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# PHOTOMETRY OF FIVE DIFFICULT ASTEROIDS: 309 FRATERNITAS, 366 VINCENTINA, 421 ZAHRINGIA, 578 HAPPELIA, 959 ANNE

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Lightcurves for five difficult asteroids studied at the Sunflower Observatory. These are objects for which less than perfect solutions were derived. However, further study at this time is not possible. Period and amplitude solutions at this point are as follows:

| | |
|---|---|
| 309 Fraternitas | 13.2 ± 0.1h and 0.13 ± 0.03m |
| 366 Vincentina | 15.5 ± 0.1h and 0.11 ± 0.03m |
| 421 Zähringia | 15.5 ± 0.1h and 0.15 ± 0.03m |
| 578 Happelia | 10.00 ± 0.05h and 0.27 ± 0.02m |
| 959 Arne | 8.60 ± 0.1h and 0.35 ± 0.02m |

Sunflower Observatory is located in Olathe, Kansas and is a participant in the Center for Asteroid Physical Studies (CAPS). Target selection is made from the Collaborative Asteroid Lightcurve Link (CALL) web site "List of Potential Lightcurve Targets" (Warner 2001).

Procedures and instrumentation used are described in Robinson (2001). Camera temperature during these runs was –10 to –25°C. Canopus software is used to measure the images and determine best fit of a lightcurve to the data. More information on this software may be obtained at http://www.MinorPlanetObserver.com. Resultant lightcurves for five difficult asteroids are presented. These were less than perfect solutions, but further study at this time is not possible. This report shares the data derived so far on these five objects.

## 309 Fraternitas

Discovered 1891 April 6 by J. Palisa at Vienna. This is the Latin word for fraternity. The asteroid was named to commemorate the 25th anniversary of the Maturitaetspruefung Fraternity. With H = 10.4, this asteroid is probably 21-52 km in diameter. A total of 235 observations were collected over five different nights, September 2 and 3 and October 16, 18, and 20, 2001. The period of the lightcurve was determined to be 13.2 ± 0.1h and the amplitude 0.13 ± 0.03m. There is a small gap at one minimum so the coverage is not complete.

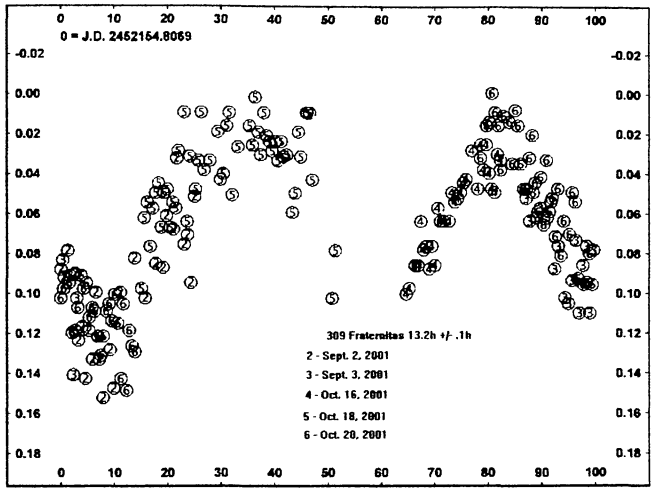


Fig. 1. The lightcurve plot for 309 Fraternitas. The derived period is 13.2 ± 0.1h and the amplitude 0.13 ± 0.03m.

## (366) Vincentina

This minor planet was discovered March 21, 1893 by A. Charlois at Nice. It was named by the orbit computer Prof. G. Boccardi to honor the Italian astronomer Vincenzo Cerulli (1859-1927). Boccardi worked for many years in the private observatory of Cerulli in Teramo. With H = 8.5, this asteroid is probably 50 -120 km in diameter. Eight different sessions were conducted on this object, but only data from five nights were useful. A total of 246 observations were acquired on September 22, October 17 and 19, and November 5 and 10, 2001, providing complete coverage of the light curve. The period of 366 Vincentina was found to be 15.5 ± 0.1h and the amplitude 0.11 ± 0.03m.

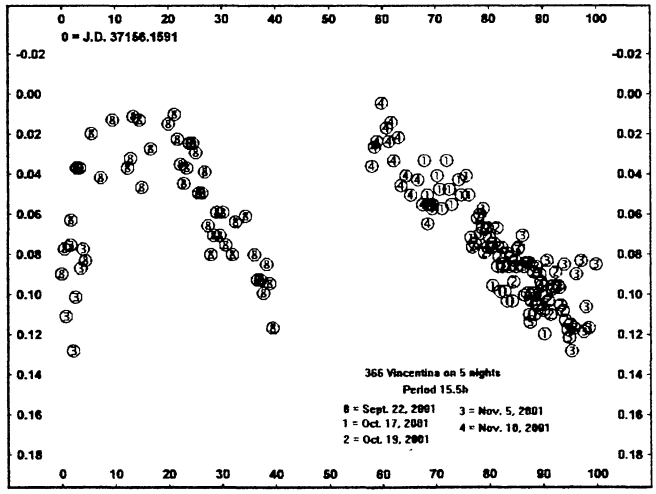


Fig. 2. The lightcurve plot for 366 Vincentina. The derived period is 15.5 ± 0.1h and the amplitude 0.11 ± 0.03m.

