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TRAPPIST monitoring of comet C/2012 F6 (Lemmon)

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1. Introduction

Comet C/2012 F6 is a long-period comet that reached perihelion on March 23, 2012. The unexpected brightness of this comet since December 2012 allowed us to obtain narrowband photometry and to study its chemical composition as well as its rotation.

2. Observations

We observed C/2012 F6 (Lemmon) before perihelion from December 11, 2012 to March 4, 2013 with the 0.6-m TRAPPIST robotic telescope at La Silla Observatory [1]. TRAPPIST is equipped with a set of narrowband cometary filters designed by NASA for the Hale-Bopp Observing campaign [2]. The comet was also observed with classic BVRI filters. So far, we have collected about 1200 frames of the comet on 27 nights. On several nights we observed the comet during several hours in order to detect variations due to the rotation of its nucleus. We also observed the comet post-perihelion in May and June (undergoing).

3. Results

3.1 Study of the chemical composition

From the images of the comet in narrowband filters, we derived OH, NH, CN, C_2 and C_3 production rates using a classic Haser model [3]. We also computed the Afrho value [4] in the different continuum filters so-called UC, BC, GC and RC in order to study the colour of the dust. Here are for example the average production rates obtained for March 3 (when r=0.84 AU): log Q(OH) = 29.36; log Q(NH) = 27.05; log Q(CN) = 26.96; log Q(C2) = 27.20; log Q(C_3) = 26.50; Afrho (BC) = 6380 cm; and Afrho (GC) = 6330 cm at 10.000km [5]. These production rates allowed us to conclude that F6 is a gas rich and has a typical chemical composition [6], [7]: log[Q(C_2)/Q(CN)] = 0.23. The Afrho value was found to be very similar in the different filters. We monitored the evolution of the gas and dust production rates until a few days before perihelion. The activity of the comet raised steeply during this period, e.g. Q(CN) was multiplied by a factor of 10 between December and March.

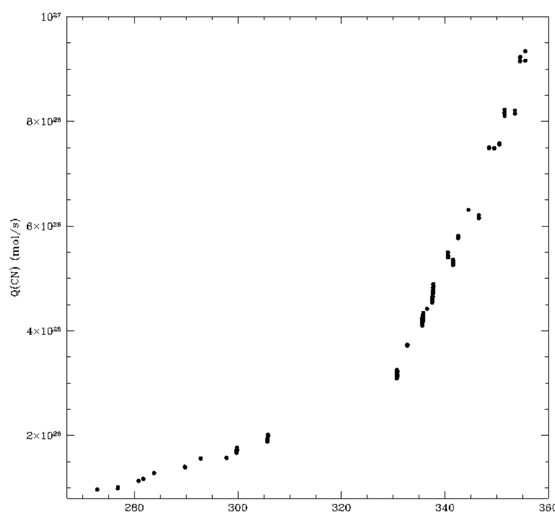

Figure 1: CN production rate of comet C/2012 F6 (Lemmon) between December 11, 2012 and March 4, 2013.

3.2 Determination of the rotation period

We applied enhancement techniques (rotational and Larson-Sekanina filters) on the narrowband images that revealed several gaseous jets in the coma. Their shape was strongly dependent on the viewing geometry and the filter used. In December and January we did not see any variation in the jets shape and orientation. However for the long series taken in February and March we could detect significant variations during the night and from night to night. We searched by eye structures repeating after a given time and we found a first approximation of the rotation period. Then we used another technique by dividing all the images between each other and computed the RMS of the resulting images. We could find minima in the RMS that repeated periodically as a function of the time difference. With the combination of these two techniques we were able to determine a rotation period of 9.52 +/- 0.12 hours.

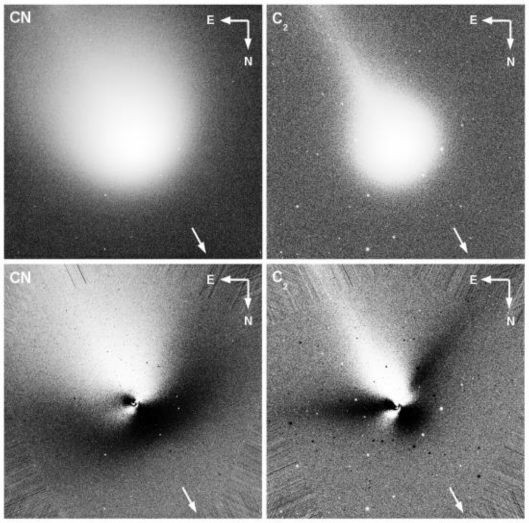

Figure 2: TRAPPIST narrowband images of comet C/2012 F6 (Lemmon) on March 2, 2013 before (top) and after (bottom) the application of a Larson-Sekanina filter. The arrow indicates the direction of the Sun. Field of view of 10'.

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