Supplement to the article:

Kuznetsov E.D., Vasileva M.A., Perminov A.S., Safronova V.S. «Search for new members of young asteroid families»

PROPER ORBITAL ELEMENTS OF ASTEROIDS BELONGING TO YOUNG FAMILIES

In Tables A1–A17, the proper orbital elements are given for the asteroid families: major semi-major axis a_p, eccentricity e_p, sine of inclination $\sin i_p$, mean motion n, proper frequencies of pericentre g and node s. The headings of the tables indicate the values of K_1 and K_2 corresponding to the given proper elements.

Table A1. Proper orbital elements of Adelaide asteroid family ($K_1 = 0.00183$ (au)$^{1/2}$, $K_2 = 0.00272$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	$\sin i_p$	n, °/year	g, "/year	s, "/year
525	2.2452337	0.1516114	0.1157649	106.995045	32.675743	–36.832505
422494	2.2456962	0.1511831	0.1159684	106.961001	32.681272	–36.831261
452322	2.2462710	0.1519367	0.1158215	106.920252	32.709314	–36.881505
463394	2.2450432	0.1516111	0.1157832	107.008302	32.668813	–36.825662
475474	2.2451485	0.1512813	0.1157270	107.001150	32.673283	–36.816458
486081	2.2456593	0.1512840	0.1157411	106.966410	32.688129	–36.833480
504375	2.2456984	0.1514785	0.1158237	106.963098	32.689080	–36.843025
517580	2.2457038	0.1514009	0.1155591	106.961629	32.673793	–36.842109
534611	2.2458014	0.1516949	0.1157146	106.953936	32.700316	–36.856548
545614	2.2457298	0.1511629	0.1157885	106.959645	32.683556	–36.832418
552867	2.2457386	0.1518393	0.1157971	106.958474	32.694536	–36.859552
555571	2.2451593	0.1517572	0.1158252	107.000426	32.671634	–36.834462
569552	2.2457134	0.1520679	0.1158305	106.961381	32.680539	–36.866925
572830	2.2456931	0.1519669	0.1158122	106.961807	32.685397	–36.862210
572868	2.2457056	0.1512505	0.1159659	106.961791	32.672320	–36.832949
578969	2.2457018	0.1517658	0.1158325	106.962050	32.668324	–36.854572
593790	2.2450376	0.1515941	0.1157707	107.008975	32.668740	–36.824787
616487	2.2456728	0.1515422	0.1158712	106.963891	32.686043	–36.843858
634009	2.2456990	0.1519943	0.1157327	106.961526	32.671499	–36.865081

