

# COLLABORATIVE ASTEROID PHOTOMETRY FROM UAI: 2023 JULY-SEPTEMBER

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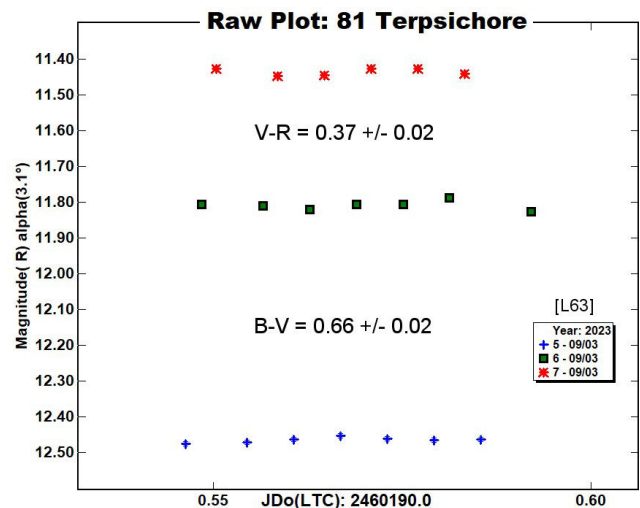
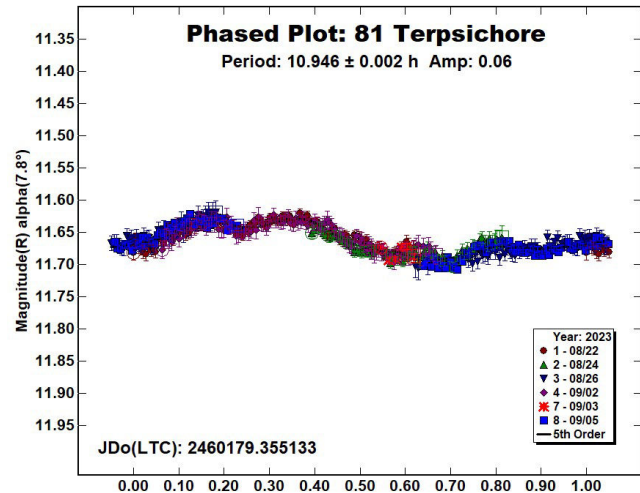
(Received: 2023 October 12)

Photometric observations of nine asteroids were made in order to acquire lightcurves for shape/spin axis modeling. Lightcurves were acquired for 81 Terpsichore, 238 Hypatia, 773 Irmintraud, 862 Franzia, 894 Erda, 914 Palisana, 2763 Jeans, 5766 Carmelofalco, and (458732) 2011 MD5.

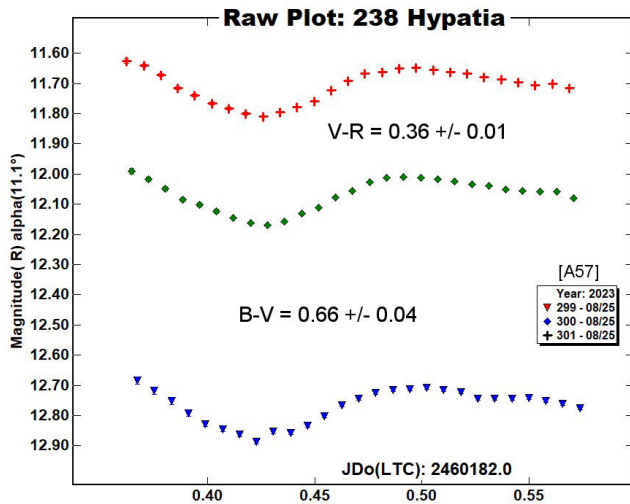
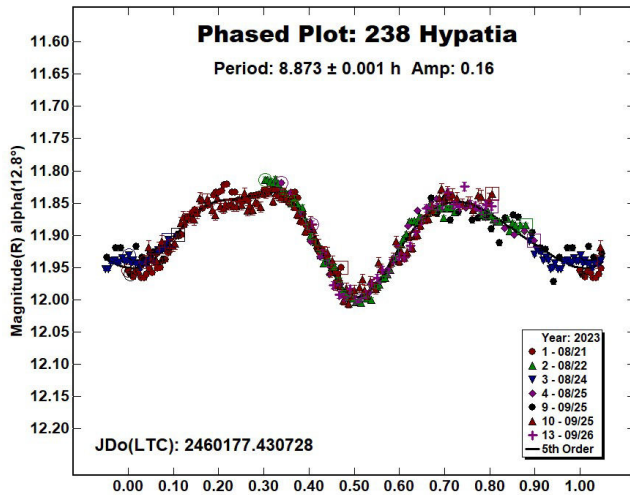
Collaborative asteroid photometry was done inside the Italian Amateur Astronomers Union (UAI; 2023) group. The targets were selected mainly in order to acquire lightcurves for shape/spin axis modeling. Table I shows the observing circumstances and results.

