APERICubes:

An on-line Astronomical and Planetary Ergonomic Research Interface for spectral Cubes

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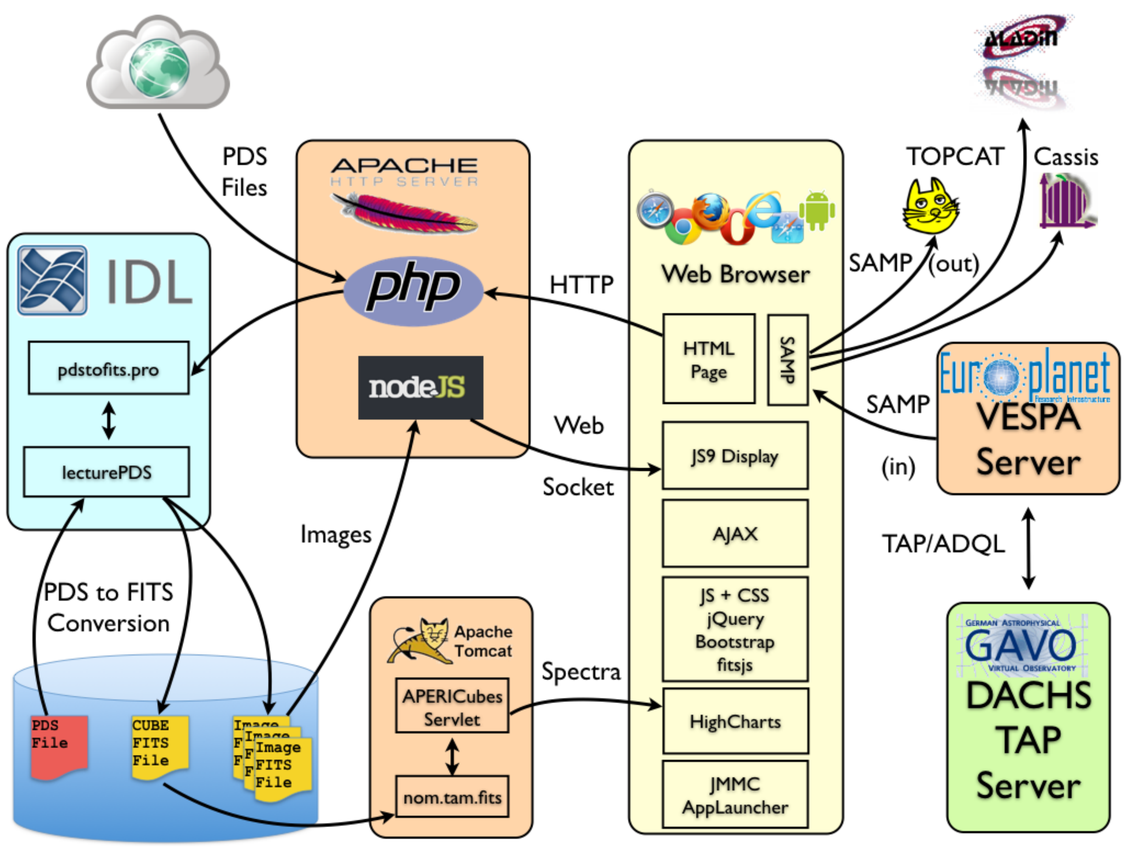
Abstract: We have developed a web-based tool to preview spectral cubes and facilitate their exploration with existing spectrum analysis programs. The APERICubes tool is part of VESPA, an integrated system connecting many data services related to Planetary Sciences and Heliophysics. APERICubes was originally designed to handle PDS cubes from the VIRTIS imaging spectrometer on the ESA Venus Express mission, but its architecture is versatile enough to accommodate other FITS IFU data cubes (data from the ESO GIRAFFE spectrograph are supported). After being prepared on the server, the cube image planes are available through JS9 (a Javascript port of the popular image visualization tool DS9). The user has access to various plugins for image analysis, and can select a pixel or a region of interest. The corresponding spectrum, computed by a servlet in real-time, is then plotted. Thanks to the VO SAMP protocol the generated spectra can be sent to dedicated clients such as Cassis to be analyzed and compared. The service is available from VESPA http://vespa.obspm.fr/ or directly on http://voparis-apericubes.obspm.fr/

