Comet 17P Holmes

John Menke
www.menkescientific.com

Updated Nov. 29, 2007

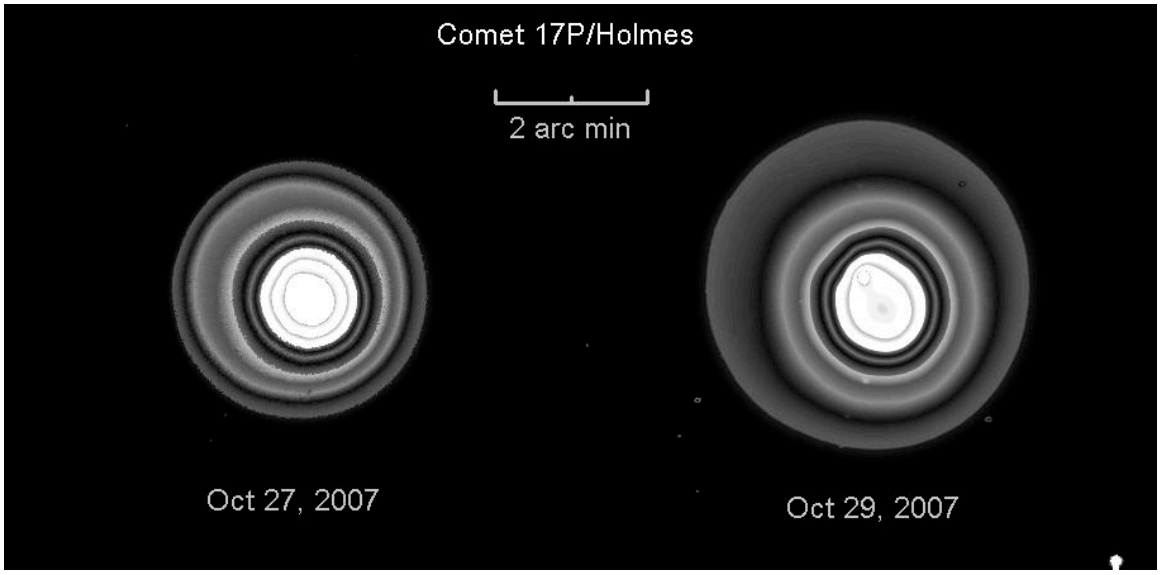
Introduction

This paper summarizes the results of observations of Comet 17P/Holmes at Starlight Farms. The equipment is a C11 at f/10, DSS7 and 402 camera for spectra, and the C11 at f/6 with ST7E/CFW8 for images. All data are taken using MaximDL. Spectroscopic data were transferred to an Excel spreadsheet for analysis and graphing.

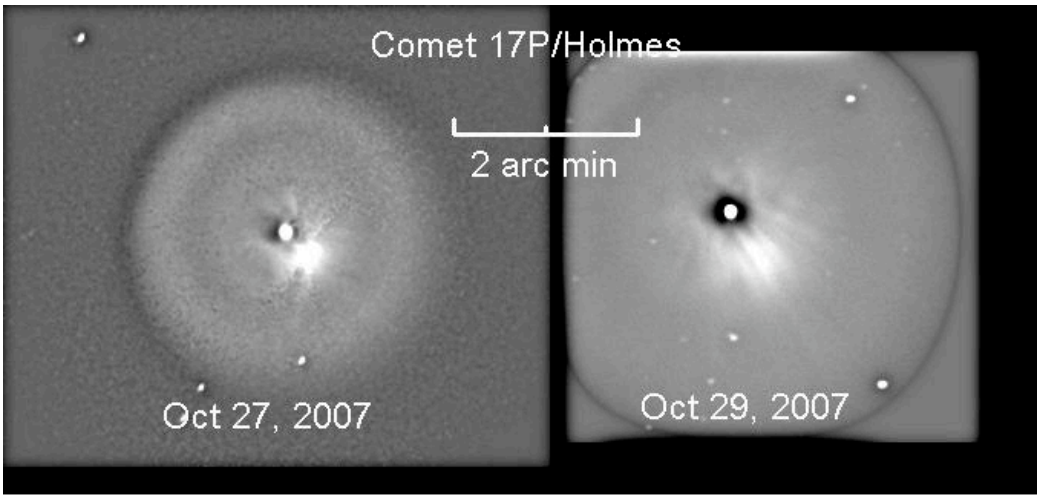
Imaging Results

The comet appears unusual in that it appears to be an expanding circle of gas/dust of approximately 180 a-s diameter. The comet is moving almost directly away from us, so presumably the almost star-like nucleus is at our near end and the gas/dust may actually be a tail pointed away from us and the sun. The starlike nucleus is offcenter from the major gas/dust cloud. There is a faint "bridge" of dust/gas from the nucleus to the brighter area close to the center of the gas/dust circle.

