PHOTOMETRY OF 201 PENELOPE FROM CHILE AND ITALY

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Photometric observations of minor planet (201) Penelope were made at Las Campanas Observatory (Chile) on February 20, 2000 UT, using the 40-inch Swope telescope with the Site #1 CCD camera and a V-band filter, and at Serafino Zani Astronomical Observatory (Lumezzane, Italy) on March 4/5 21, 2000, using a 16-inches Ritchey-Chretien telescope with a Kaf400 CCD and a V-band filter. The obtained lightcurve for the known 3.747 hour period shows an amplitude of 0.55 ± 0.02; this asteroid can display a lightcurve amplitude from 0.15 mag. to 0.73 mag.

Introduction

The object 201 Penelope, discovered by J. Palisa (Pola) on 1879 August 7 (Pilcher,1979), is a metal rich M-type main belt asteroid (Tholen 1989). Its lightcurve can display a large amplitudes (as high as 0.73 mag.) and short period of rotation (3.747 hours) that it would be modeled as an elongated tri-axial ellipsoid or a nearly-contact binary. Changes in the spectral type of the asteroid from M type to B-G (presence of hydraded silicates) was observed by Busarev et al. (1995) following its rotation phase; this minor planet may be the product of a low velocity collision of an M type asteroid with a primitive hydraded body. Surdej et al. (1983) determined the 2 maxima and minima and observed a small hump at the rotational phase 0.3.

Observations from Las Campanas Observatory, Chile

Photometric observations were made at Las Campanas Observatory located in Chile (Latitude –29° 0' 12", Longitude 70° 42' 6") by Joanna Gonzalez Morecchio, Marco A. Avila Elchiver and Francisco J. Larrain Wicha, students at the Andes-Carnegie astronomy summer school, supported by Carnegie Institution of Washington and Fundacion Andes, under agreement of Franck Marchis. We used the 40-inch Swope telescope with the Site #1 CCD (http://www.lco.cl/lco/manuals/direct_ccd/ccd_manual99.html) camera and a V-band filter. Observations cover the period from 1:56 UT to 7:59 UT of 2000 February 20, with a short break (due to technical problem), from 6:10UT to 7:18UT. The duration between images was around 50 seconds; each image has an integration time of 20 seconds. Universal Time is synchronized with Greenwich time every day and one can expect an error less than 4 seconds on these measurements. 340 images have been reduced and analysed with IRAF software using the procedures recommended by Binzel (1983). Observed relative magnitudes were plotted against the rotational phase assuming the previously known 3.747 hours rotation period. A computer program (BLANID, written by A. Gaspani) was used to fit a curve through the photometric measurements. This fit is shown in Figure 1 as a solid line, dots are observational data.

Observations from Lumezzane, Italy

Photometric observations were made at Serafino Zani Astronomical Observatory located in Lumezzane (Italy) by L. Cocca, C. Cremaschini, S. Foglia and G. Pizzetti, using a Ritchey-Chretien telescope of 16-inches of aperture, and a SETI Kaf400 CCD camera with Johnson V-band filter as the detector. Observations cover the period from 2000 March 4, 22:09 UT to 2000 March 5, 1:59 UT. The duration between images was 2 minute; each image was 10 second long. A DCF-77.5 kHz radio signal receiver was used to determine Universal Time. Images were measured with CCDIMG software (Pizzetti 1999) using the procedures recommended by Binzel (1983). Observed relative magnitudes were plotted against the rotational phase assuming the previously known 3.747 hours rotation period. We also applied a BLANID data processing indicated in Figure 2 as a solid line.

Results

Obtained lightcurves are very similar: lightcurve obtained from Las Campanas shows a primary maximum M1 at phase 0.132 and secondary maximum M2 at phase 0.629 (0.10 magn. fainter than M1). Minima, located at the rotational phase 0.399 (m1) and 0.867 (m2), are at the same flux. Lightcurve obtained from Lumezzane shows a primary maximum M1 at phase 0.129 and secondary maximum M2 at phase 0.636 (0.10 magn. fainter than M1). In this case minima, located at the rotational phase 0.378 (m1) and 0.871 (m2), are not at the same flux.

It is clear that both lightcurves show a “little hump” near the phase 0.500. If we compare our lightcurves with Surdej et al. (1983)'s one, we noticed that our hump is located at a symmetric position in reference to the first minima m1. Assuming a bifurcated shape for this asteroid, we may interpret this anomaly as an effect of eclipse between the two components. A Jacobian ellipsoid shape model of the asteroid based upon these observations will be soon available on the web page of the Institut de Mécanique Céleste (http://www.bdl.fr).