The CCD observations of nine asteroids were made in 2023 July - September using the instrumentation described in the Table II. Lightcurve analysis was performed at the Balzaretto Observatory with *MPO Canopus* (Warner, 2021). All the images were calibrated with dark and flat frames and converted to standard magnitudes using solar colored field stars from CMC15 and ATLAS catalogues, distributed with *MPO Canopus*. For brevity, the following citations to the asteroid lightcurve database (LCDB; Warner et al., 2009) will be summarized only as "LCDB".

81 Terpsichore is a Cb-type (Bus and Binzel, 2002) outer main-belt asteroid. Collaborative observations were made over five nights. The period analysis shows a synodic period of  $P = 10.946 \pm 0.002$  h with an amplitude  $A = 0.06 \pm 0.01$  mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by M. Iozzi (L63) on 2023 September 3. We found  $B-V = 0.66 \pm 0.02$  and  $V-R = 0.37 \pm 0.02$ , which are consistent with a C-type asteroid (Shevchenko and Lupishko, 1998).

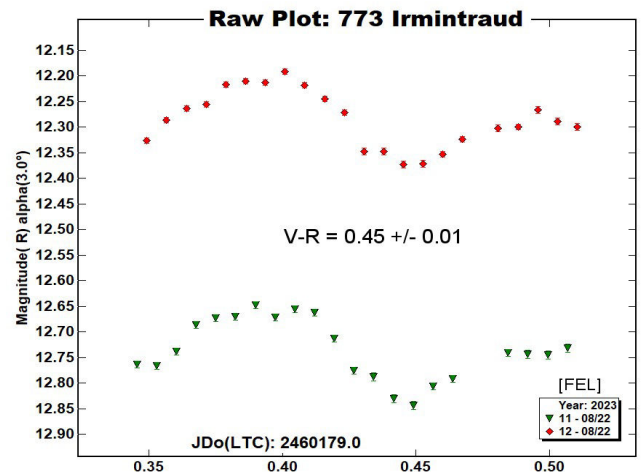
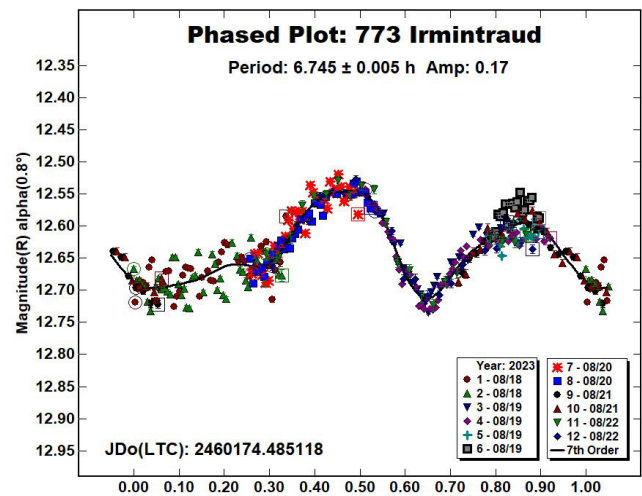