Using the data from the 27th and 28th (approx 0200UT), we may evaluate the rate of expansion of the gas/dust cloud. Because the brightness distribution appears to have a roughly gaussian shape, there is no clearly defined edge. The two images below are shown in false color the better to demonstrate the full range of brightness.



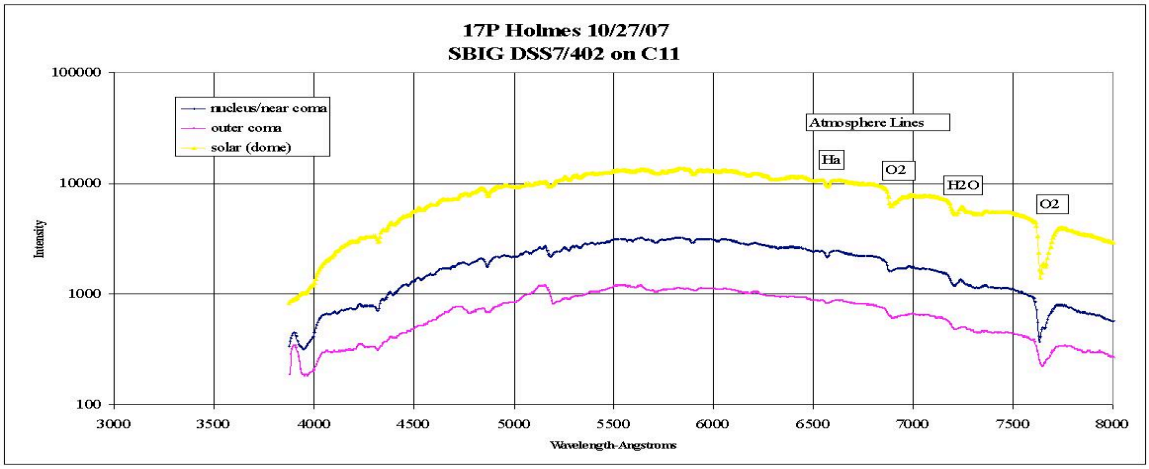
Again, using the same image sets, we can examine the details of the inner coma. Using intensive sharpening to bring out the details, we obtain the images below.



Spectroscopic Results

October 27, 2007 Observations

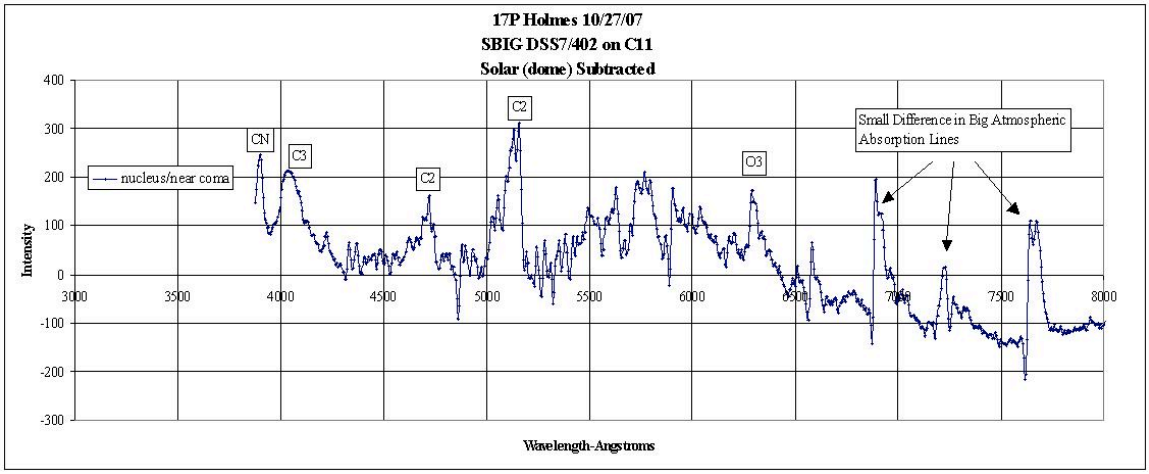
On about Oct. 25, 2007, this faint (mag 8) comet brightened to an estimated Mag. 2 in less than 12 hours. Weather prevented observation at our observatory until Oct. 27 when the following spectra were taken. . The high brightness made data taking very easy, with good spectra taken in under a minute. The data shown were from a 200 second exposure of the comet. The raw data are shown in the following graph, which shows the spectrum in the inner core including nucleus, outer core, and a reference solar spectrum (taken next day as a reflection off a nearby fiberglass dome). Virtually all the larger features in the Holmes spectrum are solar or earth features. Clearly, the major portion of the light from the comet is simple solar reflection, presumably by dust.