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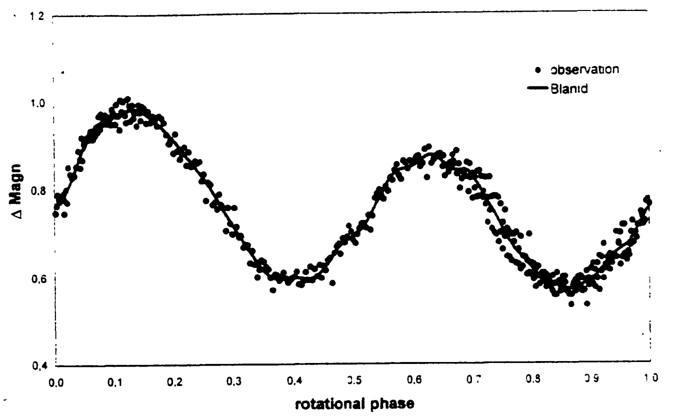

Figure 1: Rotational lightcurve of 201 Penelope obtained from Las Campanas Observatory.

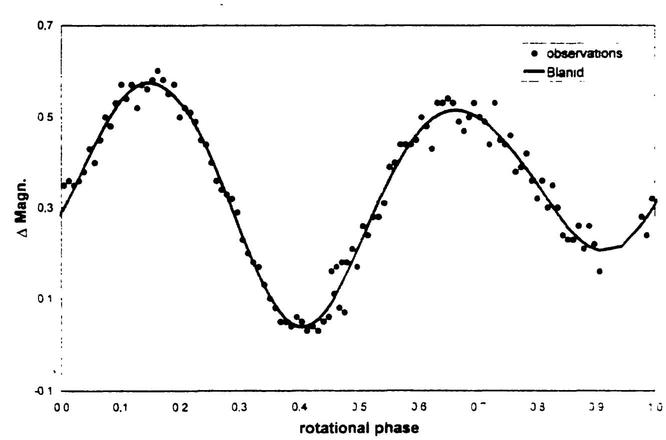

Figure 2: Rotational lightcurve of 201 Penelope obtained from Lumezzane

LIGHTCURVE PARAMETERS FOR 1582 MARTIR

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A lightcurve for 1582 Martir was measured in 2000 May at the Palmer Divide Observatory, located near Colorado Springs, CO. The period was found to be 15.757h ± 0.005h with an amplitude of 0.40m ± 0.03m.

The goal of the Palmer Divide Observatory asteroid photometry program is to measure the lightcurves of as many asteroids as possible. Initial targets are chosen by checking the list of lightcurves maintained by Dr. Alan Harris (Harris 1999). If possible, two targets per night are chosen since the control software allows the telescope to "bounce" between the targets. This maximizes the amount of time that data is being gathered. To help assure the targets remain near the center of the field, the position of each is re-computed before the telescope is moved to it and, approximately every hour, the telescope is moved to a nearby star of magnitude 3 to 7 where an automatic process centers the star and updates the telescope computer's pointing. At least two nights are dedicated to the initial run for every target. Depending on the preliminary analysis of the lightcurve data from those two nights, additional runs are allocated as necessary to assure full coverage of the lightcurve with no significant gaps, if possible. Asteroids with periods approaching and exceeding 24 hours are often, but not always, eliminated from further studies and marked for follow-up at another time or an appeal is made via the Collaborative Asteroid Lightcurve Link (http://www.MinorPlanetObserver.com/astlc/default.htm) to have other observing stations take part in a joint effort.

Commercially available software, Canopus, is used to measure the images. This program semi-automatically measures the magnitudes of comparison stars and the asteroid for each image and then stores the data for use in a Fourier analysis program. The original FORTRAN code of this program was supplied by Dr. Alan Harris (Harris et al, 1989) and converted to Delphi Pascal. If the data from a single night appears to cover at least a quarter of the period or more, an "eyeball estimate" based on a plot of the raw data is used to help narrow the possibilities when using data from two or more nights.

In Canopus, several stars of higher accuracy photometry, such as those from the LONEOS catalog from Lowell Observatory (Skiff), are measured to establish a relationship between the total pixel intensity of a given star vs. its catalog magnitude. The LONEOS catalog is not a set of standard stars but they are of higher accuracy and includes magnitudes in several common bands, thus allowing stars of near solar (and asteroid) color to be used. The LONEOS field is selected to be as near as possible to the target field.

In some cases, stars within the target field are used to establish this relationship. The difficulty here is that it is not usually easy to determine the color of stars in the field since the information is not in the Hubble Guide Star and USNO A2.0 catalogs. While the results under these circumstances are usually similar to when using a LONEOS or like set of stars, a preferred method would be to