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Observations of a CN outburst from comet 45P/Honda-Mrkos-Pajdušáková

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Abstract

Studying materials released from Jupiter-family comets (JFCs) as seen in their inner comae, the envelope of gas and dust forming as the comet approaches the Sun, provides an improved understanding of the evolution and origin of these objects. As part of a coordinated, multi-wavelength observing campaign, we observed comet 45P/Honda–Mrkos–Pajdušáková (HMP) during its close approach to Earth in early 2017. Narrowband observations were taken using the Bok 90" (2.29 m) telescope at Kitt Peak, and show structures including an outburst of material on 16 Feb 2017 in the CN filter. This feature is unique in the CN filter and does not appear in the other filters used for observations. We estimate the minimum velocity away from the nucleus for this structure as ~1 km/s.

1. Introduction

Comets form coma around nuclei as they approach the Sun. Inner coma processes provide information about volatile production from the nucleus, as well as information about coma volatile parent species. Studying inner coma processes requires either visiting a comet *in situ*, or observing comets at close (< 0.2 au) range from Earth. At long ranges from the observer, processes that occur quickly or on small spatial scales cannot be either temporally or spatially resolved by ground-based telescopes. HMP, along with 41P/Tuttle-Giacobini-Kresák and 46P/Wirtanen, passed within 0.14 au of Earth between 2016–2019 providing excellent circumstances for observing the inner comae on these objects with ground-based telescopes. Visible-wavelength observations of these three comets were conducted as part of a multi-wavelength, global, coordinated observing campaign to further understand inner coma dust and gas processes (Harris et al., 2017). The goals of the campaign are to use ground-based observations in visible, infrared, radar, and radio wavelengths to investigate changes in volatiles and dust in the inner comae of these objects.

2. Observations

Observations were conducted using the Bok telescope at Kitt Peak National Observatory outside of Sells, Arizona, USA on 16 Feb 2017. Narrowband filters originally designed for the Hale-Bopp observational campaign (Farnham et al., 2000). were used to ensure consistency of data across observing sites and telescopes. The expanding CN feature was observed between 07:02–12:35 UT at exposure times of 900–1200 s. Six images in the CN band were obtained during this night, and weather inhibited further observations the following night. This feature is only visible in our CN filter images.

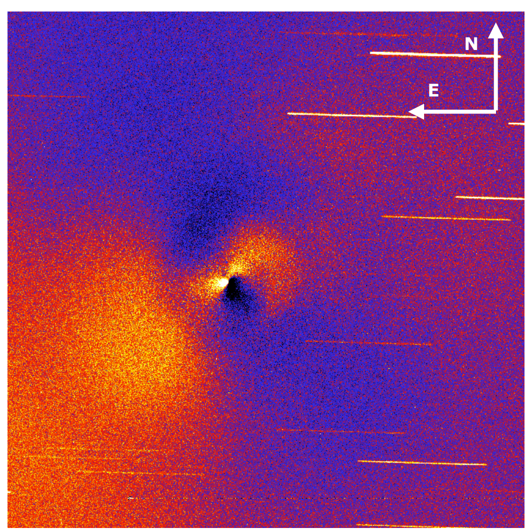

Figure 1: A 900-s integration of 45P with sky background azimuthal median subtracted, showing the bright CN region to the SE of the comet nucleus. The image is 75,000 km x 75,000 km.

We do not detect the outburst feature in other filters: r' (a proxy for dust), blue continuum, C_2, C_3, or OH filter image data.

Radial profiles of the median of non-uniform sky background surrounding the comet were azimuthally subtracted from the images to enhance coma features, such as outbursts (Figure 1).

3. Results

The subtracted images show a roughly elliptical-shaped outburst of material in the CN band in images beginning at 10:39 UT, initially 24,000 km x 16,000 km with the short axis aligned toward the nucleus, moving away from the nucleus in the images. Subsequent images show the region of material moving away from the nucleus at a projected velocity of ~1 km/s, the minimum velocity at which the outburst occurred. The material expands in the direction of the outburst.

We will present improved velocity measurements and compare the changing position of the feature to the rotational phase of the nucleus as well as the outburst timing.

4. Discussion

The detection of this outburst in CN but not other filters may be consistent with heterogeneities in source regions for volatile species as seen by space missions at other near-Earth comets. The *Deep Impact* spacecraft visited comet 103P/Hartley 2 in 2011 as part of the EPOXI mission, observing different source locations for the origin of several volatile species on the nucleus (A'Hearn et al., 2011; Dello Russo et al., 2011). The *Rosetta* mission to comet 67P/Churyumov-Gerasimenko observed heterogeneities in gas emission (Hässig et al., 2015; Bockelée-Morvan et al., 2015; Migliorini et al., 2016) and that volatile source regions are not uniformly distributed over the nucleus surface (Fougere et al., 2016). Additionally, *Rosetta* detected gas-only outbursts from 67P (Feldman et al. 2016); as we do not see this feature in r' images at the same level of contrast, perhaps a similar mechanism is at work here.

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