I then subtracted the "dome" solar spectrum, with the amount of subtraction chosen to make the average result close to zero amplitude. I then identified a series of features present in this comet, as were in Comet Swann. Some additional features (identified as

"Small Difference in Big Atmospheric Absorption Lines" appear related to the atmospheric lines; however, the features appear too strong for that explanation alone and may result from energy calibration errors in the data from the night comet data and the daytime solar data.

In any case, the various features are only about 5% or so of the original spectrum brightness, ie, this comet is showing mostly solar reflection from dust but with some weak emission lines from comet gas.



October 28, 2007 Observations

Given the limitations in the data from Oct. 27, I decided to take new data the next night and to process it differently. On the 28th, the comet had not changed appearance, though presumably the gas/dust cloud is still expanding.

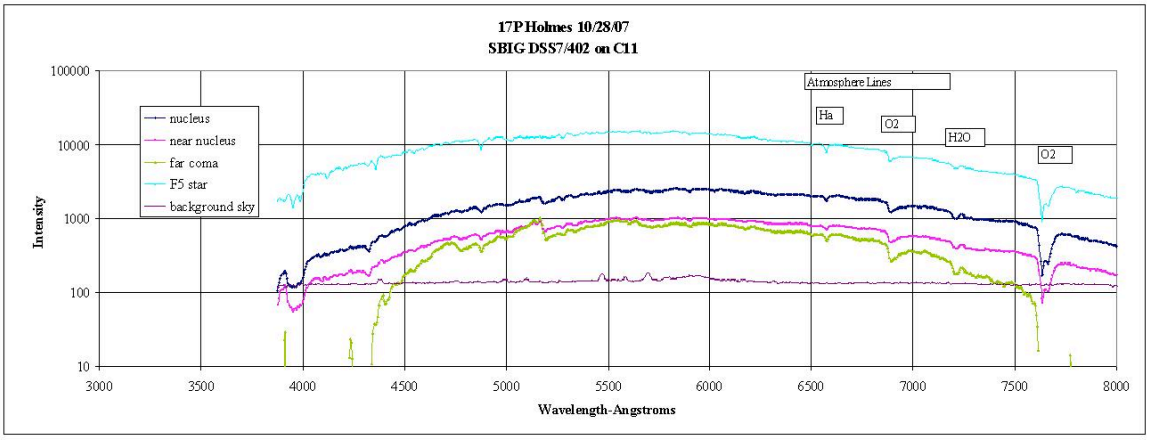
Among others, I took the following spectra

- Nucleus only
- Near nucleus coma (ie., exclude nucleus)
- Far coma area
- Background (away from the comet)
- Sunlight from the waning moon
- An F5 Star near the comet
- A G8 Star near the comet
- Wavelength calibration (fluorescent lamp)

After making the usual calibrations on the raw spectral data, I developed the graphs shown below.

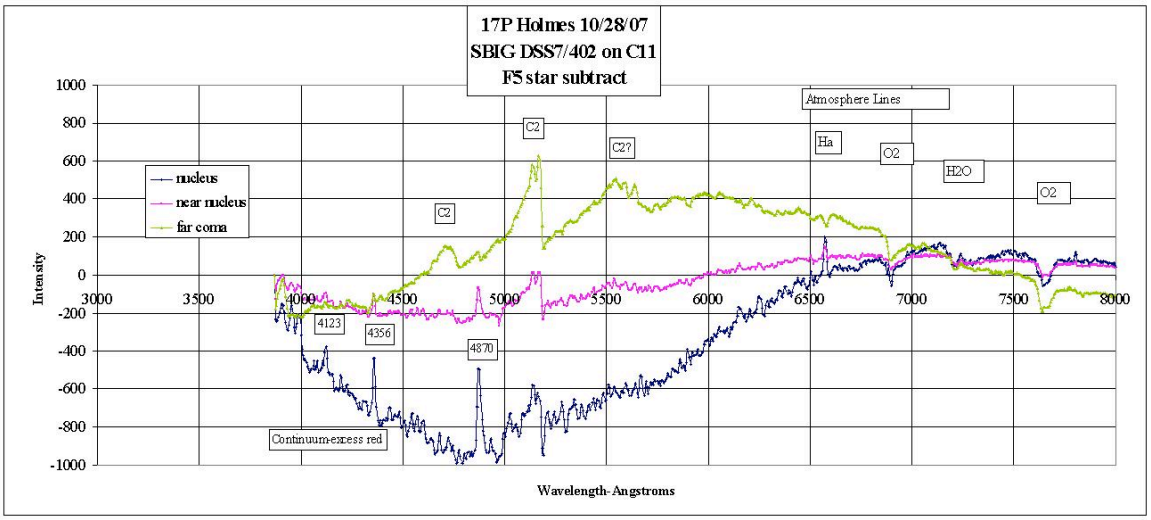
These are plotted on log scale with the three comet spectra shown. The nucleus and near-nucleus curves are very similar, but the far-coma curve shows reduced intensity in the red and blue. It shows similar structure to the other two; however, there is obviously a larger feature at about 5200.

