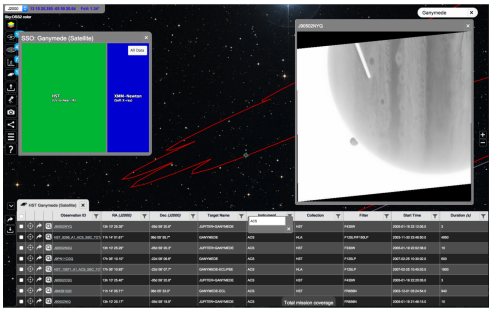
Aladin Desktop is an interactive sky atlas allowing an “all-sky” approach to the visualisation of astronomical data. Aladin V10 provides access to astronomical image surveys with capabilities for superimposing entries from astronomical catalogues or databases, and also providing access to related data and information from the SIMBAD database, the VizieR service and many other VO services.

With a new modernized and simplified look and feel interface, the main innovation of Aladin v10 is the integration of the recent IVOA protocols (SIAv2, TAP, Datalink/SODA, RegTAP, MOC and HiPS) and some CDS advanced services such as the powerful CDS X-Match engine and the CDS database collection of sky coverage maps (MocServer). This evolution opens the door to new scientific use cases — fast browsing/filtering on all VO data collections, query by sky regions and/or by criteria, and transparent remote cross-matching with any tables are just a few examples of its new potentialities.

The most visible improvement of Aladin v10 is the “Access Data Tree" panel directly available in the main window. This interactive tree enables easy manipulation and access to the 20,000 VO data sets compatible with Aladin including: All-sky image surveys, 3-d image cube surveys, catalogues, and spectra collections.

Download the Aladin v10 JAR





**ESASky v2.0**

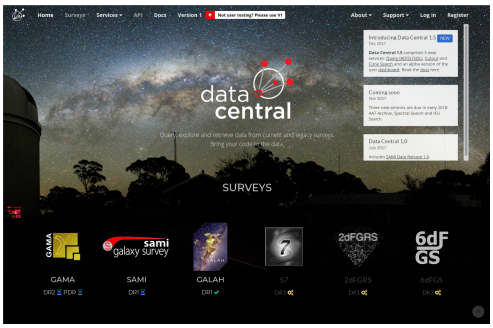
ESASky is an open science discovery portal developed at the ESAC Science Data Centre (ESDC) for exploration and discovery of data hosted by the ESA astronomical archives and archives from other data providers. We are pleased to announce the release of ESASky version 2.0. This new version includes access to spectra from the Chandra, Herschel, HST, IUE, ISO and XMM-Newton missions; and a search mechanism for solar system objects (SSOs) imaged by HST, Herschel and XMM-Newton (targeted and serendipitous images). To achieve this, the ESASky team has created a pipeline that takes the ephemeris information of each SSO with respect to the position of each spacecraft using software by the IMCCE (Institute of Celestial Mechanica and Ephemeris Calculations), Paris and performs a crossmatch on the SSO orbits against the entire mission archives to find observations in which the SSO appears within the imaging instrument's field of view during the time the images were being taken.

Finally, version 2.0 has a new and improved user interface, designed to improve the usability and user experience with ESASky. The new interface includes an improved representation of available data, with numbers and treemaps (rather than histograms); interactive footprints with the data panel; column filtering; centring on observations and sources; SSO orbits drawn on the sky; and a share button. Additionally, it is now possible to use ESASky in tablets and we now provide faster access to users outside Europe.

http://sky.esa.int/ More information here

**Introducing AAO Data Central**

We are pleased to introduce Data Central, the Australian Astronomical Observatory's new data archive system. The system is planned to be the hub for all data from AAO-supported telescopes and surveys, including raw data and high-level science products. The system can be found at https://datacentral.aao.gov.au.




Data Central is built upon Apache Hadoop infrastructure for data storage and uses PrestoDB as a query engine. Both these systems allow for distributed storage and querying; in particular, PrestoDB can query many different datastores, from all varieties of SQL to some noSQL systems such as MongoDB and Redis. This gives us tremendous flexibility when it comes to data access and interoperability.

