

The Virtual Observatory in the classroom

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Abstract

EuroVO-AIDA/WP5 (<http://wwwas.oats.inaf.it/aidawp5/>) is a project developed within the framework of the European Virtual Observatory (EuroVO) (<http://www.eurovo.org/pub/>) with the aim of disseminating EuroVO data and software to the public, in particular students, teachers and amateur astronomers. EuroVO-AIDA/WP5 offers use cases, pedagogical units, and simplified professional software that allow users a taste of scientific research, even to those approaching Astronomy for the first time. The educational material of EuroVO-AIDA/WP5 has been designed specifically for teachers in support of an effective presentation of Astronomy in the classroom.

1 Introduction

The goal of the Virtual Observatory (VO) is to allow astronomers to make the best use of the large quantity of data that are archived every day in professional observatories over the world. Developments in astronomical detectors, instrumentation, and information technologies have dramatically increased the access to astronomical data provided by an increasing number of ground- and space-based observatories. This also came together with a widening of the available data format, procedures, and software that differ from one observatory to another. Until recently, this situation has been the cause of a substantial underutilization of observations that are often very expensive.

The VO initiative aims at solving these problems with a unified “language” by all the astronomical data providers so they and their data can be accessed in a uniform way. VO allows astronomers to obtain observations already archived in any of the VO compliant observatories as if these observations would have been taken all at the same observatory. VO develops standard software tools for data visualization and analysis hiding to the user the complexities caused by the differences between various instruments and observatories and finally, develops network infrastructures and software tools needed to bring observations to the workstation of any astronomer anywhere in the world.



Figure 1: The IVOA and its constituent VO projects.

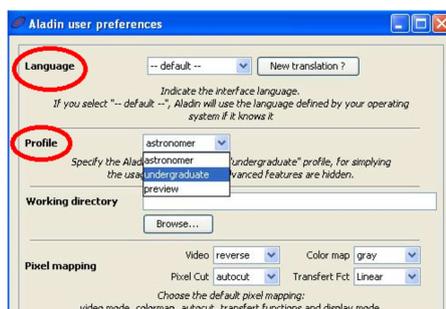


Figure 2: The language and user profile can be selected from the “Edit” tab.

VO activities are coordinated by the International Alliance of Virtual Observatories (IVOA)¹ that includes 17 VO projects at the national or supernational level (Fig. 1).

EuroVO is the European VO project that is a member of the IVOA. This project, funded by Europe, has three main branches dealing with, respectively:

1. Data centers that store and distribute observations coming from various telescopes.
2. Information technology necessary to guarantee access to the data, their use, and the development of new functions prompted by astronomers using the VO.
3. Support to those astronomical groups willing to develop VO-science cases.

The Spanish Virtual Observatory (SVO²) is a member of the IVOA since June 2004. Its purpose is to provide an efficient coordination among the different national initiatives in the framework of the VO and to achieve an effective integration of all the expertise in this research domain.

¹<http://www.ivoa.net/>

²<http://svo.cab.inta-csic.es/>

2 Euro-VO AIDA

EuroVO-AIDA's main goal is to move EuroVO from the development phase to full operation. AIDA consists of several activities, or WorkPackages, including those that aim at bringing EuroVO resources to both astronomers and general public:

- WP1: Management.
- WP2: Strategy, co-operation, and dissemination.
- WP3: Support of deployment of VO protocols and standards.
- WP4: Support of provision of VO-enabled services to the science community.
- WP5: Support to higher education and outreach.
- WP6: Evolution of VO protocols and standards.
- WP7: Data access protocols and data models.
- WP8: Assessment of emerging technologies.

Within AIDA, WorkPackage 5 (Support activities to higher education and outreach) is dedicated to software developing and other educational material in order to attract the public, and in particular students and teachers. The WP5's goal is to provide easy access to the data by simple interfaces and develop interesting scientific cases useful for:

1. Higher educational level (university, PhD students and postdocs)
2. Teachers of the 14–18 years old students (non specialists in Astronomy)

VO tools have been adjusted to the requirements of these communities. One example is Aladin³, an interactive software sky atlas allowing the user to visualize digitized astronomical images and superimpose entries from astronomical catalogues or databases. Aladin is dedicated to professional astronomers, but it can also be used by teachers, undergraduate students or amateur astronomers. Different language and profiles (like “astronomer”, “undergraduate” and “preview”, see Fig. 2) can be chosen by the user. In the “undergraduate” profile, the choice of the images and catalogues has been reduced in order to offer a selection of the most important or special interest databases (example, HST press release, Fig. 3). Following the WP5's aims, the SVO has taken part actively, organizing workshops in the main Spanish astronomical institutes and translating educational cases to Spanish. These cases are available to the public from the SVO portal (Fig. 4).

