

# CCD PHOTOMETRY OF THE MARS-CROSSER ASTEROID 2099 OPIK

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Photometric observations of the small Mars-crossing asteroid 2099 Opik were made in 1998, on November 7 and 9, at Pianoro Observatory (Italy). The lightcurves display a most likely period of 9.3 h. This solution, however, is not unambiguous. There is also another possible period of 10.3 h. The amplitude is about 0.7 magnitudes.

Taking advantage of its almost best possible conditions, some photometric observations of 2099 Opik were made at Pianoro. The Observatory (MPC Code 610) is located at 180 metres above sea level, seventeen kilometres from the town of Bologna (Italy). The purpose of this investigation was to search for the rotational period of the asteroid. Unfortunately the unfavourable meteorological situation made it impossible to get further data for greater precision.

The Observatory uses a 25 cm MEADE LX 200 Schmidt-Cassegrain f/6.3 with a focal reducer which yields a focal ratio of f/4.4. It is equipped with a 14-bit CCD Camera HiSIS22, Chip Kodak Kaf 0400 of 768x512 pixels, each pixel measuring 9x9 microns. For this investigation it was binned to produce 384x256 pixels, each 18x18 microns. The resulting image scale is about 3.4 arcsec/pixel.

On November 7, 1998 13 observations were made for the duration of one minute each, at ten-minute intervals. The range of instrumental magnitudes was from 14.6 to 15.1. On November 9, 1998 17 observations were taken using the same procedure. The range of instrumental magnitudes was from 14.9 to 15.4. All the images were shot with a yellow Wratten 8 filter and dark frames and a flat fields were used. The Win-MiPS program by C. Buil (version 1.50 1994-95) was used for photometry reduction. This program uses aperture photometry.

On November 7, the asteroid's magnitude was calculated using the average of five reference stars with a magnitude similar to the asteroid's. In the second night of observation it was not possible to use the same stars, owing to the fast movement of the target. However, it was verified that the magnitude of one of the reference stars of the first night's field – calculated with the five reference stars of the second night's – had the same range of magnitude (within  $\pm 0.05$ ) as resulting from the USNO Catalog. So the data from both nights are reliably on the same magnitude scale, even if relative. The reference stars were taken from the USNO A2.0 Catalog, and they were chosen among those with lower measured residuals. The lightcurves were corrected for light-time travel, the magnitudes reduced to unit geo, heliocentric distances and the same phase angle. The plots (see Figures 1 and 2, AVE program by R. Barbera) show that it is possible to obtain two slightly different rotational periods.

The most likely period is 9.3 h, but this solution, alas, is not unambiguous: there is also another possible period of 10.3 h. Unfortunately the result of this photometric research on 2099 Opik is thus dubious, however the data obtained constrain the period to a relatively narrow interval and they might be useful in case of further investigation.

Dr. Petr Pravec of the Ondrejov Observatory, Asteroid Photometry Coordinator for the ALPO Minor Planet Section, was involved in this project and gave his assistance to the author in the checking and reading of the results. Many thanks to him for his encouragement and suggestions in the treatment of this analysis.

## References

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- Buil, C. (1991). "CCD Astronomy". Willmann-Bell, Inc.
- Harris, Alan W. (1997). "Minor Planet Lightcurve Parameters". On Minor Planet Center web site: <http://cfa-www.harvard.edu/iau/lists/LightcurveDat.html>