644089	2.2457378	0.1516393	0.1157891	106.961418	32.690857	–36.848345
657461	2.2457089	0.1510989	0.1158165	106.961372	32.691793	–36.828779
2004 HJ85	2.2457122	0.1514485	0.1161552	106.960705	32.660231	–36.840516
2004 HU76	2.2456993	0.1510781	0.1157316	106.962397	32.681604	–36.826488
2005 UF193	2.2457093	0.1513147	0.1159864	106.961530	32.675829	–36.835684
2007 TA504	2.2457043	0.1519560	0.1158961	106.961581	32.667090	–36.862027
2007 VT345	2.2452132	0.1516217	0.1158687	106.996495	32.672121	–36.831490
2008 ET179	2.2457735	0.1517977	0.1157419	106.959262	32.696683	–36.856759
2008 UR414	2.2457206	0.1511073	0.1158932	106.961022	32.690390	–36.826429
2009 WJ157	2.2457558	0.1510011	0.1157969	106.957421	32.694239	–36.827087
2010 VF260	2.2457244	0.1521148	0.1159937	106.959980	32.675216	–36.868504
2010 XB115	2.2454022	0.1513585	0.1157879	106.982937	32.681771	–36.828520
2012 TM342	2.2450151	0.1516881	0.1157548	107.010902	32.668447	–36.827654
2013 CH251	2.2457059	0.1512096	0.1157989	106.961475	32.664009	–36.832538
2013 GR162	2.2458328	0.1514886	0.1157653	106.950597	32.699722	–36.851685
2013 HB97	2.2460957	0.1516539	0.1157298	106.933510	32.705987	–36.864668
2013 TR236	2.2459956	0.1510365	0.1159810	106.940806	32.694870	–36.834766
2013 TY219	2.2448434	0.1515884	0.1157934	107.022758	32.661489	–36.817775
2014 EM164	2.2450398	0.1515460	0.1157830	107.009567	32.667909	–36.822474
2014 EQ81	2.2460911	0.1519449	0.1158711	106.933846	32.702290	–36.874527
2014 EU96	2.2457197	0.1512515	0.1157994	106.960859	32.677553	–36.835108
2014 JY105	2.2462550	0.1515368	0.1158436	106.921494	32.707016	–36.864603
2014 WM167	2.2457333	0.1515252	0.1157546	106.959093	32.687362	–36.846989
2015 BE285	2.2453670	0.1511791	0.1158492	106.985631	32.677554	–36.819905
2015 HU72	2.2456792	0.1508725	0.1159253	106.964302	32.677972	–36.816068
2015 RM186	2.2462383	0.1519369	0.1157611	106.923288	32.709734	–36.880069
2015 TD44	2.2446766	0.1515670	0.1157500	107.034862	32.657115	–36.811444
2015 UR18	2.2456873	0.1513097	0.1160726	106.962518	32.661315	–36.833013
2015 XC92	2.2460889	0.1514761	0.1160977	106.934022	32.694310	–36.854091
2016 AH353	2.2455792	0.1514204	0.1158089	106.973073	32.688695	–36.834256
2016 AL322	2.2454007	0.1513599	0.1160488	106.982995	32.673899	–36.826134
2016 CP95	2.2461554	0.1515009	0.1156823	106.929254	32.708652	–36.861239
2016 CX104	2.2446383	0.1515858	0.1158003	107.037701	32.654347	–36.810588
2016 EX318	2.2447129	0.1515525	0.1157826	107.032480	32.657224	–36.811664
2016 FA34	2.2453694	0.1514544	0.1159296	106.985020	32.676592	–36.829895
2016 FR33	2.2456570	0.1521878	0.1159819	106.965427	32.678049	–36.867505

2016 GO11	2.2447557	0.1516131	0.1157831	107.029230	32.658762	–36.816091
2016 TN41	2.2445409	0.1516207	0.1157969	107.044642	32.651377	–36.808533
2016 UO110	2.2450447	0.1516894	0.1157744	107.008729	32.668979	–36.828647
2017 AU38	2.2457144	0.1515897	0.1157162	106.960610	32.679156	–36.848992
2017 HL72	2.2462644	0.1516303	0.1156988	106.921375	32.711565	–36.870067
2017 RS100	2.2449639	0.1511789	0.1160494	107.014273	32.656908	–36.803507
2017 TG26	2.2450487	0.1517084	0.1158123	107.008216	32.667994	–36.830130
2017 UF65	2.2451274	0.1515548	0.1159088	107.002732	32.667453	–36.825332
2017 WP50	2.2449379	0.1516561	0.1158653	107.016283	32.662511	–36.822821
2019 BT11	2.2452314	0.1517372	0.1158109	106.995522	32.674509	–36.836233
2019 TC62	2.2462753	0.1518723	0.1158108	106.920892	32.708764	–36.878603
2019 YE29	2.2460345	0.1514756	0.1158916	106.937949	32.699239	–36.854155
2019 YU35	2.2462561	0.1511604	0.1160908	106.922000	32.698602	–36.847463
2020 ML45	2.2457124	0.1513653	0.1159639	106.960956	32.662839	–36.836954
2020 PM79	2.2453830	0.1510890	0.1159681	106.984240	32.674960	–36.815351
2022 BM6	2.2457126	0.1518458	0.1157563	106.960670	32.691222	–36.859345
2022 CU16	2.2452291	0.1513824	0.1159973	106.995393	32.667873	–36.821389
2022 TC6	2.2457409	0.1517578	0.1157744	106.958256	32.693599	–36.856614
2023 BX6	2.2453013	0.1516925	0.1157923	106.990273	32.677868	–36.838217
2023 AH4	2.2457172	0.1516377	0.1156912	106.960618	32.683729	–36.850334
2022 BM50	2.2457353	0.1518410	0.1155342	106.954305	32.704978	–36.866255
2023 BZ6	2.2459895	0.1515306	0.1157158	106.941037	32.704193	–36.856282
2023 BS11	2.2473386	0.1519275	0.1155128	106.844816	32.754401	–36.922244
2023 BP9	2.2487364	0.1525481	0.1155196	106.744711	32.798682	–36.996251
New members of the family						
2020 HG179	2.2457070	0.1514305	0.1157595	106.960790	32.670812	–36.842579
2020 BE131	2.2438217	0.1520596	0.1158064	107.096013	32.628076	–36.801054

