Aiding the Science Return of Astronomical Time-Series Data: The HCV Explorer

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Introduction

The Hubble Catalog of Variables is the first homogeneous catalog of variable sources in our Galaxy and nearby galaxies. Prepared by the National Observatory of Athens, and funded by the European Space Agency, the catalog unveils all the variables found within the Hubble Source Catalog (HSC), which is based on the measurements of astronomical objects observed with the Hubble Space Telescope over more than 25 years of exploring the universe.

The ESAC Science Data Centre (ESDC) has developed an online tool to access and visualize the time-series data from the HCV, called the HCV Explorer. Released in September 2019, the HCV Explorer offers interactive and connected exploration of the catalog with the aim of aiding the exploration of the catalog, as well as enhancing data discovery and user experience through visual exploration.

Exploring the Hubble Catalog of Variables
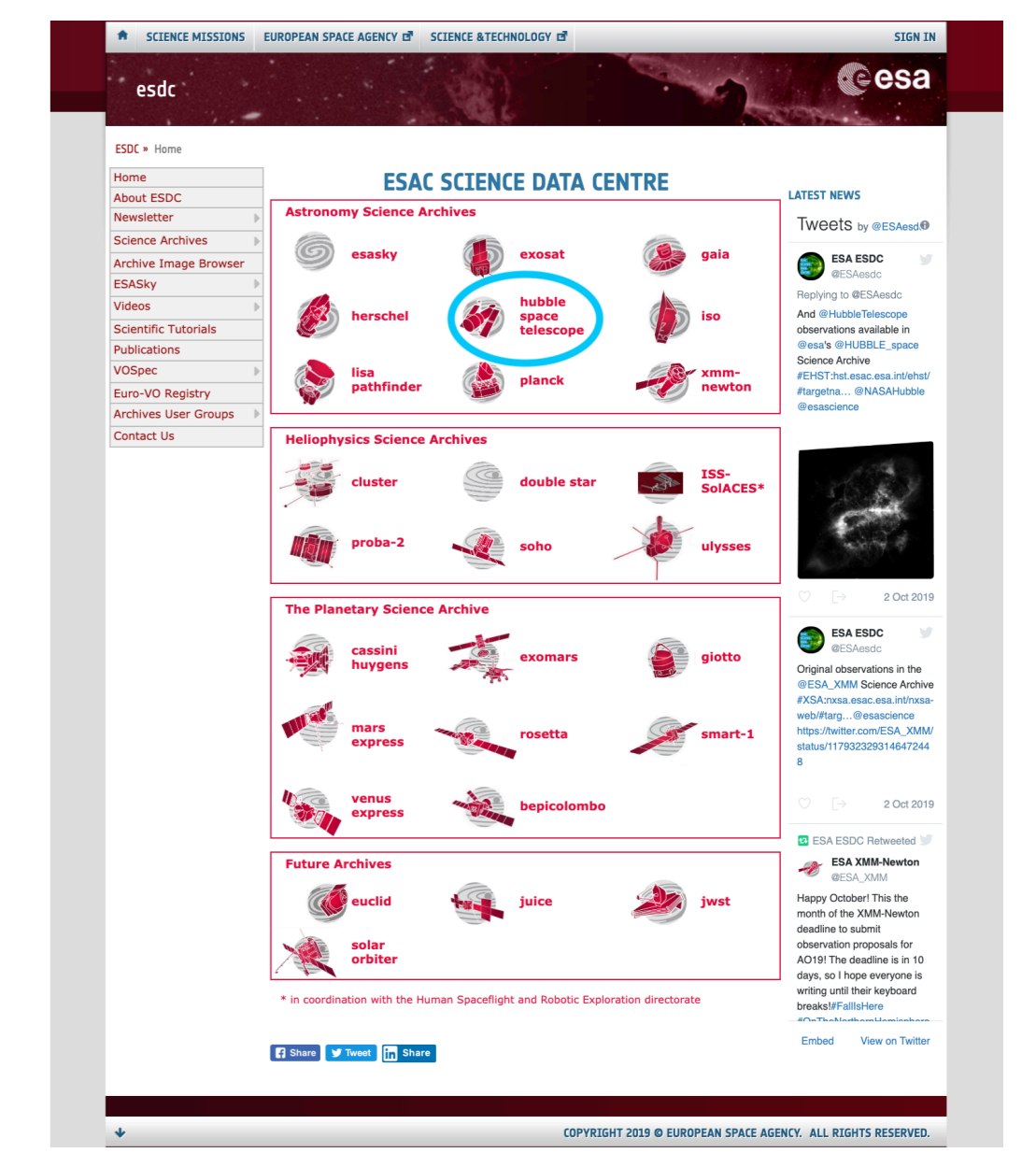
European HST Archive at ESDC
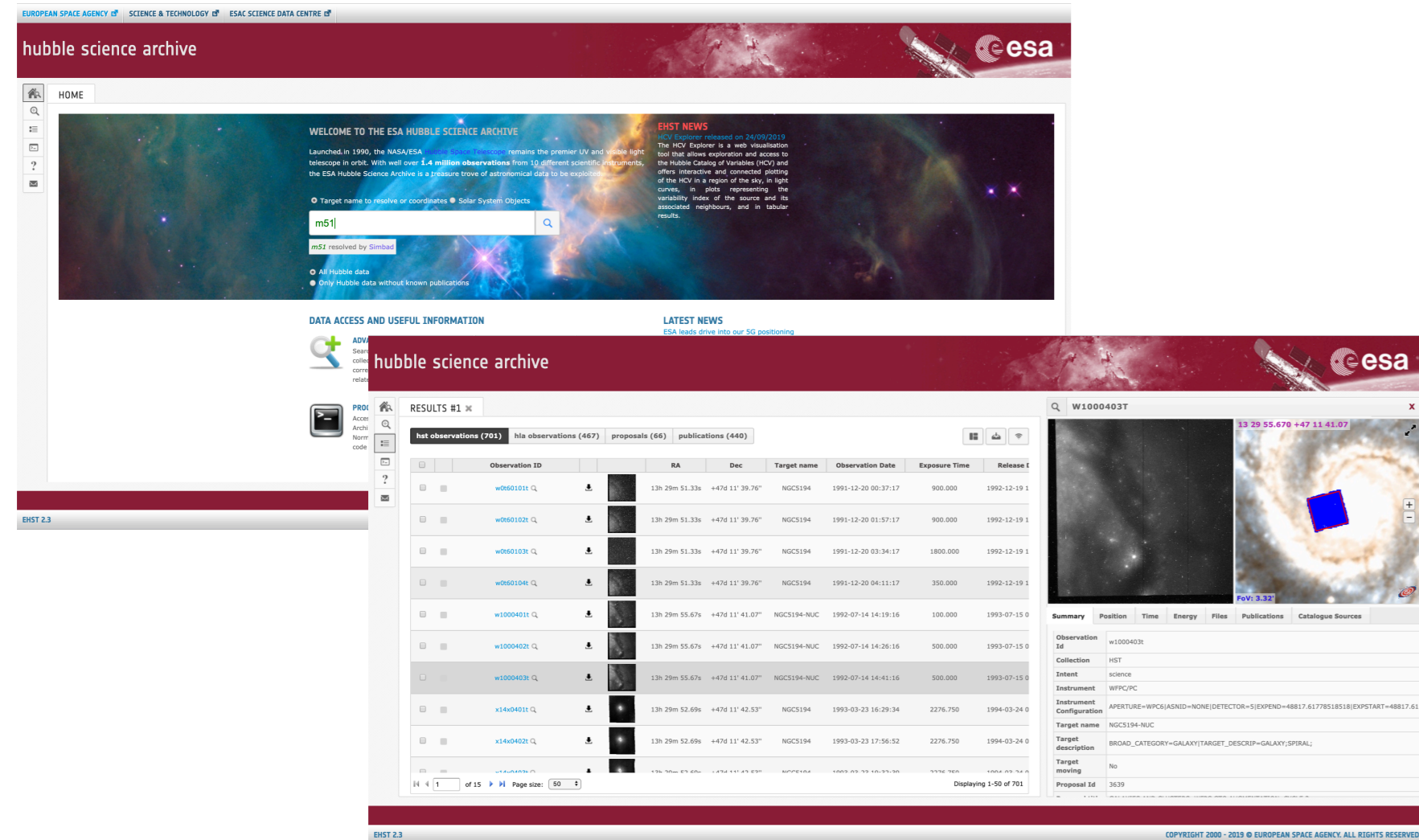
eHST
The European HST Science Archive allows searching all the HST and HLA collections of all public sicence data that the Hubble Space Telescope observes every day. Within the new Home page, users can directly access to all the observations which do not have any publication associated yet. Data can be retrieved via our Web interface or using the dedicated programatic access.