We currently host the GAMA DR2 and Panchromatic DR, the SAMI galaxy survey DR1, the GALAH stellar survey DR1, the DEVILS galaxy survey DR0 and the AAT raw data archive. There are around 15 other surveys and raw data archives to be included in the system in the next 12 to 18 months.

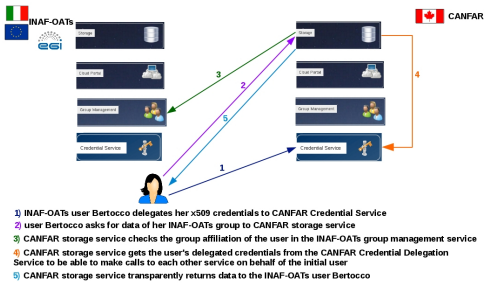
Data Central currently offers the following services:

- Query tool

- Cone search
- Image cutout
- Spectrum viewer (coming soon)
- New Single Object Viewer (coming soon)

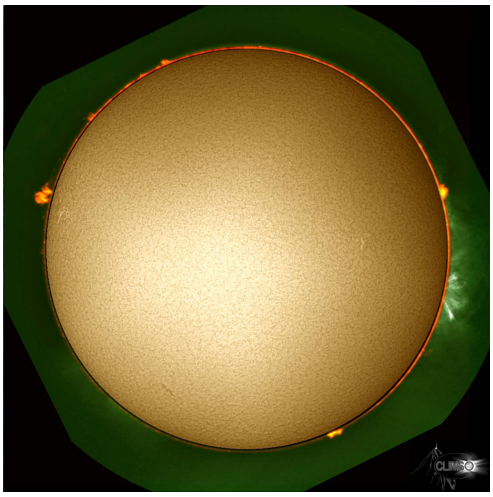
We also provide or will soon provide the following IVOA services:

- TAP service — https://datacentral.aao.gov.au/vo/tap
- Simple Cone Search (coming soon)
- Simple Image Access (coming soon)
- Simple Spectrum Access (coming soon)




**Interoperable geographycally distributed VOSpaces**
A collaboration between the Trieste Astronomical Observatory of Italian National Institute of Astrophysics (OATs-INAF) and the Canadian Astronomy Data Center (CADC) of the National Research Council Canada, has taken a new step toward the global Virtual Observatory. A set of services based on IVOA standards and recommendations has been deployed using open-source available software (https://github.com/opencadc and https://github.com/oats-cadc). Interoperability tests involving Authentication, Authorization, Data Access and Movement have been successfully concluded. A pre-production test-bed providing services accessibility in a cloud environment is available at OATs-INAF (https://cloud.oats.inaf.it). All the software used has been fully documented (https://goo.gl/3fq5na) offering the opportunity to replicate a similar set of services and to interoperate them with the already existing one. Specifically, a storage management solution, called vospace-backend, interfaced with the CADC VOSpace interface implementation, has been developed. It provides support for posix-based and OpenStack Swift storage solutions, but its plug-in architecture easily allows the support to other storage solutions with minimal development effort.

**Solar Survey at Pic du Midi Observatory**
The CLIMSO solar survey started in 2007 and is expected to extend for many more years. All the data (images and films) can be downloaded from http://climso.irap.omp.eu/data/index.html. This survey is done with four instruments (two coronagraphs and two solar refractors) that take images of the whole solar disc and prominences every minute (weather permitting), and the corona every hour. The Pic du Midi site in the French Pyrenees allows for a very good seeing and relatively frequent coronal skies.



