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The Optical Monitoring Camera Data Server: Contents and Functionalities

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Abstract. We describe here the functionalities and contents of the OMC data server, a facility developed at LAEFF to provide access to the data generated by the OMC (Optical Monitoring Camera), an instrument on-board the INTEGRAL satellite, designed to obtain V-Johnson photometry.

1. Introduction

The ESA's space observatory INTEGRAL (INTErnational Gamma-Ray Astrophysics Laboratory) was launched on October 17, 2002. The OMC (Optical Monitoring Camera) is one of the on-board instruments, designed to obtain V-Johnson photometry from the prime targets of the two INTEGRAL gamma-ray instruments (15 keV-10 MeV) with the support of the X-ray monitor (3-35 keV). OMC offers the first opportunity to make long observations in the optical band simultaneously with those at X-rays and gamma-rays. This capability is particularly important in high-energy astrophysics where variability is typically rapid and unpredictable and will provide invaluable diagnostic information on the nature and the physics of the sources over a broad wavelength range. A full description of the OMC instrument is given in Mas-Hesse et al. (2003).

Since January 2003, LAEFF[1] is developing a scientific archive, containing the data generated by the OMC, and an access system capable of performing complex searches. A remarkable point is the existence of visualization and analysis tools, available from the user's interface, aiming at optimizing the scientific return of the OMC data. The system is opened to the scientific community since November 2003 and can be reached at `http://sdc.laeff.esa.es/omc`. At the time of writing the system contains 56106 light curves, each of them processed using three different sampling times (1, 630 and 5000 seconds).

2. Functionalities

The main functionalities of the system are outlined below.

Archive Search: The OMC catalogue (Domingo et al. 2003) comprises 504819 objects. The query to access the archive is made by means of an HTML fill-

[1] `http://www.laeff.esa.es`

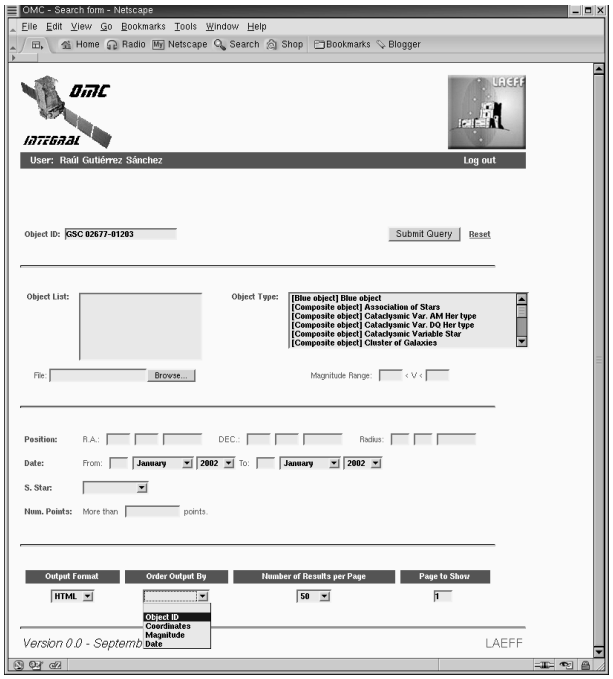

Figure 1. Search capabilities of the OMC Data Server.

in form which permits to perform queries by object name, coordinates, object type, V-magnitude range, date of observation, number of points of the light curve and/or sampling time (see Figure 1). The output data may be ordered by object name, coordinates, magnitude or date and time of observation. Two output formats are available: HTML or ASCII.

The system has a built-in name resolver utility which makes possible to query the archive using any of the object names provided by SIMBAD. The name resolver gives more than three million and a half identifications for the astronomical objects contained in the OMC catalogue. The full list of the names associated to a given object can be obtained by simply clicking on the target name in the output form.

The archive contains both public and private data (which becomes public after a period of time) and both types of data can be accessed through the web interface. Security and privacy of the private data are assured in two ways: user authentication and encrypted data transfer. There are several types of user profiles, each of them with different data access policies.

Results from Search: The following utilities are provided in HTML output format to the users with proper access rights (Figure 2):

Plot utility: A browse plot of a light curve can be generated on-the-fly by clicking on the corresponding link (Figure 3).

Fits Header Display: Links are provided to display the FITS headers of each requested light curve file.