As on the data from the 27th, it is clear that most of the comet light is reflected from the sun. Because the atmospheric lines absorption strength depends on the altitude of the object as well as the weather conditions, we need to be able to subtract the proper solar spectrum as modified by the atmosphere to show any components in the comet spectrum other than solar reflection. The moon, F5, and G8 star spectra are candidates for this subtraction, and all are fairly close to the general shape of the nucleus and near nucleus curves. I show the blue (upper) line is the spectrum of the F5 star which is close in altitude and time to the spectral observations and which has about the same 7650 absorption fraction as the nucleus spectrum. Thus, I subtract a scaled version of this curve, where the scale is chosen to result in a solar-removed spectrum that has minimal solar features.

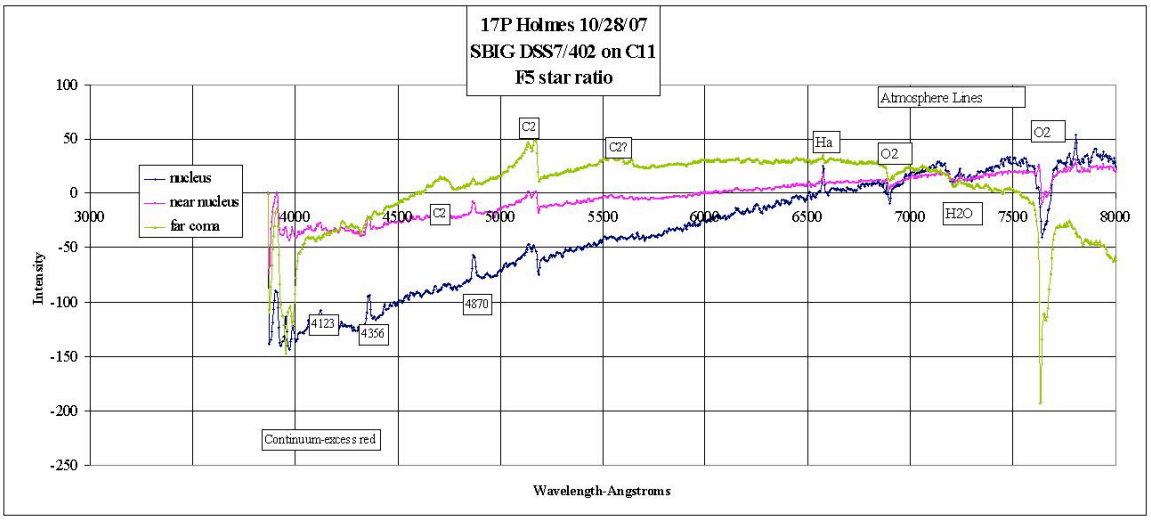


The result is the graph below showing each of the three spectra with a solar-type curve subtracted.

First observe that the atmospheric absorption lines were substantially removed by the solar subtraction: this process is much more accurate than what was done the previous day Oct. 27. In the green far-coma curve, the C2 features at 5200 and 5600 are much stronger as one moves outward in the coma. The nucleus spectrum shows a major dip in the shorter wavelength, ie., there is a deficiency of blue (redder) relative to the portions of the coma farther away. Further, there are apparent emission lines at 4123, 4356, and 4870 in the nucleus that appear weaker as one moves out into the coma. Within the energy resolution, the first may be a cometary C3 emission, while the latter two likely are inaccurate subtractions from the solar by the Hgamma and Hbeta in the F5 spectrum.

