ASTEROID LIGHTCURVE ANALYSIS AT THE PALMER DIVIDE OBSERVATORY – SPRING 2005

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The lightcurves for the following asteroids were obtained at the Palmer Divide Observatory and then analyzed to determine the synodic period and amplitude: 157 Dejanira, 209 Dido, 630 Euphemia, 731 Sorga, 858 El Djezair, 1042 Amazone, 1952 Hesburgh, 3066 McFadden, 3094 Chukokkala, 4418 Fredfranklin, and 5775 Inuyama. The solutions for 157 Dejanira, 630 Euphemia, 858 El Djezair, and 1952 Hesburgh are marginally secure at best.

The Palmer Divide Observatory is equipped with three telescopes, a 0.5m Ritchey-Chretien and two 0.35m SCT telescopes. The 0.5m and one 0.35m use Finger Lakes Instruments CCD cameras with Kodak 1001E chips run at –30°C and 2x2 binning. The pixel scale is approximately 2.4 arcseconds per pixel on both telescopes. The remaining 0.35m SCT uses an SBIG ST-9 and Optec focal reducer that also gives a pixel scale of approximately 2.4 arcseconds with 1x1 binning. The camera was run between –5° and –10°C. All observations made for this paper were unfiltered (Clear). Exposure times were 120–180s, all unguided.

Targets were chosen by comparing the list of known lightcurve periods maintained by Harris and Warner (Harris 2005) against a list of well placed asteroids. Asteroid are often selected with the intent of removing the observational biases against faint objects (due to size and/or distance) as well as asteroids with lightcurves of small amplitudes, long periods, or complex nature. A high priority is also given to the Hungaria group as part of a long-term study of these inner main-belt objects. The images were measured using MPO Canopus, which employs differential aperture photometry to determine the values used for analysis. The period analysis was also done within Canopus, which incorporates an algorithm based on the Fourier analysis program developed by Harris (1989).

Results are summarized in the table below. The individual plots are presented afterwards. The data and curves are presented without additional comment except when the circumstances for a given asteroid require more details. Column 3 gives the full range of dates of observations while column 4 gives the number of actual runs made during that time span. Column 5 is the range of phase angles over the full date range. If there are three values in the column, this means the phase angle reached a minimum with the middle value being the minimum. Columns 6 and 7 give the range of values for the Phase Angle Bisector (PAB) longitude and latitude respectively. Column 9 gives the period error in hours and column 11 gives the amplitude error in magnitudes.

157 Dejanira. The period of just under 16h was nearly at a 1.5:1 commensurability with the interval between observations. Fortunately, runs were sufficiently long on three occasions to put some constraints on the solution.

209 Dido. This asteroid had been previously worked by Tedesco (1979), who found a period of 8.0 hours. Behrend et al (2004), found a period of 5.736h and amplitude of 0.25m. It was worked in 2005 in hopes of providing additional data for shape modeling.

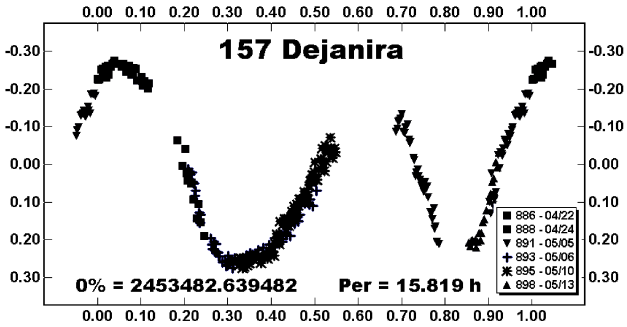
630 Euphemia. The period of 79.18h is the best fit that involved all sessions. Regardless, the fit does not appear to be very secure and so the solution must be viewed with some suspicion.

