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Rosetta observations of 21 Lutetia

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Abstract

Here we will describe the first observations collected by VIRTIS during the fly-by of asteroid 21 Lutetia performed by the Rosetta spacecraft on the 10th of July 2010. The overall observation period last for a long time span and it is articulated in different phases. In the various phases we will perform several observations that can be summarized as follow:

- Light Curve; this will be performed during the approach phase up to about 1 hour before closest approach. During this phase the angular size of the object varies from about 75μrad up to 2000 μrad. Two full rotations of the target shall be followed. The spectral light curve in the range 300nm-5000nm shall provide an indication of the degree of the spectral heterogeneity of the asteroid's surface as a function of the rotational phase allowing to correlate any brightness variation to either compositional or morphological variegation of the surface itself. At closer range, although the spatial resolution will be much higher, we shall not be able to map the full asteroid surface.

- Scanning Imaging; From Close Approach -1800s to Close Approach-500s relative speed between S/C and asteroid is low enough to allow to acquire hyperspectral images with VIRTIS-M with its internal scan mirror.

- Pushbroom Imaging; at closer range the speed is too large to allow scanning; both V-M and V-H will be operated in pushbroom mode. After CA due to large phase and low night temperature, observations shall be limited to about 20min.

During the scan and pushbroom phases the Spacecraft shall adopt a common pointing to satisfy VIRTIS-H, MIRO and ALICE needs.

1. Introduction

21 Lutetia is a main belt asteroid with an elliptical orbit with aphelion at 2.8 astronomical units from the Sun. Lutetia is a relatively big asteroid with about 100km diameter. A wide observational campaign was carried out in 2004-2009 in order to be prepared for the Rosetta fly-by in July 2010. I.N. Belskaya, et al (2010) [1] obtained BVRI photometric and V-band polarimetric measurements over a wide range of phase angles, and visible and infrared spectra in the 0.4-2.4 micron range. The results obtained, according to these authors, seem to indicate that Lutetia has a non-convex shape, which might be related to the presence of a large crater, and heterogeneous surface properties. The authors also claim that part of Lutetia's surface is covered by regolith, composed of particles having a mean grain size less than 20 micrometers. From mineralogical point of view Lutetia's surface composition seem to be in agreement with a subset of carbonaceous chondrites, even if it was previously classified as metallic (ibid) . At any rate, it has been difficult to learn much about Lutetia because its spectrum is nearly featureless. The VIRTIS data will permit to achieve the needed spatial and spectral resolution to decipher the nature of this asteroid.

.2. VIRTIS Expected performances

We have tried to evaluate in advance the performances of VIRTIS at Lutetia. As an input to calculate the expected signal from VIRTIS we have used a compilation of spectra taken from several authors: (see Barucci et al. 2008 and references therein) [2] the observed reflectances have been scaled to an albedo of 0.20 @550nm, and resampled on the VIRTIS bands. In the region 3.5 to 5 micron a constant value has been adopted. In figure 1 is reported the synthetic spectrum that we have used obtained collecting spectra published in [3] and [4] In this figure the presence of a band around 3 micron seems to be an indication of the OH absorption band [2]. Moreover the spectrum seems to be characterized by the presence of several other small bands in the region 1- 1.5 micrometers., whose presence needs to be confirmed and interpreted. In the region longward of 3 micron, as there are no data available, we have used a flat reflectance.

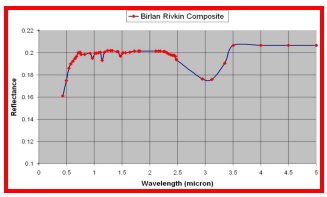

Figure 1: The Synthetic spectrum put together from individual spectra from [3] and [4]. The range in the regions around 3 micron is dominated by a wide water absorption band.

In Figure 2 and 3 reported the expected signal seen by VIRTIS–M having as input the synthetic Lutetia spectrum showed in Figure 1, and assuming two different surface temperatures. The signal considerably reduces for wavelengths longer than 3micron. This will force us to use two different integration times, one for the region below 2.5μm and a longer one for the 2.5 μm - 5 μm range.

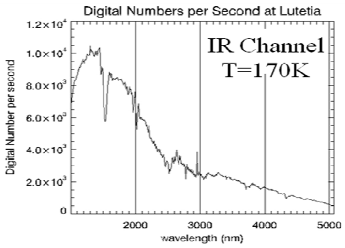

Figure 2. Expected VIRTIS M Signal, assuming a surface temperature of 170K.

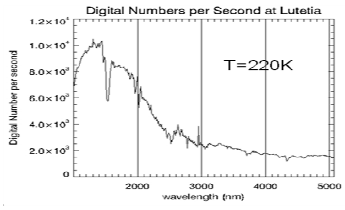

Figure 3. Expected VIRTIS M Signal, assuming a surface temperature of 220K.

3. Summary and Conclusions

The expected results of Lutetia analysis by VIRTIS are noticeable. The ground based observations don't allow to observe the asteroid spatially resolved. We expect to confirm the spatial variability indicated by the analysis of the light curve [1]. Another important goal of these observations shall be the determination of the asteroid surface temperature.

Acknowledgements

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