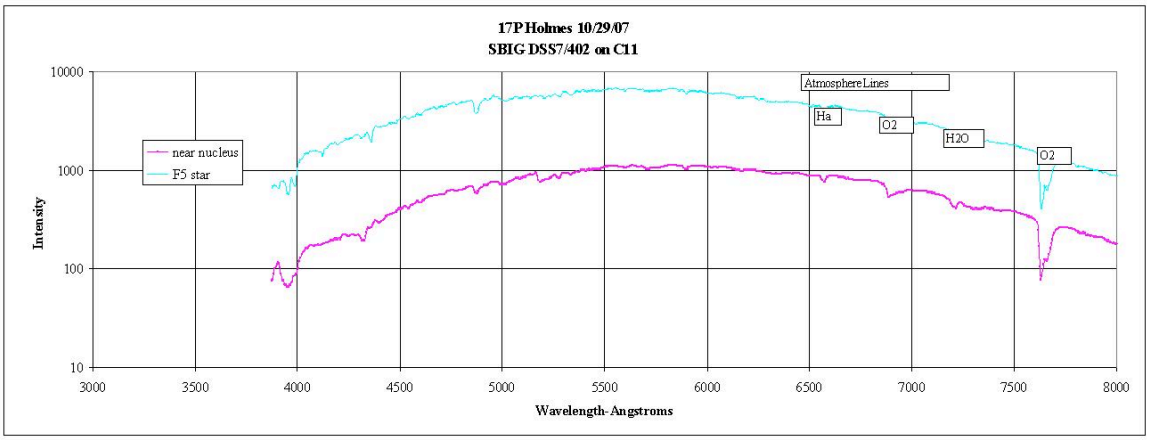


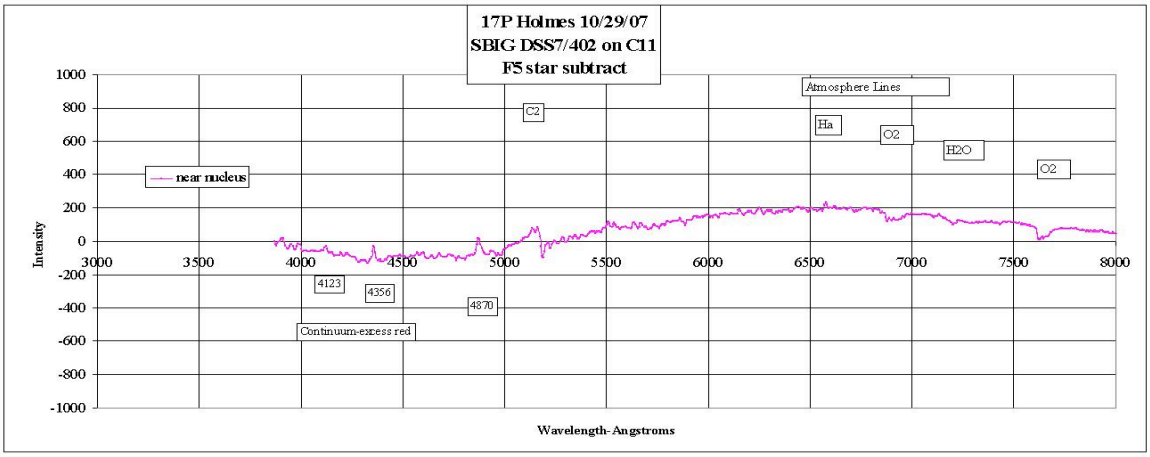
To gain a better understanding of these apparently spurious lines, I instead took the ratio (x1000) of the comet spectra to the reference F5 star spectrum. The result is below. The blue deficiency is still present, as are the two C2 emissions. However, now the three H lines are all the same height, plausible that the line strengths in the F5 and sun are about the same, and are not comet related. The differences in intensity of these and the O2 line at 7632 in the three regions of the comet are likely not real, but due to the analysis process.



October 29, 2007 Observations

The graphs below show the results of the Oct 29 spectral observations, treated the same way as the Oct 28 data. Only near nucleus data were taken, and the results are essentially unchanged from Oct. 28.