**238 Hypatia** is a Ch-type (Bus and Binzel, 2002) outer main-belt asteroid. Collaborative observations were made over six nights. The period analysis shows a synodic period of  $P = 8.873 \pm 0.001$  h with an amplitude  $A = 0.16 \pm 0.03$  mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by N. Montigiani and M. Mannucci (A57) and by G. Baj (K38), respectively on 2023 August 25 and 2023 September 25-26. We found  $B-V = 0.66 \pm 0.04$  and  $V-R = 0.36 \pm 0.01$  as the average of three values. These color indices are consistent with a C-type asteroid (Shevchenko and Lupishko, 1998).

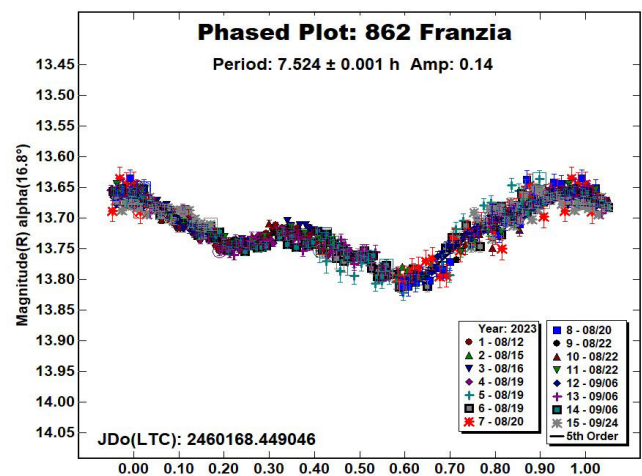


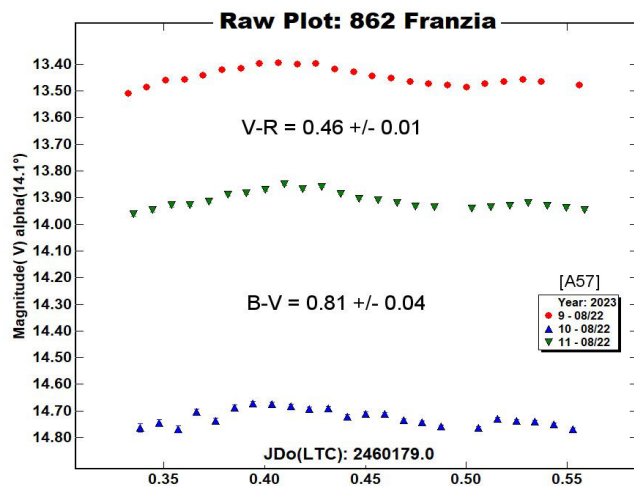
**773 Irmintraud** is a T-type (Bus and Binzel, 2002) outer main-belt asteroid. Collaborative observations were made over six nights. The period analysis shows a synodic period of  $P = 6.745 \pm 0.005$  h with an amplitude  $A = 0.17 \pm 0.03$  mag. The period is close to the previously published results in the LCDB.

Multiband photometry was made by P. Fini and G. Betti (L73) and by P. Aceti and M. Banfi, respectively, on 2023 August 17-20 and 2023 August 21-22. We found  $V-R = 0.45 \pm 0.01$  as the average of six values. This color index is consistent with T-type asteroid (Pravec, 2012).