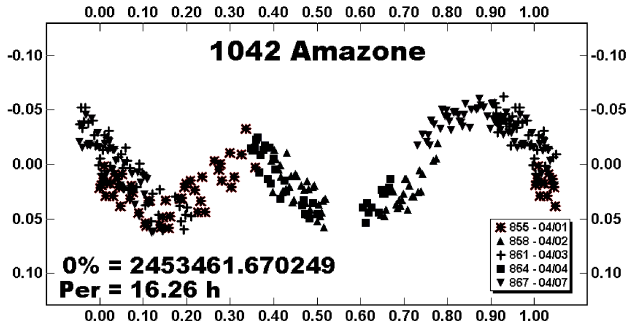
1042 Amazone. The author originally worked this asteroid in 2001 May. At that time, the period was reported on the CALL site (2004) to be 4.0h but with considerable uncertainty.

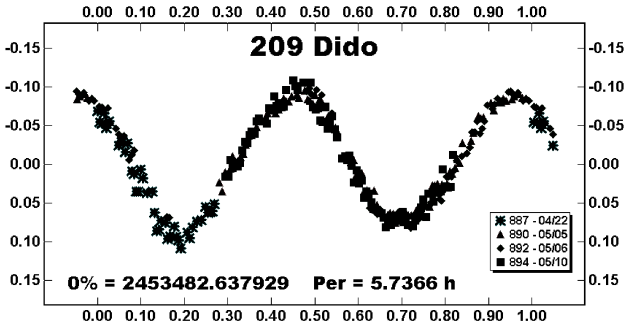
1952 Hesburgh. This was a case where the period was approximately half the interval between observation runs and so alternating parts of a bimodal curve, assuming the period is correct, were obtained on two instances of runs on consecutive nights. Since no run covered a maximum, the full amplitude of the curve could not be estimated.

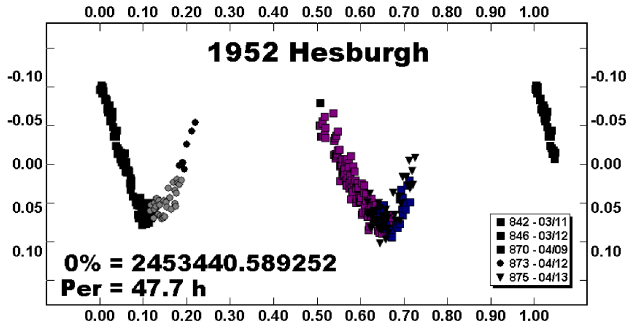
3066 McFadden. Wisniewski (1997) worked this asteroid for a single night, 1989 May 31. No period was reported but an amplitude of 0.04m was.

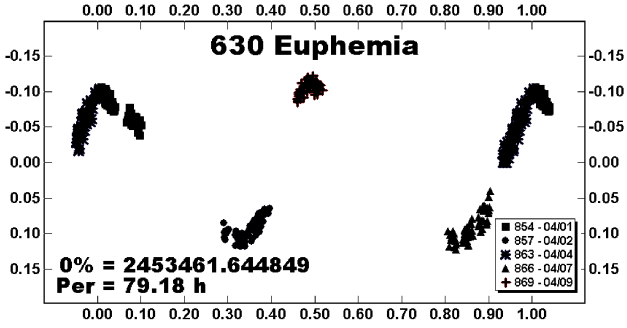
#	Name	Date Range 2005	Sess	Phase	L_{PAB}	B_{PAB}	Per (h)	PE	Amp	AE
157	Dejanira	04/22–05/13	6	19.1, 22.9	173.3, 177.0	13.3, 11.6	15.819	0.005	0.52	0.02
209	Dido	04/22–05/10	4	11.0, 15.6	181.7, 182.8	-0.9, -1.4	5.7366	0.0005	0.17	0.02
630	Euphemia	04/01–04/09	5	9.8, 11.6	185.6, 186.0	18.4, 18.3	79.18	0.2	0.2	0.02
731	Sorga	04/15–04/18	4	5.9, 6.8	189.8, 189.7	7.3, 7.1	8.184	0.005	0.52	0.02
858	El Djezair	04/19–04/20	2	7.1, 7.4	196.5	8.6	22.31	0.2	0.1	0.02
1042	Amazone	04/01–04/07	5	11.5, 12.5	158.1, 158.2	22.4, 22.0	16.26	0.02	0.10	0.02
1952	Hesburgh	03/11–04/13	5	10.2, 16.6	146.5, 148.5	16.3, 15.6	47.7	0.1	>0.18	0.02
3066	McFadden	06/07–07/01	7	9.7, 15.6	248.4, 249.0	19.5, 19.3	13.798	0.002	0.13	0.02
3094	Chukokkala	04/19–05/13	5	6.7, 15.6	199.6, 200.7	9.7, 11.0	8.3711	0.0004	0.33	0.02
4418	Fredfranklin	07/02–07/11	4	10.3, 11.1	281.0, 281.6	17.4, 17.6	4.8190	0.0006	0.24	0.02
5775	Inuyama	07/05–07/11	3	8.9, 10.2	278.2, 278.5	15.1	4.8345	0.0007	0.57	0.02

