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Analysis of phase curve of 67P/Churyumov-Gerasimenko at small phase angles using Rosetta-OSIRIS images

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Abstract

The Rosetta spacecraft reached its target 67P/Churyumov-Gerasimenko (hereafter 67P) in August 2014 and orbited around the comet until 30th September 2016. During the 2.5 years of mission, two zero-phase-angle fly-bys were performed by Rosetta. During these, OSIRIS, the Optical, Spectroscopic, and Infrared Remote Imaging System [1], the scientific imaging system onboard Rosetta, acquired high resolution images of the comet surface in different filters in the visible wavelength range. The first zero phase angle fly-by took place on 14th February 2015, with closest approach at 6 km from the nucleus. A study of this fly-by is presented in [2] and [3]. The second zero phase angle fly-by took place on 09-10th April 2016. Rosetta reached a minimum distance of 30 km from the comet and OSIRIS acquired images with the Wide Angle Camera (WAC) and the Narrow Angle Camera (NAC).

For our study we analyze a set of NAC images, acquired on 09-10th April 2016, in the F84 (480.7 nm), F82 (649.2 nm), and F88 (743.7 nm) filters, spanning the phase angle range from 0.2° to 8.0°. The NAC images cover an area in the Ash-Khepry-Imhotep region [4].

At small phase angle range, the opposition effect (OE) manifests itself as a rapid increase in the surface reflectance with decreasing phase angle. The reflectance dependence on the phase angle (known as surface phase function) contains information about photometric and structural properties of the surface.

We built a surface phase function for the Ash-Khepry-Imhotep region. In order to separate the surface phase function and disk function contributions to the measured reflectance, we evaluate the images with different disk functions, such as Lommel-Seelinger, Minnaert and Akimov. Our goal is to explore the photometric properties of the comet's surface together with the physical mechanisms that play a role in the OE.

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