VirGO: A Visual Browser for the ESO Science Archive Facility

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VirGO is the next generation Visual Browser for the ESO Science Archive Facility (SAF) developed in the Virtual Observatory Project Office. VirGO enables astronomers to discover and select data easily from millions of observations in a visual and intuitive way. It allows real-time access and the graphical display of a large number of observations by showing instrumental footprints and image previews, as well as their selection and filtering for subsequent download from the ESO SAF web interface. It also permits the loading of external FITS files or VOTables, as well as the superposition of Digitized Sky Survey images to be used as background. All data interfaces are based on Virtual Observatory (VO) standards that allow access to images and spectra from external data centres, and interaction with the ESO SAF web interface or any other VO applications.

VirGO as an alternative to the traditional ESO archive query

The main ESO archive query form[1], a web interface, allows the user to search the ESO archive based on Target Name or Coordinates, Observing Date or Programme ID, request the type of observations (Imaging, Spectroscopy, Interferometry etc.) and the Category (Science or Calibration frames). The query may take anything from a few seconds to several tens of minutes, depending on the volume of the requested data required by the user. The information is returned in the form of a table, listing the frames, as well as the position, programme ID, exposure time, filter and other quantities and is followed by two tables summarising the total number of frames and exposure times, broken down by the various instruments or exposure time/instrument/filter.

VirGO[2] offers an alternative to this "traditional" querying form, by providing a visual impression of the available data, their overlaps and the instrument footprints, while allowing the resulting frames to be filtered in real-time, before launching the query to the ESO archive. This solution presents many challenges in the field of user interface design, such as displaying and navigating through many observations simultaneously without confusing the observer, or filtering out and selecting relevant observations in an intuitive way. An important aspect of VirGO is its capacity to access and handle large data collections on both the client and server sides, as well as to exchange data with other VO tools. These two features are achieved thanks to VO standards: the Simple Image Access/Simple Spectral Access (SIA/SSA) protocols for retrieving images and spectra, respectively, from a variety of astronomical repositories through a uniform interface; and the PLASTIC (Platform for Astronomy Tool InterConnection) protocol for communication with other VO tools.

Overview of main features

VirGO is a plug-in for the open source (GPL) software Stellarium (Chéreau et al., 2007, 2008), whose target audience is the general public, and it therefore benefits from many standard features such as the display of star and planet positions, landscape rendering, intuitive real-time navigation, a variety of projection modes, etc. To this set of standard features, VirGO adds the necessary tools for browsing through the ESO data archive. Figure 1 gives an overview of the general look-and-feel of VirGO. The main features of VirGO are:

1) The main Graphical Window contains the dynamical view of the observations in the current field of view. Images with footprints and previews (Rite et al., 2008) as well as superimposed spectra can be visualised simultaneously, all on a multi-resolution Digitized Sky Survey (DSS) background, if the user so desires (see below).

2) The List Browser displays a single summary line for each frame selected in the Graphical Window. The displayed information includes observation date, exposure time, filter and instrument. The existence of a preview is also indicated by the presence of a tick-box.

3) The Info Window contains detailed information about the observation

Figure 1. Overview of the main Virgo window. For an explanation of the numbered items, see text.

Figure 2. An example of the multi-resolution DSS background implemented in VirGO.

currently selected in the List Browser. It also provides a direct link to access the datasets, the preview images or transmission curves if available.

4) The View Selector allows the user to choose which observations to show/hide by defining a set of constraints such as observation type (images or spectra), processing type (raw data, highly processed data etc.), date or exposure time. The second part of this window is the Tree Browser, which contains a telescope/instrument/filter tree reflecting which observations are currently loaded in VirGO. It gives refined control over what to show/hide from the Graphical Window.

5) The Target Selection uses either the Simbad name resolver or the exact coordinates.

6) Additional functionalities in form of Tabs allow the user to see the servers being queried, select grouping options (e.g., footprint blending) and frame blending (depending on the number of superposed frames), or to send a direct query for the selected frames to the ESO Archive.

7) Finally, the Menu Bar gives quick access to functionalities such as the download of observations from the ESO SIA/SSA servers; the activation of the DSS background, grid display, etc.

