EuroVO-AIDA

Euro-VO Astronomical Infrastructure for Data Access

D4.2

–

First release of on-line science-oriented tutorials

Final version

DOCUMENT INFORMATION

Project

Project acronym:	EuroVO-AIDA
Project full title:	Euro-VO Astronomical Infrastructure for Data Access
Grant agreement no.:	212104
Funding scheme:	Combination of Collaborative Projects & Coordination and Support Actions
Project start date:	01/02/2008
Project duration:	30 months
Call topic:	INFRA-2007-1.2.1 Scientific Digital Repositories
Project web sites:	http://www.euro-vo.org/pub/general/intro.html
	http://cds.u-strasbg.fr/twikiAIDA/bin/view/EuroVOAIDA/WebHome

Document

Deliverable number:	D4.2
Deliverable title:	First release of on-line science-oriented tutorials
Due date of deliverable:	April 2009
Actual submission date:	12 May 2009
Authors:	E. Hatziminaoglou
Work Package no.:	WP4-SA2
Work Package title:	Service Activities in support of provision of VObs-enabled services to the science community
Work Package leader:	ESO
Lead beneficiary:	ESO
Dissemination level:	PU
Nature:	Other
No of pages (incl. cover):	11

TABLE OF CONTENT

New end-to-end science cases using Virtual Observatory (VO) tools and services, including examples from galactic and extragalactic astronomy are now available online, forming the first EuroVO-AIDA release of Online Scientific Tutorials. The new tutorials, along with older releases, can be found at http://www.euro-vo.org/pub/fc/workflows.html.

1. THE CONTENT AND STRUCTURE OF THE TUTORIALS

1.1. Confirmation of a Supernova candidate

Supernovæ, stellar explosions, are extremely energetic events that can briefly outshine their host galaxy until they eventually fade out in timescales of weeks or months. The physical processes driving these explosions are very important for the understanding of stellar evolution. Supernovæ are rare events and can only be observed by chance.

The first tutorial (http://www.euro-vo.org/pub/fc/workflows/SN.html) describes how a Supernova candidate appearing on an image of the galaxy NGC 6946, taken by a project "hunting" Supernovæ, is confirmed by comparison of the mentioned image against archival image data retrieved through VO interfaces, namely Aladin (http://aladin.u-strasbg.fr/), a sky atlas and data discovery tool. First the parent image undergoes some manipulation in order for it to be astronomically useful (e.g. modification of the pixel distribution, astrometric calibration). The workflow then describes how to identify the Supernova either by comparing the parent image to other images or by comparing source catalogues extracted from other images and overlaid on the parent image. TOPCAT (http://www.star.bris.ac.uk/~mbt/topcat/), a table manipulation tool, is used for the cross-correlation and comparison of the various source catalogues.

Figure 1 shows the Supernova candidate tagged on the parent image, framed inside the Aladin main window. The bulk of the galaxy can be seen at the top part of the image.