Architecture

The spectral cubes from VIRTIS [1] in PDS [2] format are downloaded from a remote FTP/HTTP site and are stored on the server. During the pre-processing phase they are transformed by an IDL procedure *pdstofits.pro* using the LecturePDS [3] library, into a series of FITS images for optimizing the subsequent access by the web client. The FITS cube is also loaded into the server memory by a Java servlet to allow fast spectra extraction using the nom.tam.fits [4] library.

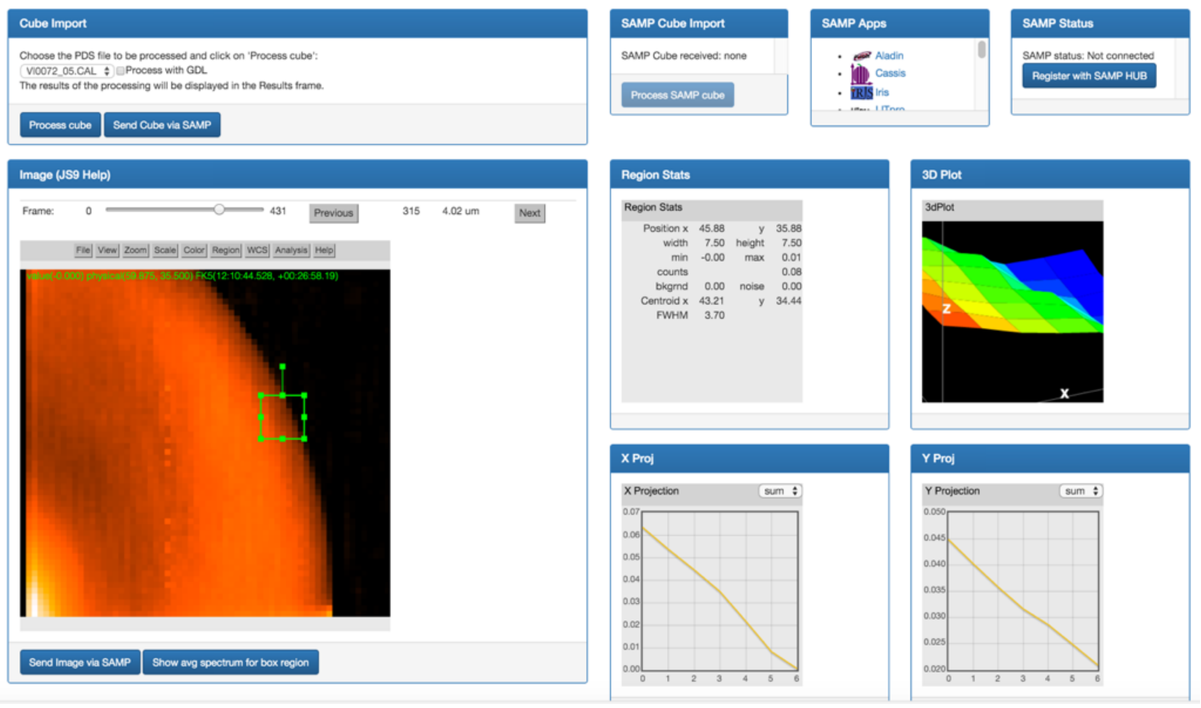


On the web client, the images are rendered using the JS9 [5] astronomical image display suite which provides a set of tools for image analysis. We have added a slider for selecting the wavelength of the current image. Since images are already prepared on the server, the entire cube can be quickly browsed. In a spectral cube, a spectra lies behind each pixel, so the user can click on a pixel to request the corresponding spectrum. That spectrum is then computed by the servlet from the in-memory spectral cube and delivered in real time to the client, where it is displayed, including its error bars, using the HighCharts [6] JavaScript library. Furthermore, using JS9 regions, the user can select a box region and request the average spectrum to be displayed.