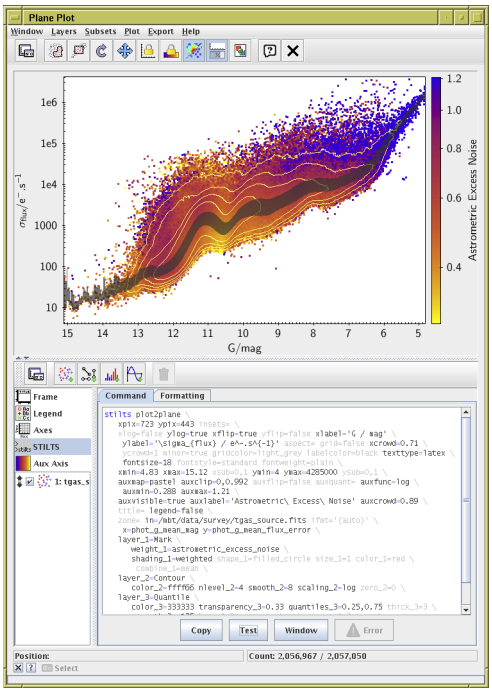
The covered spectral channels are :

- whole solar disk at λ= 656.28nm Δλ=0.05nm (H-α), 15 cm refractor
- solar prominences at λ= 656.28nm Δλ=0.25nm (H-α), 20 cm coronagraph
- whole solar disk at λ= 393.3nm Δλ=0.25nm (Ca II), 9 cm

refractor
- solar prominences at λ= 1068.0nm Δλ=0.25nm (He I), 20 cm coronagraph
- solar corona at λ= 1074.7nm Δλ=0.25nm (Fe XIII), 20 cm coronagraph

The FITS images (2048*2048 pixels) are preprocessed and presented in a way that comply with the VO standards. They are calibrated in physical units for the whole disk images, and simply normalized for the prominences and corona images.

More information: http://climso.irap.omp.eu/data/index.html




**TOPCAT v4.5**

TOPCAT is an interactive graphical desktop application for working with source catalogues and other tables. It provides VO access, crossmatching, visualisation and many other features. It comes with a sister application, STILTS, that lets you do all the same things from the command line. STILTS is very useful for scripting and reproducible work such as preparing plots for publication, but harder to learn than TOPCAT's point and click interface. The recent v4.5 release of TOPCAT has a new control that displays the STILTS command to reproduce the current plot, either on the screen or to a graphics format like PNG or PDF. This lets you set up a plot interactively and then save the command for later scripting and adjustments.

More information: http://www.starlink.ac.uk/topcat/

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## SOME RECENT PAPERS ABOUT VO-ENABLED SCIENCE

**Featured Science Publication**

*Gaia TGAS search for Large Magellanic Cloud runaway supergiant stars. Candidate hypervelocity star discovery and the nature of R 71*

**Lennon, Daniel J.; van der Marel, Roeland P.; Ramos Lerate, Mercedes; O'Mullane, William; Sahlmann, Johannes**

*Astronomy and Astrophysics (2017) Vol. 228, Volume 603, A75*

Aims: Our research aims to search for runaway stars in the Large Magellanic Cloud (LMC) among the bright Hipparcos supergiant stars included in the Gaia DR1 Tycho-Gaia astrometric solution (TGAS) catalogue.
Methods: We compute the space velocities of the visually brightest stars in the Large Magellanic Cloud that are included in the TGAS proper motion catalogue. This sample of 31 stars contains a luminous blue variable (LBV), emission line stars, blue and yellow supergiants, and an SgB[e] star. We combine these results with published radial velocities to derive their space velocities, and by comparing with predictions from stellar dynamical models we obtain each star's (peculiar) velocity relative to its local stellar environment.

Results: Two of the 31 stars have unusually high proper motions. Of the remaining 29 stars we find that most objects in this sample have velocities that are inconsistent with a runaway nature, being in very good agreement with model predictions of a circularly rotating disk model. Indeed the excellent fit to the model implies that the TGAS uncertainty estimates are likely overestimated. The fastest outliers in this subsample contain the LBV R 71 and a few other well known emission line objects though in no case do we derive velocities consistent with fast (100 km $s^{-1}$) runaways. On the contrary our results imply that R 71 in particular has a moderate deviation from the local stellar velocity field (40 km $s^{-1}$) lending support to the proposition that this object cannot have evolved as a normal single star since it lies too far from massive star forming complexes to have arrived at its current position during its lifetime. Our findings therefore strengthen the case for this LBV being the result of binary evolution. Of the two stars with unusually high proper motions we find that one, the isolated B1.5 $Ia^{+}$ supergiant Sk-67 2 (HIP 22237), is a candidate hypervelocity star, the TGAS proper motion implying a very large peculiar transverse velocity (360 km $s^{-1}$) directed radially away from the LMC centre. If confirmed, for example by Gaia Data Release 2, it would imply that this massive supergiant, on the periphery of the LMC, is leaving the galaxy where it will explode as a supernova.