Table A2. Proper orbital elements of Brugmansia asteroid family (K_1 = 0.00019 (au)$^{1/2}$, K_2 = 0.00019 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	$\sin i_p$	n, °/year	g, "/year	s, "/year
16598	2.6200114	0.1751126	0.0493869	84.871794	53.979114	–58.068104
190603	2.6202305	0.1750494	0.0493778	84.860808	53.988356	–58.070617
218697	2.6202862	0.1750036	0.0493832	84.857548	53.991412	–58.069626
New members of the family						
2006 SK443	2.6201662	0.1750847	0.0493760	84.865766	53.984644	–58.072312

Table A3. Proper orbital elements of Datura asteroid family ($K_1 = 0.00389$ (au)$^{1/2}$, $K_2 = 0.00470$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	$\sin i_p$	n, °/year	g, "/year	s, "/year
1270	2.2346236	0.1520992	0.0920445	107.758057	32.972240	–36.639469
60151	2.2348764	0.1520923	0.0920091	107.740085	32.984663	–36.649638
89309	2.2352054	0.1523488	0.0920936	107.716096	33.005389	–36.673637
90265	2.2349806	0.1521589	0.0920275	107.732613	32.987808	–36.656364
203370	2.2349159	0.1522121	0.0919356	107.737156	32.989237	–36.657149
215619	2.2345764	0.1521483	0.0920662	107.761657	32.969739	–36.639186
338309	2.2349879	0.1520829	0.0918976	107.731544	32.991609	–36.655618
429988	2.2313305	0.1532145	0.0897779	107.994869	32.916540	–36.582664
433382	2.2346519	0.1520354	0.0920030	107.756105	32.974300	–36.638369
452713	2.2367659	0.1532267	0.0920049	107.603251	33.052316	–36.770692
485010	2.2357004	0.1525947	0.0920829	107.689822	33.024468	–36.696701
553350	2.2358309	0.1524499	0.0916258	107.674197	33.038098	–36.706652
585600	2.2349742	0.1520741	0.0919447	107.732486	32.988335	–36.653928
628444	2.2348154	0.1520847	0.0920561	107.744187	32.980545	–36.646446
641003	2.2349579	0.1520217	0.0919634	107.734934	32.989516	–36.650350
641406	2.2350687	0.1522502	0.0919558	107.725956	32.997079	–36.664982
2002 UU58	2.2350884	0.1520018	0.0919179	107.724511	32.998731	–36.656522
2005 RK54	2.2365432	0.1530535	0.0918118	107.617361	33.060048	–36.760712
2006 KA77	2.2343045	0.1519847	0.0920921	107.781310	32.958288	–36.621628
2006 SD382	2.2357405	0.1524321	0.0920698	107.675589	33.036269	–36.702811
2006 SY376	2.2331624	0.1515547	0.0920622	107.863913	32.918714	–36.560588
2006 WV222	2.2349720	0.1519812	0.0918554	107.732868	32.992592	–36.650879
2007 RM332	2.2347849	0.1519781	0.0919647	107.746389	32.980968	–36.642078
2008 YV51	2.2349780	0.1522083	0.0919586	107.732172	32.988885	–36.659735
2010 VB265	2.2349772	0.1522208	0.0921164	107.732389	32.984905	–36.657639
2010 VN260	2.2349131	0.1520125	0.0920945	107.737581	32.984391	–36.646809
2010 VU261	2.2347546	0.1521602	0.0920651	107.748736	32.977423	–36.646740
2012 VN143	2.2350955	0.1519952	0.0918837	107.723992	32.999935	–36.657065
2014 NZ88	2.2349587	0.1520168	0.0919182	107.733437	32.991489	–36.651826
2014 OA86	2.2345987	0.1517875	0.0919315	107.759925	32.973390	–36.627151
2014 OE206	2.2351110	0.1520486	0.0919184	107.722881	33.000336	–36.659452
2014 OR378	2.2348167	0.1520264	0.0919788	107.744088	32.982206	–36.645194

