ASTEROID PHOTOMETRY AND THE AMATEUR

by

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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 19^h $05^m.2$ - a new record. (The previous record, 18^h $48^m.8$, 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 $14^h\ 10^m$, which had been accepted as the rotation period for some fifteen years, was incorrect. Melpomene's actual period is $11^h\ 50^m$, 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 because of an imperfect understanding of the variation of visual magnitude with the elongation of the object from the antisolar 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 compare 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 minutes. 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 between 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 comprised the bulk of our activities, but light curves are starting 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 variable 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.

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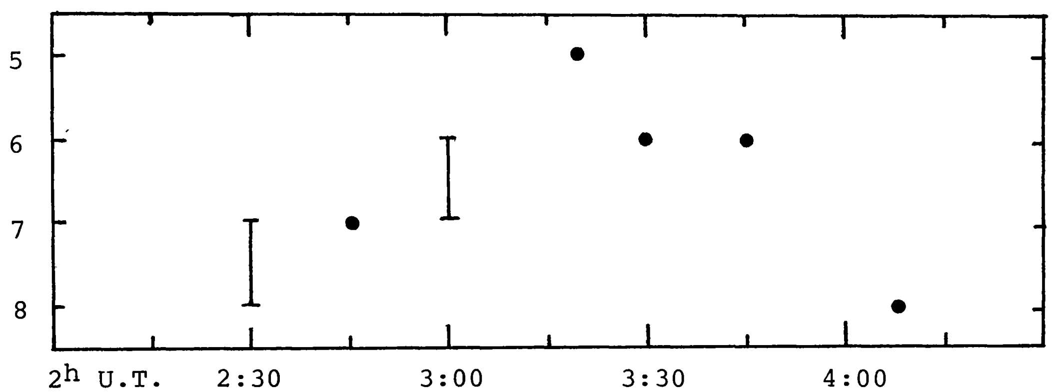

Figure 1. Light curve of Asterope by Alain Porter on Aug. 29, 1975. Telescope used was a 15cm f/8 reflector, magnification 45x. On this and the next figure the ordinate is an arbitrary sequence, some nearby star having been assigned the value 0 and another, the value 10.

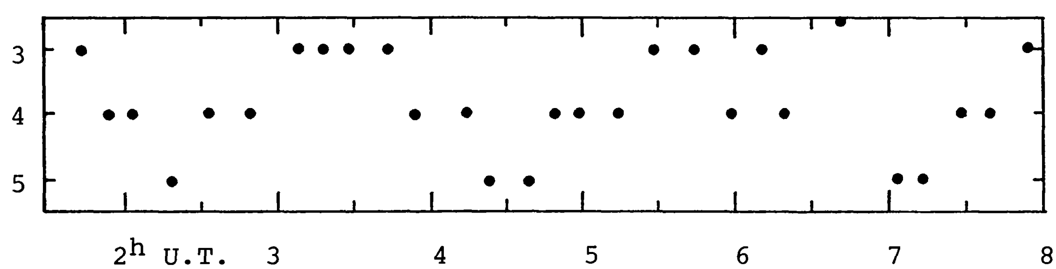

Figure 2. Light curve of Asterope by Frederick Pilcher on Sept. 14, 1975. Telescope used was a 36cm Celestron reflector. The ordinate is an arbitrary sequence similar to that described for Figure 1.