EPSC Abstracts
Vol. 10, EPSC2015-617, 2015
European Planetary Science Congress 2015

Photometric correction of VIR spectra of Ceres: empirical approach

A. Longobardo (1), E. Palomba (1), M.C. De Sanctis (1), M. Ciarniello (1), F. Tosi (1), J.-Y. Li (2), F.G. Carrozzo (1), F. Zambon (1), A. Raponi (1), E. Ammannito (3), C.A. Raymond (4), C.T. Russell (3)

(1) IAPS-INAF, via Fosso del Cavaliere 100, 00133, Rome; (2) Planetary Science Institute, Tucson, AZ, USA; (3) UCLA, Institute of Geophysics, CA, USA; (4) JPL, California Inst. Techn., Pasadena, CA, USA;

Abstract

The application of the photometric empirical model, already tested for the Vesta asteroid and for the 67P/CG comet, is extended for the first data of Ceres provided by the Dawn/VIR imaging spectrometer.

1. Introduction

The NASA's Dawn mission [1] inserted on 6th March in the orbit of the (1) Ceres dwarf planet.
The Visible and Infrared (VIR) mapping spectrometer on board Dawn [2] is composed of a single optical head, including two channels, working in the visible (0.2-1 μm) and in the infrared (1-5 μm) wavelength range, respectively.
Currently, VIR acquired Ceres images having a spatial resolution down to 1 km, but better resolution will be achieved in the next mission phases.
An important operation to perform on VIR data is the photometric correction, aimed at removing the trend of reflectance with incidence, emission and phase angles. This not only is a fundamental process of data reduction (since makes it possible to compare observations taken at different illumination and viewing angles), but also allows the study of physical and optical properties of the asteroid surface, which drive the reflectance vs illumination angles behaviour, such as regolith grain size, surface roughness, presence of contaminants, role of multiple and single scattering (e.g. [3], [4], [5]).
The application of an empirical photometric model on Ceres data provided by VIR is the aim of this work.

2. Approach

The correction is based on the method already applied on VIR data of Vesta [5] and currently being also tested on VIRTIS data of 67P/CG [6].
The procedure, based on a statistical analysis of the whole dataset, does not need the assumption of theoretical photometric models and can be very helpful in studying the photometric behaviour of spectral parameters, such as band depths or slopes.
It applies on calibrated reflectance spectra on four steps:

1. Removal of incidence and emission effects, by dividing the radiance factor for the most appropriate disk function among those present in literature (e.g. Lambert, Lommell-Seeliger, Akimov).
2. Building of ten reflectance families, defined by reflectance values corresponding to 10%, 20%... 90% of brightest pixels at each phase angle.
3. For each reflectance family, retrieval of the curve describing reflectance as function of phase angle by means of a least squares fit.
4. For each pixel, retrieval of the reflectance at standard illumination conditions (i.e. normal illumination or incidence and phase at 30°).

3. Preliminary results

The method has been currently applied only to data obtained during the Approach phase to the target.
These results suggest a similar reflectance-phase angle behaviour for reflectance at different wavelengths in the visible range (Fig. 1). This would be consistent with what observed on other asteroids, where the steepness of photometric curve is almost constant through visible spectrum, except at wavelengths contained in absorption bands (e.g. [5], [7]).
A confirmation of these results can be obtained by considering in the data at better spatial resolution that will be obtained during the Dawn orbit on Ceres.

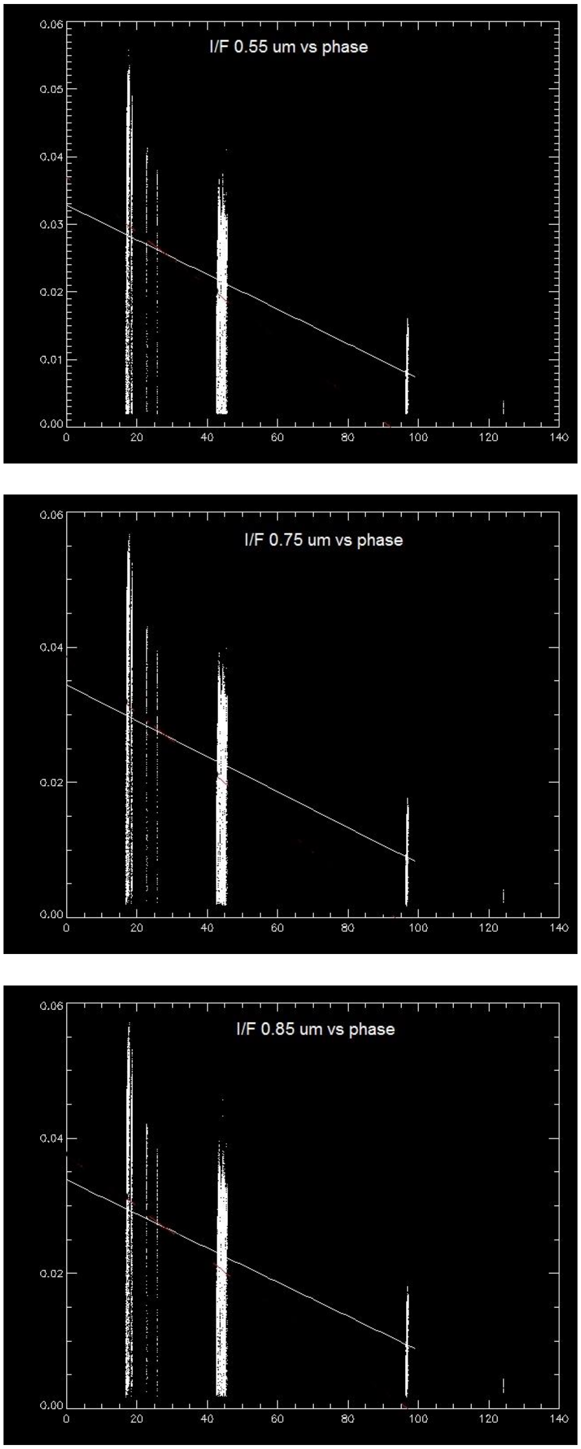

Figure 1. Reflectance as function of phase angles for three different wavelengths (0.55, 0.75 and 0.85 μm). The white line is a linear fit corresponding to the 50% of brightest pixels.

Acknowledgements

VIR is funded by the Italian Space Agency–ASI and was developed under the leadership of INAF-Istituto di Astrofisica e Planetologia Spaziali, Rome-Italy. The instrument was built by Selex-Galileo, Florence-Italy. The authors acknowledge the support of the Dawn Science, Instrument, and Operations Teams. This work was supported by ASI and NASA.

References

[1] Russell, C.T., et al. (2011). Springer, ISBN: 978-1-4614-4902-7.

[2] De Sanctis M.C. et al. (2011). *SSR, 163,* 329-369

[3] Hapke, B. (1984). *Icarus* 59, 41-59.

[4] Schröder, S.E et al. (2013). *Planetary and Space Science*, doi: 10.1016/j.pss.2013.06.009.

[5] Longobardo, A. et al. (2014). *Icarus*, doi: 10.1016/j.icarus.2014.02.014.

[6] Longobardo, A. et al. (2015). *EPSC abstract*, Rosetta session.

[7] Clark B.E. et al. (1999) *Icarus*, *140,* 1, 53-65.