EARLY EVOLUTION OF THE OUTBURST OF COMET 17P/HOLMES.

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Introduction:17P/Holmes is a Jupiter family comet discovered by E. Holmes on November 6, 1892 [1], most likely during the early phase of the first outburst ever detected of this comet. The onset of the 2007 outburst occurred probably on October 23.7±0.2 UT [2]. In only 42 hours the comet brightened from a magnitude of about 17 to about 2.8. In 1892, this comet experienced a double outburst and Whipple [3] attributed the phenomenon as due to the result of a satellite nucleus striking the primary nucleus. This outburst is exceptionally adequate to infer the nucleus rotation properties from morphological studies, and to test dust tail models.

Observations: The observations were made with the 0.45-m f/2.8 reflector telescope at La Sagra Observatory in Granada, Spain (MPC code J75). The detector was a 4008×2672 pixel CCD camera at 1.47 arcsec/pix and a field of view of 1.63°×1.08°. We did not use any filter in the observations, but checked with independent observations in red wavelengths that the structures observed are due to scattering of solar light by dust. The observations span a period of a month from October 30th to November 29th. Image processing was performed with the Larson-Sekanina filter. The processed images show a group of (generally three) bright "jets" coming from the optocenter and directed opposite the Sun direction, and a wide shell towards the Sun. Figure 1 shows two sample images.

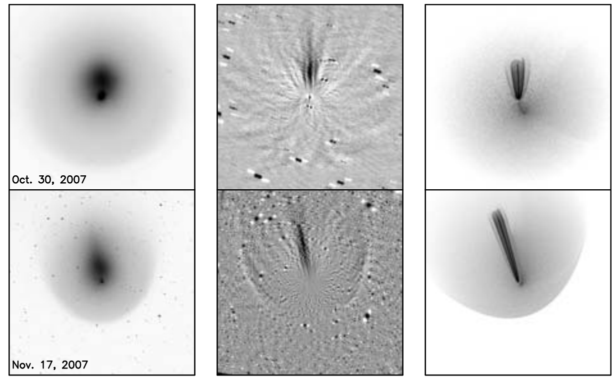

Figure 1: From left to right: Original, processed (Larson-Sekanina filter), and Monte Carlo synthetic images. The axes refer to the (N, M) system [6], corresponding to a square area of about 6.9×10^5 km on 10/30/2007, and 3.5×10^6 km on 11/11/2007 in side length.

Monte Carlo simulations: Dust morphology is modeled using a Monte Carlo computer simulation code, using a procedure similar to that developed by Sekanina [4]. We assumed a rotation period of 10.3 hours [5], and a particle ejection velocity given by $v_{eject}^{-1} = C(A + B\beta^{-1/2})$ (in s/km), where β is the ratio of solar pressure force to solar gravity force [6], and A=1.2 and B=10 are constants derived by Sekanina [7]. For β, we assumed a wide range between 10^{-3} and 3, which corresponds to particle radii between 0.2 and 600 μm, for $\rho = 1$ g cm^{-3}. The size distribution was given by $n(r) \propto r^{-3.5}$. C is determined in the fitting procedure.

Results: In order to derive the rotational parameters and position of active areas that best fit the observations we made a visual comparison of the observed and synthetic images, that were generated for a fine grid in the rotational parameters Φ (argument of the subsolar meridian at perihelion) and I (obliquity). The bright jets were best simulated by considering Φ=213±2°, and I=90±3°, and active areas at –90° and –75° latitude, with constant C=1.1. The outer wide shell should be produced by emission of particles from essentially the whole sunlit southern hemisphere of the comet, with C=6.1. The upper value of β, β_{max}=3 is constrained essentially by the length of the jets observed. Regarding the factor of 5 difference in dust ejection velocities between main jets and background hemispherical emission, we are limited by the simplicity of our model, and cannot give at present any specific physical reason, although secondary emission from dust fragmentation could possibly play a role. Also important to note is the similarity in the comet images after the 2007 and 1892 outbursts: we have verified that Monte Carlo simulations for the 1892 images also fit the overall behavior in dust ejecta. The outburst dates relative to perihelion times were very close, which suggest solar radiation as a necessary condition driving those events. A complete description of the observations and modeling results is given by Moreno et al. [8]

References: [1] Holmes, E. *The Observatory, 15, 441* [2] Sekanina, Z. (2007) *CBET, 1118* [3] Whipple, F.L. (1984) *Icarus, 60, 522* [4] Sekanina, Z. (1987) *ESA SP-278, Brussels, Belgium, p.315* [5] Snodgrass, C., Lowry, S.C., and Fitzsimmons, A. (2006) *MNRAS 373, 1590* [6] Finson, M. and Probstein, R. (1968) *ApJ, 154, 327* [7] Sekanina, Z. (1990) *AJ, 100, 1293* [8] Moreno, F., et al. (2008) *ApJL, in press.*