This case relies heavily on a case used for outreach, bearing the same name, within EuroVO-AIDA WP5.
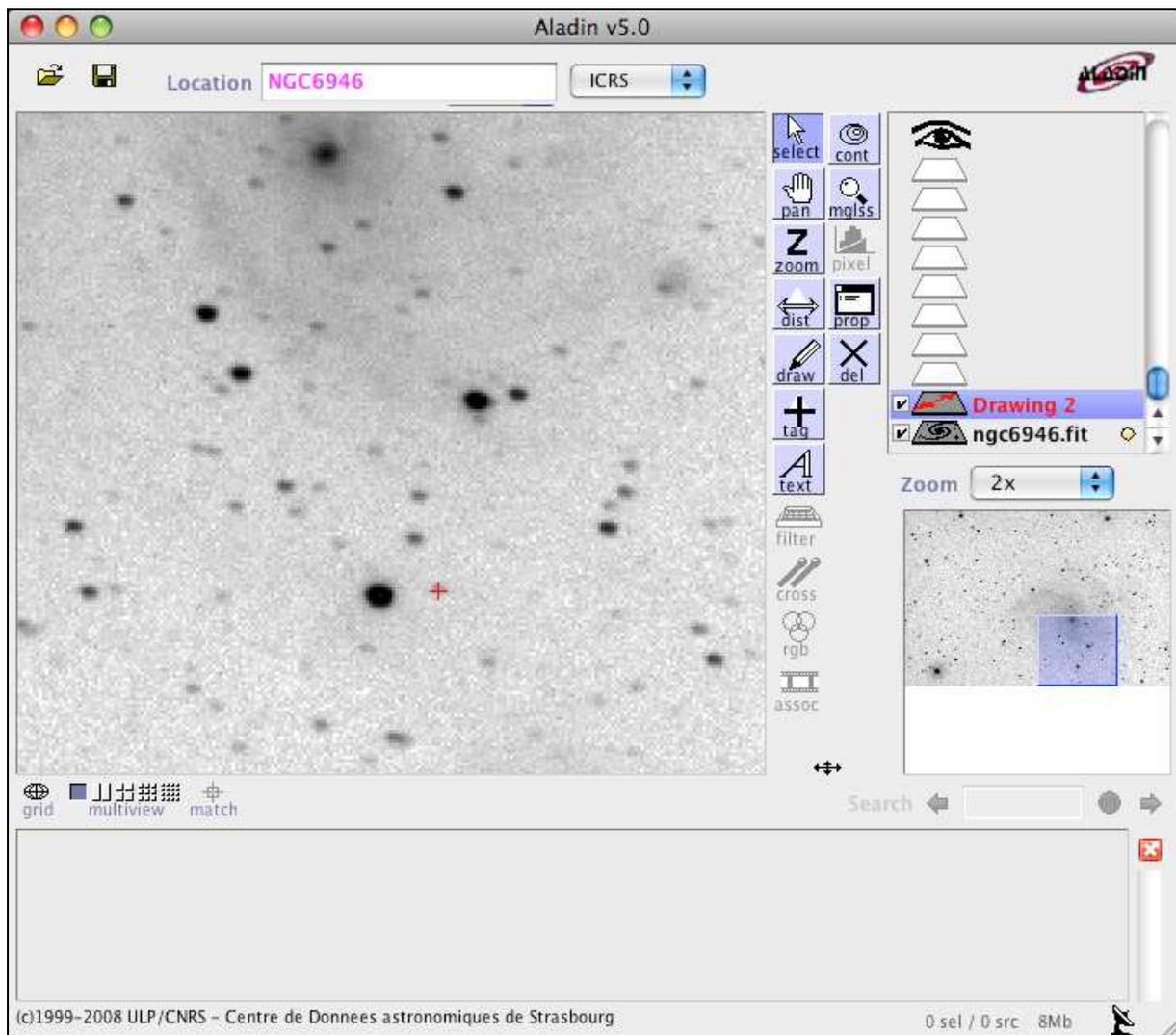
Figure 1 – Aladin screen shot showing the Supernova candidate (red cross) on the parent image of NGC 6946.

1.2. Quasar candidates in selected fields

Quasars are the brightest representatives of Active Galaxies, galaxies that harbour in their centre a super-massive Black Hole accreting material and releasing huge amounts of energy. The understanding of the physics of Active Galaxies is of great importance for the fields of galaxy evolution and cosmology. Quasars are rare objects in the sky and their selection among all other astrophysical objects is a difficult task.

