

Imaging polarimetry of the dust in the comet 103P/Hartley 2*

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Abstract

We present results of imaging polarimetry of the dust of the comet 103P/Hartley 2 at phase angles 30.1° – 58.8° , obtained during the 2010 apparition before, during and after the EPOXI mission encounter on 4 November 2010. The polarimetric observations of the comet were carried out with the 2m Ritchey-Chretien-Coude (RCC) telescope of the Bulgarian National Astronomical Observatory (BNAO)–Rozhen equipped with a 2-channel focal reducer (FoReRo2) and Wollaston prism. Narrow-band filters centered on the blue and red continuum at 443 and 642 nm respectively were used.*

1. Introduction

One of the main goals of cometary polarimetry is to determine the physical properties of cometary dust. The aim is to learn more about the dust's origin and formation and about the origin and formation of the comets themselves. In principle, polarimetry could be a very sensitive tool to probe the nature of cometary dust. The problem of light scattering by arbitrary dust particles, however, is still unsolved and any interpretation of polarimetric data of comets based on physical principles is uncertain as yet. The light scattered by dust in a cometary coma is partially linearly polarized. The polarization level depends on the phase angle and on the wavelength. The overall polarization on the whole coma provides information on the dust particles bulk physical properties. Three classes of comets, comets with a low maximum of polarization, comets with a high maximum of polarization and Hale-Bopp have been defined by their dust optical properties [2].

2. Observations

The observations of the comet 103P/Hartley 2 were carried out with the 2m RCC telescope of the BNAO–Rozhen equipped with FoReRo2. A Wollaston prism was used to split the image into two mutually perpendicular polarizations. Details concerning the instrumentation are given in [1]. Narrow-band filters centered on the blue and red continuum at 443 (IF443) and 642 (IF642) nm respectively were used. The observations were carried out simultaneously in blue and red arm of FoReRo2. For the purpose of this investigation 4 nights (2 before and 2 after the EPOXI encounter) were utilized. The data are spread at 3 vastly different phase angles. The geometrical conditions during the observations are shown in Table 1.

Table 1: Times, heliocentric distance (r), geocentric distance (Δ) and phase angle (α) during the observations.

Date	r , AU	Δ , AU	α , deg
2010 Aug 11	1.465	0.570	30.1
2010 Nov 03	1.063	0.154	58.8
2010 Nov 06	1.067	0.167	58.7
2010 Dec 02	1.167	0.297	46.2

3. Results

The result are separated in two groups - total dust coma polarization and detailed map of polarization in the near nucleus region. The total linear polarization is measured in a circular synthetic diaphragm centered on the nucleus and having a sizes of $8.8''$ for 11 Aug and $17.6''$ for the other 3 nights in November and December. The comparison of the total linear polarization of comet Hartley 2 with data from the Database of Comet Polarimetry by Kiselev *et al.* [3] (see Fig. 1) suggests that comet 103P/Hartley 2 belongs to the class of dust-rich comets with high degree of linear

*Based on data collected with 2-m RCC telescope at Rozhen National Astronomical Observatory.

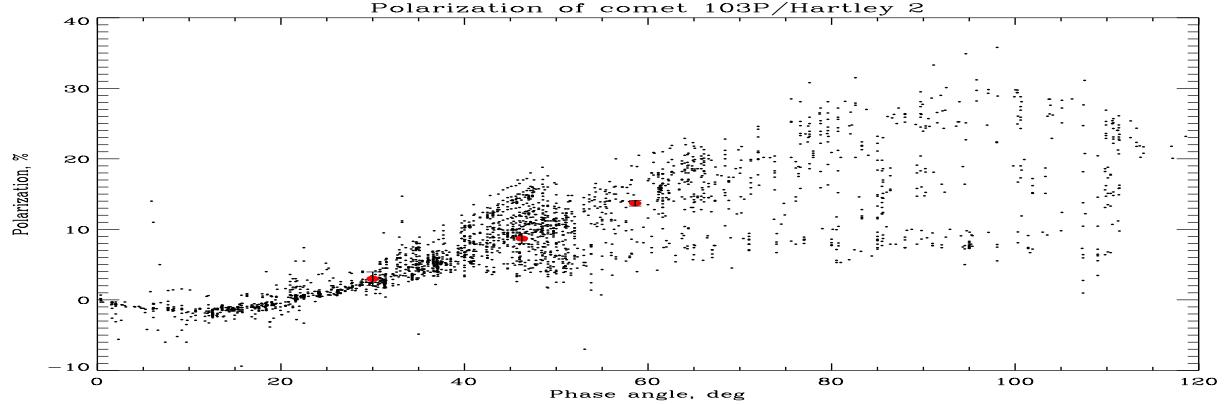


Figure 1: Polarization vs phase angle plot shows comparison of the result obtained at 642 nm and presented in this paper with the values for all comets in Database of Comet Polarimetry by Kiselev *et al.* [3]

polarization but not as extremely high as Hale-Bopp. Maps of the polarization degree around the nucleus show its distribution in the field (see Fig. 2). The coma structures in both filters (IF443 and IF642) are similar. Close to the nucleus the linear polarization reaches 15%. Several condensations with higher polarization seem to correlate with structures in the dust coma.

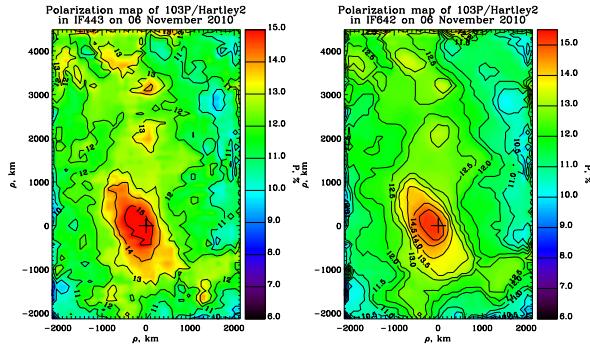


Figure 2: Maps of the polarization degree around the nucleus in percents obtained in IF443 (left panel) and in IF643 (right panel) filters on 6 November 2010 – 2 days after the EPOXI encounter.

4. Summary and Conclusions

1. Comet 103P/Hartley 2 was observed for 4 nights (before and after EPOXI encounter) in polarimetric mode with the FoReRo2 at the 2m RCC telescope of the BNAO–Rozhen.
2. The linear polarization of the dust coma was obtained and it was compared with Database of Comet Polarimetry by Kiselev *et al.* [3]. The

comet was characterized as dust rich comet.

3. Maps of the polarization degree around the nucleus were created in both of the dust continuum filters – IF 443 and IF 642. Condensations with higher polarization seem to correlate with structures in the dust coma.

Acknowledgments

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