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A planetary Virtual Observatory service for Vesta data from DAWN-VIR mission

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Abstract

We present a data access service in the frame of IVOA standard techniques for virtual observatories. This service will be registered in the IVOA registry system and thus allowing to query its data among other datasets already registered. The service functionalities will be presented addressing free data access and analysis tools compliant with IVOA protocols and publicly available.

Data presented here consists of spectral cubes produced by the VIR instrument [1], a visible and infrared spectrometer on board the NASA Dawn mission. The published spectra covers various mission phases targeted to Vesta observation in the time frame starting from May 2011 till September 2012: these data products are currently under revision and will soon be available for the community at the NASA PDS Small Bodies Node.

1. Introduction

The virtual observatory approach represents an opportunity to develop interoperability and data distribution among the scientific community. By adopting IVOA (International Virtual Observatory Alliance) standards, public datasets can be easily accessed through a common registry system, operated with free user friendly tools and also exported to custom data formats.

EuroPlaNet – Research Infrastructure (EPN-RI) developed a protocol for data access specifically designed for planetary science. This protocol is based upon the IVOA TAP (Table Access Protocol) recommendation and hence is called EPN-TAP [2]. The IVOA TAP protocol defines a way to expose a relational schema to user queries by means of a SQL-like query language. The TAP compliance allows to integrate services developed in EPN-TAP with those developed in TAP into the same search engine. From the scientist point of view, this feature can be explained as seeing a single data repository, simplifying the data harvesting and analysis, without the need of licensed software.

The Dawn mission objective is to explore main belt asteroids in order to yield insights into important questions about the formation and evolution of the solar system. On board the Dawn spacecraft the VIR instrument, an imaging spectrometer covering the range from the near UV to the near IR, is producing a dataset containing spectral data, appropriate for the determination of global (size, shape, albedo, etc.), and local (mineralogical features, topography, roughness, dust and gas production rates, etc.) properties of Vesta and Ceres .

2 Service description

2.1 Functionalities

Once published in the registry system, the service can be easily accessed by means of any client software implementing the TAP protocol. One of these is TOPCAT, a tool specifically developed for data manipulation. Through a keyword based search in the registry system, it is straightforward to obtain the reference to query directly the matching services (i.e. using the keyword “vesta” in our case). The query language to be used to extract the data is the Astronomical Data Query Language, a language based on SQL92 and allowing a subset of the SQL grammar.

Thanks to the SAMP technology, data extracted into TOPCAT can be transferred directly to any application implementing the SAMP protocol. So it is possible to choose or develop any software capable of plotting and analyzing the spectrum (i.e. Splat-VO).

2.2 Implementation

Starting from the original PDS3 dataset of VIR data, we translated this file based archive in a SQL database schema representing the same information. The target schema used was derived from a generic data model already defined for similar purposes and used for the instrument VIRTIS on board the VEX mission [3]. The data tables obtained were then processed to generate the necessary infrastructure required by EPN-TAP service implementation : this step was performed by the IA2 staff using their dedicated software products [4].

3 VIR instrument and its data structure

VIR is the imaging spectrometer on board the Dawn Mission, a NASA project to define the mineral compositions of the surface materials and the nature of the solid compounds of the asteroids Vesta and Ceres. This spectrometer combines two data channels in one instrument: the visible and the infrared sensor are housed in the same optical subsystem, an imaging spectrometer having moderate spectral resolution.

The instantaneous field of view of VIR is represented by a slit of 64 milliradians per 250 microradians, the radiation from the slit is split by the optics in such way to have a flat stimulus in both the sensors. The results are two planes of data, one for each channels: an axis of the plane represent the wavelength of the radiation while in the other axis are stored the signal intensity sampled by the sensor. The instrument, set to implement a repetition time of acquisition, produces more plans of data stored in a structure called cube.

We call the sides of the cube: bands, samples and lines. The bands represent the wavelength of the radiations, the samples are the position on the slit while the lines are the number of acquisitions. A cut along the bands produces an image of the target observed at the wavelength chosen, while a contemporary cut along the samples and the lines produces a spectrum observed in a given point of the target.

4 Conclusions

We believe that a Virtual Observatory approach for VIR data can contribute to the knowledge of the scientific community on Dawn's targets and facilitates the search for information on these data. We intend this service as a Virtual Observatory prototype which can be extended to more dataset related to different instruments for planetary science.

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