The second tutorial (http://www.euro-vo.org/pub/fc/workflows/quasarCandidates.html) deals exactly with the issue of quasar candidates' selection from multi-wavelength data. The necessary datasets can be located using Aladin, VODesktop (http://www.astrogrid.org/wiki/Install/Downloads), a data discovery and resource browsing tool, or TOPCAT. The quasar candidates are then selected based on their "colours", i.e. the ratio of their fluxes at different wavelengths. Figure 2 shows how the quasar colours change as a function of redshift (i.e. their cosmological distances from us). Once the candidates have

been selected, the various data are combined to create the spectral energy distributions (SEDs) using VOSED (http://sdc.laeff.inta.es/vosed/index.jsp), a VO interface that allows for quick SED building from selected resources. These SEDs are compared to theoretical models of stars, accessible through VO protocols, using VOSpec (http://www.sciops. esa.int/index.php?project=ESAVO&page=vospec), a spectral analysis tool that also provides access to observed and theoretical spectra. Stars are the most important "contaminants" of quasar candidate samples when selected based on their colours.
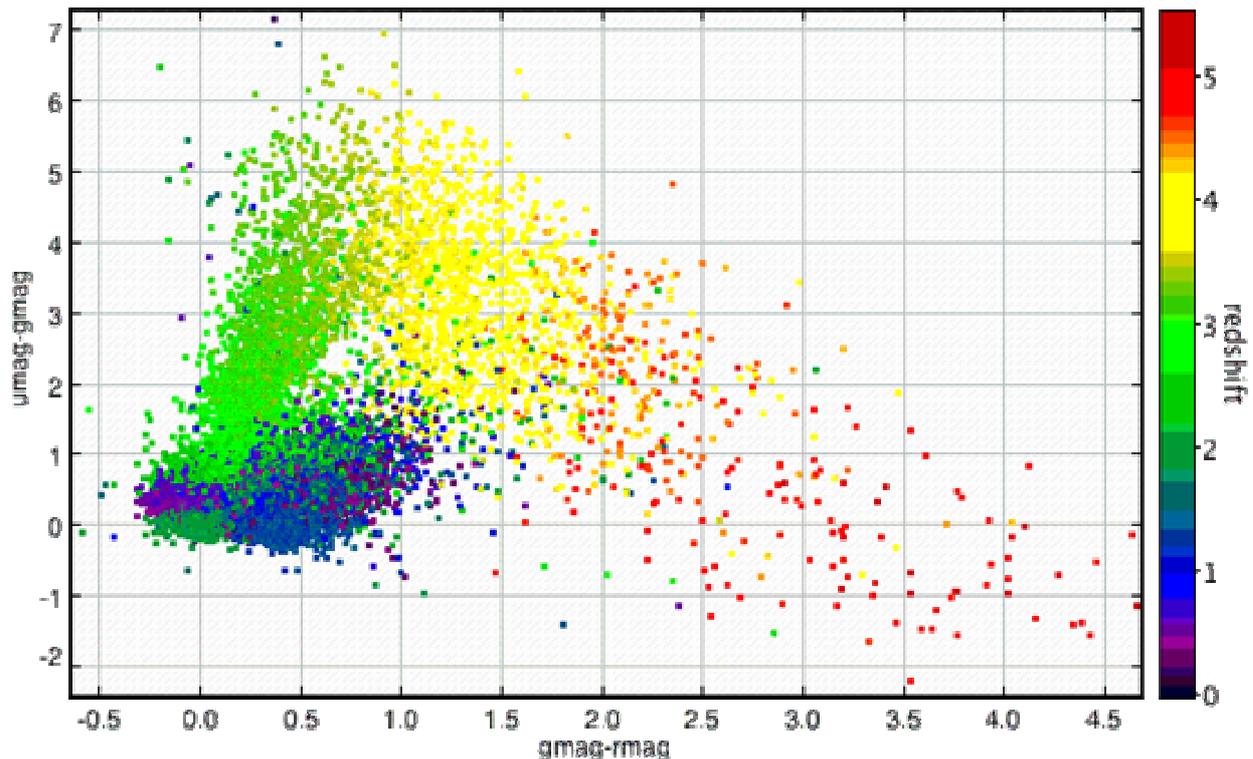

Figure 2 - Optical colour-colour diagram showing how the colours of quasars vary with redshift

1.3. The discovery of Brown Dwarfs mining the SDSS and 2MASS databases

Brown dwarfs are objects occupying the gap between the least massive stars and the most massive planets. They are intrinsically faint objects and their detection is not straightforward. In fact, until large surveys at deep optical and near-infrared bands like SDSS, 2MASS or DENIS came along, their discovery was almost impossible.