2014 OY85	2.2340091	0.1519366	0.0920993	107.802709	32.946882	–36.608020
2014 WG250	2.2347567	0.1520495	0.0920312	107.748262	32.978374	–36.643126
2014 WL96	2.2358718	0.1531444	0.0920206	107.673309	33.039921	–36.731746
2014 WM249	2.2334352	0.1517928	0.0922126	107.844206	32.924797	–36.579172
2014 WT96	2.2351064	0.1521691	0.0919228	107.723222	33.000094	–36.664005
2015 PD191	2.2366865	0.1528974	0.0919416	107.608835	33.053560	–36.755942
2015 PH144	2.2342426	0.1521211	0.0920732	107.785689	32.956806	–36.624961
2015 PQ47	2.2348259	0.1520496	0.0920017	107.743608	32.982104	–36.646025
2015 PR301	2.2349416	0.1520329	0.0918127	107.734540	32.993662	–36.653312
2015 QW31	2.2346162	0.1520230	0.0919848	107.758728	32.973207	–36.636601
2015 SS31	2.2358166	0.1529625	0.0921331	107.671013	33.009575	–36.718456
2015 TL455	2.2350302	0.1520021	0.0918869	107.729001	32.995657	–36.654345
2015 TU306	2.2360473	0.1520839	0.0920421	107.652325	33.044684	–36.702508
2015 WQ25	2.2349422	0.1519700	0.0919835	107.735220	32.989120	–36.647906
2015 XK452	2.2349059	0.1520047	0.0920557	107.738159	32.985237	–36.646768
2015 XK88	2.2344290	0.1520341	0.0920585	107.772197	32.964003	–36.628963
2015 XQ432	2.2349225	0.1521077	0.0919875	107.736338	32.988592	–36.653039
2015 XX321	2.2351204	0.1520741	0.0919225	107.722217	33.000901	–36.660905
2016 PY22	2.2358304	0.1531704	0.0920086	107.672980	33.041013	–36.736156
2016 TR115	2.2349545	0.1520339	0.0919212	107.734926	32.989288	–36.651107
2016 TW15	2.2349475	0.1520481	0.0919409	107.734327	32.990339	–36.652045
2017 OS162	2.2359870	0.1529517	0.0920208	107.659579	32.996428	–36.723927
2017 OU162	2.2349794	0.1520507	0.0919114	107.732342	32.988409	–36.653202
2017 QX88	2.2358156	0.1528894	0.0922809	107.675782	33.019991	–36.714621
2017 SC233	2.2338420	0.1525073	0.0923853	107.814213	32.935511	–36.622863
2017 SG152	2.2358354	0.1527024	0.0922232	107.672235	33.035593	–36.713060
2017 SS269	2.2359499	0.1525444	0.0922712	107.662115	33.008565	–36.702167
2017 SU3	2.2349844	0.1520979	0.0918568	107.732073	32.992283	–36.656248
2017 SV143	2.2366023	0.1533742	0.0921820	107.612965	33.050808	–36.770766
2017 SV193	2.2348542	0.1520898	0.0920288	107.741441	32.983147	–36.648513
2017 UU155	2.2357042	0.1523609	0.0921329	107.678457	33.031179	–36.697122
2017 UW137	2.2339840	0.1517855	0.0920671	107.804252	32.947293	–36.601525
2017 VP37	2.2349569	0.1520610	0.0920448	107.733622	32.986543	–36.651679
2017 WC50	2.2349129	0.1520353	0.0920167	107.737515	32.986649	–36.648769
2018 TM7	2.2349873	0.1520303	0.0919053	107.731935	32.989884	–36.652706
2018 UL40	2.2366505	0.1524932	0.0916311	107.609712	33.059768	–36.744136

