

COLLABORATIVE ASTEROID PHOTOMETRY FROM UAI: 2019 OCTOBER-DECEMBER

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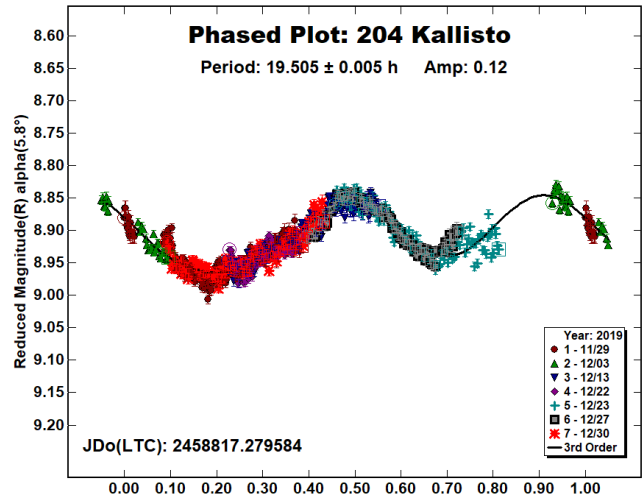
(Received: Revised:)

Photometric observations of six main-belt and one near-Earth asteroids were made in order to acquire lightcurves for shape/spin axis models. The synodic period and lightcurve amplitude were found for: 204 Kallisto: 19.505 ± 0.005 h, 0.12 mag; 459 Signe: 5.3555 ± 0.0003 h, 0.32; 563 Suleika: 5.6656 ± 0.0004 h, 0.13; 773 Irmintraud: 6.7484 ± 0.0008 h, 0.05 mag; 1060 Magnolia: 2.9102 ± 0.0006 h, 0.11 mag; 3533 Toyota: 2.9816 ± 0.0004 h, 0.15 mag; (162082) 1998 HL1: 9.50 ± 0.02 h, 0.19 mag.

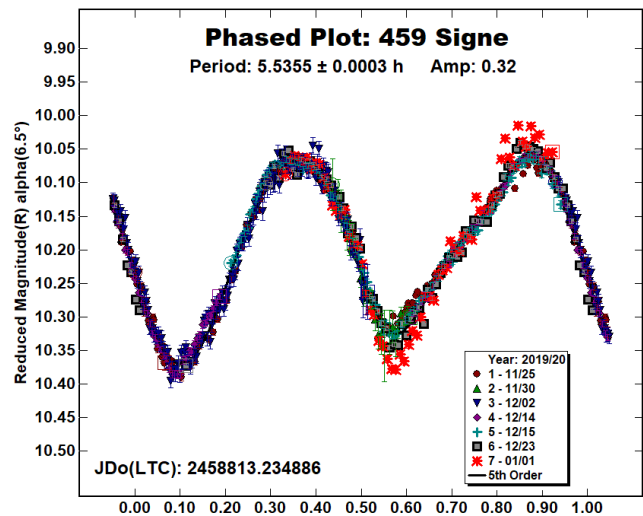
Collaborative asteroid photometry was made inside the UAI (Italian Amateur Astronomers Union) group. The targets were selected mainly in order to acquire lightcurves for shape/spin axis models. The CCD observations were made in 2019 October-early 2020 January using the instrumentation described in the Table I. Lightcurve analysis was performed at the Balzaretto Observatory with *MPO Canopus* (BDW Publishing, 2016). All the images were calibrated with dark and flat frames and converted to R magnitudes using solar colored field stars from CMC15 catalogue,

distributed with *MPO Canopus*. Table II shows the observing circumstances and results.

