GAVO

# THE GERMAN ASTROPHYSICAL VIRTUAL OBSERVATORY

The German Astrophysical Virtual Observatory (GAVO) is developing a platform to support modern astronomical research in Germany, and forms the German contribution to international activities establishing a global Virtual Observatory (VO) network. GAVO was recommended as one of the highest priority projects in the Denkschrift Astronomie/Astrophysik 2001.

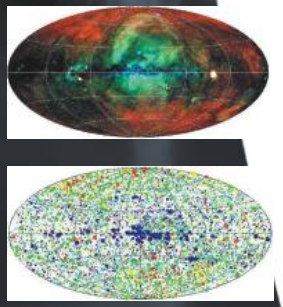
GAVO is a collaboration between German astronomers, institutes and data centres. Participating institutes include the Max-Planck-Institut f r extraterrestische Physik (MPE) in Garching, Germany, the Astrophysikalisches Institut Potsdam (AIP), the Hamburger Sternwarte and the Max-Planck-Institut f r Astrophysik (MPA), Garching. These institutes will each:

- Contribute data archives and relevant expertise.
- Develop ideas and tools to store, manipulate, process and exploit this collection of data archives, and
- Act as primary contact points for all people interested in using the VO, ranging from professional scientists, teachers and students at high-schools or universities, to amateur astronomers.

The GAVO activities will merge into the global VO network, currently being established by the international astronomical community. Within this context common standards for storage, dissemination, processing and visualisation are being developed for the data products handled by the VOs. GAVO is already collaborating closely with the Canadian Virtual Observatory (CVO) and with the US National Virtual Observatory (NVO) in the ClassX project.

The GAVO project team will to provide fast and easy access to astronomical data archives and related documentation, as well enabling the use of highly sophisticated software tools for new studies. All of GAVO's efforts are driven by the scientific interests of the participating institutions. In its pilot phase GAVO will provide a portal enabling the activities described below.

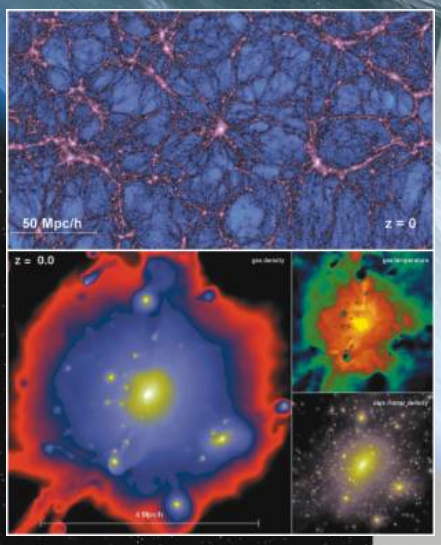
**Federation of astronomical data archives**
A priority of GAVO is to work towards a federation of important local astronomical data archives. The MPE and MPA already support key data sets. They comprise the ROSAT X-ray mission archive and the optical Sloan Digital Sky Survey (SDSS) data, along with results from the theoretical simulations of the Virgo-consortium and from the Planck cosmic microwave background mission. The interoperability between these data sets will facilitate the comparison between such simulations and observational multi-wavelength data sets.



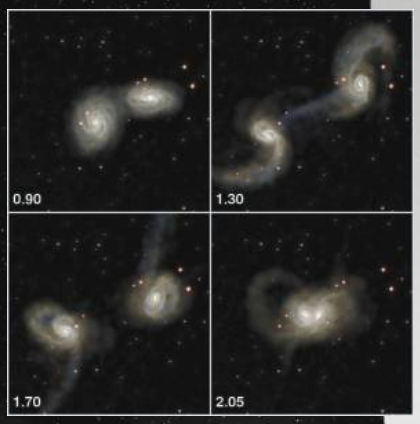
*ROSAT All Sky Survey background map and Bright Source Catalogue.*

**Data mining**
Once the data archives are connected via powerful and easy-to-use computer networks, the GAVO-team will

focus on adapting data mining tools to operate on large data sets. These tools will comprise a "next generation search engine" for object grouping and identification. Methods for unsupervised classification based on cluster analysis, and for supervised classification based on e.g. maximum-likelihood, and Bayesian techniques are envisaged. ROSAT All Sky Survey background map and Bright Source Catalogue.




*Examples of cosmological and hydrodynamical cluster simulations.*




*Example of a galaxy merger simulation*

**Theoretical VO**

GAVO also intends to be a theoretical virtual observatory by publishing results from dark matter simulations of large scale structure. Hydrodynamical simulations of individual galaxy clusters, supernovae and stellar evolution will also be included. The main aim is to bridge the gap between the observational and theoretical communities by presenting results from simulations and observations in a common model. To this end, GAVO has taken the lead in the International Virtual Observatory Alliance (IVOA) data modeling effort for simulations. GAVO will provide tools for operating a virtual telescope to observe the simulation results with physically motivated parameters. A prototype of this is being developed in collaboration with the Planck group at the MPA.

**Simulations based on GAVO-Grid**

The computational GAVO-Grid builds on the Globus toolkit. It currently consists of a testbed of 6 machines distributed on two sites with a total of 16 CPUs. Using the Globus version of MPI, parallel test simulations across the network are performed. One aim of the GAVO-Grid is to build a framework for running simulations on larger scales than any single site can afford. The architecture of the GAVO-Grid allows easy integration of sites with different architectures and operating systems.

**GAVO Simulator**

The GAVO simulator is a utility that provides theoretical models for commonly used astrophysical applications on-demand. Examples include the calculation of simulated stellar spectra of stars as a function of their mass, age and metallicity, the generation of composite spectra of aging stellar populations and the performance of dedicated galaxy merger simulations in order to reproduce the properties of observed merger remnants.

For more technical details see the GAVO poster at this conference.

**GAVO Project team**

**MPE:** Wolfgang Voges (PI), Hans-Martin Adorf, Gerard Lemson.
**AIP:** Matthias Steinmetz (Co-I), Harry Enke.
**Hamburg:** Dieter Reimers (Co-I)
**MPA:** Simon White, Anthony Banday, Matthias Bartelmann, Volker Springel

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

GAVO is sponsored by the German Federal Ministry for Education and Research.
Thanks to Volker Springel, MPA, and Michael Freyberg, MPE, for providing some of the images.