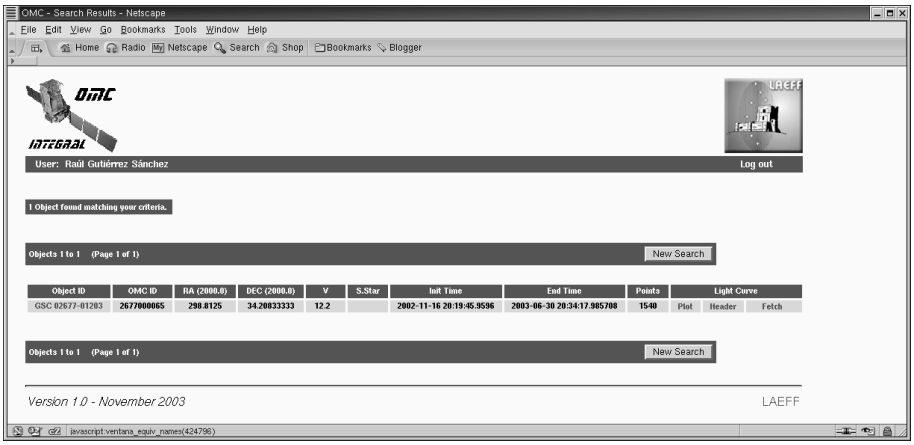

Figure 2. Result of the search displayed in Figure 1

Data Retrieval: Light curves may be retrieved individually or in groups. If a single light curve is requested, it is delivered as an uncompressed FITS file. Multiple light curve retrieval generates a packed file in either tar.gz or zip format.

On-line Help: Help on a specific keyword can be obtained by simply clicking on it.

Help-Desk: A Help Desk facility to channel questions and to provide continuous support to users of the archive is provided.

3. Future tools

A variety of data analysis tools are being developed and will be available in the near future. The aim of these tools is to provide added-value functionalities to the system giving the ability to perform data analysis tasks remotely.

Setting of the extraction window size: The extraction is presently performed using a window of 5×5 pixels wide centered on the object. This setting is not optimum, for instance, for crowded fields where stars falling within less than around $50''$ from the target source will contaminate the extraction region. Furthermore, crowded fields will induce a highly structured background leading to lower photometric accuracy which is of relevance, in particular, for faint stars. To cope with all possible scenarios the system will offer the possibility of an on-the-fly data processing with different choices in the size of the extraction window.

Setting of the sampling time: The OMC processing pipeline samples the observations at three different intervals: 1, 630 and 5000 seconds. These samples come from the combination of consecutive integrations of different duration (currently in cycles of 100, 100, 30, 100 and 10 s). Nevertheless, monitoring of fast variable objects would require shorter values (even down to 3s) whereas light curves of faint objects with long-term variability would be improved if longer

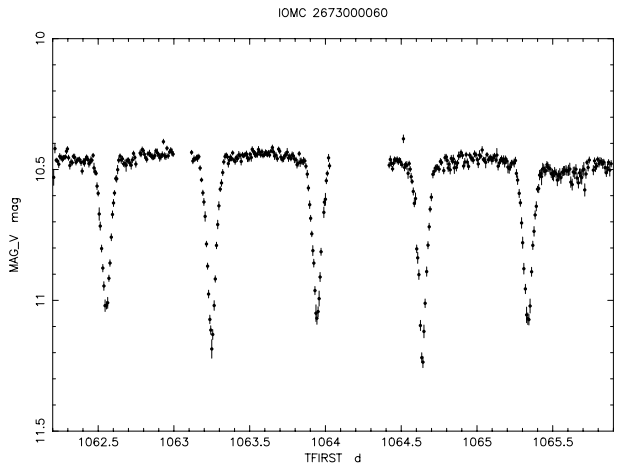

Figure 3. Browse plot of the resulting light curve.

samples are chosen. As for the case described in the above paragraph, subsequent releases of the OMC data server will incorporate a facility to perform on-the-fly data processing according to the sampling time selected by the user.

Time series analysis: The operation of INTEGRAL from a high orbit allows a continuous observation (only interrupted by the radiation belts crossing) for periods of several weeks giving a unique photometric capability that cannot be addressed from ground-based observatories. Our aim is that the OMC data server also provides information in the frequency domain. Given the diversity of the OMC targets (AGNs, X-rays binaries, gamma-ray burst, eclipsing binaries, pulsating variables, ...) and the variability patterns (long/short-term variations, mono/multi-periodicity,...), a detailed study on the techniques to be applied in each case must be performed.

Data mining. Light curve characterization: Even though the OMC data server allows making queries by object type based on the classification provided by SIMBAD, it is clear that this classification can be greatly improved with the use of the OMC data. Given the vast amount of data to be handled, classification procedures based on the visual inspection by experts are not adequate and data mining techniques must be used instead. We are presently working in a neural network system to classify light curves of periodic variable stars. The network will be trained with the HIPPARCOS light curves and, in a first step, it will allow for the automatic classification of eclipsing binary stars with a further extension to other types of variable stars (e.g. pulsating variables). The system is designed to perform a unsupervised topological mapping based on morphological proximity among the light curves.

References

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