Optical Observations of the Outburst of Comet 17P/Holmes in Its Early Phase. H. Meng[1], M. Zhang[2], L. Mei[3,4], L. Zhang[5], M. Zhai[3,4], J. Zhu[1,3], H. Shan[5], [1]Meteorite and Cosmochemistry Laboratory, Beijing Planetarium, Beijing 100044, China, [2]College of Physics and Electronic Information, Tianjin Normal University, Tianjin 300387, China, [3]National Astronomical Observatories, Chinese Academy of Sciences, Beijing 100012, China, [4]Graduate University of Chinese Academy of Sciences, Beijing 100049, China, [5]Yunnan Observatory, National Astronomical Observatories, Chinese Academy of Sciences, Kunming, Yunnan Province 650011, China.

Introduction: An unprecedented great outburst occurred on the Jupiter-family comet 17P/Holmes, with its optical brightness increased from 17+ to ~2 magnitude. This event was monitored by our regular multicolor imaging and occasional spectroscopic observations since October 24, with the telescopes at Xinglong Station, NAOC. The ejecta of primary outburst formed a concentrated dust blob leaving from the nucleus at 140 m s^{-1} with outflow streaks therein, a sunward inner arc expanding at 240 m s^{-1}, a spherically symmetric outer shell expanding at 430 m s^{-1}. A secondary outburst of ~0.6 magnitude was detected on October 29.8.

Early Dust Coma: As an indicator of the state of coma, the radial profile of Holmes on October 24 could be well fitted by a first order exponential decay, suggesting a substantial deviation from the canonical $1/\rho$ form. If assuming spherically uniform outflow, we find that the reflection-effective dust production, depending on the nucleocentric distance, had to be a peak function to be reconciled to the radial profile observed. With the data between October 24.634 and 24.826, this peak was measured expanding with a slightly wavelength-differential speed around 70 m s^{-1}. Since the nucleocentric distance could be regarded as some inverse form of time, this means the dust production had had an apparent attenuation near the time of our observation.

According to the HST observation [1], the nucleus of Holmes should be 19.79 magnitude in R band and 1.44 mas in radius at the time of our observation on October 24. Ground-based observation [2] essentially confirmed the values by a <3% difference. We extrapolate this surface brightness for the saturation level in the case of full filling by dust with identical albedo with the nucleus. Comparisons with the results of aperture photometry reveal oversaturated equivalent filling factors on October 24.6, suggesting an optically thick circumnuclear environment, and effective dust albedo higher than that of the nucleus. Such more reflective dust has also been detected around other comets, e.g. [3], and probably is right that well evidenced as icy grains [4].

Color: On October 24, the color indices of the inner coma, except B-V, appeared systematically higher in larger apertures. But the same trend is not found in later days. Meanwhile, the V-R and R-I indices are higher and lower than that of the nucleus [2], respectively, suggesting a higher scattering efficiency in R band. Numerical simulations with Mie scattering put an upper limit of such eligible grain radius at 0.83 micron. The coma color was getting blue in the first week after the eruption.

Ejecta Mass: With the R-band images on October 25.824, when no significant background source was close to the comet field and the coma had been considerably optically thin, we find the scattering cross section of the coma was $(1.07 \pm 0.04) \times 10^7$ times greater that of the nucleus. By taking the grain size between 0.5 and 50 microns [5], we estimate the total ejecta mass is from 0.002 to 0.3 nuclear mass. The 0.83 micron upper limit found in color simulation yields a mass loss 0.003 nuclear mass.

References:

[1] Lamy P. L. et al. (2000) *BAAS, 32,* 1061. [2] Snodgrass S. C. et al. (2006) *MNRAS, 373,* 1590-1602. [3] Lisse C. M. et al. (1999) *Icarus, 140,* 189-204. [4] Campins G. H. et al. (1983) *Nature, 301* 405-406. [5] A'Hearn M. F. et al. (2005) *Science, 310* 258-264.

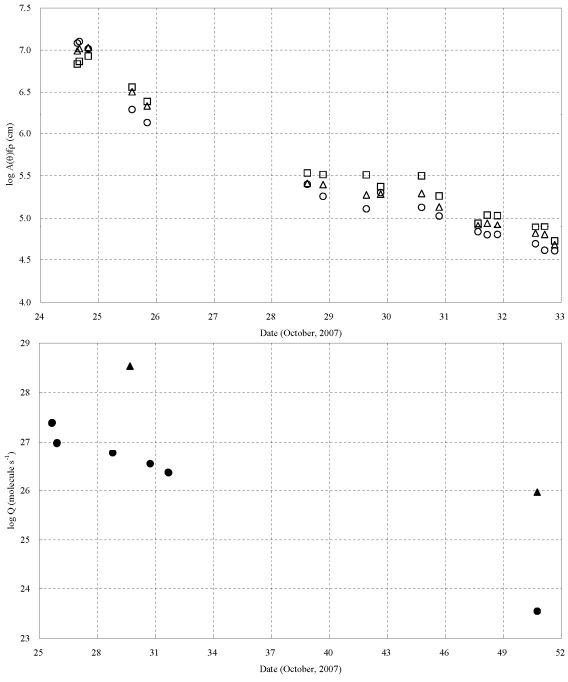

Fig 1. $A(\theta)f\rho$ in various apertures and production rates of CN (triangles) and O(^{1}D) (circles) of comet Holmes.