2018 UN34	2.2357727	0.1521564	0.0914422	107.677048	33.039696	–36.696654
2019 QA14	2.2348587	0.1519311	0.0920268	107.741150	32.983076	–36.642455
2019 SE28	2.2342583	0.1520818	0.0920989	107.784618	32.956693	–36.623699
2019 TD28	2.2361336	0.1526536	0.0914903	107.641909	33.061486	–36.738671
2019 XJ15	2.2362116	0.1526247	0.0915833	107.652438	33.048255	–36.725102
2020 OS89	2.2346240	0.1525955	0.0922630	107.758207	32.967541	–36.657203
2020 PM28	2.2349664	0.1520672	0.0919930	107.732939	32.989711	–36.653368
2020 QM36	2.2349704	0.1521078	0.0919578	107.733429	32.988891	–36.654361
2020 RR103	2.2358925	0.1526854	0.0927831	107.666366	32.913075	–36.703456
2020 UV37	2.2359116	0.1525853	0.0918509	107.664577	32.980651	–36.707601
2021 NF47	2.2347572	0.1520512	0.0920165	107.748345	32.978665	–36.643331
2021 NK57	2.2351812	0.1521315	0.0918353	107.717996	33.007983	–36.666953
2021 PX107	2.2349438	0.1519521	0.0919451	107.735112	32.989496	–36.647992
2021 QZ40	2.2347875	0.1521179	0.0920313	107.746337	32.979732	–36.646831
2021 RB114	2.2349619	0.1520356	0.0919658	107.733464	32.988728	–36.651345
2021 RE149	2.2346412	0.1520257	0.0920392	107.756839	32.972961	–36.637249
2021 VU20	2.2365418	0.1524893	0.0914229	107.617605	33.067723	–36.743579
2022 PN15	2.2357740	0.1524682	0.0917672	107.676427	33.038026	–36.706066
2022 QC148	2.2347438	0.1520815	0.0920594	107.749478	32.976992	–36.643331
2022 QK69	2.2358781	0.1519453	0.0917919	107.663356	33.043162	–36.694490
2022 QT171	2.2366184	0.1525523	0.0918490	107.613193	33.056326	–36.741593
2022 SO76	2.2343536	0.1520715	0.0920414	107.777667	32.961615	–36.627641
2022 SV168	2.2364638	0.1532423	0.0919187	107.623685	33.062439	–36.765398
2022 TV22	2.2367581	0.1532905	0.0921791	107.603839	33.048250	–36.771067

Table A4. Proper orbital elements of Emilkowalski asteroid family ($K_1 = 0.00050$ (au)$^{1/2}$, $K_2 = 0.00062$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	$\sin i_p$	n, °/year	g, "/year	s, "/year
14627	2.5992389	0.1759808	0.2959963	85.894988	33.888411	–48.588366
126761	2.5995005	0.1760815	0.2960312	85.882117	33.886503	–48.605316
224559	2.5993961	0.1757770	0.2959853	85.887025	33.888412	–48.580920
256124	2.5993719	0.1757736	0.2959962	85.888694	33.887241	–48.579900
434002	2.6000234	0.1758728	0.2960324	85.856137	33.887452	–48.614724
476673	2.5999400	0.1759008	0.2959962	85.860307	33.891506	–48.614696
653857	2.6000898	0.1758327	0.2960138	85.852956	33.889723	–48.615396
679223	2.5993006	0.1758642	0.2959479	85.891851	33.893180	–48.583998