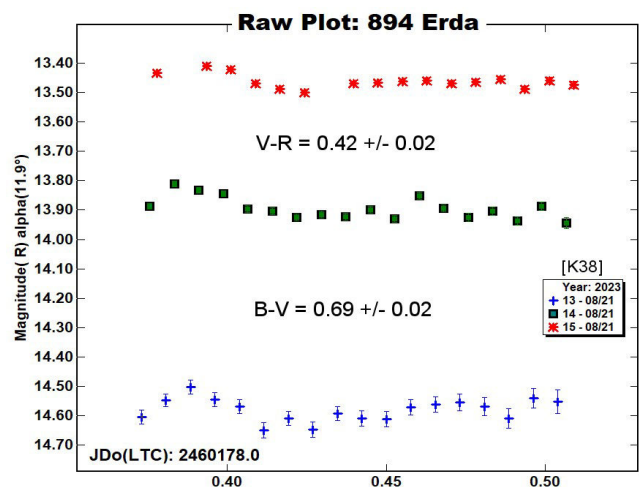
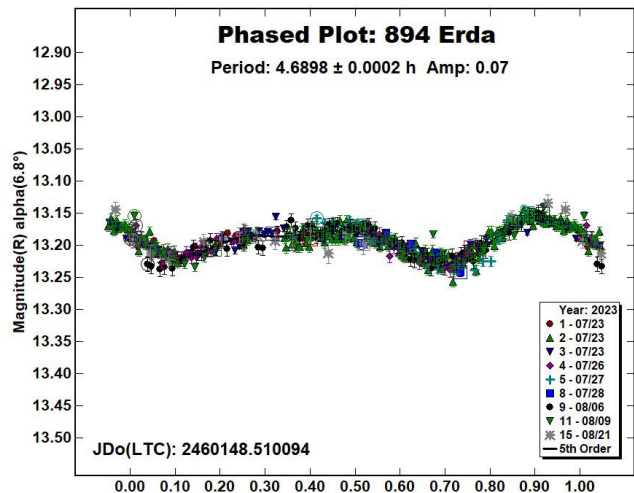
**862 Franzia** is a S-type (Bus and Binzel, 2002) middle main-belt asteroid. Collaborative observations were made over eight nights. The period analysis shows a synodic period of  $P = 7.524 \pm 0.001$  h with an amplitude  $A = 0.14 \pm 0.03$  mag.





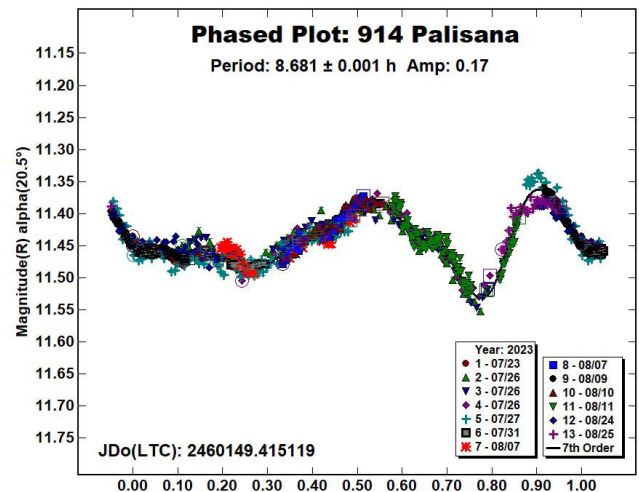
The period is close to the previously published results in the LCDB. Multiband photometry was made by N. Montigiani and M. Mannucci (A57) and by G. Baj (K38), respectively (BVR) on 2023 August 22 and (VR) 2023 August 19-20, September 7. We found  $B-V = 0.81 \pm 0.04$  and  $V-R = 0.46 \pm 0.01$ , this last as the average of four values. These color indices are consistent with a S-type asteroid (Shevchenko and Lupishko, 1998).

