INTERNATIONAL VIRTUAL OBSERVATORY ALLIANCE

IVOA Newsletter - December 2016

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IVOA Newsletter Editors: Mark G. Allen, Deborah Baines, Chenzou Cui, Enrique Solano.

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.

IVOA NEWS

Gaia in the VO

The 14th September 2016 saw the release of the long awaited Gaia Data Release 1 (DR1), which includes positions and G magnitudes for over 1 billion sources, the five-parameter astrometric solution for over 2 million sources (Tycho-Gaia Astrometric Solution, TGAS), photometric data of selected RR Lyrae and Cepheid variable stars, positions and G magnitudes for over 2000 quasars, and cross-matches between Gaia sources and many other catalogues (see here for the full list of contents). Many of the IVOA member organisations and individual members have played an important role in the Gaia Data Processing and Analysis Consortium (DPAC), and as such, a host of data centres and institutes are now providing the Gaia DR1 data using VO protocols. These data centres and institutes include ESA's ESAC Science Data Centre (ESDC), Centre de Données astronomiques de Strasbourg (CDS), Astronomisches Rechen-Institut (ARI), Leibniz-Institute for Astrophysics Potsdam (AIP) and the ASI Science Data Center (ASDC). Other institutes around the world are also hosting the Gaia DR1 data, these include the Japanese Virtual Observatory, NASA/IPAC Infrared Science Archive and the German Astrophysical Virtual Observatory (GAVO). Additionally, new functionalities to access and analyse Gaia data have been implemented in a number of VO Tools, including Aladin Desktop, TOPCAT and VOSA. Within this newsletter, we highlight some of the data centres and VO tools providing access to Gaia data using VO protocols.
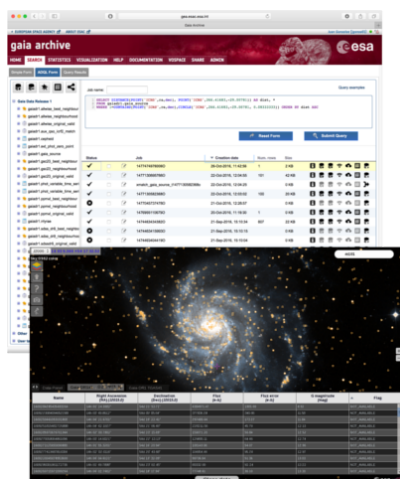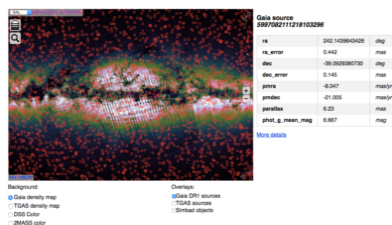

Gaia DR1 at ESA
The ESA Gaia Archive was released to the public on the 14th September 2016 with Gaia DR1. As the official repository for Gaia data, it has been validated by the DPAC consortium and provides access to all of the DR1 data. Being a VO inside archive based in TAP, its services are fully interoperable and available from VO tools (eg. Topcat). Its back-end infrastructure allows users to perform SQL analytics over billion scale catalogues. While keeping compatibility with TAP 1.0, the protocol has been extended to TAP+, providing authentication, stateful uploads, server side crossmatches and other functionalities, allowing data analysis to move closer to the data.

Gaia DR1 catalogues are also available via ESASky, a science driven discovery portal for space-based astronomy missions.

The ESA Gaia Archive can be accessed at: http://archives.esac.esa.int/gaia and ESASky at: http://sky.esa.int
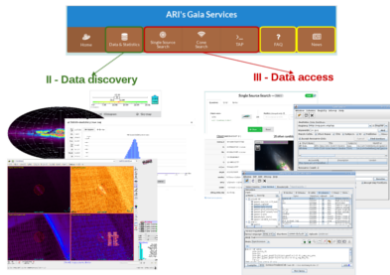
Gaia DR1 at CDS
Gaia DR1 data are available since September 14th in CDS services: VizieR, Aladin and the CDS cross-matching service. In addition to the regular VizieR interface, VO access is provided through cone search queries and through TAP allowing the user to formulate SQL-like queries from our web interface or from any TAP client (Topcat or TAPHandle for instance). Aladin Desktop features a dedicated form for easy access to Gaia data and visualization of proper motions. The cross-match service offers fast spatial cross-identifications of Gaia data with VizieR 16,000+ tables with positions or user-uploaded tables. Access to the cross-match is done either via

our web page or via Topcat. Gaia DR1 has also been made available as HiPS progressive catalogues, seamlessly browsable from Aladin Desktop and Aladin Lite as demonstrated here.