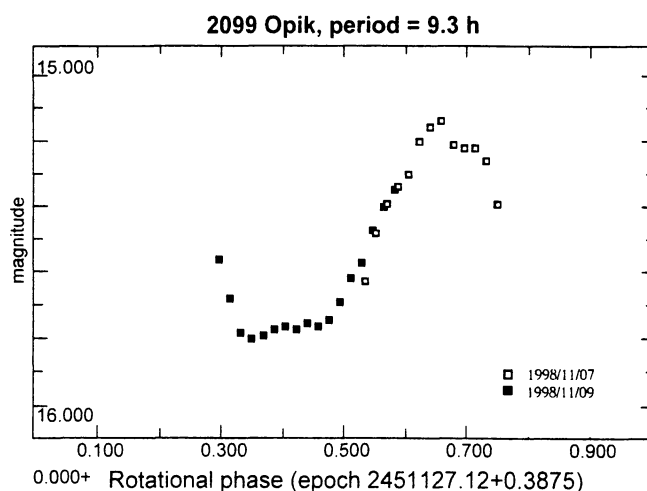


Figure 1

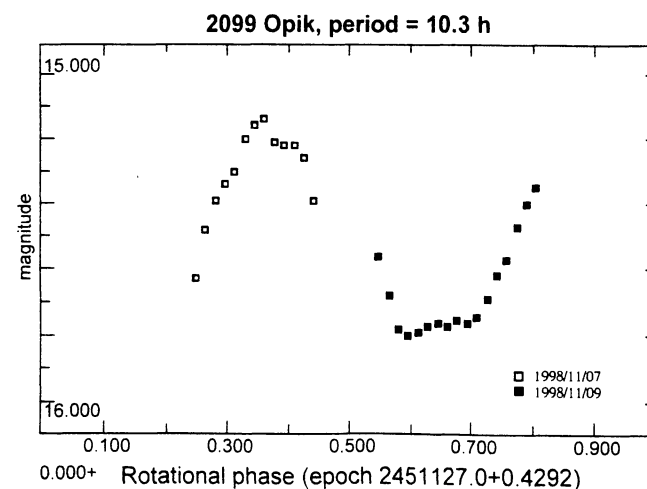


Figure 2

## THE MINOR PLANET OBSERVER: PROGRESS

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It was gratifying to get the third quarter edition of the *Minor Planet Bulletin* a few months back and see so many asteroid lightcurves. I don't propose to take credit for this, though I was fortunate enough to help in some small way with most of those who submitted papers. A cheerleader does not win the game; it is the player on the field who achieves ultimate success but those on the sidelines can still take some pride in the team's victories.

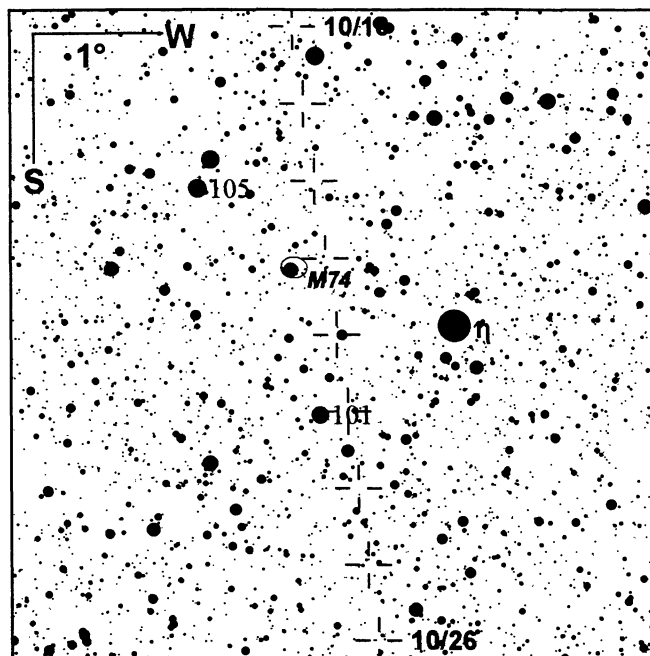
There are signs this trend will continue following the Minor Planet Amateur-Professional Workshop 2000 in Alfred, NY, this past June. It was a very successful meeting with special congratulations going to Roy Tucker who served as chairman and Drs. David DeGraff and John Stull of Alfred University who were hosts. There was a fair amount of discussion about photometry and lightcurve work that would indicate that these pages might soon sprout lightcurves.

A quick check shows there's no less than 150 asteroids reaching their brightest in 2000 October through December that have no established periods or have a period that needs checking. That's just from a pool of numbered asteroids reaching a maximum brightest of at least 15m more than a week from a full moon. There's still no lack of work!

A significant point made during the Alfred conference was the use of filters and reducing observations to a standard system. Using filters has the disadvantage of reducing the limiting magnitude that one can work but many advantages such as being able to combine observations with other observers and establishing phase coefficients, among others. For the very adventurous and sufficiently equipped, there's the possibility of helping to determine an asteroid's class by measuring the object's brightness through several filters.