2009 VF107	2.6002740	0.1757358	0.2959891	85.843805	33.892930	–48.617577
New members of the family						
2015 WH29	2.5989965	0.1760364	0.2959752	85.907146	33.890046	–48.582464
2016 CS377	2.5996400	0.1758908	0.2959472	85.875340	33.895456	–48.601448
2017 UY114	2.5996253	0.1759155	0.2960155	85.876086	33.887769	–48.600776
2022 SA160	2.5999671	0.1759953	0.2960030	85.859081	33.891661	–48.621857

Table A5. Proper orbital elements of Hobson asteroid family ($K_1 = 0.00099$ (au)$^{1/2}$, $K_2 = 0.00140$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	$\sin i_p$	n, °/year	g, "/year	s, "/year
18777	2.5637057	0.1870969	0.0551365	87.683500	53.219070	–55.967187
57738	2.5638277	0.1870131	0.0551562	87.678012	53.215583	–55.976079
363118	2.5635333	0.1868725	0.0551571	87.693115	53.222232	–55.927283
381414	2.5639496	0.1871847	0.0551727	87.671722	53.213833	–56.004103
436620	2.5638208	0.1870161	0.0551425	87.678339	53.215755	–55.973563
450571	2.5634016	0.1867702	0.0551692	87.699786	53.224517	–55.904040
465404	2.5636597	0.1866284	0.0551061	87.685622	53.214473	–55.927403
520394	2.5633990	0.1867846	0.0552006	87.700120	53.224378	–55.904666
537249	2.5634683	0.1868851	0.0551843	87.697022	53.224837	–55.920960
548822	2.5639766	0.1871245	0.0551192	87.670332	53.212967	–56.000803
557505	2.5631858	0.1866261	0.0551672	87.710921	53.229588	–55.865824
654981	2.5633611	0.1867582	0.0551470	87.701905	53.226367	–55.898236
663387	2.5635814	0.1869367	0.0551077	87.690983	53.222939	–55.934689
2007 EH116	2.5638387	0.1871292	0.0551505	87.677420	53.216562	–55.983639
2008 WV149	2.5632961	0.1867716	0.0551920	87.705319	53.227768	–55.892046
2009 SY179	2.5634147	0.1867501	0.0551756	87.699157	53.223782	–55.904486
2010 GN203	2.5636029	0.1870435	0.0551762	87.689501	53.222765	–55.952003
2011 SU302	2.5634017	0.1868143	0.0552073	87.699794	53.224431	–55.908283
2012 JM71	2.5638470	0.1870791	0.0551638	87.677003	53.215416	–55.981894
2012 LN31	2.5640207	0.1872339	0.0551360	87.668075	53.213032	–56.015392
2013 JG48	2.5634027	0.1867686	0.0551736	87.699797	53.224499	–55.904558
2013 MW20	2.5636612	0.1868844	0.0551457	87.685794	53.217567	–55.949404
2013 NA73	2.5642231	0.1873158	0.0551307	87.657694	53.208329	–56.046110
2014 HH103	2.5635401	0.1867892	0.0551357	87.692998	53.220926	–55.920238
2014 JH120	2.5634012	0.1868108	0.0552049	87.699797	53.224583	–55.908647
2014 KY102	2.5636633	0.1871189	0.0551313	87.685697	53.221721	–55.966106