This tutorial (http://www.euro-vo.org/pub/fc/workflows/BDs.html) proposes to mine the SDSS and 2MASS databases to identify T-type brown dwarfs through an appropriate combination of colours in the optical and the infra-red. Figure 3 illustrates colour selection criteria for ultra-cool dwarfs in the (J-H)/(H-K) colour diagram: blue triangles are nearby main-sequence stars; green points ultra-cool M and L dwarfs; red stars are T-dwarfs (the objects of the present science case); deep blue circles are M sub-dwarfs; and purple crosses are giants. The plot has bee taken from a detailed study that can be found

here: http://www.stsci.edu/~inr/nstars1a.html. This science tutorial explores four different ways of performing the same tasks (e.g. cross-matching, sources selection) with different VO tools and services, namely Aladin, VizieR (http://vizier.u-strasbg.fr/viz-bin/VizieR) and TOPCAT, including the scripting capabilities of Aladin. Given the capabilities of each VO tool, there can be indeed several ways to execute the same workflow (series of steps in the data processing).
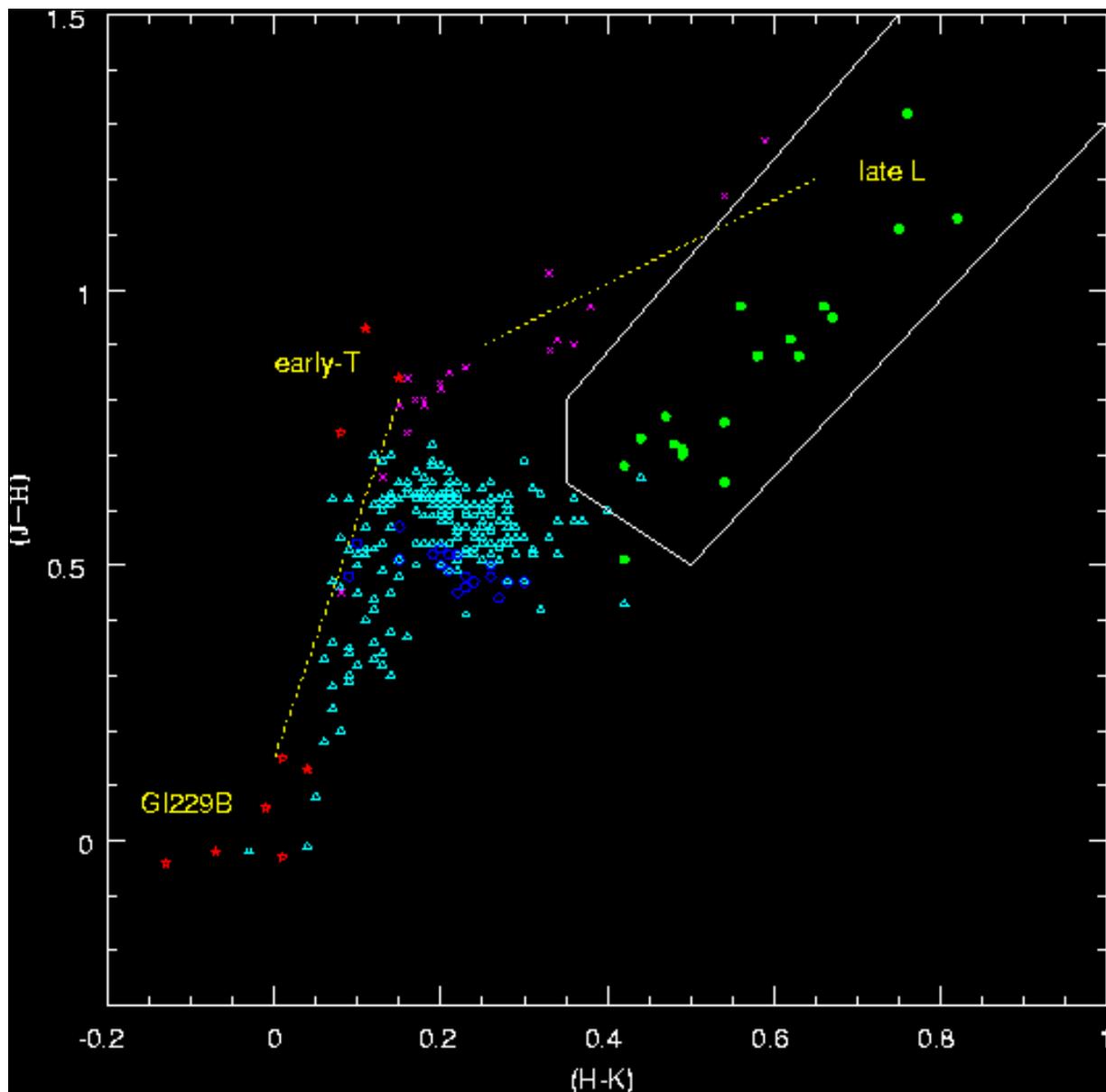

