

# Analysis of Opposition effect on 67P/Churyumov-Gerasimenko's nucleus from Rosetta-OSIRIS images

N. Masoumzadeh (1), C. Feller (2, 3), S. Fornasier (2, 3), P. H. Hasselmann (2), C. Leyrat (2), M.A. Barucci (2), N. Oklay (1), J.-B. Vincent (1), H. Sierks (1), F. Preusker (4), F. Scholten (4), C. Tubiana (1), C. Güttler (1) and the OSIRIS team

(1) Max Planck Institute for Solar System Research, Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany, (2) LESIA, Obs. de Paris, CNRS, Univ Paris 06, Univ. Paris-Diderot, 5 place J. Janssen, 92195, Meudon, France, (3) Univ. Paris Diderot, Sorbonne Paris Cite, Paris, France, (4) Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Planetenforschung, Rutherfordstraße 2, 12489 Berlin, Germany.

## Abstract

We aim to assess two mechanisms involved in opposition effect phenomenon, i.e. shadow hiding effect (SHOE) and coherent backscattering effect (CBOE), using OSIRIS images taken on the 14th of February 2015.

## 1. Introduction

Launched in 2004, the Rosetta spacecraft woke up on January 20, 2014 after 10 years in cruise and 30 months of deep space hibernation. OSIRIS, the Optical, Spectroscopic, and Infrared Remote Imaging System [1] is the scientific imaging system onboard Rosetta. It contains two cameras: the Narrow Angle Camera (NAC) and the Wide Angle Camera (WAC) covering the wavelength range of 250 nm to 1000 nm with total of 25 filters. NAC and WAC have been designed as a complementary pair that addresses the study of the nucleus surface such as its morphology [2] or its photometric properties [3] and the investigation of the dynamics of the sublimation processes. During the close flyby (~ 6 km) on the 14th of February 2015 zero phase angle observations were performed and acquire images taken in combination of various filters. These observations allow us to increase our understanding of the sharp spike in the brightness near zero phase angles of atmosphereless bodies. This phenomenon is called opposition effect and is of special interest among photometric studies.

## 2. Methodology

We apply the Hapke [4] and Shkuratov [5] photometric models since formalism of both models considers the contribution of SHOE and CBOE

mechanics in the opposition effect. The main difference between SHOE and CBOE is that SHOE does not vary with wavelength, while the CBOE depends on the wavelength of incidence light.

We evaluate a spectral appearance of CBOE [6] for the regions of the images obtained at phase angles less than  $3^\circ$  using NAC images in three filters F84 (480.7 nm), F82 (649.2 nm) and F88 (743.7 nm). Since the CBOE mechanism is believed to occur due to multiple scattering, we also apply the Minnaert photometric modeling [7] to estimate the contribution of multiple scattering at opposition. In order to extract the intensity and the associated geometric angles for the images, we used the shape model of comet [8] and the SPICE toolkit [9].

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