Hubble Science Archive Data
Access to the Hubble science observational data collections: *HST*, the classic *HST* collection and the *HLA*, the Hubble Legacy Archive. All of them are linked to their corresponding *Proposals* and *Publications*.
The eHST also provides access and visualization to catalogs, as the *HSC*, the Hubble Source Catalogue, and the recently released *HCV*, the Hubble Catalog of Variables.
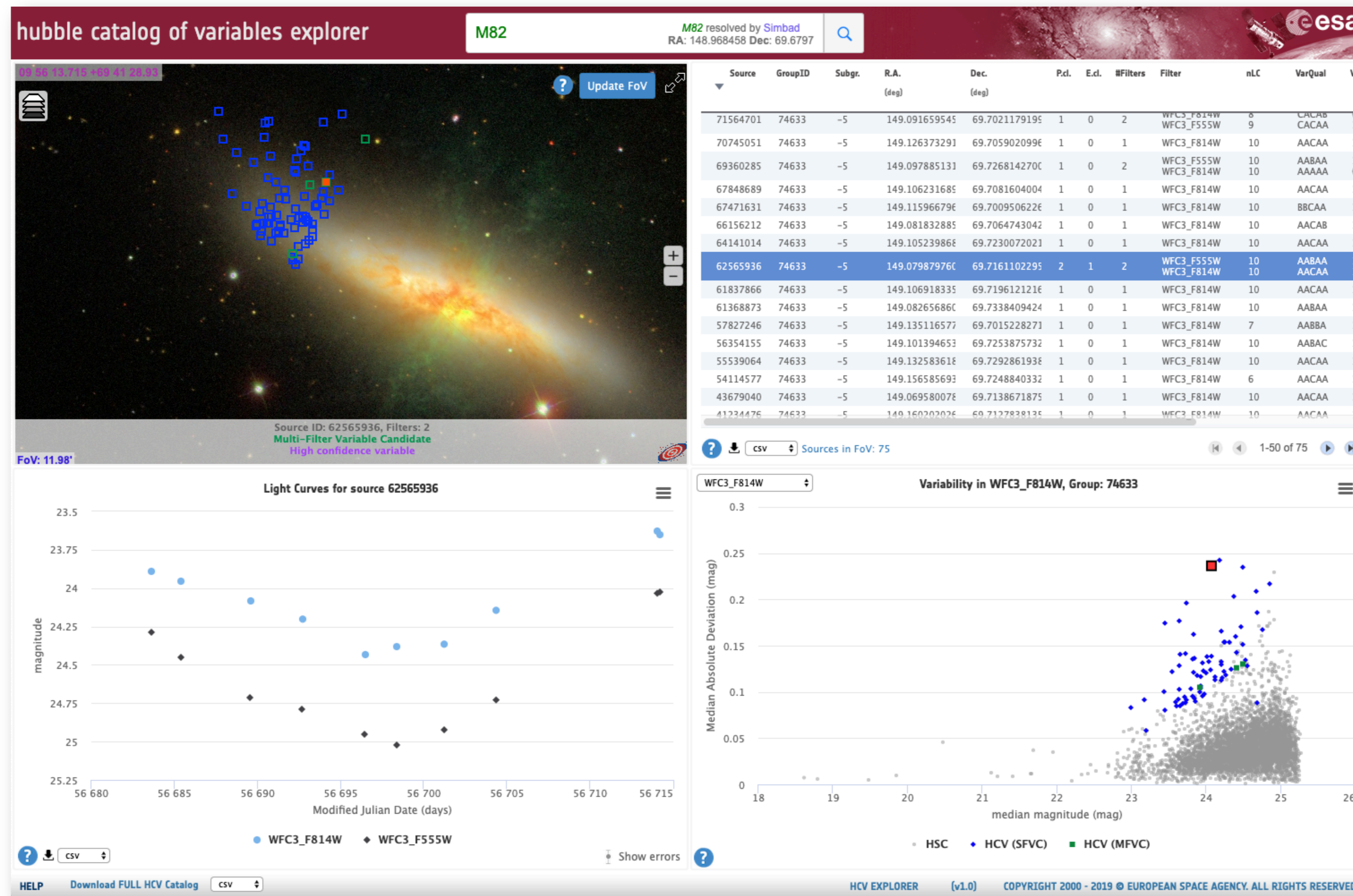
http://archives.esac.esa.int/ehst