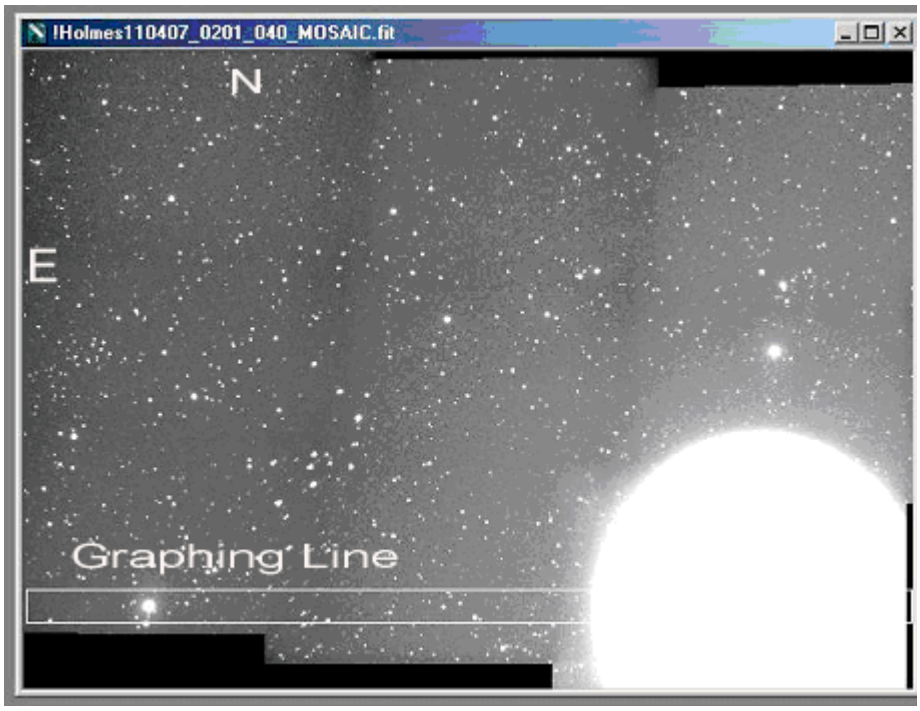
November 4, 2007

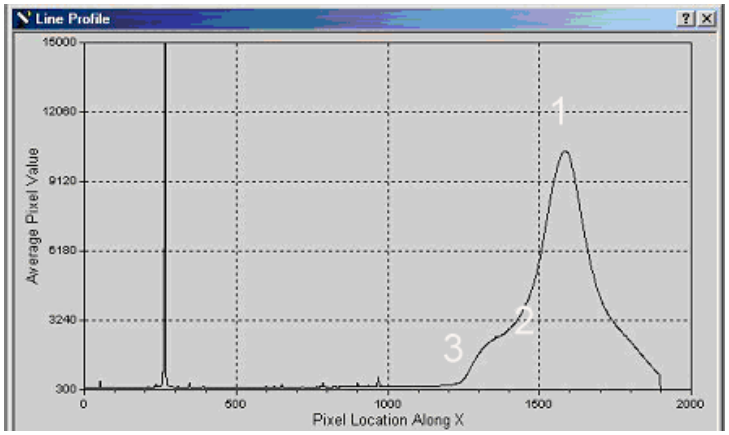
The general morphology of the comet has remained unchanged, though expansion of the "blob" has continued. With limited ability to do a good widefield image, I did a 3x3 mosaic (3x60 sec each piece) with the comet in the lower right corner (ie, not centered). The mosaic is shown below, with the white rectangle showing the area of brightness measurement. As you can see, there were some gradients and other faults in the images. The sky was poor, with about mag. 3 or so stars visible. The faint comet tails that many people with dark skies are imaging would be to the SW, so would not show in this image.

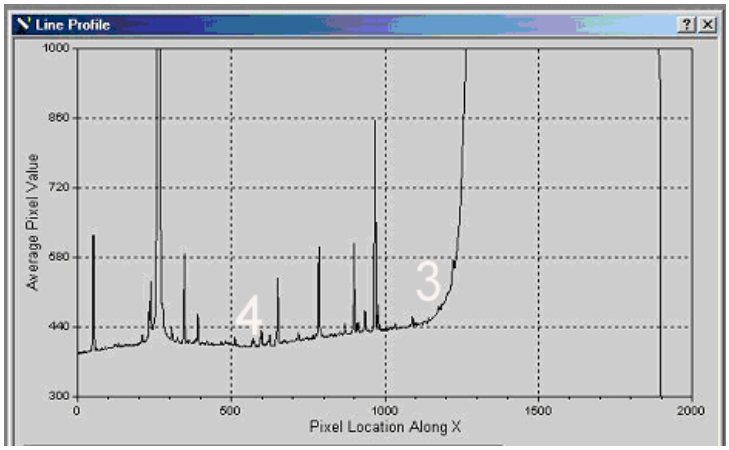
The radii from the center of the coma to each inflection point in the E. direction are approximately

Center to Point 1	230a-s
Center to Point 2	320a-s
Center to Point 3	980a-s (16.3a-m)

These radii are almost identical to those traces taken at 45deg, ie., to the NE.