³<http://aladin.u-strasbg.fr/aladin.gml>

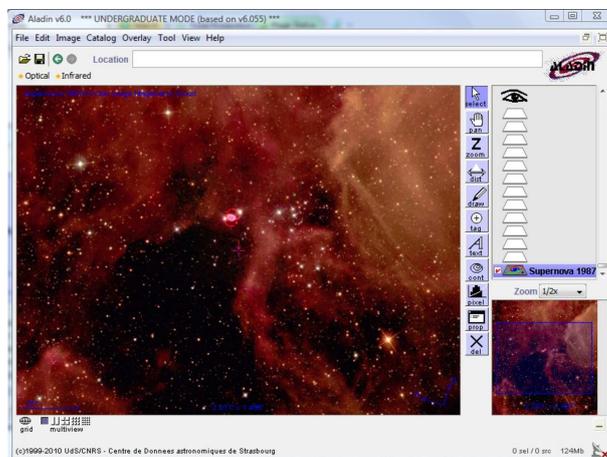


Figure 3: Example of an image from an HST press release: Supernova 1987A.

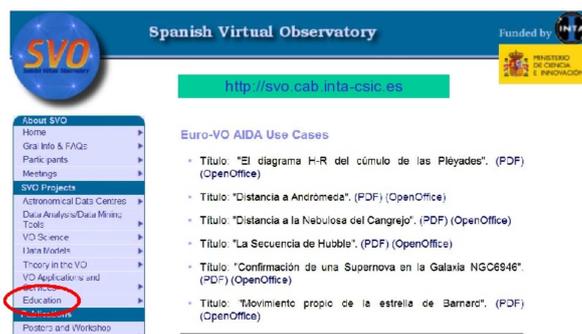


Figure 4: Educational cases available from the SVO portal.

2.1 An example of educational case: determination of the proper motion of the Barnard's star

The determination of the proper motion of the Barnard's star is one of the educational cases available at the SVO portal. As a brief overview of these scientific cases, here we present the typical scenario to carry out them. The estimated time for each case is about three hours and is divided into three parts:

1. An introduction about the scientific case and a description of the VO tool (1 h).

In this part, the student will learn the goal of the scientific case and the scientific concepts needed to carry it out. In this example, they will learn that the Barnard's star is a red dwarf star approximately six light-years away from Earth in the constellation of Ophiuchus and that it is a very well-known star because its proper motion (10.3 arcseconds per year) is the largest-known of any star relative to the Sun (Fig. 5).

1 Introducción

En la antigüedad se solía utilizar el término “estrellas fijas” para denominar a aquellos objetos que, aparentemente, no cambiaban de posición en la esfera celeste y distinguirlos de otros cuerpos como la Luna y los planetas. En este caso práctico veremos que las estrellas fijas no están realmente “tan fijas”.

2 Movimiento propio

Entendemos por movimiento propio la variación real de la posición de una estrella en el cielo debido al movimiento relativo entre ella y el Sol (figura 1).

3 La estrella de Barnard

La estrella de Barnard (también llamada V2500 Oph) es la estrella con mayor movimiento propio (10,3"/año, figura 2). Se encuentra muy cerca de la Tierra (5,9 años luz. Tan sólo el Sol y las tres componentes de Alfa Centauri están a una distancia menor). Tiene una masa de 0,15 masas solares, una temperatura superficial de “tan sólo” 2000K (el Sol tiene 5700K) y una

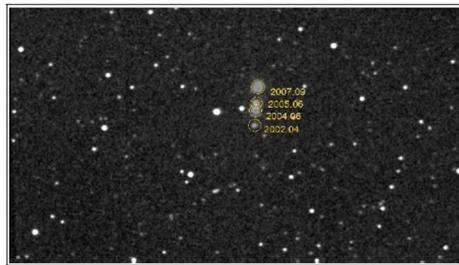


Fig . Movimiento propio de la estrella Barnard desde los años 2002 al 2007.

Figure 5: Introduction to the Barnard’ star educational case.

2. Development of the scientific cases step by step (1.5 h).

The easiest way to load an image in Aladin is to use the menu “File \mapsto Load astronomical image” and to specify a name or an object position, in our example “Barnard’s star”. Then, just press the “SUBMIT” button to visualize the images. The form opened in the previous step displays the data servers that Aladin can access. The image servers appear on the left hand side and at the right hand side the tabular data servers are shown (see Fig. 6). Aladin shows all the downloaded data as a stack of “planes”. When the Barnard’s star images have been downloaded, the user will be able to perform the exercise in order to obtain the final results.