## (421) Zähringia

This minor planet was discovered September 7, 1896 by M. Wolf at Heidelberg. It was named for a family of Grand Dukes of Baden. With H = 11.78, this asteroid is probably 12 – 27 km in diameter. Several nights of data collected on this object were so noisy as to be unusable. From the useful nights of data a total of 264 observations were made on August 17, 26, and 29, September 13 and 22, and October 17, 2001, but not covering the entire lightcurve. In addition data was provided by Robert Stephens and



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Brian Warner, but not used in the final solution. The period of the lightcurve was determined to be 15.5 ± 0.1h and the amplitude 0.15 ± 0.32m. This is a relatively weak solution and requires further study.

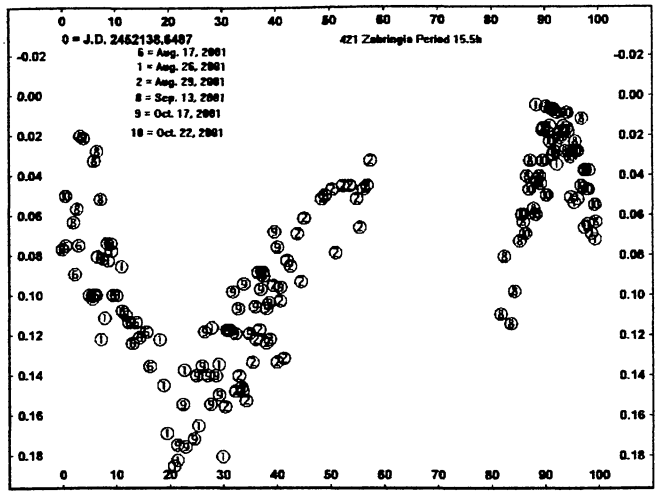


Fig. 3. The lightcurve plot for 421 Zähringia. The derived period is 15.5 ± 0.1h and the amplitude 0.15 ± 0.03m.

(578) Happelia

This minor planet was discovered November 1, 1905 by M. Wolf at Heidelberg. It was named in honor of Carl Happel (1820-1914), painter and great benefactor to the Heidelberg Observatory. From his financial support the Happel-Labor on the Königstuhl was erected. With H = 9.2, this asteroid is probably 38 - 88 km in diameter. Ten different sessions were conducted on this object, but only data from six nights were useful. A total of 325 observations were acquired on October 16, 17, 18, 20, November 16, and December 2, 2001 yet still there was a significant gap in the light curve. The period of Happelia was found to be 10.00 ± 0.05h and the amplitude 0.27 ± 0.02m.

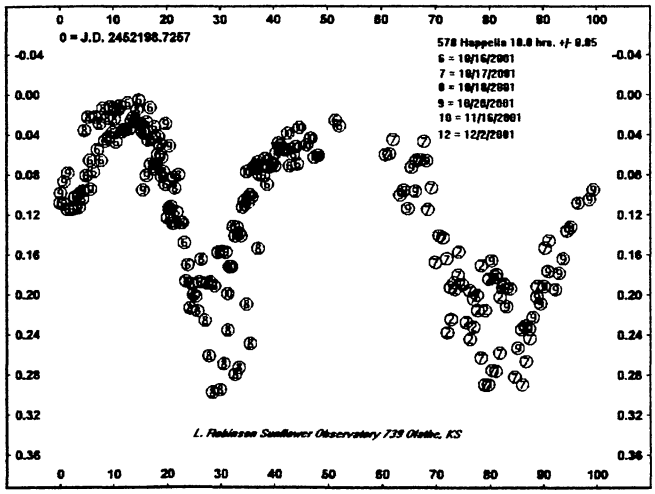


Fig. 4. The lightcurve plot for 578 Happelia. The derived period is 10.00 ± 0.05h and the amplitude 0.27 ± 0.02m.

(959) Arne

This minor planet was discovered 1921 September 30 by K. Reinmuth at Heidelberg. It was named in honor of a son of B. Asplind. With H = 10.2, this asteroid is probably 23 – 57 km in diameter. Twelve different sessions were conducted on this object, but only data from six nights were useful. A total of 249 observations were acquired on November 11, December 7, 8, 18, 20, and 21, 2001 yielding full coverage of the lightcurve. The period of 959 Arne was found to be 8.60 ± 0.1h and the amplitude 0.35 ± 0.02m.

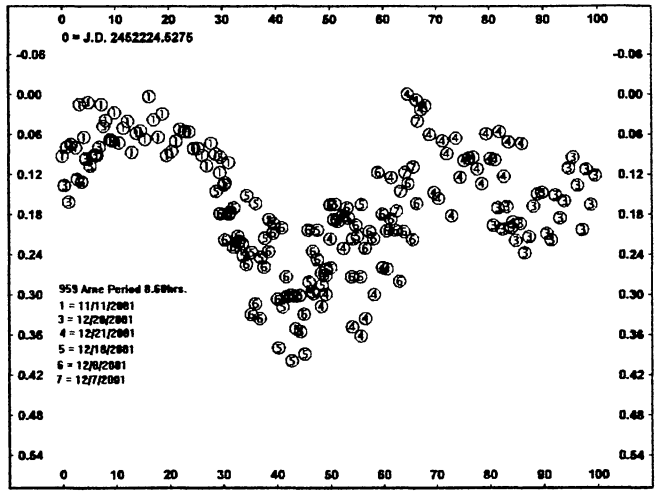


Fig. 5. The lightcurve plot for 959 Arne. The derived period is 8.60 ± 0.1h and the amplitude 0.35 ± 0.02m.

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