More information: http://cds.unistra.fr/GaiaDR1News

Gaia DR1 at ARI

The Astronomisches Rechen Institut (ARI) in Heidelberg (Germany) is one of the few institutes officially publishing the Gaia data. It is providing access to the Gaia catalogue through three services:

- Single Source Search: it is a simple service returning the closest Gaia (or TGAS) source from a given position, object name (resolved by Simbad) or Gaia source ID. It is not a VO service and is then accessible only on the web page or by HTTP requests using tools like wget or curl.
- Cone Search: it is following the IVOA standard SCS. There is one entry for Gaia and another one for TGAS. Both are registered in the VO Registry and are then easily accessible through VO clients like TOPCAT.
- TAP: eight Gaia DR1 tables and some famous catalogues can be queried here using the freedom of ADQL. This service is also listed in the VO Registry.

A nice feature for data discovery has been added to this TAP service: metadata describing the numerical columns with simple summary statistics (e.g. mean, quartiles, min, max). These additional pieces of information are visible in TOPCAT (versions >= 4.3-4). Besides, histograms and sky maps for the same catalogue columns can also be seen and downloaded through the web site. These sky-maps show the average value of the represented catalogue column on the whole sky using Healpix maps (which can be downloaded and displayed in Aladin for more interactivity). Of course a density map for almost all published tables is also available.

More information: http://gaia.ari.uni-heidelberg.de

## Aliyun becomes strategic partner of the China-VO

On 13 October, Yan Jun (Director of National Astronomical Observatory of China, NAOC) and Hu Xiaoming (President of Aliyun Cloud Computing Co., Ltd.) announced the news in the 2016 Computing Conference, held in Hangzhou, that Aliyun has become a strategic partner of the China-VO. Aliyun is the largest public Cloud computing service provider in China, and third largest in the world.

Big data not only provides broad prospects for astronomy discoveries and innovation, but also brings many technical challenges, which covers the whole life cycle of data, including collection, transmission, storage, process, analysis and open access. As strategic partners, NAOC and Aliyun are planning to establish "NAOC-Aliyun Astronomical Big Data Joint Research Center". The Chinese Virtual Observatory (China-VO) will be migrated into the Aliyun platform to enhance its capability as a full lifecycle data management and open access environment.

Virtual Observatory India News
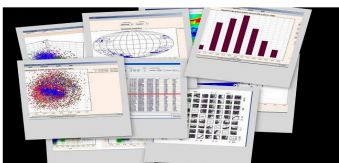
Virtual Observatory India (VO-I) and the Data Intensive Science projects based at IUCAA together organise a number of workshops on Astronomy with the VO every year. Two such workshops during 2016 have been "Astronomy With Small telescopes and the Virtual Observatory" at IUCAA, and "Big Data in Astronomy" at BITS-Pilani in Hyderabad, which is a major engineering and technology institute. VO basics and Data Analysis are discussed in these workshops, along with hands-on VO sessions, which have exercises like Motion of Bernard's Star and the Fundamental Plane of Galaxies.

SCHOOLS AND WORKSHOPS

Second ASTERICS Virtual Observatory School
The ASTERICS project held its second VO school at the Observatoire Astronomique de Strasbourg, France, on 15-17 November 2016. 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. A large fraction of the time was dedicated to hands-on exercises 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, including the hands-on tutorials.

Gaia Data Access Workshop in Heidelberg
From 21st to 24th November 2016 the Gaia Data Access Workshop took place at the "Haus der Astronomie" in Heidelberg. Organised by the GAVO and Gaia groups at ARI/ZAH and in collaboration with CDS and AIP, the 57 participants learned about the contents of Gaia DR1 and about warnings and caveats using them. In hands-on tutorial sessions the particpants learned how to use TAP and ADQL to access the Gaia data via TOPCAT. The Gaia data centres at ARI, CDS, AIP and ESAC presented the different features of their services and how to use them for using the Gaia data.

Overall the (secret) aim of using Gaia as an opportunity for VO outreach was a success.

