EPSC Abstracts
Vol. 6, EPSC-DPS2011-876, 2011
EPSC-DPS Joint Meeting 2011

Polarization observations of the dust ejected by comet 103P/Hartley 2 from OHP (France) and IUCAA (India)

E. Hadamcik (1), A.K. Sen (2), A.C. Levasseur-Regourd (3), R. Gupta (4), J. Lasue (5)
(1) UPMC Univ. Paris 6 / LATMOS-IPSL-CNRS, 78280 Guyancourt, France, (2) Assam Univ., Silchar, India, (3) UPMC Univ. Paris 6 / LATMOS-CNRS, Paris, France (4) IUCAA, Pune, India, (5) LANL, Space Science and Applications, Los Alamos, USA. (edith.hadamcik@latmos.ipsl.fr)

Abstract

Comet 103P/Hartley 2 was the target of the EPOXI mission. Remote observations from France and India, of the scattered light properties (and mainly its linear polarization) allowed us to determine an evolution of the physical properties of the dust particles in the coma. The properties displayed seem similar to those of other Jupiter Family comets (JFC).

1. Introduction

The Deep Impact spacecraft flew by Comet 103P/Hartley 2, for the EPOXI mission on 4 November 2010. It first encountered Comet 9P/Tempel 1 during the Deep Impact mission in July 2005 [1]. To help prepare and interpret the spacecraft observations (as previously for 9P/Tempel 1 [4]) an Earth and space-based worldwide campaign has been organized. The first results are published in [5] Remote observations, of the light scattered by the dust particles allow to display different optical properties in the coma regions and tentatively interpret the results in terms of physical properties of the particles. The observations are also compared to optical and physical properties of the dust ejected by other comets (JFC and more active comets).

2. Observations

In a French-Indian collaboration, two telescopes had already been used to observe 67P/Churyumov-Gerasimenko with polarimetric imaging capabilities [2]. A 0.80 m telescope at observatoire de Haute-Provence (OHP) in France and a 2 m telescope at Girawali Observatory (IGO) in India. The observations periods are 5-7 October and 3-6 November 2010 at OHP and 2 November 2010 at IGO. The phase angle α, for the two periods are about 47° and 57°, respectively.

The polarization is measured using four Polaroid filters on a rotating wheel at OHP and a Wollaston system at IGO. Different continuum filters allow us to avoid or reduce pollution by the gaseous components with for each observatory narrow-band ESA filters (narrow blue CB: 443 nm, $\Delta\lambda$ 4 nm; narrow red CR 684 nm, $\Delta\lambda$ 9 nm) broadband red_{IGO} R_1 630 nm, $\Delta\lambda$ 120 nm; red_{OHP} R_2 650 nm, $\Delta\lambda$ 90 nm). A broadband I filter is also used at OHP (900 nm . $\Delta\lambda$ 300 nm).

3. Results

For both observation periods, the dust coma is asymmetric with a structure in the solar-antisolar direction, which extends to more than 10000 km on the antisolar direction and to 1000-2000 km on the solar direction; jet structures extending at large photocentric distances are not detected in other directions (Fig. 1). The radial intensity decrease is about nominal for the two periods as for an isotropic coma (slope -1). The linear polarization is larger in the solar direction (Fig 2) and its value varies with time (without clear correlation with the rotation period). The polarization decreases with the increase of the aperture. Figure 3 gives an example of such a decrease.

The spectral gradient in the visible domain is positive (polarization through the narrow filters higher in red than in blue at α=57°). Comparisons between the polarization values measured through the narrow red filter and the broadband red filters indicate a contamination for apertures larger than 2000 km for the IGO (R_1) filter centered on 630 nm, with no evident contamination up to 9000 km aperture for the OHP filter (R_2) centered on 650 nm (mostly used at OHP for cometary dust observations). Except for the solar direction, the integrated polarization through red filters (CR, R_2) and different apertures on

November 2-3 and 4 are about 15% in a 1000 km aperture and 11% in a 9000 km aperture. The latter value is typical of polarization values found for Jupiter Family comets [3] and more generally for comets with a low polarization at maximum as observed through large apertures. As stated in this work, the low P value is probably not only the result of a depolarization by the gaseous emissions (no difference between the broadband and narrow band cometary filters, except for one of them). A more complete discussion is needed taking into account the dust physical properties.

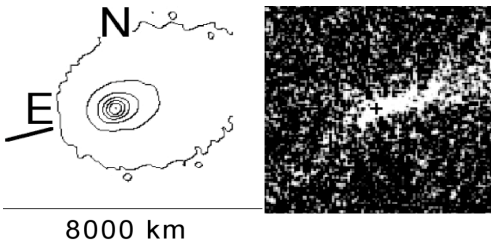

Figure 1: Intensity image of the dust coma (isophotes in log scale for the intensity and treated image by a rotational gradient method). Nov. 3, OHP, CR filter.

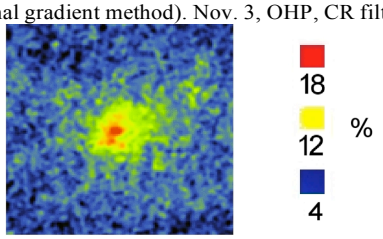

Figure 2: Polarization image. Same scale and orientation than Fig 1. Photocenter at the center of image. Nov. 3, OHP, CR filter.

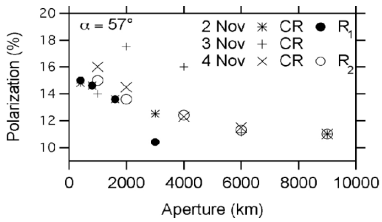

Figure 3: P vs aperture size. Red filters.

For October observations (α= 59°), the polarization values through large apertures are close to 7 % as expected from classical Jupiter family comets [3]. The results are compatible with those found by other observers as indicated in [5] with a polarization value of 13-14 % in the red wavelength domain at a phase angle of about 59° through a 9600 km aperture.

4. Summary and Conclusions

- The dust coma is asymmetric with dust emitted in the solar direction. Structures with important intensity gradient are mainly detected in the solar-antisolar direction

- The polarization value increases with decreasing photocentric distance, and is greater in the solar direction.

-In the visible domain the spectral gradient in polarization is positive.

Comet 103P/Hartley 2 properties are consistent with those of average Jupiter Family comets

Acknowledgements

We gratefully acknowledge ESA and F. Colas for the narrow-band filters, OHP and IUCAA for allocation of observation time, PNP for funding the French observations.

References

[1] A'Hearn, M.F, and 32 colleagues: Deep Impact excavating Comet Tempel 1, Science 310, 258, 2005.

[2] Hadamcik, E., Sen, A.K., Levasseur-Regourd, A.C., Gupta, R., Lasue, J.: Polarimetric observations of comet 67P/Churyumov-Gerasimenko during its 2008-2009 apparition, A&A 517, A86, 2010.

[3] Hadamcik, E., Levasseur-Regourd, A.C.: Optical properties of dust from Jupiter Family Comets, PSS 57, 1118, 2009.

[4] Meech, K.J., and 200 colleagues: Observations from a worldwide Earth-based campaign, Science 310, 265, 2005.

[5] Meech, K.J., A'Hearn, M.F., and 191 coauthors: EPOXI: Comet 103P/Hartley 2 observations from a worldwide campaign, ApJL 734, Vol. 1, L1, 2011.