Figure3 - Colour selection criteria for ultra-cool dwarfs in the (J-H)/(H-K) two-colour diagram (taken from http://www.stsci.edu/~inr/nstars1a.html)

1.4.   The Pleiades open cluster

The Pleiades are an open cluster, a group of stars gravitationally loosely bound, in the constellation of Taurus. Because all stars belonging to the same cluster originate from the same gas cloud, have the same age and chemical composition, stellar cluster are important entities for the understanding of stellar evolution. The Pleiades are one of the stellar clusters nearest to earth. Figure 4 shows an RGB image of the centre of the cluster created using Aladin.

This science tutorial describes how to use Aladin to measure the "parallax", i.e. the displacement of the stars relative to the background, of the cluster members. From the histogram of the parallax of the objects in the field (using TOPCAT), one can see that there are many background stars (with smaller parallax) and a few foreground ones. The cluster members will all have the same parallax (8-9"). One can the collect multi-wavelength data and create a colour-colour Hertzsprung-Russel diagram, i.e. the absolute magnitude of a star versus its spectral type, using TOPCAT, in order to study the evolution of the cluster.
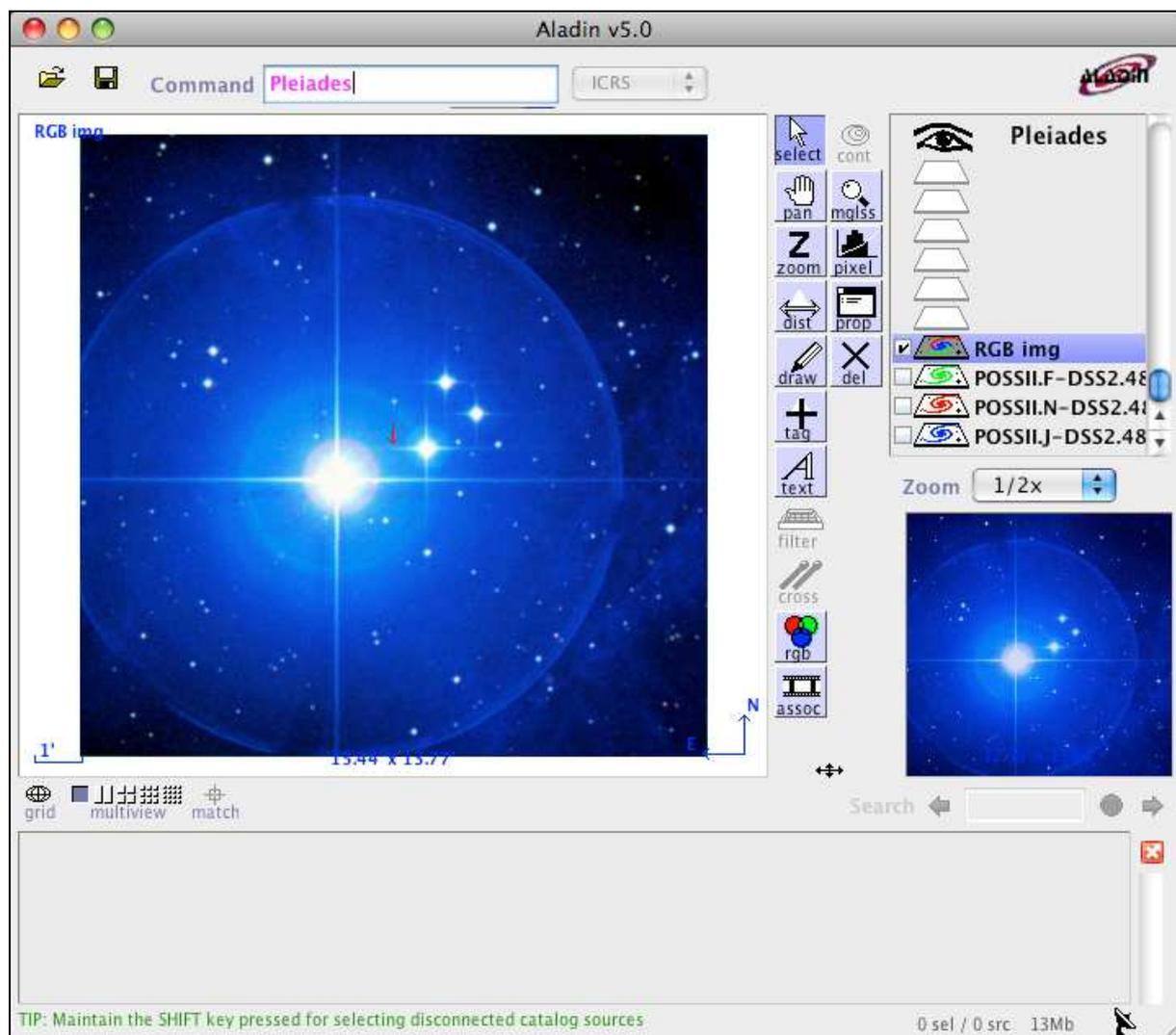