More information: http://gaia.ari.uni-heidelberg.de/gaia-workshop-2016/

VO APPLICATIONS AND IMPLEMENTATION HIGHLIGHTS

APOGEO (Automatic POrtal GEneratOr)
APOGEO (Automatic POrtal GEneratOr) is a tool under development at IA2 that automatizes the creation of web interfaces for querying astronomical archives, after an administrator performs a proper configuration process guided by a graphical wizard. It is possible to select which tables to use for queries, design the search form interface and customize the layout. The output of the generation is a package that can be deployed in an application server. The generated portal is able to query the astronomical archive, manage users login, retrieve astronomical images consistently with configured data access policies and send tabular data (VOTables) and files to external applications using the SAMP VO standard.

More information: http://www.ia2.inaf.it/index.php/13-software/35-apogeo.
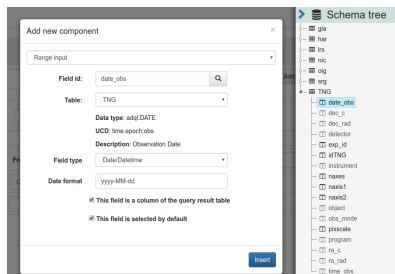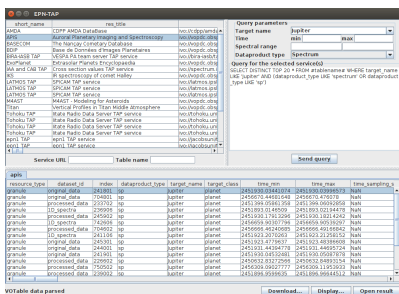
CASSIS New Release
The CASSIS Team will release a new version (4.0) of the free spectral tool in November 2016. CASSIS (Centre d'Analyse Scientifique de Spectres Instrumentaux et Synthétiques) is a Java tool designed to visualize, treat and analyze observational and synthetic spectra. It uses several pieces of information to allow the user to perform these tasks: atomic and molecular spectroscopic databases, radiative transfer models and access to other synthetic and observational spectra through SAMP, SSA and user files.

In this new version, we have upgraded the tool to use the EPN-TAP protocol to access spectra from the services of the solar and planetary community. To do that, we use an independent java library tool developed in collaboration between the CDPP (Centre de Données de la Physique des Plasmas) and CASSIS, as part of the Europlanet H2020 project.

Furthermore, we have improved the access to the VAMDC service (Virtual and Molecular Data Center). Users can now

access up to 12 services containing thousands of species and hundreds of millions of transitions.

More Information: http://cassis.irap.omp.eu/

Gaia Photometric Science Alerts at Institute of Astronomy, Cambridge (UK)
Gaia is a European Space Agency (ESA) satellite mission, with the aim of creating a three-dimensional map of our Galaxy. In the process of measuring the positions, distances and motions of about a billion stars in the Milky Way Gaia will also observe thousands of transient events. The Gaia Alerts project is working to find these events in the Gaia data, and to announce them to the world in real time.

The Gaia alerts team has been publishing these discoveries in various formats to enable follow-up, including a dedicated web page for every alert. Beginning on 1st November, Gaia alerts will also be broadcast as VOEvents at this stream of 4 PI SKY project.

If you have any questions please contact us.
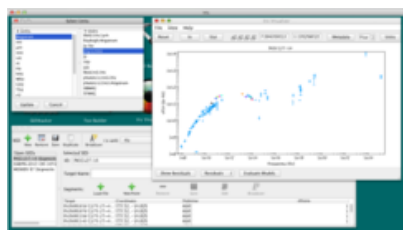
Iris 3.0 beta Release
We are happy to announce the release of Iris 3.0 beta. Iris has undergone a round of plastic surgery, with a full overhaul on the Visualizer, Metadata Browser, and Fitting Tool. The Visualizer now uses the STILTS plotting API as its plotting backend. Iris internals, in particular the new Metadata Browser and the Visualizer, are now heavily based on STIL -- the library both TOPCAT and STILTS use.

Other new features include high-resolution spectra plotting capabilities, improved layouts to the Fitting Tool and SED Stacker (a tool for statistically combining SEDs), and a dedicated client for the VizieR photometry service in Strasbourg.

For the full list of new features and download instructions, please refer to the release notes at http://cxc.cfa.harvard.edu/iris/v2.1/3.0b1-release.html.