2014 NN71	2.5635961	0.1865933	0.0551823	87.689792	53.214982	–55.910872
2014 OG277	2.5627594	0.1867999	0.0551633	87.733080	53.247619	–55.828692
2014 OJ66	2.5634595	0.1867979	0.0551909	87.697568	53.223132	–55.910822
2014 PJ87	2.5631215	0.1866158	0.0552630	87.714228	53.229725	–55.859173
2014 QL520	2.5635222	0.1869863	0.0551072	87.693948	53.225635	–55.933521
2014 QQ580	2.5636942	0.1872381	0.0551939	87.685951	53.223074	–55.973782
2015 HV138	2.5638175	0.1870242	0.0551561	87.678487	53.215892	–55.975088
2015 KA91	2.5640616	0.1872052	0.0551447	87.665920	53.211095	–56.018139
2015 KM237	2.5640357	0.1873156	0.0551725	87.667313	53.212923	–56.023778
2015 OP104	2.5635270	0.1871821	0.0551328	87.694096	53.228730	–55.949667
2015 PA184	2.5627870	0.1865042	0.0551160	87.731489	53.240859	–55.808496
2015 PM156	2.5641224	0.1871841	0.0551150	87.662842	53.209512	–56.023047
2015 XL282	2.5632635	0.1866767	0.0551779	87.706980	53.227713	–55.879727
2016 GW276	2.5635526	0.1867396	0.0551731	87.692317	53.219829	–55.918403
2016 GY256	2.5632734	0.1867215	0.0552282	87.706383	53.226937	–55.886711
2016 GZ310	2.5636018	0.1871449	0.0551946	87.690715	53.224435	–55.956466
2017 NY29	2.5640359	0.1872071	0.0551323	87.667272	53.212063	–56.014238
2017 PA68	2.5639371	0.1870850	0.0551072	87.672385	53.214165	–55.994045
2017 PK70	2.5627926	0.1865765	0.0551654	87.731002	53.238986	–55.821308
2017 SM25	2.5635469	0.1870680	0.0551677	87.693227	53.225488	–55.943085
2017 SQ83	2.5635382	0.1867484	0.0552028	87.693195	53.218939	–55.916401
2017 WO47	2.5635124	0.1868676	0.0551764	87.694278	53.222371	–55.923462
2018 NQ48	2.5632557	0.1867093	0.0552188	87.707472	53.227468	–55.880932
2019 GR115	2.5636385	0.1865447	0.0551440	87.687277	53.214032	–55.915836
2019 NP44	2.5635921	0.1864599	0.0551954	87.690549	53.213888	–55.903163
2019 PS30	2.5633336	0.1867247	0.0551762	87.703279	53.225946	–55.892546
2020 HQ57	2.5643072	0.1872153	0.0550481	87.653468	53.206079	–56.047405
2020 JM31	2.5633990	0.1867921	0.0551717	87.699931	53.225146	–55.906272
2020 KP36	2.5644436	0.1873551	0.0550927	87.646376	53.203162	–56.074871
2020 OY50	2.5633124	0.1866650	0.0551370	87.704332	53.226550	–55.884205
2021 MO5	2.5632553	0.1866367	0.0551522	87.707423	53.227836	–55.875256
2023 JA22	2.5638775	0.1869759	0.0551635	87.675325	53.212630	–55.977555
2023 JZ8	2.5632113	0.1866801	0.0551372	87.709635	53.230219	–55.872584

Table A6. Proper orbital elements of Iochroma asteroid family (K_1 = 0.00011 (au)$^{1/2}$, K_2 = 0.00013 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
39991	2.4446918	0.1592823	0.0694133	94.167933	41.696066	–46.178689
340225	2.4446633	0.1592966	0.0694091	94.169591	41.694456	–46.178177
349730	2.4447008	0.1592725	0.0694140	94.167439	41.696456	–46.178510
428243	2.4448346	0.1592532	0.0694221	94.159503	41.706915	–46.184101
513212	2.4447986	0.1592252	0.0694520	94.161788	41.702248	–46.180327

Table A7. Proper orbital elements of Irvine asteroid family (K_1 = 0.00064 (au)$^{1/2}$, K_2 = 0.00064 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
6825	2.1674265	0.0692514	0.0815528	112.809483	30.912937	–32.489252
143797	2.1671526	0.0696800	0.0814911	112.830643	30.905673	–32.491905
180233	2.1672083	0.0694918	0.0815285	112.826313	30.906828	–32.490014
236156	2.1672521	0.0695007	0.0815507	112.823306	30.904756	–32.494554