In the current release of VirGO (1.4), observational data are accessed from ESO Science Archive Facility servers using VO SIA/SSA services. The VOTables provided by these services are loaded by VirGO in streaming mode to allow a fluid interaction even when downloading large datasets. The background is a multi-resolution false-colour JPEG version of the DSS originally created at STScI[3] by processing and combining the original blue, red and near-IR DSS images, allowing for more flexibility, e.g., at the time of defining an archive query. The special version hosted at ESO was post-processed and indexed for use in VirGO (see Figure 2 for an example).

Interaction with VO tools and services

VirGO is able to communicate through the PLASTIC protocol with a variety of other VO-compliant tools and services, such as Aladin[4] (a sky atlas allowing for visualisation of images, superimposition of catalogues, or access of related data and information from e.g., Simbad or VizieR), SPLAT-VO[5] (a spectral analysis tool) or TOPCAT[6] (an interactive graphical viewer and editor for tabular data). For example, FITS images can be sent to Aladin for quick visualisation before being requested from the archive. Similarly, all reduced spectra available as Advanced Data Products (comprising most UVES and HARPS spectra as well as FORS2 and VIMOS GOODS spectra) can be visualised using SPLAT-VO. VirGO's communication with the VO world is a two-way communication. For instance, it can receive and display catalogues retrieved using Aladin or TOPCAT.

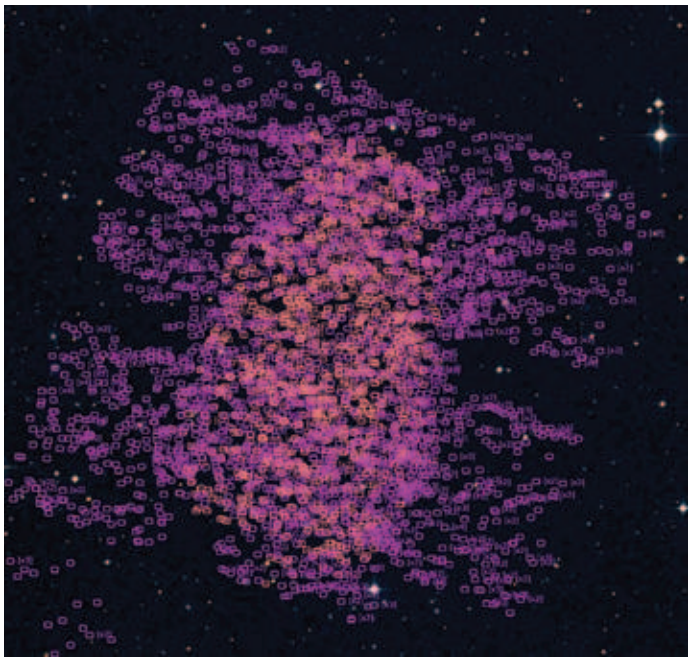
Use cases

We illustrate two examples of where using VirGO has advantages over the archive query form.

– A user preparing an observing proposal in the Chandra Deep Field South (CDF-S)

Mark	More	Release_Notes	RA [deg]	DEC [deg]	PI Name	Program ID	Instrument Name	Filter/Grism	Exposure Time [s]	Filename
		GOODS VIMOS spectroscopy	53.070313	-27.842175	CESARSKY	171.A-3045(D)	VIMOS	MR	10799.94	GOODS_MR_NEW_2_B_Q2_29_1
		GOODS VIMOS spectroscopy	53.071323	-27.798475	CESARSKY	171.A-3045(B)	VIMOS	LR_Blue	14400.00	GOODS_LRB_002_Q2_20_1
		GOODS VIMOS spectroscopy	53.071356	-27.820814	CESARSKY	171.A-3045(D)	VIMOS	LR_Blue	14399.88	GOODS_LRB_003_NEW_2_Q3_45_1
		GOODS VIMOS spectroscopy	53.071356	-27.820814	CESARSKY	171.A-3045(D)	VIMOS	LR_Blue	14399.88	GOODS_LRB_003_NEW_2_Q3_45_2
		GOODS VIMOS spectroscopy	53.071360	-27.814937	CESARSKY	171.A-3045(B)	VIMOS	LR_Blue	14400.00	GOODS_LRB_002_Q2_16_1
		GOODS VIMOS spectroscopy	53.072368	-27.822115	CESARSKY	171.A-3045(D)	VIMOS	MR	14399.98	GOODS_MR_NEW_2_1B_Q2_33_1
		GOODS VIMOS spectroscopy	53.072719	-27.767697	CESARSKY	171.A-3045(B)	VIMOS	LR_Blue	14400.00	GOODS_LRB_001_Q2_29_1
		GOODS VIMOS spectroscopy	53.073063	-27.834870	CESARSKY	171.A-3045(D)	VIMOS	MR	1200.00	GOODS_MR_NEW_1_D_Q2_30_1