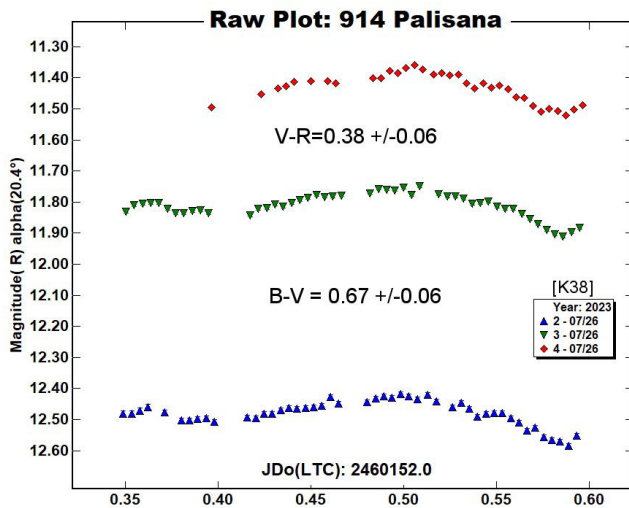
894 Erda is a low-medium albedo outer main-belt asteroid. Collaborative observations were made over seven nights. The period analysis shows a synodic period of  $P = 4.6898 \pm 0.0002$  h with an amplitude  $A = 0.07 \pm 0.02$  mag.



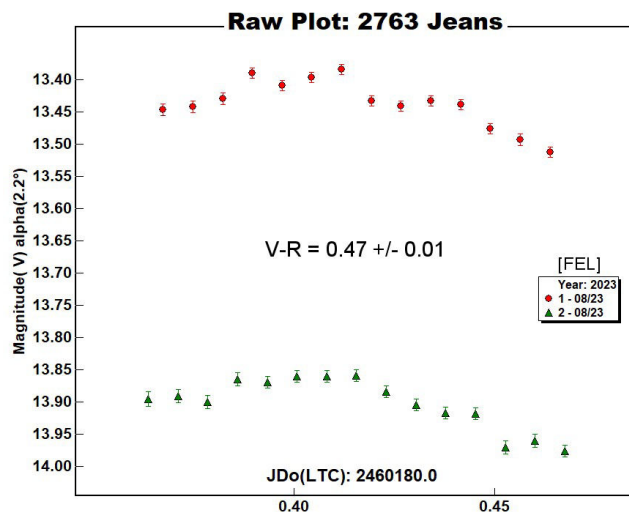
The period is close to the previously published results in the LCDB. Multiband photometry was made by M. Iozzi (L63) and by G. Baj (K38), respectively on 2023 July 28 and 2023 August 21. We found  $B-V = 0.69 \pm 0.02$  and  $V-R = 0.42 \pm 0.02$  as the average of a pair of two values. These color indices are close to M-type asteroid (Shevchenko and Lupishko, 1998).

914 Palisana is a CU-type (Tholen, 1984) inner main-belt asteroid. Collaborative observations were made over nine nights. The period analysis shows a synodic period of  $P = 8.681 \pm 0.001$  h with an amplitude  $A = 0.17 \pm 0.03$  mag. The period is close to the previously published results in the LCDB. Multiband photometry was made by G. Baj (K38) on 2023 July 26. We found  $B-V = 0.67 \pm 0.06$  and  $V-R = 0.38 \pm 0.05$ , which are close to C-type asteroid (Shevchenko and Lupishko, 1998).

