Calibration pipeline for VIR data. F.Carraro, S. Fonte, A. Coradini, M. C. De Sanctis, F. Capaccioni, M. T. Capria, G.Filacchione, E. Ammannito, F. Tosi , M. Cartacci, R. Noschese, INAF-IAPS, Via Fosso del Cavaliere 100, Rome - Italy. E-mail: francesco.carraro@ifsi-roma.inaf.it

Introduction: During the second quarter of 2011 VIR-MS (VIS and IR Mapping Spectrometer) [1] aboard Dawn mission [2] has approached Vesta in order to start a long period of acquisitions that will end at the beginning of 2012. Data acquired by each instrument always require a calibration process in order to remove all the instrument effects that could affect the scientific evaluations and analysis. The word *calibration*, when related to an instrument, is generally referred to a set of techniques and calculation processes aimed to the removal of all the instrumental effects that affect an acquisition made by the instrument itself. Starting from the raw data, the data 'as is' at the end of the measurement process, the final result of the whole calibration process is the physical quantity, measured with the appropriate physical units, extracted from the acquisition.

VIR-MS instrument team has realized a calibration pipeline which has the goal of producing calibrated (1b level) data starting from the raw (1a level) ones [3]. The other goal of the tool has been the check of the goodness of acquired data by means of the evaluation of a series of minimum requisites of each data file, such as the percentage of the saturated pixels, the presence of spikes or the mean S/N ratio of each qube.

An apposite tool, named *VIR Calibration*, has been developed to complete the calibration process. Great attention was required in choosing the informatics instruments used for the realization of the tool. A wide plethora of languages and instruments are available in today's informatics technology panorama, each of which has its own main advantages and disadvantages. This is particularly true if speaking about high performance calculations. Basing the choice only on the pure calculations performance, a restricted group of languages, including *C* or *C++*, emerges over the others. Its, in fact, well known that those kind of languages, being compiled depending on the platform, are constantly at the first positions at the end of each benchmark test.

In the "real" programming work, anyway, other values like development speed and security are also very important issues today. Taking into account those other values the global opinion about the language choice is completely different. Is widespread opinion that it goes much faster to develop complex apps with other kinds of languages such as *Java* or *C#*, than with plain *C* or *C++*. Also a lot of commonly used operations in development work are handled by *Java* or *C#* better and faster that *C* or *C++*.

One of the main features of Java and C# is the so-called multithreading, very useful to realize a kind of parallelization of calculations on several frames or images contemporaneously.

A further consideration is related to the operating system (OS in the following) dependency in choosing the language for the tool development. By selecting a strictly OS dependent language the possibility of using the tool on other platforms is automatically cut off. Speaking about used OS, the research environment is extremely varied. This lead to the conclusion that a cross-platform language could allow the usage of the tool by each member of the team, during the mission, or by any other scientist, in the future, having not care for the platform used by each user. Having this in mind, the obvious conclusion has been the decision of using Java for the development of the *VIR Calibration* tool. Exelis IDL has been also used to implement a part of the pipeline dedicated to the detilt process because of its speed in performing this calculation.

A series of several analysis are completed on the 1a level data before the application of the calibration matrix. Among those analysis, only the first one process, the detilt process, really affects the data while all the others are used to have some reports on the quality of the data, e.g. the presence of saturation and the signal to noise ratio

The main phases of this pipeline are the following ones: 1) detilt process (only on VIS channel), to remove effects of misalignment of optical components of the VIR instrument; 2) saturation analysis, to evaluate the result of the chosen integration times; 3) SNR analysis, to evaluate the signal to noise ratio; 4) Application of the calibration matrix. For each analysis a specific accurate algorithm has been realized and validated during first runs of the calibration tool.

The *VIR Calibration* tool is able to calibrate a qube data file in a few minutes. The tool generates, starting from a 1a level file, the corresponding 1b level files (both reflectance and radiance) and a series of products such as files containing info about saturation, SNR, despiked pixels, histograms from the calibrated file and from the SNR analysis. The tool also creates a report showing the results from the main analysis and is able

to send mail to the whole VIR-MS team containing the report and the log files from the process. A sample of a raw spectrum and the related calibrated one are shown in Fig. 1 and Fig. 2.

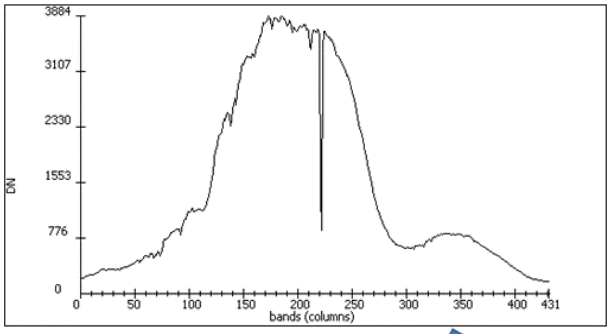

Fig 1. A sample of a raw spectrum

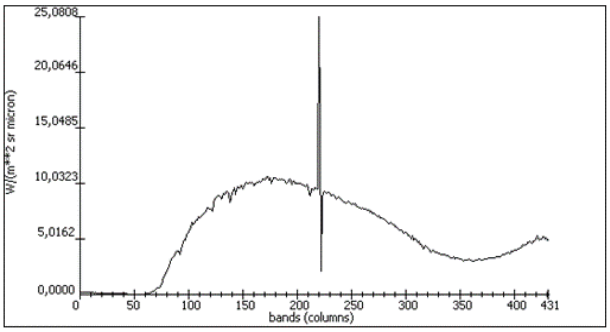

Fig 2. The same sample after the calibration

References

[1] M.C. De Sanctis, et al. (2010), *The VIR Spectrometer*, Space Sci Rev DOI 10.1007/s11214-010-9668-5. [2] C.T. Russell, et al. (2004), *Dawn: A journey in space and time*. Planetary and Space Science, 52, 465–489. [3] Filacchione, G. et al. (2011), *Validating Dawn/VIR-MS VIS-IR spectrometer calibration at Vesta*, EPSC-DPS Joint Meeting 2011, Bibliographic code: 2011epsc.conf..832F