3. Results presentation (0.5 h).

At the end of this exercise, the student will be able to visualize the proper motion of the Barnard’s star combining images of two diferents epochs and to put together coloured images to measure the angular distance (Fig. 7). If we know the elapsed time between the two images, we can easily infer the proper motion. Finally, this value will be confronted with that in the Simbad database to confirm it.

5 Desarrollo del caso práctico

5.1 Lanzamos Aladin (tal y como se indicó en el apartado anterior).

5.2 Seleccionamos "español" como lenguaje de Aladin.

- Edit → User Preferentes → Language → Spanish → Apply
- Aparecerá el mensaje "You have to restart Aladin to validate this configuration modification"
 - Hacer click en "OK"
- Repetimos el paso 5.1. Ahora ya nos debería aparecer la página de bienvenida de Aladin en español (figura 5).

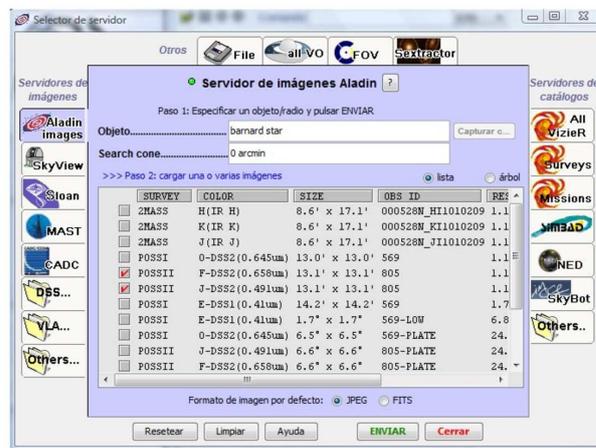


Figure 6: *Left*: The scientific case is described step by step. *Right*: The user can access images and catalogues of Barnard's star through the "server selector" Aladin window.

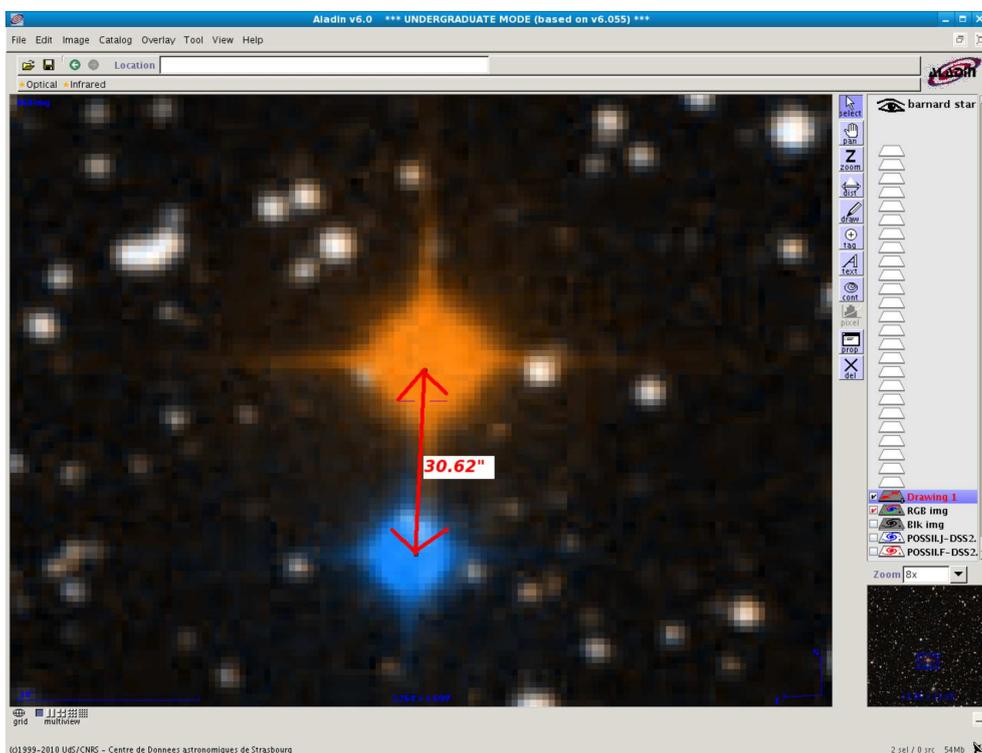


Figure 7: Color frame built from two images of Barnard's star. The user measures the angular distance and, hence, estimates the proper motion.