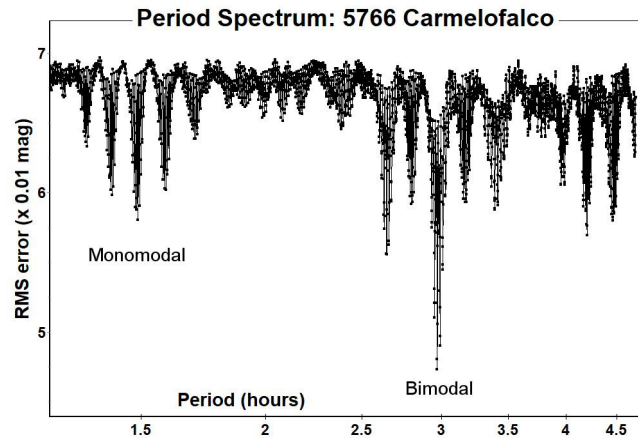
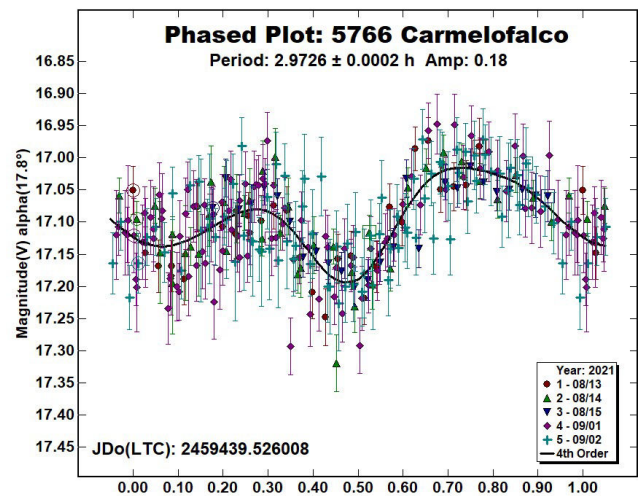




2763 Jeans is a V-type (Bus and Binzel, 2002) inner main-belt asteroid. Multiband photometry was made by P. Aceti and M. Banfi and M. Iozzi (L63), respectively on 2023 August 23 and 2023 September 3. We found  $V-R = 0.47 \pm 0.01$  as the average of two values. This color index is consistent with V-type asteroid (Pravec, 2012).



5766 Carmelofalco is a high albedo inner main-belt asteroid. Observations were made over five nights by C. Falco and A. Nastasi (L34). We found a bimodal solution with a synodic period of  $P = 2.9726 \pm 0.0002$  h with an amplitude  $A = 0.18 \pm 0.06$  mag. For this asteroid, no periods were found in the LCDB.

