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Numerical simulations of the radiance from the limb measurements of dusty coma of the Comet 67P/Churyumov Gerasimenko

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Abstract

The work we present deals with the spectrometric measurements of the VIRTIS instrument part of the payload of the Rosetta mission to the Comet 67P/Churyumov-Gerasimenko. This spectrometer will monitor (VIRTIS M channel: 0.25μm - 0.98μm; $\Delta\kappa$=20cm^{-1} ; 0.980 - 5.0 μm; $\Delta\kappa$=5cm^{-1}; VIRTIS H channel: 2.0 μm- 5.0 μm ; $\Delta\kappa$=5cm^{-1}) the nucleus and the coma in order to provide a picture of coma's composition, the production of gas and dust, and the structure and variation of mineralogy of the nucleus surface.

The dust is an important constituent of cometary environment and is always present on the surface of the nucleus and in the coma. The cometary spectra are strongly affected by the processes taking place in the coma and by the structure, composition and the spatial distribution of cometary solid particles. The particles of the dust, illuminated by solar light, scatter, absorb and emit radiation. The reflected and emitted radiation are transmitted through the coma region before being collected by instruments such as VIRTIS. The reflection, absorption, scattering, and emission processes in the coma depend on the Comet-Sun geometry.

In the VIRTIS team we have initiated and effort to simulate the dust radiance using several radiative transfer models (see Rinaldi et al, this issue).

In the present paper, which is the continuation of our previous works (e.g. AGU fall meeting 2011, EGU 2012, EPSC2012 -abstracts), we are mainly concentrated on the influence of optical parameters of dust on spectra we expect from the VIRTIS/Rosetta measurements. To this purposes the equation of radiative transfer in limb geometry through the assembly of various dust grains and gases is solved. The number density distribution of the dust grains around the coma and their size distribution are drawn from recent theoretical models (e.g.Tenishev et.al.2011). A few phenomenological scattering phase functions are taken into account. We have assumed in the simulation the presence on the surface of H_2O ice, in which are embedded dust grains of various mineralogies. These grains, when freed by the gas sublimation, were considered as the main constituent of the dusty coma. At the beginning the particles are spherical. Such an assumption would be reasonable in many cases. We have confined ourselves to the compact dust particles only. But it should be noted here that fluffy grains would have different optical properties and their presence would lead to different conclusions.

The main purposes of the paper are:

1) discussion of the influence of the mineralogical composition of cometary dust including mixtures with ices, the size distributions and optical parameters
- using the various possible phase functions, extinction and asymmetry factors

2) influence of cometary activity on parameters of the coma and then the signal to be measured by the VIRTIS spectrometer at various distances from the Sun (3.7AU; 3.5AU; 3.0AU; 1.24AU)

In Fig. 1 one can see the examples of our modeling

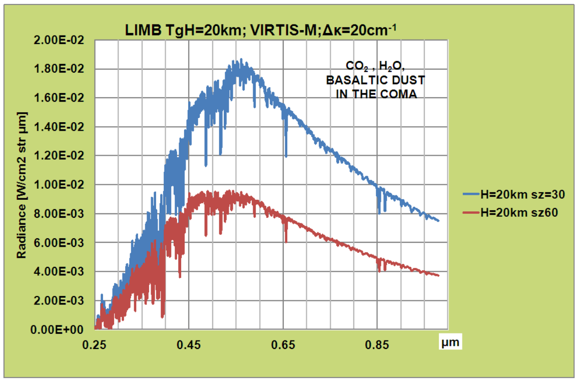

Figure 1: The limb radiance spectra of the coma for two Solar zenith angles (30^o and 60^o). The two gases (H_2O and CO_2) and basaltic grains are taken into account in our calculations. Tangent height H=20km. Spectral range: 0.25-1.0μm

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