Figure 4 - RGB image of the Pleiades cluster created using Aladin

1.5. Searching for available data for the bright galaxy M51

Various astrophysical processes leave their signatures in different parts of the electromagnetic spectrum, i.e. different wavelengths. In order to understand the structure and intrinsic properties of an astrophysical object, one is often compelled to find as many data as possible for a given object.

This workflow describes how to collect all available data, through the VO, for the bright galaxy M51, making use of a variety of VO tools and services, namely Aladin, VizieR, SIMBAD (http://simbad.u-strasbg.fr/simbad/), TOPCAT and VOSpec. In doing so, it also presents a variety of functionalities of the various tools and services. Figure 5 shows part of a spectrum taken on M51 by the Hubble Space Telescope and discovered using SPLAT (http://star-www.dur.ac.uk/~pdraper/splat/splat-vo/), a spectral analysis tool, alternative to VOSpec.
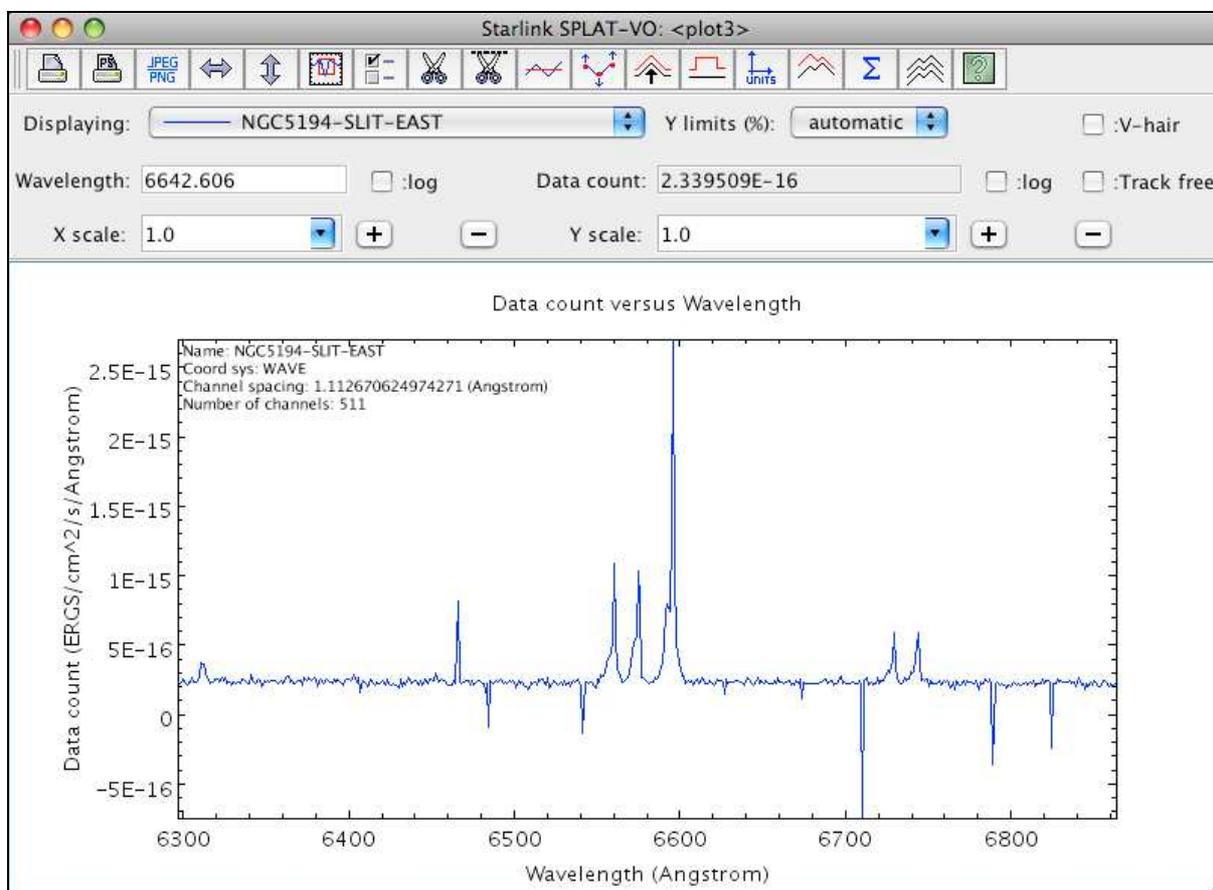