IHolmes110407_0201_040_MOSAIC.fit
N
E
Graphing Line

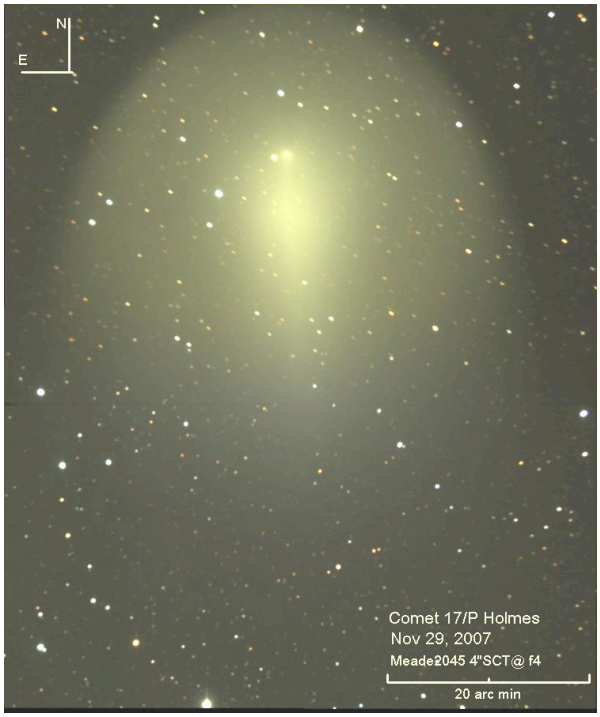

Line Profile
15000
12060
9120
6180
3240
300
Average Pixel Value
0
500
1000
1500
2000
Pixel Location Along X
1
2
3

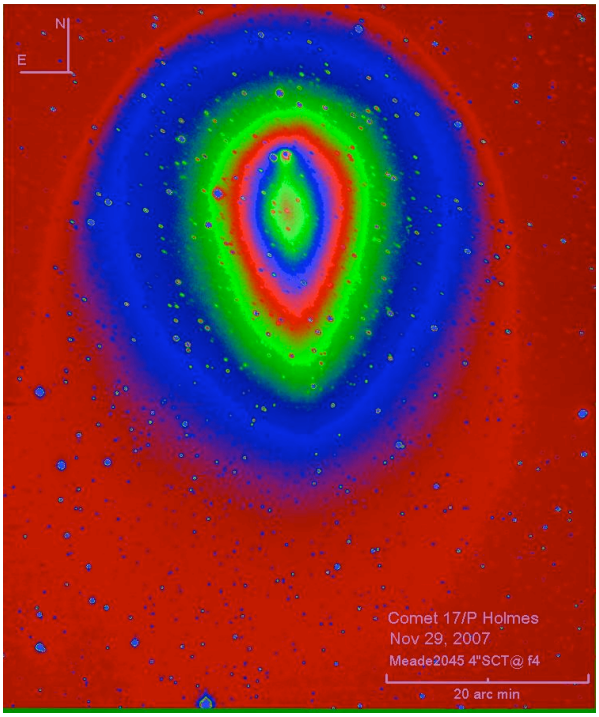

Line Profile
1000
860
720
580
440
300
Average Pixel Value
0
500
1000
1500
2000
Pixel Location Along X
3
4

Nov. 29, 2007

Poor weather prevented any observations since the last entry above. ON Nov. 29, there were high clouds with about mag.3 skies; however, I was able to build a color image and obtain minimal spectra.

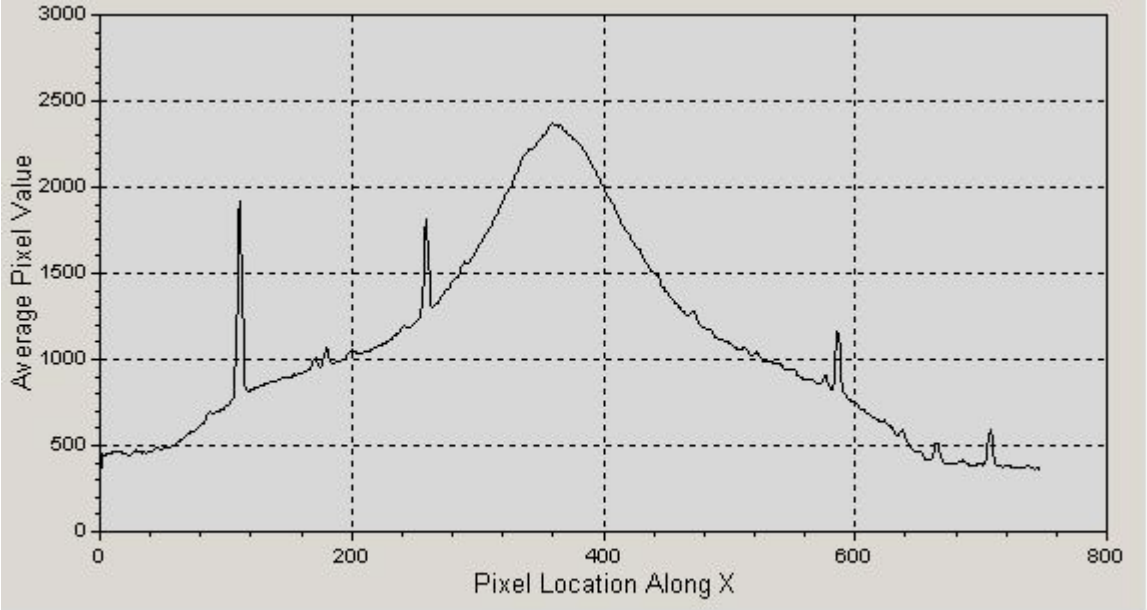
The image was made with a Meade 2045 4" SCT telescope, with a f3.3 reducer operating at about f/4 with a FOV on the SBIG 402 camera of about 40x60a-min. The RGB images were interspersed, with exposures of 60, 90, and 120 sec respectively with approximately 10 image sets obtained. To show the tail, the scope was then moved 30 a-min North, and a second set of 8 exposures obtained. The first set, containing the comet nucleus (note the mag. 9 star immediately to its left), was combined with the nucleus serving as the fixed point, while the second set was combined on the stars. The yellow color was chosen roughly to match the spectra, below. The two resulting images were combined into the mosaic shown. Only linear processing was done (ie, no sharpening was done. Because the stretched image does not show the relative brightness of the false nucleus (below the real nucleus) I show a false color contour.