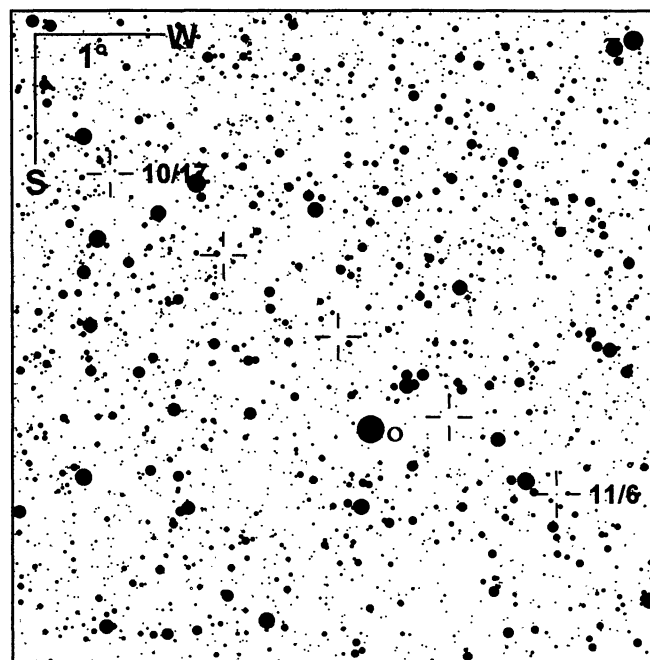
On the "home-front", the 20-inch is finally doing some legitimate work again. Two more lightcurves have been determined and, for the first time in nearly a year, I made some astrometric observations. Being out of practice I was victim to some of the common mistakes, e.g., bad times, measuring the wrong target and so on. It's easy to forget that even the "simplest" scientific research requires constant care and attention.

Since the 20-inch cannot yet be fully remotely controlled via software for astrometry, I must stay near the computer during a run. That has allowed progress on a different front: my piano playing. If you remember from the first of the year, I vowed to devote more time to getting back to learning how to play. As always, one thing or another kept getting in the way but now I have the perfect excuse to be in the same room with the instrument: it's in the same room as the telescope computer. Far more than relearning the tricks of astrometry, relearning scales, arpeggios, and – more important – which key on the piano corresponds to that black splotch on the paper is proving a difficult task. With the long winter nights, I'll have plenty of time to practice *and* to observe. Clear Skies!



**391 Ingeborg.** Note that the chart interval is 2 days and the near miss with M74. Max Wolf discovered Ingeborg in 1894 November. Based on brightness alone, this would be a good "beginners" target. Whether or not the lightcurve is an easy one is what's to be determined.

| Date  | RA2000  | Dec2000  | RA1950  | Dec1950  | M    | PA   | E   |
|-------|---------|----------|---------|----------|------|------|-----|
| 10/17 | 1 37.01 | +18 15.1 | 1 34.30 | +17 59.9 | 10.7 | 5.6  | 171 |
| 10/22 | 1 35.24 | +15 16.7 | 1 32.56 | +15 01.3 | 10.6 | 3.1  | 175 |
| 10/27 | 1 33.66 | +12 20.9 | 1 31.01 | +12 05.5 | 10.8 | 4.8  | 172 |
| 11/01 | 1 32.46 | +9 33.4  | 1 29.83 | +9 18.0  | 11.0 | 8.2  | 166 |
| 11/06 | 1 31.80 | +6 58.9  | 1 29.18 | +6 43.5  | 11.2 | 11.7 | 160 |



**1309 Hyperborea.** Named after a region of ancient Greece, Hyperborea was discovered by G.N. Neujmin in 1931 October. It is an unclassified asteroid with a size of about 32 km. Omicron Piscium is near chart center.

| Date  | RA2000  | Dec2000  | RA1950  | Dec1950  | M    | PA  | E   |
|-------|---------|----------|---------|----------|------|-----|-----|
| 10/12 | 1 57.02 | +11 43.2 | 1 54.35 | +11 28.5 | 14.4 | 4.2 | 168 |
| 10/17 | 1 53.59 | +11 06.9 | 1 50.92 | +10 52.2 | 14.2 | 2.2 | 174 |
| 10/22 | 1 50.03 | +10 29.6 | 1 47.37 | +10 14.8 | 14.0 | 0.3 | 179 |
| 10/27 | 1 46.44 | +9 52.0  | 1 43.80 | +9 37.1  | 14.2 | 1.9 | 174 |
| 11/01 | 1 42.95 | +9 15.0  | 1 40.31 | +9 00.0  | 14.3 | 4.0 | 168 |