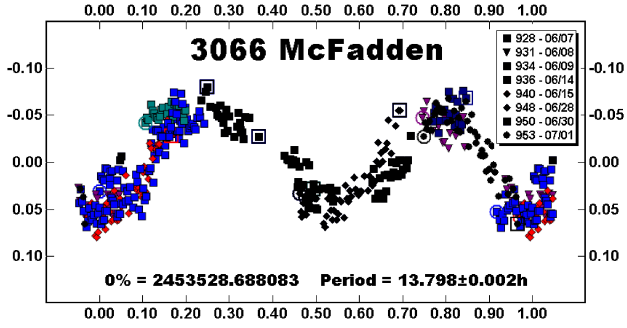


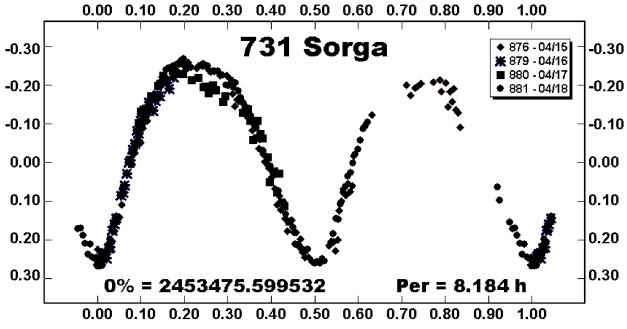


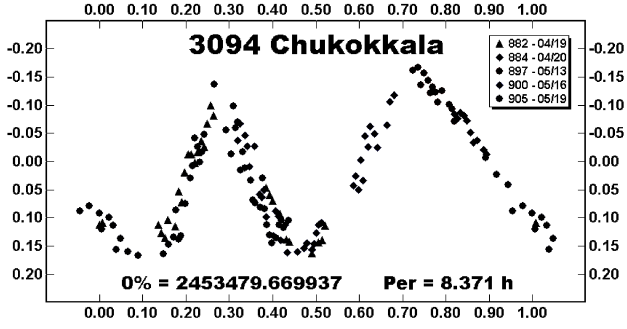


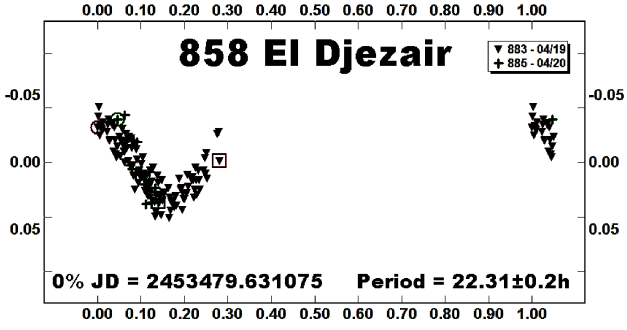


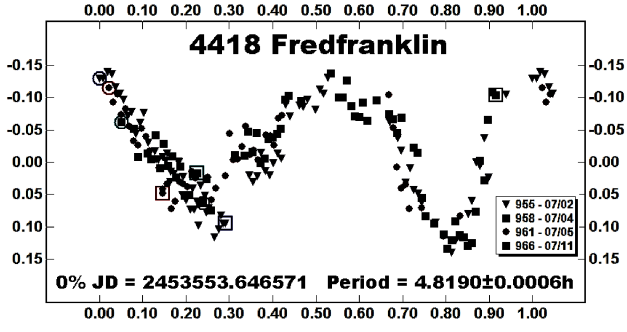


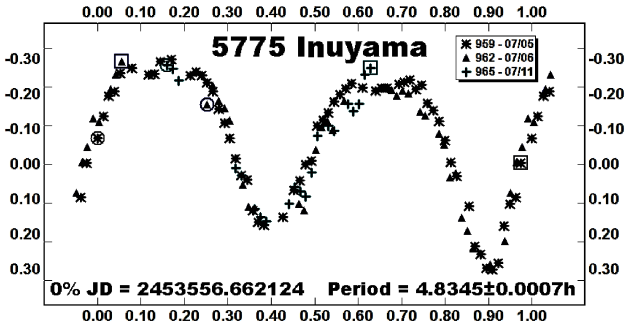












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THE MINOR PLANET OBSERVER: A BUSY SUMMER

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It happens every year: I go to the Society for Astronomical Science's (SAS) annual symposium in Big Bear, CA, and end up wanting to do even more things despite the fact I don't have enough time to do half of what I'm trying to do. The meeting this past May was particularly filled with temptations this year. I felt like the little kid peering into the candy shop window.

One of the highlights of the meeting was the presentation by Valerie Desnoux and Christian Buil. Christian, of course, is one of the experts on CCD imaging in the world, having written a classic book on the topic. He and Valerie are part of the Astronomical Ring for Access to Spectroscopy (ARAS). You can find the web site at http://astrosurf.com/aras/index1.htm. The group is dedicated to promoting spectroscopy by those with modest equipment. The work that is being done is nothing less than spectacular. Valerie and Christian's paper concerned Be Stars, bright hot stars with emission spectra.

Their talk was preceded by a mini-workshop by David Bradstreet, author of Binary Maker 3, which is a modeling tool that converts lightcurves of binary stars in to models. It never ceases to amaze me that so much can be learned from merely analyzing the change of light from an object over time. I know these are not related to asteroids but every once in awhile it's refreshing to look to other areas were smaller observatories can and are making strong contributions to science.

