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Photometric properties of Comet 67P/CG as seen by VIRTIS-M onboard Rosetta: light curves and disk-integrated phase curves

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Abstract.

VIRTIS-M is the Visible InfraRed Thermal Imaging Spectrometer onboard the Rosetta Mission orbiter (Coradini et al. 2007) devoted to investigate the spectrophotometric properties of the comet 67P/Churyumov-Gerasimenko in the 0.25-5.1 μm spectral range. Here we present data acquired during the first observations of the comet, starting from mid-July 2014, when the spacecraft-target distance was approximately 13000 km and the comet nucleus as seen by the instrument was pixel-size, up to more recent acquisitions in which the surface was resolved (Ciarniello et al. 2015). The far-approach data have allowed us to produce both light curves of the nucleus at different solar phase angles and disk-integrated phase curves over the entire instrument spectral range within the $1.2° - 14.9°$ phase angle interval. The light curve is characterized by two asymmetric peaks due to the elongated, e.g. double-lobed, shape of the nucleus. The disk-integrated phase curves exhibit a back -scattering behavior and a well defined surge at low phase angle due to the Shadow Hiding Opposition Effect. The derived geometric albedo at 0.55 μm is $A_{geo} = 0.062 \pm 0.002$. Dependence of color ratios on rotational phase and phase angle will be discussed in order to exploit large scale surface compositional variations. We also present a retrieval of the main photometric parameters by means of Hapke model (Hapke 1993) from analysis of disk-resolved images. The derived single scattering albedo at 0.55 μm is $w = 0.052$ while the asymmetry parameter of the single particle phase function is $b = -0.42$. These values indicate a very dark and back-scattering surface, common also to other comets (Li et al. 2007a,b, 2009, 2013). Hapke photometric parameters have been used to perform the photometric correction of the whole investigated dataset and albedo maps of the nucleus have been produced in the visible and infrared range. Albedo appears fairly ho mogeneous across the surface with Api and Imothep regions showing relatively larger values. Color maps have been produced as well, indicating that Api region has a more neutral spectral slope with respect to the rest of the surface.

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