Figure 5 - Partial HST spectrum of M51

1.6. A VOSpec typical session

This last new release, found in the URL http://www.sciops.esa.int/SD/ESAVO/images/VOSpec/VOSpecV5_ABAur_flash.htm, is different from the previous five. It is actually a recorded session of the use of VOSpec, a real step-by-step introduction that takes the user through the various capabilities of the tool. It is a navigation through data discovery, comparison with theoretical models and examples of some spectral analysis tools. Figure 6 shows a screenshot of the recorded VOSpec session.
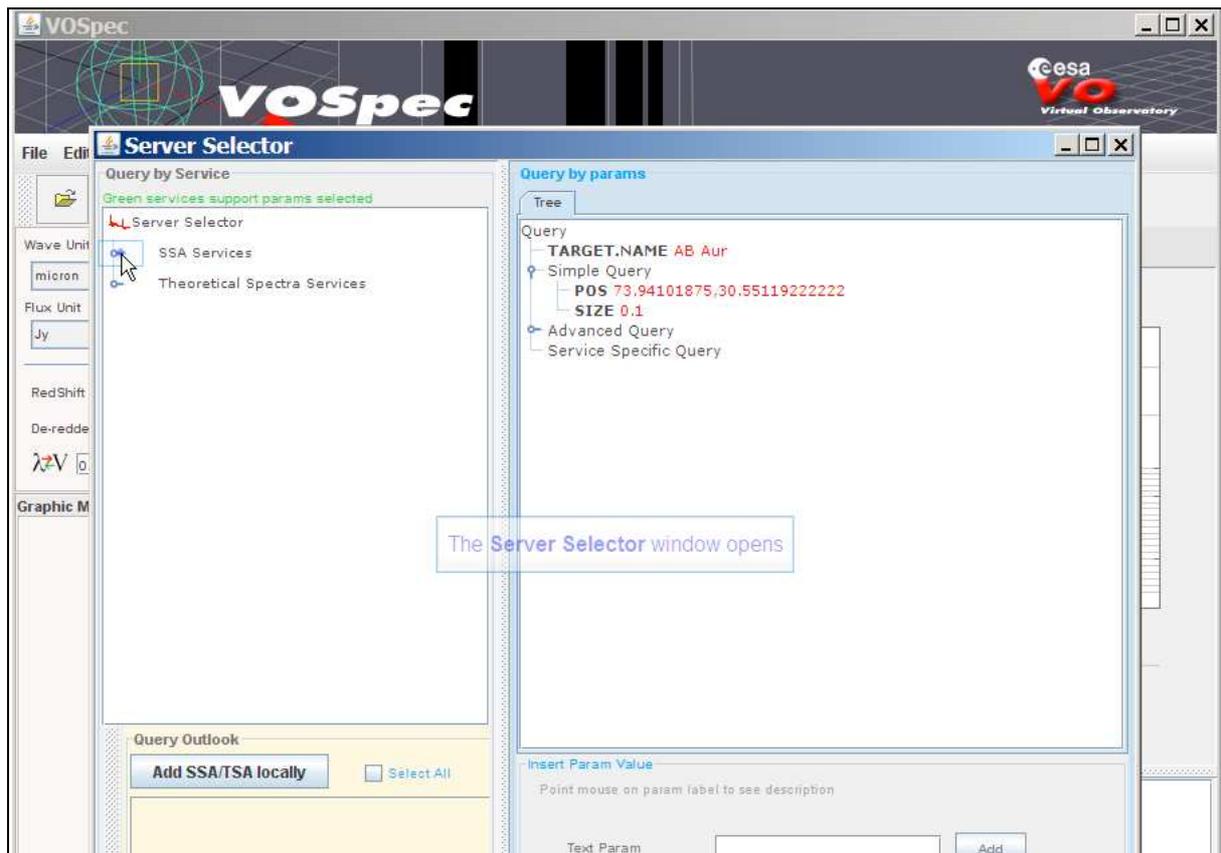

Figure 6 - A screenshot of the recorded VOSpec session

2. FUTURE RELEASES

In the second and final EuroVO-AIDA online science tutorial release, the tutorials presented here will be further expanded and enriched with visual material, i.e. screen shots or recorded examples. New tutorials will also be added to the collection.

ACRONYM AND TOOL LIST

2MASS	Two Mícron All Sky Survey
AIDA	Astronomical Infrastructure for Data Access
Aladin	Sky atlas and data discovery tool
D#	Deliverable number
DENIS	DEep Near Infrared Survey
ESO	European Southern Observatory
Euro-VO	European Virtual Observatory
EuroVO-AIDA	European Virtual Observatory - Astronomical Infrastructure for Data Access (FP7 Project)
HST	Hubble Space Telescope
M#	Messier catalogue
NGC#	New General Catalogue
PU	Public
RGB	Red-Green-Blue (a three-channel image)
SA	Service Activity
SED	Spectral Energy Distributions
SDSS	Sloan Digital Sky Survey
SIMBAD	Set of Identifications, Measurements and Bibliography for Astronomical Data
SPLAT	Spectral Analysis Tool
TOPCAT	Tool for Operations of Catalogues And Tables
URL	Uniform Resource Locator
Vizier	Database of astronomical catalogues and published tables
VO	Virtual Observatory
VODesktop	A VO interface suited for filtering of VO resources
VOSED	SED builder & Fitting tool
VOSpec	A tool to handle spectra in the VO context
WP#	Work Package number