Of course, asteroids were not overlooked at the meeting. Petr Pravec traveled from the Czech Republic to present a paper on a study he and a group of others (OK, I'll say it – some are "amateurs") have been doing on binary asteroids, in particular those among the Near Earth Asteroid (NEA) population. Some very interesting findings have been made as a result of the study. A large paper is being prepared for publication in *Icarus* and some of the findings were presented at the Asteroids, Comets, and Meteors (ACM2005) meeting in Brazil in August. The initial study was expanded to cover inner main belt asteroids as well, i.e., Hungarias, Floras, and "Vestoids". Including these, especially the binary members found in recent years, yielded even more information for those studying the dynamics and evolution of asteroids.

There were also updates from Lance Benner from the Jet Propulsion Laboratory regarding radar imaging of asteroids. Support from the lightcurve and astrometry communities is critical to the success of the radar efforts. High-precision astrometry is need to confirm the predicted positions for pointing the Goldstone and Arecibo telescopes while lightcurve work can often confirm findings, e.g., binary asteroids, or determine that the asteroid is spinning too slowly to get good measurements. In the latter case, another target might be selected in order to maximize the results from limited observing time.

If you'd like to read the papers from the SAS meeting, you can go on-line at http://www.SocAstroSci.org. The proceedings are available as a large PDF. What you'll find in those is just some of many possibilities for contributing to science with even humble equipment. I know I've harped on this topic before but after attending meetings such as the SAS symposium, it's hard to imagine not wanting to do research with all the wonderful equipment that's available these days. The meeting refreshes my resolve to keep up my work, which has been concentrating on the Hungaria family (or group) at the urging of Alan Harris for the past couple of years.

Among the first of the Hungarias I measured was 70030 Margaretmiller, which I happened to discover and is named after my wife. How many of us get the opportunity to both find and name an asteroid for a spouse or close friend and then measure its