Figure 3. Example output of the Advanced Data Products query form for ESO spectroscopy in the Chandra Deep Field – South (CDF–S).



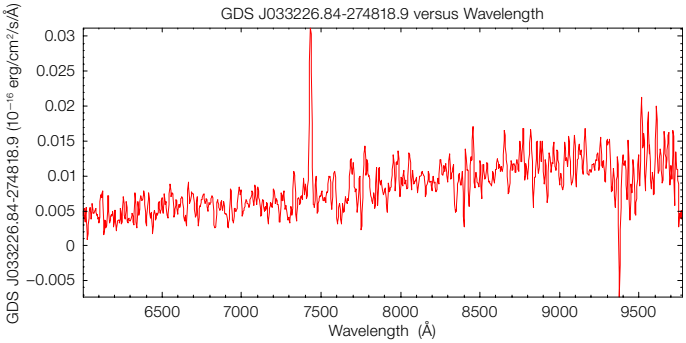


Figure 4. Output of VirGO from a search for spectroscopy in the CDF-S. Each object within a box has a spectrum, and zoom-in and visualisation of a selected spectrum using SPLAT-VO is shown.

wants to know about all the available ESO observations within one square degree in this field. Using the main ESO archive query form, the user will have to wait about 28 minutes for all the frames (more than 31 000) to be returned in the form of an HTML table. The same query using VirGO will require only four minutes and will return the list in a visual form, like that shown in Figure 1, allowing the user to see the overlaps between observations immediately, to get a feeling for the depth of the exposures (using the footprint blending option) or to look selectively at the reduced data.

– A user wants to know which targets have been followed up spectroscopically by ESO/GOODS in the CDF-S. The Advanced Data Products query form[7] will again return an HTML list of files with the relevant information, like that shown in Figure 3. The same query using VirGO will return a visualisation of the available reduced spectra, shown in Figure 4. The user can then select an image to use as a background to identify the sources or, by zooming in, see the orientation of the slit (whenever available) or the number of spectra composing the final product per object, or even visualising individual spectra using other VO tools (here SPLAT-VO) before requesting them from the archive.

Future developments

Although fully functional, VirGO is a recent application, and several major capabilities as well as technical features still have to be implemented. The next objectives are the following:

– add access to more ESO data, especially science-ready data such as Large Programmes and Surveys, large sets of pipeline-processed data, and Press Release images;

– dissemination: some features of VirGO will be included in the standard version of Stellarium, e.g., the display of Press Release images (Kapadia et al., 2007). VirGO/Stellarium, along with other VO tools, is also brought to schools in organised practical sessions in classrooms with teachers and students, as part of a dedicated outreach effort within AIDA[8] (Astronomical Infrastructure for Data Access) and this effort will continue in the future;

– on the technical side, the immediate objectives include the improvement of server scalability, the optimisation of image and catalogue access and the use of improved caching, as well as a deeper integration with the ESO website.

References

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Rité, C. et al. 2008, in ASP Conf. Series, Vol.394, ADASS XVII, ed. Argyle R. W., Bunclark P. S. & Lewis J. R., 605

Notes

[1] http://archive.eso.org/eso/eso_archive_main.html
[2] http://archive.eso.org/cms/virgo
[3] http://www-gsss.stsci.edu/Acknowledgements/DataCopyrights.htm
[4] http://aladin.u-strasbg.fr/
[5] http://astro.dur.ac.uk/~pdraper/splat/splat-vo/splat-vo.html
[6] http://www.star.bris.ac.uk/~mbt/topcat/
[7] http://archive.eso.org/eso/eso_archive_adp.html
[8] http://cds.u-strasbg.fr/twikiAIDA/bin/view/EuroVOAIDA/WebHome