Although APERICubes was written for VIRTIS spectral cubes, its modular design allows to easily expand its usage to other IFU cubes by writing a corresponding IDL or Python wrapper. We currently support spectral cubes from the ESO GIRAFFE spectrograph and are planning to support more formats in the future. If you are interested to use APERICubes with your spectral cubes, please contact us !

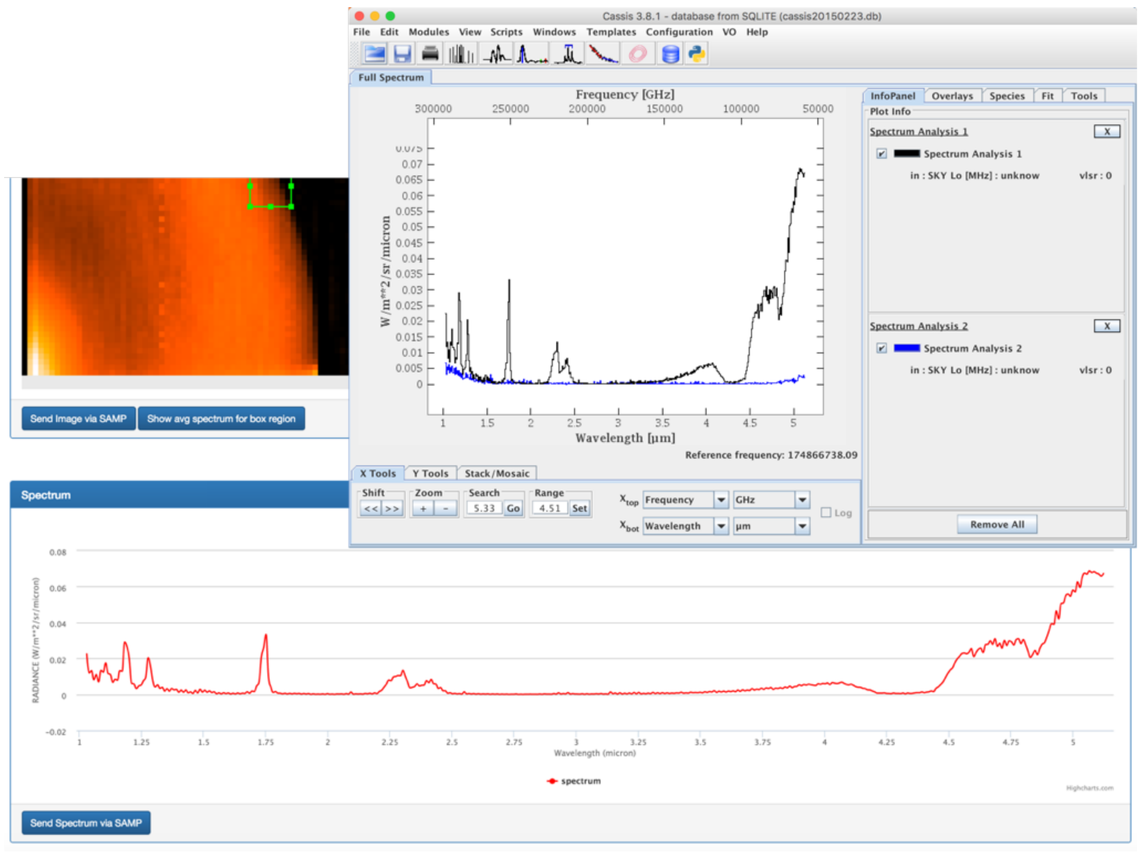
Visualization

A typical VIRTIS cube showing the atmosphere of the night side of Venus is loaded into APERICubes. Several image analysis tools are shown:



Interoperability

Using the IVOA SAMP [7] protocol, data can be exchanged with APERICubes in 2 ways. First, the generated FITS cube, images and spectra can be sent to SAMP-compatible tools such as Aladin [8], TOPCAT [9] or Cassis [10]. Archive browsers such as VESPA [11] can also send the cubes to APERICubes from their result pages.



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