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Photometric studies of 81P/Wild 2 at last apparition

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Abstract

Comet 81P/Wild 2 has been a target of space mission named Stardust. The spacecraft flew by this comet in Jan. 2004 and gathered some dust particles back to Earth for science's researching. In early 2010, comet Wild 2 has passed its perihelion at fifth times and in parallel a number quantity of photometric images were obtained at Lulin observatory in the narrow-band comet filters from ESA covering the line emission of C_2, CN, BC and RC and broad-band R filters. Images taken in early Jan. 2010 showed the dust coma displayed a certain degree of asymmetry and a large structure was found beside the dust tail. The Q(CN) and Q(C_2) in depleted comet 81P/Wild 2 are 3.47 ± 0.47 and 2.59 ± 0.35 (10^{25} molecule/s), respectively.

1. Introduction

Comet 81P/Wild 2 was discovered in 1978 by Swiss astronomer Paul Wild. The orbital had changed from 43 years to about 6 years due to the closest distance to the Jupiter (0.006 AU) in 1974. This implies the surface properties (i.e. activity) would be affected by an increase in solar radiation. In addition, the image obtained by the Stardust spacecraft in 2004 shows there are a few impact craters which did not resemble in previous image of comet 1P/Halley and 19P/Borrelly. Thus the new and pristine in its properties was expected in coming apparitions, a fact that was confirmed by Ferrn et al. (2007). In 2010, the distance is only 0.67AU to the Earth, it is, therefore, a good chance to see the surface properties and chemical abundance by monitoring this comet from January to May. 2010. Here, we present our preliminary results from our analysis of these data.

2. Observation

The images were obtained using the 1-m telescope of the Lulin Observatory, Taiwan, from Jan. to May 2010. The observations were done using the ESA Rosetta comet filters centered on the emissions of CN ($\Delta v=0$) and C_2 ($\Delta v=0$) and on two wavelength ranges containing solar continuum only ("Blue" continuum at 445nm, FWHM=4nm and "Red" continuum at 687.4 nm, FWHM=6nm). For the Lulin observations, a PI1300B 1340 x 1300 CCD camera with an effective pixel scale of 0.515" pixel^{-1} was used. Table 1 gives the geometry of the comet 81P/Wild 2 during the observation.

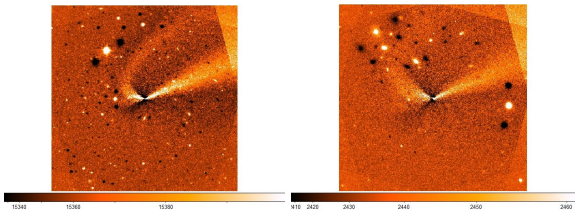
Table 1: Log of Observations performed at the Lulin observatories

Date (UT)	r_H (AU)	Δ (AU)	Solar P.A. (degree)	Pixel scale (km)
Jan. 14	1.64	1.10	215.5	410.8
Jan. 15	1.64	1.09	215.4	407.1
Jan. 17	1.64	1.07	215.4	399.7
Jan. 18	1.64	1.03	215.3	384.7
Feb. 26	1.60	0.78	208.7	291.3
Apr. 7	1.66	0.67	190.3	250.3
May 7	1.76	0.77	190.2	287.6

Note: Δ and r_H are the geocentric and heliocentric distances in AU; Solar P.A. is the position angle of the projected solar direction, measured from North towards East.

3. Coma structures

The images taken on early Jan. 2010 show a large structure after image processing by Lason-Sekanina filter. This structure changes the position angle in one day (from Jan. 14 to Jan. 15) and however it seems at the same position angle in our data set (Figure 1).



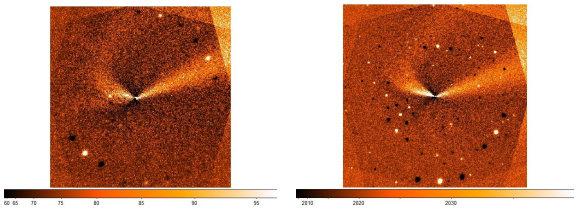


Figure 1: Images taken on Jan. 14 (up-left), Jan. 15 (up-right), Jan. 18 (bottom-left) and Feb. 26 (bottom-right). In all images, North is up, East is to the left, and the field of view corresponds to a distance of 5.4×10^5 km (in January) and 3.8×10^5 km (in February) at the comet. All images were obtained with a broadband R filter.

Due to the position angle changes a lot within one day, we quickly did the slope measured from the mean-profile in whole image in between surface brightness and projected distance and we found the slope on Jan. 14 is deeper than that measured on the other days.

4. Dust and Gas production rate

Here we used Afρ (A'Hearn et. al. 1984) to characterize the dust activity of a comet and the derived values in Jan. 2010 are presented in Figure 2.

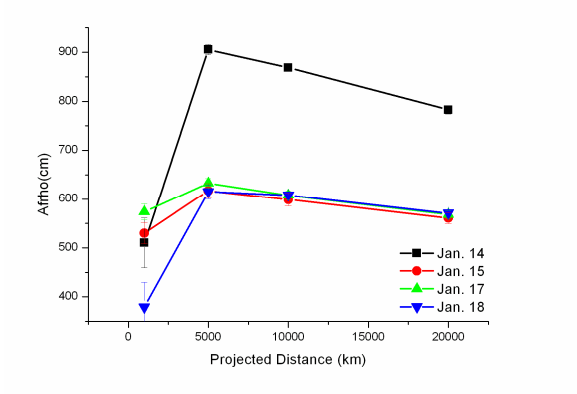


Figure 2: The Afρ measurement in early January, 2010.

Gas production rates were measured by using Haser Model (Haser 1957). The parameters used for gas outflow velocity is $V_{gas} = 0.85\ r^{-0.5}$ kms^{-1} and for the fluorescence efficiency factors (g-factors) of CN, and C_2 are the 3.16×10^{-13} and the 4.5×10^{-13}, respectively. The scale-length used here is listed in Table2. The result on Jan 15, 2010 in Q(CN) and Q(C_2) are 3.47± 0.47 and 2.59±0.35 (10^{25} molecules /s), respectively.

Table 2

Molecular	l_d (km)	l_p(km)
CN	$1.3x10^4$	$2.1x10^5$
C_2	$2.2x10^4$	$6.6x10^4$

5. Conclusions

We found the slope and morphology on Jan. 14 are quite different to compare with that on the other days. We associated phenomenon with higher dust production rate (Afρ) measured on Jan. 14. Unfortunately, no observations are available before Jan. 14 and we can't make conclusion where or how it occurs. However, the Afρ seems to be normally decreasing with increasing the distance between the comet and Sun from February to May. This unusual phenomenon might be caused by a small outburst and then a large of dust particles were erupted from the cometary nucleus. There are no day-series data since February due to the bad weather condition and we hope we can get more data in coming days.

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