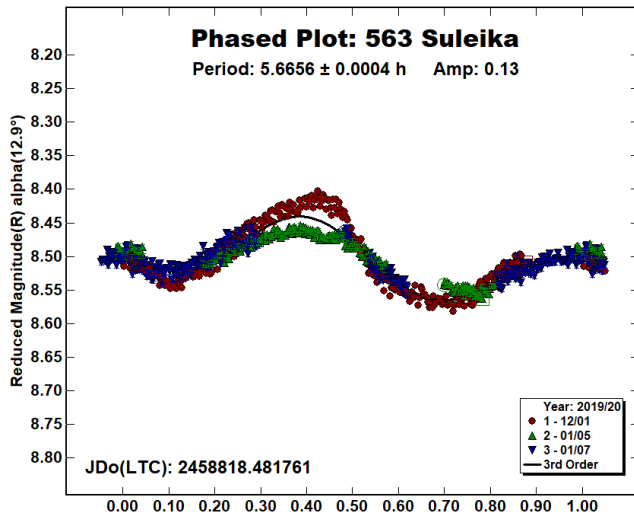
204 Kallisto is an S-type middle main-belt asteroid discovered on 1879 October 08 by J. Palisa at Pola. Collaborative observations were made over seven nights by G. Scarfi. We found a synodic period of $P = 19.505 \pm 0.005$ h with an amplitude $A = 0.12 \pm 0.03$ mag. The period is close to the previously published results by F. Pilcher (Pilcher, 2010).



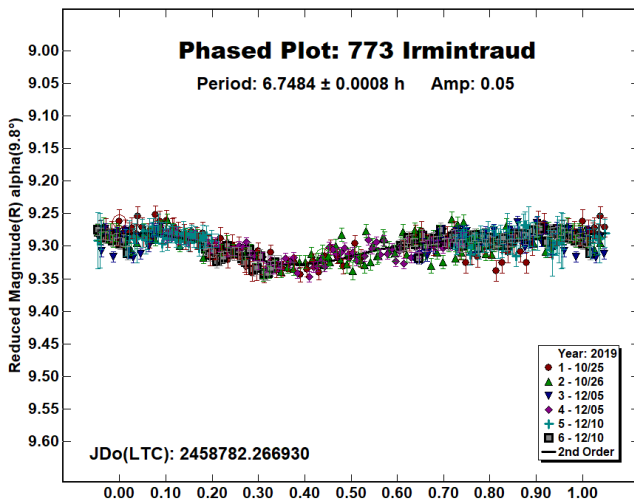
459 Signe is an S-type middle main-belt asteroid discovered on 1900 October 22 by M. Wolf at Heidelberg. Observations were made over seven nights. We found a synodic period of $P = 5.3555 \pm 0.0003$ h with an amplitude $A = 0.32 \pm 0.03$ mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009).



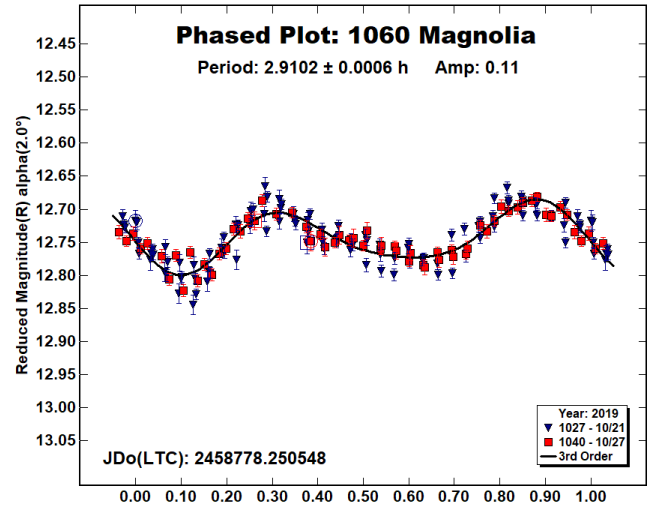
563 Suleika is an SI-type (Bus & Binzel, 2002) outer main-belt asteroid discovered on 1905 April 6 by P. Gotz, at Heidelberg. Collaborative observations were made over three nights. We found a synodic period of $P = 5.6656 \pm 0.0004$ h with an amplitude $A = 0.13 \pm 0.04$ mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009).



