GAVO III: The Virtual Observatory in Operation

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Abstract

The *German Astrophysical Virtual Observatory* has recently started its third phase. We offer a variety of interesting services to the community: Standardised publication procedures for the different forms of astrophysical results, access to theoretical models, and different methods and tools to retrieve and evaluate data.

This contribution presents an overview of the most prominent GAVO products so far and our plans for the coming years.

Introduction

GAVO is a BMBF sponsored project for operating the *Virtual Observatory* platform. We support modern astronomical research in Germany, especially where large amounts of data are involved. The GAVO team aims to aid data publication by applying standardised methods and to provide extensive but easy access to astronomical results.

GAVO is also the German contribution to the international activities of the VO network, the IVOA.

GAVO Data Center: Easy Data Publication

Easy publication of scientific data with assistance - this is the aim of the GAVO data center at ARI (Heidelberg). It offers a VO compatible, integrated publication infrastructure. GAVO facilitates the preparation of the necessary metadata (e.g. observational details and errors) and the VO compliant publication of the results. Access can also be restricted, if desired.

The data center currently offers more than a dozen services ranging from catalogue and image access to ephemerides calculation, synthetic light curves and data extraction. It also manages the IVOA registration. The services of the GAVO data center are open to any astronomer interested.

http://vo.uni-hd.de

TheoSSA: Spectrum on Demand

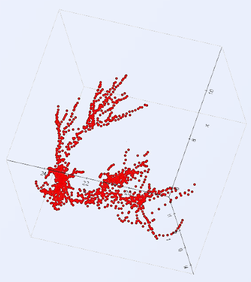
The *Tübingen NLTE Model-Atmosphere Package* (TMAP) calculates NLTE stellar atmospheres in spherical or plane-parallel geometry in hydrostatic and radiative equilibrium (Werner et al. 2003). GAVO offers an online service to retrieve or calculate theoretical spectral energy distributions based on such models. Depending on parameters such as element abundance, the spectrum is retrieved from a database of pre-calculated data or computed in reasonable time.

The service can be queried by a HTTP request (i.e. by URL) that is compliant to the VO *Simple Spectral Access Protocol*. It is registered and can be called by a provided web interface, from VO tools or even your own software.

http://vo.ari.uni-heidelberg.de/ssatr-0.01/TrSpectra.jsp

Access to Cosmological Models

The Millennium Simulation is a data set from a GADGET dark matter simulation. Two galaxy-formation algorithms have been applied to it to study structure and development of galactic halos (“merger trees”). The results are stored in a relational database and can be queried using SQL language.



This service shows how a scientific problem can be translated into the computer-science domain as a database query. Access is possible by a web interface, VO tools (Topcat) or from within a program (e.g. IDL).

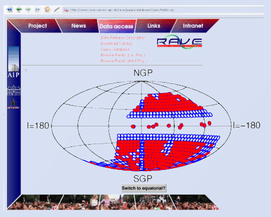
In the first two years, the Millennium service has handled more than five million queries and returned about fifty billion rows of data. It was used in half of the 140 publications on the Millennium simulation.

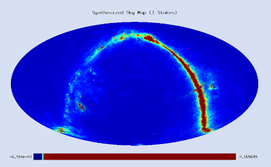
http://www.g-vo.org/Millennium/

More to Discover

Additionally GAVO offers many other products and services to the community. Further examples are:

- The RAVE survey of radial velocities
- The ROSAT all sky survey and pointed observations
- The MAXI service offering data release and viewing facilities for X-Ray observations of galaxies and clusters
- “Virtual Telescopes” for the Planck microwave background and galaxy clusters
- Spectra for the Chandra Deep Field South sources
- Collaboration with AstroGrid-D
- ADQL services
- Libraries and programs to aid data access



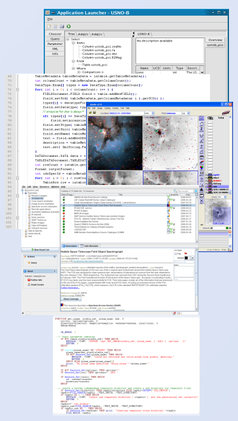


http://www.g-vo.org/www/Services/

Outreach and Community Support

The possibilities of the Virtual Observatory can change the way we approach our daily scientific work. However, it is not always easy to discover, retrieve and select the desired data from the extensive amount of available resources.

The international VO initiative (IVOA) has produced numerous tools to help the virtual observer. Most important examples are Aladin (CDS) for catalogue search and image display, Topcat (Astrogrid UK) for plots and cross matching, VoSpec and Specview for spectra



display and calibration, and VOExplorer for searching within the VO registry and querying databases (part of the VO Desktop from AstroGrid UK).

GAVO offers regular tutorials and demonstration of these tools, for example during this conference. Also GAVO members can support projects with supplying routines for connection to the VO and data export or import.

http://www.g-vo.org/www/External/

Ongoing Work and Future Plans

In the coming three years GAVO will extend its work on data publication and standard development. One main topic is to define standards to describe results of theoretical models in general, work that will be carried out together with the corresponding IVOA “Theory” working group. In that context more results of cosmological and N-body simulations will be published.

Another important topic is to make more observational data available for the public. Together with smaller projects, such as catalogues of photographic plates, GAVO will prepare to include the results of several surveys into the VO (e.g. from HETDEX and LOFAR solar data). VO compliant data output will also become part of the THELI reduction pipeline package, a popular application for wide field cameras.

We care for your data.

Further areas of our future work are the development of the *Astronomical Data Query Language* (ADQL) and software packages, European and international collaborations (with AIDA and the IVOA), as well partnership with the AstroGrid-D to use the compute- and storage resources of grid computing.

Finally, GAVO will continue its outreach with tutorials and training courses to make the German astrophysical community aware of the significant potential of the Virtual Observatory and the benefits of its use.

http://www.g-vo.org

GAVO is a collaboration of the following institutes: Zentrum für Astronomie Heidelberg (ZAH); Argelander-Institut für Astronomie der Universität Bonn (AIfA); Astrophysikalisches Institut Potsdam (AIP); Institut für Astronomie und Astrophysik (IAAT) der Eberhard-Karls-Universität, Tübingen; Max Planck Digital Library (MPDL), Max-Planck-Institut für extraterrestrische Physik (MPE), Garching; Technische Universität München

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