http://www.cosmos.esa.int/web/esdc

HCV Explorer

http://archives.esac.esa.int/hcv-explorer

https://www.cosmos.esa.int/web/hst/hcv-help

Target Search
The search field is located at the top and accepts coordinates or an object name that can be resolved by SIMBAD. After launching a search, the tool centres on this target in the sky view with a default field of view (FoV). HCV sources found in the FoV are displayed in the sky view and table view.

Sky View
The sky view uses AladinLite, created by CDS. Upon a target search request, the sky view updates and centres on the object and any HCV sources found in the FoV are displayed. Clicking on a source highlights it in red and brings up a panel at the bottom of the sky view with a summary on the source: the SourceID number; the number of available filters for that source; the pipeline classification and the expert classification. Selecting the source will also highlight the relevant row in the table view curve(s) (bottom left) and median absolute deviation plot (bottom right).

Light Curves plot
When a source is selected either in the sky view, in the table results or in the variability index plot, all the light curves in all available filters for the chosen source the are plotted. The plot is interactive and can be zoomed in on by clicking and dragging the mouse in the desired area. Hovering over each point will show the data values. Error bars can be shown-hidden by clicking the corresponding 'Show errors' control. The light curves for the source can be downloaded in various formats via the download button, located to the bottom left of the plot.

Table Results
The results table is shown in the top right area of the HCV Explorer and lists all the HCV sources in the FoV of the sky view (top left). Clicking on a source (the corresponding row) will highlight the row and the relevant source in the sky view. It will also trigger plotting the source light curve(s) (bottom left) and median absolute deviation plot (bottom right), see more information below. A download button is located at the bottom left of the table, where the results table can be downloaded in various formats.

Variability index plot
Shows the median absolute deviation (MAD) of the magnitude versus the median magnitudes for the selected filter and group. Plotted in green are the HCV multi-filter variable candidates: HCV (MFVC); in blue are the HCV single-filter variable candidates: HCV (SFVC); and in grey are the HSC sources for the selected filter and HSC group. This MAD plot indicates the scatter in a source's light curve, for the selected filter, and can be used as a variability index. The selected source is highlighted in red. Any source can be selected and will trigger the light curve plot to be reloaded, for this selected source, and will highlight the source in the sky and results table.

Download the full HCV
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Scripting access

The HCV, and the ESA Hubble Science Archive (eHST) database content, can be queried via the Table Access Protocol (TAP) (see: http://www.ivoa.net/documents/TAP/). The default query language for TAP is the Astronomical Data Query Language (ADQL), which includes most features of SQL plus some spatial search functions. TAP services can process synchronous (immediate) or asynchronous (batch job) queries. The eHST TAP can be accessed via command line or via several clients such as TOPCAT or Jupyter Notebooks with astroquery.

References

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4. Fernique, P. et al, "HiPS - Hierarchical Progressive Survey Version 1.0", IVOA Recommendation 19 May 2017

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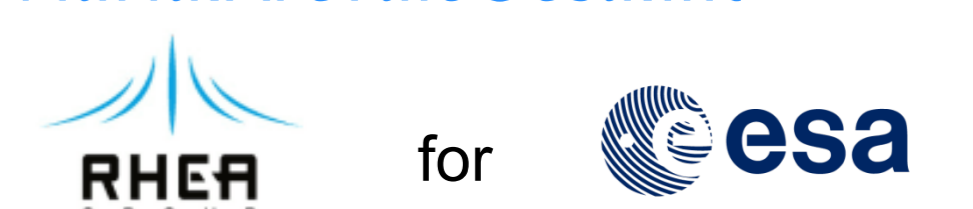
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