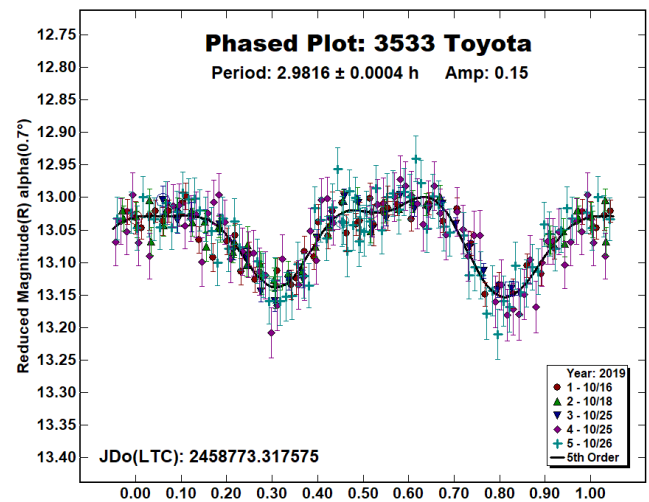
773 Irmintraud is an T-type (Bus & Binzel, 2002) outer main-belt asteroid discovered on 1913 December 22 by F. Kaiser at Heidelberg. Collaborative observations were made over four nights. We found a synodic period of $P = 6.7484 \pm 0.0008$ h with a low amplitude $A = 0.05 \pm 0.02$ mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009).



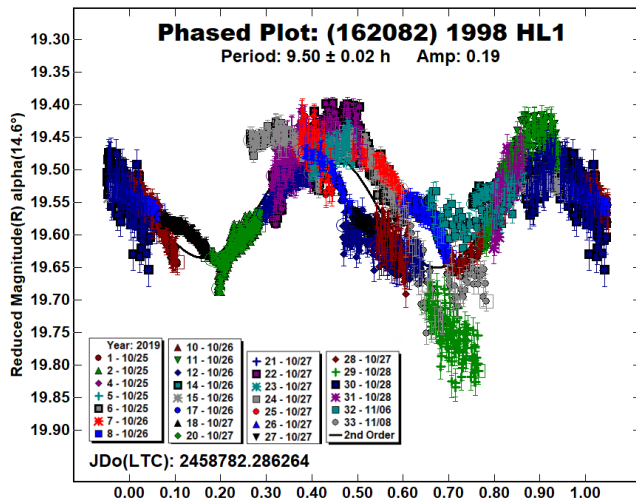
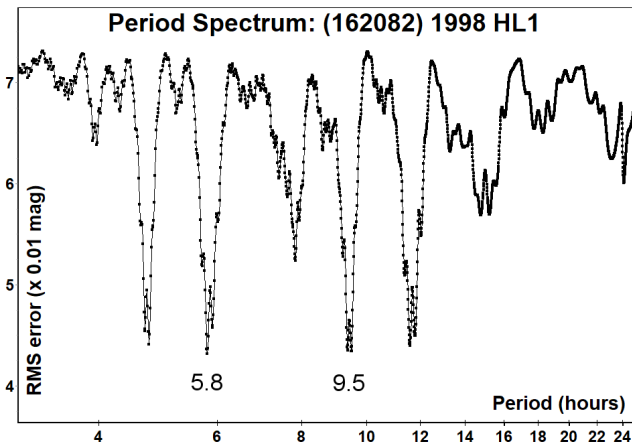
1060 Magnolia is a medium albedo inner main-belt asteroid, member of the Flora family; was discovered on 1925 August 13 by K. Reinmuth at Heidelberg. Observations were made over two nights by A. Marchini. We found a synodic period of $P = 2.9102 \pm 0.0006$ h with an amplitude $A = 0.11 \pm 0.03$ mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009).



3533 Toyota is an Xk-type (Bus & Binzel, 2002) inner main-belt asteroid, member of the Flora family; was discovered on 1986 October 30 by K. Suzuki and T. Urata at Toyota. Collaborative observations were made over four nights. We found a synodic period of $P = 2.9816 \pm 0.0004$ h with an amplitude $A = 0.15 \pm 0.03$ mag. The period is close to the previously published results in the asteroid lightcurve database (LCDB; Warner et al., 2009).



(162082) 1998 HL1 is an Amor near-Earth asteroid, classified as PHA; was discovered on 1998 April 18 by LINEAR at Socorro. Collaborative observations were made over six nights, starting with his close approach to the Earth on 2019 October 25. The period spectrum shows several solutions between 4 and 12 hours with almost the same strength. The prominent solutions are one monomodal, near 5.8 hours, and another one bimodal, near 9.5 hours. This last one with a synodic period of $P = 9.50 \pm 0.02$ h with an amplitude $A = 0.19 \pm 0.07$ mag. The period is significantly different to the solution published by Carreño et al. (2020; 3.024 ± 0.003 h). The lightcurve shows some variations in phase and amplitude that could be due to the tumbling behaviour of this asteroid.



