ASTROPHYSICAL VIRTUAL OBSERVATORY

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News release:
**Exploring the Digital Universe with Europe's Astrophysical Virtual Observatory**

05-December-2001 **A new European initiative called the Astrophysical Virtual Observatory (AVO) is being launched to provide astronomers with a breathtaking potential for new discoveries. It will enable them to seamlessly combine the data from both ground- and space-based telescopes which are making observations of the Universe across the whole range of wavelengths - from high-energy gamma rays through the ultraviolet and visible to the infrared and radio.**

The aim of the Astrophysical Virtual Observatory (AVO), which started on 15 November 2001, is to allow astronomers instant access to the vast databanks now being built up by the world's observatories and which are forming what is, in effect, a 'digital sky'.

Using the AVO astronomers will, for example, be able to retrieve the elusive traces of the passage of an asteroid as it passes the Earth and so enable them to predict its future path and perhaps warn of a possible impact. When a giant star comes to the end of its life in a cataclysmic explosion called a supernova, they will be able to access the digital sky and pinpoint the star shortly before it exploded so adding invaluable data to the study of the evolution of stars.

Modern observatories observe the sky continuously and data accumulates remorselessly in the digital archives. The growth rate is impressive and many hundreds of terabytes of data – corresponding to many thousands of billions of pixels - are already available to scientists. The real sky is being digitally reconstructed in the databanks! The richness and complexity of data and information available to the astronomers is overwhelming.

This has created a major problem as to how astronomers can manage, distribute and analyse this great wealth of data. The Astrophysical Virtual Observatory will allow astronomers to overcome the challenges and enable them to 'put the Universe online'.

The AVO project is a three-year project, funded by the European Commission under its Research and Technological Development (RTD) scheme, to design and implement a virtual observatory for the European astronomical community. The European Commission awarded a contract valued at 4 million Euro for the AVO project, starting 15 November 2001. AVO will provide software tools to enable astronomers to access the multi-wavelength data archives over the Internet and so give them the capability to resolve fundamental questions about the Universe by probing the digital sky. Equivalent searches of the 'real' sky would, in comparison, be both costly and take far too long.

**Towards a *Global* Virtual Observatory**
The need for virtual observatories has also been recognised by other astronomical communities. The National Science Foundation in the USA has awarded 10 million Dollar (11.4 million Euro) for a National Virtual Observatory (NVO). The AVO project team has formed a close alliance with the NVO and both teams have representatives on each others committees. It is clear to the NVO and AVO communities that there are no intrinsic boundaries to the virtual observatory concept and that all astronomers should be working towards a truly global virtual observatory that will enable new science to be carried out on the wealth of astronomical data held in the growing number of first class international astronomical archives.

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The AVO involves six partner organisations led by the European Southern Observatory (ESO) in Munich. The other partner organisations are the European Space Agency (ESA), the United Kingdom's ASTROGRID consortium, the CNRS supported Centre de Données Astronomiques de Strasbourg (CDS) at the University Louis Pasteur in Strasbourg, the CNRS supported TERAPIX astronomical data centre at the Institut d'Astrophysique in Paris and the Jodrell Bank Observatory of the Victoria University of Manchester.

Image credit: ESO, ESA, ASTROGRID, CDS (CNRS/ULP), TERAPIX (CNRS) and Jodrell Bank Observatory.

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**Notes for editors**
A 13 minute background video (broadcast PAL) is available from ESO PR and the Hubble European Space Agency Information Centre (addresses below). This will also be transmitted via satellite Wednesday 12 December 2001 from 12:00 to 12:15 CET on "ESA TV Service": http://television.esa.int

This is a joint Press Release issued by the European Southern Observatory (ESO), the Hubble European Space Agency Information Centre, ASTROGRID, CDS, TERAPIX/CNRS and the University of Manchester.

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# Background Information

## *Introduction to Europe's Astrophysical Virtual Observatory (AVO)*

**The Digital Data Revolution**
Over the past thirty years, astronomers have moved from photographic and analogue techniques towards the use of high speed, digital instruments connected to specialised telescopes to study the Universe. Whether these instruments are onboard spacecraft or located at terrestrial observatories, the data they produce are stored digitally on computer systems for later analysis.

**Two Challenges**
This data revolution has created two challenges for astronomers.

Firstly, as the capability of digital detector systems has advanced, the volume of digital data that astronomical facilities are producing has expanded greatly. The rate of growth of the volume of stored data far exceeds the rate of increase in the performance of computer systems or storage devices.

Secondly, astronomers have realised that many important insights into the deepest secrets in the Universe can come from combining information obtained at many wavelengths into a consistent and comprehensive physical picture. However, because the datasets from different parts of the spectrum come from different observatories using different instruments, the data are not easily combined. To unite data from different observatories, bridges must be built between digital archives to allow them to share data and 'interoperate' – an important and challenging task.

**The Human Factor**
These challenges are not only technological. Our brains are not equipped to for instance analyse simultaneously the millions and millions of images available. Astronomers must adapt and learn to deal with such diverse and extensive sets of data.

The 'digital sky' has the potential to become a vital tool with novel and fascinating capabilities that are essential for astronomers to make progress in their understanding of the Cosmos. But astronomers must be able to find the relevant information quickly and efficiently. Currently the data needed by a particular research program may well be stored in the archives already, but the tools and methods have not yet been developed to extract the relevant information from the flood of images available.

A new way of thinking, a new frame of mind and a new approach are needed.

**The Astrophysical Virtual Observatory**
The Astrophysical Virtual Observatory will allow astronomers to overcome the challenges and extract data from the digital sky, thus 'putting the Universe online'. Like a search engine helps us to find information on the Internet, astronomers need sophisticated 'search engines' as well as other tools to find and interpret the information.

"We're drowning in information and starving for knowledge" a Yale University librarian once said. Or to paraphrase a popular series on TV: "The information is out there, but you have to find it."

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Using the latest in computer technology, data storage and analysis techniques, AVO will maximise the potential for new scientific insights from the stored data by making them available in a readily accessible and seamlessly unified form to professional researchers, amateur astronomers and students.

Users of AVO will have immense multi-wavelength vistas of the digital Universe at their fingertips and the potential to make breathtaking new discoveries. Virtual observatories signal a new era, where data collected by a multitude of sophisticated telescopes can be used globally and repeatedly to achieve substantial progress in the quest for knowledge.

The AVO project, funded by the European Commission, is a three-year study of the design and implementation of a virtual observatory for European astronomy. A virtual observatory is a collection of connected data archives and software tools that utilise the Internet to form a scientific research environment in which new multi-wavelength astronomical research programs can be conducted. In much the same way as a real observatory consists of telescopes, each with a collection of unique astronomical instruments, the virtual observatory consists of a collection of data centres each with unique collections of astronomical data, software systems and processing capabilities.

The programme will implement and test a prototype virtual observatory, focussing on the key areas of scientific requirements, interoperability and new technologies such as the GRID, needed to link powerful computers to the newly formed large data repositories.

**The GRID and the Future of the Internet**

The technical problems astronomers have to solve are similar to those being worked on by particle physicists, by biologists, and by commercial companies who want to search and fill customer databases across the world. The emerging idea is that of the GRID where computers collaborate across the Internet. The World Wide Web made words and pictures available to anybody at the click of a mouse. The GRID will do the same for data, and for computer processing power. Anybody can have the power of a supercomputer sitting on their desktop. The Astrophysical Virtual Observatory, and GRID projects like the ASTROGRID project in the United Kingdom (funding 5 million £ or 8 million Euro), are closely linked to these developments.