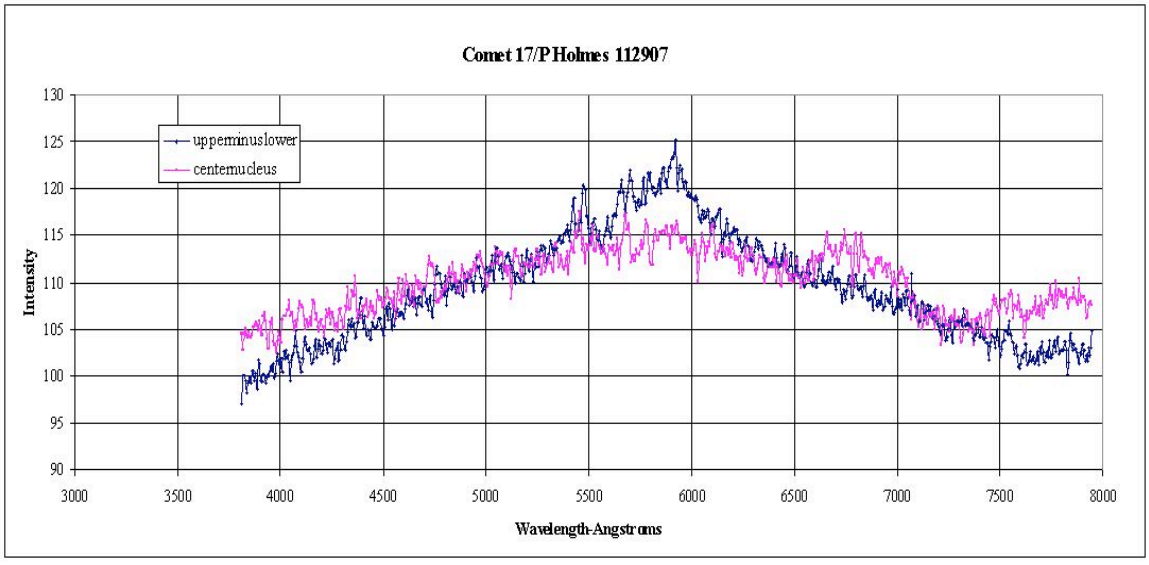


Below the center of the color image, there is an area that appears less yellow (slightly more blue?): this does not appear to be an artifact of the imaging. Also, in the region between the nucleus and false nucleus there are at least three parallel vertical (N-S) streaks that show up faintly on more highly magnified images. Finally, I did a rough measure of the overall brightness of the comet at about mag 2.8.

A graph of the intensity across the false nucleus is shown below.



I obtained two spectra of the comet using the DSS7 and C11 telescope. The high clouds plus the low surface brightness of the comet limited the quality of the measurement. The first spectrum used the narrowest DSS7 slit (higher resolution) and included the comet nucleus. The second is from the lower resolution slit pair that flank the narrow slit. One was set above the nucleus in the faint coma ("upper spectrum") and the other below the nucleus in the region of the false nucleus ("lower spectrum"). All three were exposed for the same 10x60 sec period. The upper spectrum (lower brightness) was subtracted from the lower spectrum, and is labeled as such.



Both traces show the same peaking at about 5700 as seen the previous month. The "centernucleus" trace shows an unidentified broad feature at 6600-7000, and signs of a feature beyond 7500. The "upperminuslower" shows a stronger peak at around 5800-5900 which may also be a spectral feature (unidentified). The emissions structures at 5450 and 5700 are remnants of terrestrial lines.