ASTEROID PHOTOMETRY AND THE AMATEUR

by

ALAIN PORTER
10 Sea Lea Drive
Narragansett, R I. 02882

Abstract

Amateurs are invited to participate in a program of visual asteroid photometry. Results of studies of 18 Melpomene, 233 Asterope, and 270 Anahita indicate the potential of such research.

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In recent years, there has been a remarkable upsurge of interest in asteroid studies, particularly asteroid photometry. Having taken root, this interest has grown rapidly through widespread advertisement of events such as the 1971 Minor Planets Conference in Tucson, the discovery of the Apollo asteroid Object Kowal 1974MA last summer, and the spectacular flyby of Eros and occultation of Kappa Geminorum last winter. Perhaps the field's greatest attraction to potential observers is its newness. For many years, an astronomer who said he was working with asteroids almost certainly meant he was hunting or tracking them. Now, asteroid work is expanding into photometry, polarimetry, non-visual astronomy, and numerous other areas. Most of these are out of the amateur's reach, but one--photometry--can be done simply and inexpensively. This new field (even the most recent lists show that no more than about 70 out of the nearly 2000 numbered asteroids have ever been studied for rotational variation) offers an opportunity for relatively valuable work with a small telescope. Thanks to the number of asteroids within the reach of even a modest telescope--and it runs into the hundreds--the amateur can do some worthwhile work here, and is indeed already doing it.

The most obvious purpose of photometric asteroid studies is observation of the rotational light curve. Depending on the date and the asteroid, this variation may be undetectable or it may in some rare cases be on the order of two magnitudes. With so many asteroids yet unstudied, it is anyone's guess how a particular object will behave. Less than two months ago, 233 Asterope was found to have a rotation period of probably 5-5.5 hours and an amplitude of 0.2-0.3 magnitudes (see Figures 1-2). This discovery was made visually by an amateur using a 15cm telescope, and observations are still being made to get a more accurate period. More recently, program coordinator Derek Wallentine has discovered a variation in 270 Anahita. The period derived by least squares analysis is 19h 05m2 - a new record. (The previous record, 18h 48m8, was held by 532 Herculina.)

Another important application of amateur photometry is to verify the accuracy of past observations. A striking illustration of this is last year's redetermination of the rotation period of 18 Melpomene. Rick Binzel and Douglas Welch with Joe Patterson (their director at Camp Uraniborg, a summer astronomy camp in California), monitored Melpomene with a
photometer and a telescope on two nights, and were able to
determine that the value of 14h 10m, which had been accepted
as the rotation period for some fifteen years, was incorrect.
Melpomene's actual period is 11h 50m, exactly 5/6 of the old
value. It is almost certain that the periods determined for
some other asteroids are incorrect as well.

As more observations become available for any particular
asteroid, we will also be able to determine that object's axial
orientation. Knowing that will enable us to predict the nature
and amplitude of its variation at future apparitions.

A fourth application of photometry, which has nothing to
do with rotation, is improvement of magnitude ephemerides and
study of the phase effect. Very frequently, an asteroid will
appear to have a magnitude different from that predicted be-
cause of an imperfect understanding of the variation of visual
magnitude with the elongation of the object from the anti-
solar point. An excellent attack has been mounted on this
problem in E. F. Tedesco's Minor Planet Bulletin papers, but
there is still plenty of room for study of this phenomenon.

Last but not least, such observations will, when numerous
enough, become important in statistical studies of the asteroid
belt as a whole.

Considerations of equipment are next. Not all of us are
fortunate enough to own a Pacific Instruments photoelectric
system, but you who observe variable stars know that a well-
trained eye, while it can't compete to a good photometer, is
a fair instrument in its own right. An example of this is the
visual light curves made of Eros last winter. The report in
the May 1975 Sky and Telescope (pp 331-2) indicates that they
established an average period only one second longer than
that determined during a professional survey in 1971, with an
average deviation of about 5.7 minutes.

Visual photometry also has the great advantage of not being
limited to the brighter asteroids. Objects which a photometer
could never pick up can be monitored at leisure so long as
they are within the magnitude reach of one's telescope. This
will ensure a more statistically uniform selection of asteroids
which have been photometrically examined.

The typical asteroid has a rotation period of about 5-6
hours, which means it covers the extent of its amplitude every
75-90 minutes. This amplitude is usually 1/3-1/4 magnitude,
so a good estimate interval to start with would be 10-15 min-
utes. Keep the curve going at least several hours, if possible,
and get observations on more than one night. This is important
because the accuracy with which a visual observer can time a
maximum is not sufficient to eliminate resonance effects be-
tween similar candidate periods. Observations over an extended
period also help time the passage of Earth through the asteroid's
equatorial plane.

In order to encourage observations of rotation in asteroids,
Derek Wallentine of Albuquerque, NM, and the author have been
appointed ALPO Minor Planets Section photometry coordinators.
Thus far, making predictions and gathering observers has com-
prised the bulk of our activities, but light curves are start-
ing to come in, and we hope before too long to have enough
material for our first report. We are presently publishing
quarterly predictions of asteroid passages through AAVSO var-
iable star fields. These sequences are the only access many
amateurs have to real magnitudes of very faint stars, and
they screen a nice selection out of the innumerable minor planets.
available for study at any given moment. To limit the selection further, we plot asteroids only 4 weeks or less from opposition, and usually only above magnitude 12 or 13. This leaves 10-15 passages quarterly.

In closing, I'd like to encourage anyone who believes he might be interested to give asteroid photometry a try. The amplitudes in question are rather small, but that only makes success more gratifying. Address inquiries to me, and please enclose a large self-addressed stamped envelope for prediction or observation form requests. Membership in the ALPO Minor Planets Section and a year's subscription to the Minor Planet Bulletin are available for $3 per year from Prof. Richard G. Hodgson, Dordt College, Sioux Center, IA 51250.

REFERENCES

Ashbrook, J. 1975, Sky & Tel., 49, 162.
1975, Sky & Tel., 49, 331.

Figure 1. Light curve of Asterope by Alain Porter on Aug. 29, 1975. Telescope used was a 15cm f/8 reflector, magnification 45x. On this and the next figure the ordinate is an arbitrary sequence, some nearby star having been assigned the value 0 and another, the value 10.

Figure 2. Light curve of Asterope by Frederick Pilcher on Sept. 14, 1975. Telescope used was a 36cm Celestron reflector. The ordinate is an arbitrary sequence similar to that described for Figure 1.