**Refereed Publications**

The full list of refereed publications from July 2017 to December 2017 can be found at the following list, curated by the Spanish Virtual Observatory.

**More Ways to Find VO-related Publications**

All ADS links mentioning the "virtual observatory" in the abstract.

All refereed publications mentioning the "virtual observatory" in the abstract.

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## VO CALENDAR

**7-12 January 2018 - 231st AAS Meeting**
Washington, DC, USA
The American Astronomical Society (AAS) meetings serve as a venue for the general astronomical community to gather and discuss the latest science, tools, and technologies in astronomy. At the 231st AAS Meeting, there will be a couple of VO-related sessions and exhibits, including presentations from international VO partners, open to all astronomers. On Jan. 7 at 10:00 am, EST, NASA Astronomical Virtual Observatories will be leading a workshop on accessing the NASA astrophysical archives via Python tools. On Monday, Jan. 8, the USVOA will be holding an open meeting from 2:00-3:30pm, during which the latest US-based VO efforts will be presented by partner institutes, new demos shown, and current/future VO tasks discussed. IVOA affiliated institutions will have booths in the exhibition hall throughout the week, demonstrating tools and services such as the NASA Astrophysics Data System, SciServer, VizieR, and other VO data access interfaces. Attendees may learn more about the data and services provided by those institutions, and have face-to-face discussions with developers.

**4-5 April 2018 - Software in astronomy**
EWASS 2018, Liverpool, UK
This Symposium will provide information on software engineering skills that are useful for and reasonably attainable by astronomy researchers and cover some of the best practices in software development. It will cover the issues that arise from having a poor rewards system for software contributions and efforts to improve this situation and will present useful codes that are available for use by researchers. It will analyse and discuss the problems of balancing the incoming data deluge with well-proportioned Astroinformatics solutions, based on robust and efficient processing/simulation environments and scalable data analytics methods. It will also invite engagement between the widest European community of astronomers and space scientists with the agencies large and small that provide archival data and associated services.

**28 May - 1 June 2018 - IVOA Interoperability Meeting**
Victoria, Canada
The International Virtual Observatory Alliance (IVOA) semi-annual Interoperability meetings provide an opportunity for discussion and development of virtual observatory standards and VO-based applications, and are open to those with an interest in utilizing the VO infrastructure and tools in support of observatory

operations and/or astronomical research. The Northern Spring 2018 IVOA Interoperability meeting will be held in Victoria, Canada, and will be hosted by the CADC.

**8-10 November 2018 - IVOA Interoperability Meeting**
College Park, Maryland, USA
The International Virtual Observatory Alliance (IVOA) semi-annual Interoperability meetings provide an opportunity for discussion and development of virtual observatory standards and VO-based applications, and are open to those with an interest in utilizing the VO infrastructure and tools in support of observatory operations and/or astronomical research. The Northern Fall 2018 IVOA Interoperability meeting will be held in College Park, Maryland, USA, and will be hosted by the USVOA.

**11-15 November 2018 - ADASS XXVII**
College Park, Maryland, USA
This annual Astronomical Data Analysis Software and Systems (ADASS) conference, held in a different location each year, is a forum for astronomers, computer scientists, software engineers, faculty members and students working in areas related to algorithms, software and systems for the acquisition, reduction, analysis, and dissemination of astronomical data. The ADASS XXVIII program will include invited talks, contributed papers, display sessions, tutorials, computer demonstrations, and special interest (“Birds of a Feather” or BoF) meetings.

## For Astronomers

Getting Started / Using the VO
VO Glossary / VO Applications
IVOA newsletter / VO for Students & Public

## For Deployers/Developers

Intro to VO Concepts /
IVOA Standards/ Guide to Publishing in the VO / Technical Glossary

## For Meml

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