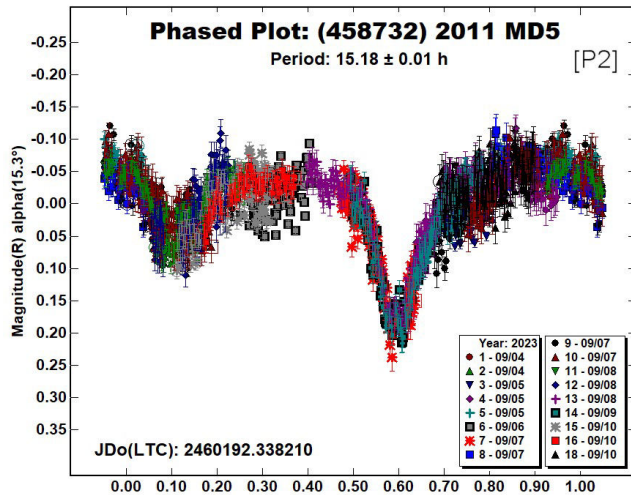
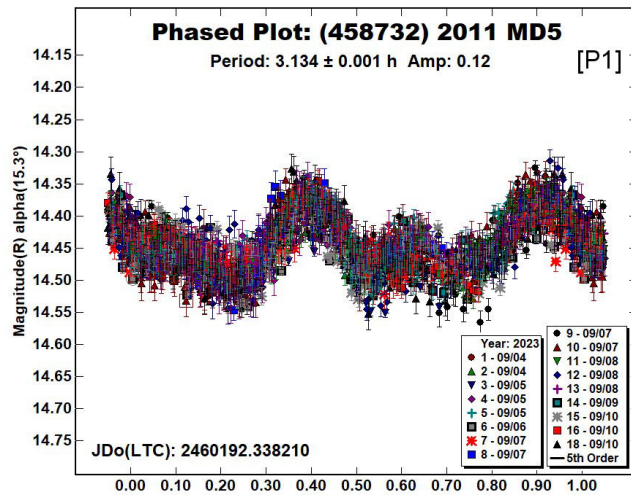
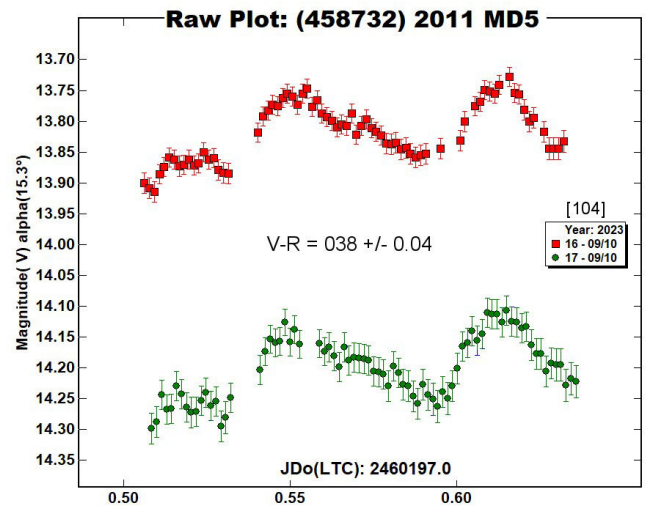
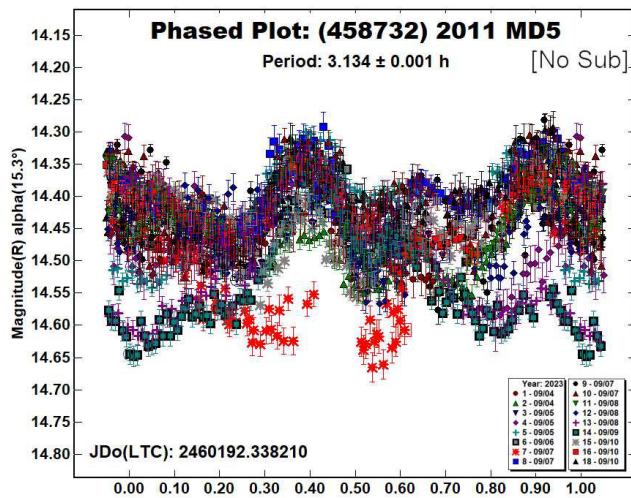


(458732) 2011 MD5 is an Apollo Near-Earth asteroid. Collaborative observations were made over seven nights, before its close approach to the Earth. The first observed lightcurves showed some anomalous attenuations which let us to hypothesize its binary nature. This hypothesis became certainty when we read the CBET 5287, published on August 24 by P. Pravec et al. (2023).

The analysis was done using the dual-period search function implemented in *MPO Canopus*. We found a primary synodic rotational period of  $P_1 = 3.134 \pm 0.001$  h with an amplitude  $A_1 = 0.12 \pm 0.06$  mag and an orbital period  $P_2 = 15.18 \pm 0.01$  h with an amplitude  $A_2 = 0.20 \pm 0.03$ . The deep drop of the secondary eclipse,  $0.09 \pm 0.03$ , gives a lower limit to secondary-to-primary mean-diameter ratio of  $D_s/D_p$  of  $0.29 \pm 0.05$ . These results are in agreement with those published by Pravec et al. (2023) and confirm the binary nature of this asteroid.

Multiband photometry was made by P. Bacci and M. Maestriepieri (104) on 2023 September 10, deriving a color index  $V-R = 0.38 \pm 0.04$ , which is consistent with a C-type asteroid (Shevchenko and Lupishko, 1998).