VOSA New Release
The Spanish VO released a new version of VOSA in October 2016. VOSA (VO Sed Analyzer) is a web-based tool designed to build observational spectral energy distributions and to estimate physical parameters (Teff, logg, [M/H], masses, ages, etc) from comparison with models.

New photometric catalogues and collections of theoretical models, determination of stellar radius and masses from the SED fitting, new treatment for upper limits, footprint visualization of extinction maps using Multi-Object Coverage (MOC), more efficient management of the fitting results and more detailed statistical information on the physical parameters obtained from the fit are some of the functionalities implemented in this new version.

Special attention deserves the upgrades made to deal with Gaia DR1 data. Photometric information (G magnitudes) as well as parallaxes from TGAS can now be used in the VOSA workflow.

More Information: http://svo2.cab.inta-csic.es/theory/vosa/

SOME RECENT PAPERS ABOUT VO-ENABLED SCIENCE

Featured Science Publication

Search for associations containing young stars (SACY). VII. New stellar and substellar candidate members in the young associations
Elliott, P.; Bayo, A.; Melo, C. H. F.; Torres, C. A. O.; Sterzik, M. F.; Quast, G. R.; Montes, D.; Brahm, R.
Astronomy & Astrophysics (2016) Vol. 590, A13, 28 pp.
Context. The young associations offer us one of the best opportunities to study the properties of young stellar and substellar objects and to directly image planets thanks to their proximity (<200 pc) and age (≈5-150 Myr). However, many previous works have been limited to identifying the brighter, more active members (≈1 M⊙) owing to photometric survey sensitivities limiting the detections of lower mass objects.
Aims: We search the field of view of 542 previously identified members of the young associations to identify wide or extremely wide (1000-100 000 au in physical separation) companions. Methods: We combined 2MASS near-

infrared photometry (J, H, K) with proper motion values (from UCAC4, PPMXL, NOMAD) to identify companions in the field of view of known members. We collated further photometry and spectroscopy from the literature and conducted our own high-resolution spectroscopic observations for a subsample of candidate members. This complementary information allowed us to assess the efficiency of our method.

Results: We identified 84 targets (45: 0.2-1.3 M$\odot$, 17: 0.08-0.2 M$\odot$, 22: <0.08 M$\odot$) in our analysis, ten of which have been identified from spectroscopic analysis in previous young association works. For 33 of these 84, we were able to further assess their membership using a variety of properties (X-ray emission, UV excess, Hα, lithium and K I equivalent widths, radial velocities, and CaH indices). We derive a success rate of 76-88% for this technique based on the consistency of these properties.

Conclusions: Once confirmed, the targets identified in this work would significantly improve our knowledge of the lower mass end of the young associations. Additionally, these targets would make an ideal new sample for the identification and study of planets around nearby young stars. Given the predicted substellar mass of the majority of these new candidate members and their proximity, high-contrast imaging techniques would facilitate the search for new low-mass planets.

Refereed Publications

The full list of refereed publications from the past year can be found at the following list (over 250 publications), 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.

VO CALENDAR

25-28 February 2017 - Detecting the Unexpected: Discovery in the Era of Astronomically Big Data
Space Telescope Science Institute, Baltimore, MD, USA
What tools do astronomers need to discover new classes of objects and complex trends in data sets too large to inspect by eye? This STScI workshop will explore this question in specific astronomical contexts and a with a range of tools. How can we find new events in the time domain, and make smart choices about follow-up in real time with limited resources? How can we find new features of our Galaxy in rich databases with more than spatial and kinematic information? What are the prospects for tools to explore the spectroscopic data sets of the present and future? We will focus on three kinds of discovery tools during the workshop: citizen science, machine learning, and data-integrated visualization.

15-19 May 2017 - IVOA Interoperability Meeting
Shanghai, China
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 Spring 2017 IVOA Interoperability meeting will be held on 15-19 May 2017, in Shanghai, China, and will be hosted by the China-VO.

22-26 October 2017 - ADASS XXVII
Santiago, Chile
This annual conference, held in a different location each year, is a forum for scientists, developers and programmers working in areas related to algorithms, software and systems for the acquisition, reduction, analysis, and dissemination of astronomical data.

27-29 October 2017 - IVOA Interoperability Meeting
Santiago, Chile
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 Autumn 2017 IVOA Interoperability meeting will be held on 27-29 October 2017, in Santiago, Chile, and will be hosted by the Chilean VO (ChiVO).