References

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| Observatory (MPC code) | Telescope | CCD | Filter | Observed Asteroids |
|--------------------------------|--------------------|--------------------------|--------|------------------------------|
| Balzaretto Observatory (A81) | 0.20-m SCT $f/5.0$ | SBIG ST8-XME | C | 563 |
| DSFTA Observatory (K54) | 0.30-m MCT $f/5.6$ | SBIG STL-6303e(bin 2x2) | Rc, C | 459, 563, 1060, 3533, 162082 |
| Iota Scorpii (K78) | 0.40-m RCT $f/8.0$ | SBIG STXL-6303e(bin 2x2) | Rc | 204, 773, 3533 |
| GAMP(104) | 0.60-m NRT $f/4.0$ | Apogee Alta | C | 773, 162082 |
| El Sauce Observatory (X02) | 0.60-m CDK $f/6.5$ | FLI PL 9000 | C | 162082 |
| GiaGa Observatory (203) | 0.36-m SCT $f/5.8$ | Moravian G2-3200 | Rc | 459 |
| Filzi School Observatory | 0.35-m RCT $f/8.0$ | QHY9 (KAF8300) | Rc | 459 |
| M57 (K38) | 0.30-m RCT $f/5.5$ | SBIG STT-1603 | C | 773 |
| WBRO (K49) | 0.235-m SCT $f/10$ | SBIG ST8-XME | Rc | 773 |
| G.Pascoli (K63) | 0.40-m NRT $f/3.2$ | QHY22 C 1318 | C | 162082 |
| GAV | 0.20-m SCT $f/6.3$ | SXV-H9 | Rc | 459 |
| Hypatia Observatory | 0.25-m NRT $f/4.9$ | SBIG ST8-XE | C | 563 |
| Cherryvalley Observatory (I83) | 0.20-m SCT $f/7.1$ | SBIG STL-1301 | Rc | 162082 |

Table I. Observing Instrumentations. CDK: Corrected Dall-Kirkham, MCT: Maksutov-Cassegrain, NRT: Newtonian Reflector, RCT: Ritchey-Chretien, SCT: Schmidt-Cassegrain.

| Number | Name | 20yy/mm/dd | Phase | L_{PAB} | B_{PAB} | Period(h) | P.E. | Amp | A.E. | Grp |
|--------|------------|-------------------|---------------|-----------|-----------|-----------|--------|------|------|------|
| 204 | Kallisto | 19/11/29-19/12/30 | 5.5,14.5 | 52 | -5 | 19.505 | 0.005 | 0.12 | 0.03 | MB-M |
| 459 | Signe | 19/11/25-20/01/01 | 6.7,16.7 | 70 | 10 | 5.3555 | 0.0003 | 0.32 | 0.03 | MB-M |
| 563 | Suleika | 19/12/01-20/01/07 | 12.9,1.0,7.9 | 92 | 1 | 5.6656 | 0.0004 | 0.13 | 0.04 | MB-O |
| 773 | Irmintraud | 19/10/25-19/12/10 | 10.0,12.9 | 47 | 21 | 6.7484 | 0.0008 | 0.05 | 0.02 | MB-O |
| 1060 | Magnolia | 19/10/21-19/10/27 | 2.5,0.9,1.6 | 31 | 2 | 2.9102 | 0.0006 | 0.11 | 0.03 | FLOR |
| 3533 | Toyota | 19/10/16-19/10/26 | 1.1,0.5,5.1 | 24 | -1 | 2.9816 | 0.0004 | 0.15 | 0.03 | FLOR |
| 162082 | 1998 HL1 | 19/10/25-19/11/08 | 14.5,1.2,44.8 | 36 | -16 | 9.50 | 0.02 | 0.19 | 0.07 | NEA |

Table II. Observing circumstances and results. The first line gives the results for the primary of a binary system. The second line gives the orbital period of the satellite and the maximum attenuation. The phase angle is given for the first and last date. If preceded by an asterisk, the phase angle reached an extrema during the period. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009b).