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Number	Name	2023 mm/dd	Phase	L <sub>PAB</sub>	B <sub>PAB</sub>	Period(h)	P.E.	Amp	A.E.	Grp
81	Terpsichore	08/22-09/05	7.8, 1.9	345	-3	10.946	0.002	0.06	0.01	MB-O
238	Hypatia	08/21-09/26	*12.7, 2.1	358	3	8.873	0.001	0.16	0.03	MB-O
773	Irmintraud	08/17-08/22	0.3, 2.5	323	0	6.745	0.005	0.17	0.03	MB-O
862	Franzia	08/12-09/24	16.7, 7.1	0	15	7.524	0.001	0.14	0.03	MB-M
894	Erda	07/23-08/21	13.8, 12.1	216	4	4.6898	0.0002	0.07	0.02	MB-O
914	Palisana	07/23-08/25	20.4, 22.7	313	32	8.681	0.001	0.17	0.03	MB-I
2763	Jeans	08/23-09/03	2.1, 8.5	328	2					MB-I
5766	Carmelofalco	2021/08/13-09/02	17.8, 8.8	354	-4	2.9726	0.0002	0.18	0.06	MB-I
458732	2011 MD5	09/04-09/10	9.2, 8.2	206	6	3.134	0.001	0.12	0.06	NEA
						15.18	0.01	0.20	0.03	

Table I. 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<sub>PAB</sub> and B<sub>PAB</sub> 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., 2009).

Observatory (MPC code)	Telescope	CCD	Filter	Observed Asteroids (#Sessions)
Iota Scorpii (K78)	0.40-m RCT f/8.0	SBIG STXL-6303e (bin 2x2)	C, Rc	894 (2), 914 (1), 862 (3), 238 (3), 458732 (3)
M57 (K38)	0.35-m RCT f/5.5	SBIG STT1603ME	C, B, V, Rc	894 (2), 914 (1), 862 (3), 238 (2), 458732 (3)
HOB Astronomical Observatory (L63)	0.20-m SCT f/6.0	ATIK 383L+	C, B, V, Rc	894 (3), 914 (3), 2763 (1), 81 (1), 458732 (2)
Zen Observatory (M26)	0.30-m RCT f/7.4	ATIK 383L+	C, Rc	914 (2), 862 (1), 238 (1), 458732 (2)
Astronomical Observatory, University of Siena (K54)	0.30-m MCT f/5.6	SBIG STL-6303e (bin 2x2)	C, Rc	81 (5), 458732 (1)
GAL Hassin Robotic Telescope 2 (L34)	0.40-m RCT f/8.0	Andor Aspen CG16M	C	5766 (5)
Blessed Hermann Observatory (L73)	0.30-m SCT f/6.0	QHY 174MGPS (bin 2x2)	V, Rc	773 (4)
GAMP (104)	0.60-m NRT f/4.0	Apogee Alta	C, V, Rc	458732 (4)
Osservatorio Astronomico Margherita Hack (A57)	0.35-m SCT f/8.3	SBIG ST10XME (bin 2x2)	B, V, Rc	894 (1), 862 (1), 238 (1)
Osservatorio Serafino Zani (130)	0.40-m RCT f/5.8	SBIG ST8 XME (bin 2x2)	C	894 (1), 914 (2)
Iris Versari (Felizzano)	0.20-m SCT f/6.3	Moraviann KAF 8300	V, Rc	773 (2), 2763 (1)
GiaGa Observatory (203)	0.36-m SCT f/5.8	Moravian G2-3200	C, Rc	862 (1), 458732 (2)
Osservatorio Astronomico Nastro Verde (C82)	0.35-m SCT f/6.3	SBIG ST10XME (bin 2x2)	C	458732 (1)
GAV	0.20-m SCT f/7.0	SXV-H9	Rc	862 (1)

Table II. Observing Instrumentations. MCT: Maksutov-Cassegrain, NRT: Newtonian Reflector, RCT: Ritchey-Chretien, SCT: Schmidt-Cassegrain.