EPSC Abstracts
Vol. 13, EPSC-DPS2019-1442-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Colors and Structures of the Dust in the Inner Coma of Comet 67P/Churyumov-Gerasimenko

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Abstract

Multi-filter observations of comet 67P/Churyumov-Gerasimenko obtained by OSIRIS NAC camera onboard Rosetta spacecraft are used to characterize the colors and structures of the dust in the inner 2-8 km around the nucleus in the dayside. A wide dataset covering the period around perihelion has been investigated allowing to monitor the long-term variation of dust colors and structures. The dust in the inner coma results having blue colors with spectral slope of about 12-16 %/100 nm in the range between 480 and 649 nm at phase angles of about 60-90° where the straylight contribution is minimal (Bertini et al., 2017). Dust colors are quite uniform with radial distance and no significant long-term variations have been observed from May to November 2015. A slight phase reddening effect is highlighted. Interesting ripple structures are visible in color maps possibly connected with dust motion between observations in different filters.

1. Introduction

Numerous observations have been obtained by OSIRIS-NAC camera onboard Rosetta using different filters to characterize the colors of the nucleus surface (i.e. Fornasier et al., 2015; La Forgia et al., 2015). Those observations however, do often cover also the very inner region of the coma and can therefore be used to characterize colors and structures of the dust field in the very vicinity of the nucleus. This is extremely important to characterize the dust in the inner coma region and, in turn, is essential for an accurate measurements of the gas product species density using OSIRIS WAC gas filters (see Bodewits et al., 2016).

2. Data and Methods

9 dataset acquired from May to November 2015 have been analyzed covering the period around the perihelion of the comet allowing to monitor the long-term variation of the dust color properties.

Date	SS Lat [°][a]	r_h [AU][b]	Δ [km][c]	α [°][d]
16/05/2015	-3	1.63	125	61
04/06/2015	-11	1.49	208	87
04/07/2015	-27	1.33	177	90
09/08/2015	-46	1.24	308	89
30/08/2015	-52	1.26	404	87
05/09/2015	-58	1.28	689	70
11/10/2015	-44	1.44	527	61
31/10/2015	-36	1.56	297	62
28/11/2015	-26	1.77	125	90

Table 1: OSIRIS/NAC observation dataset. [a] Sub-Solar Latitude in degrees, [b] heliocentric distance in AU, [c] spacecraft-comet distance in km, [d] phase angle in degrees.

Multifilter images have been co-aligned at the level of a quarter of a pixel using an automated pipeline based on the physical coordinates on the nucleus.

The observations allowed to map the coma dust colors in a region of about 2 to 8 km around the nucleus in the dayside. The low S/N ratio in the nightside often does not allow to deduce accurate measurements.

3. Results

The color of the dust measured between 480 and 649 nm appears to be fairly uniform in the vicinity of the nucleus. The spectral slope shows values ranging from 12 to 16 %/100 nm. No jet structures are visible in the color maps, while these are evident in single-filter images, thus indicating that jets do not have significantly different colors than the background coma. Examples

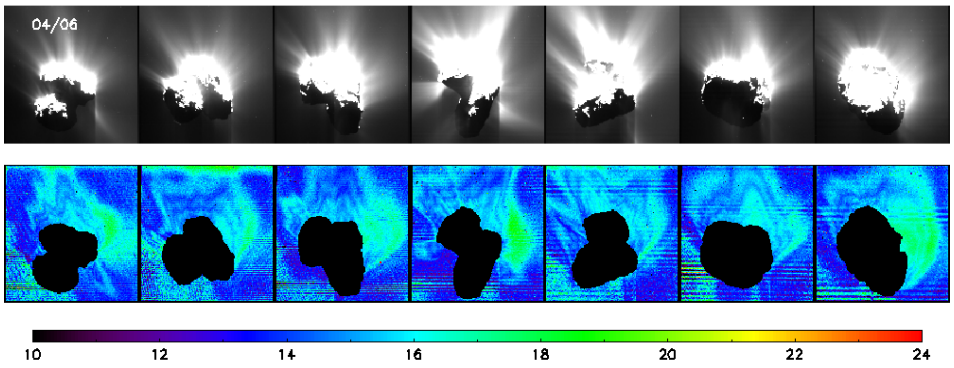

Figure 1: Stretched original images and corresponding color maps for dataset n. 2 in Table 1. Colorbar shows values in %/100 nm from 480 to 649 nm.

of the color maps associated with each cube in the second dataset is shown in Figure 1.

Radial profiles have been produced showing a flat-to-slightly-linear behavior of the dust spectral slope at such small distance from the nucleus in the dayside. This is consistent with the reddening values ranging from 11.3 to 14.4 %/100 nm measured in off-pointing images by Bertini et al. (2015) in the outer coma.

The dust colors do not show a significant long-term variation. Only a slight bluer distribution is observed around perihelion.

Phase depencence of the dust spectral slope has been investigated showing a slight phase reddening evidence.

Interestingly ripple structures are visible in many color maps, with amplitude higher than the signal noise. Compression, squarerooting and other possible artifact causes have been investigated with no resulting correspondence. Therefore, this might be interpreted as associated with the actual dust motion in the timeframe passing across two observations in distinct filters and might give further information on the dust speed.

Acknowledgements

OSIRIS was built by a consortium led by the Max-Planck-Institut fuür Sonnensystemforschung, Göttingen, Germany, in collaboration with CISAS, University of Padova, Italy, the Laboratoire d'Astrophysique de Marseille, France, the Instituto de Astrofìsica de Andalucia, CSIC, Granada, Spain, the Scientific Support Office of the European Space Agency, Noordwijk, The Netherlands, the Instituto Nacional de Teécnica Aeroespacial, Madrid, Spain, the Universidad Politéchnica de Madrid, Spain, the Department of Physics and Astronomy of Uppsala University, Sweden, and the Institut für Datentechnik und Kommunikationsnetze der Technischen Universität Braunschweig, Germany. The support of the national funding agencies of Germany (DLR), France (CNES), Italy (ASI), Spain (MEC), Sweden (SNSB) and the ESA Technical Directorate is gratefully acknowledged.

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