Table A8. Proper orbital elements of Kap'bos asteroid family (K_1 = 0.00042 (au)$^{1/2}$, K_2 = 0.00042 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
11842	2.2502848	0.1234263	0.0742371	106.634981	33.832076	–36.292446
228747	2.2503571	0.1234045	0.0742283	106.629838	33.834745	–36.294386
349108	2.2511409	0.1235535	0.0742870	106.574129	33.861629	–36.327446
436415	2.2502981	0.1234397	0.0742462	106.634009	33.832390	–36.293336
445874	2.2512490	0.1236044	0.0742717	106.566198	33.866180	–36.333297

Table A9. Proper orbital elements of Lucascavin asteroid family (K_1 = 0.000054 (au)$^{1/2}$, K_2 = 0.000061 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
21509	2.2811152	0.1276946	0.0904748	104.479976	34.543995	–37.448016
180255	2.2810489	0.1276900	0.0904825	104.484525	34.540736	–37.445310
209570	2.2811578	0.1276601	0.0904689	104.477029	34.546146	–37.448425

Table A10. Proper orbital elements of Mandragora asteroid family (K_1 = 0.00054 (au)$^{1/2}$, K_2 = 0.00104 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
22280	3.0406838	0.2350279	0.0339524	67.871037	105.716718	–115.503475
180105	3.0411150	0.2351864	0.0339609	67.856461	105.660261	–115.615038
284995	3.0406291	0.2350488	0.0339618	67.871476	105.722959	–115.512166
296045	3.0413145	0.2352544	0.0339518	67.847190	105.621221	–115.658644
324154	3.0409803	0.2350010	0.0339384	67.861391	105.660425	–115.527562
446436	3.0404901	0.2353459	0.0340224	67.875899	105.800822	–115.612740
472944	3.0416585	0.2347713	0.0338946	67.836553	105.501978	–115.498390
513829	3.0405914	0.2349724	0.0339501	67.872399	105.715396	–115.475483
New members of the family						
43239	3.0402316	0.2348712	0.0339080	67.882308	105.774322	–115.385570
391017	3.0398682	0.2347456	0.0340142	67.897244	105.895879	–115.337521
459310	3.0409806	0.2349327	0.0339345	67.860759	105.636416	–115.493321
514734	3.0415991	0.2349105	0.0338757	67.838807	105.534835	–115.546325

Table A11. Proper orbital elements of Martes asteroid family (K_1 = 0.00048 (au)$^{1/2}$, K_2 = 0.00065 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
5026	2.3774822	0.2075253	0.0862841	98.189949	38.527276	–45.759948
2005 WW113	2.3767560	0.2072396	0.0863126	98.237041	38.509927	–45.702267
2022 QB59	2.3774645	0.2074190	0.0863284	98.191340	38.527099	–45.750622
2022 RM50	2.3774818	0.2074438	0.0863065	98.190020	38.513792	–45.756352
2011 RF40	2.3775086	0.2074819	0.0862955	98.187228	38.544750	–45.759582
2010 TB155	2.3776111	0.2076422	0.0862820	98.184727	38.554620	–45.772244

Table A12. Proper orbital elements of Nicandra asteroid family (K_1 = 0.00031 (au)$^{1/2}$, K_2 = 0.00042 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
66583	2.6341698	0.1986578	0.0679751	84.187897	54.221894	–61.012552
279777	2.6345691	0.1988015	0.0679843	84.168730	54.240977	–61.056346
2008 SO34	2.6346602	0.1988061	0.0679294	84.164365	54.247171	–61.065613
2012 TF228	2.6347376	0.1988138	0.0679795	84.160675	54.248953	–61.070647
2014 QV272	2.6347267	0.1988189	0.0679455	84.161204	54.249691	–61.070955
New members of the family						

2006 ST295	2.6342535	0.1986010	0.0679805	84.183897	54.224979	–61.012832
2007 RC364	2.6348144	0.1987886	0.0679801	84.156977	54.252262	–61.073895
2007 TM252	2.6345659	0.1987190	0.0679018	84.168856	54.243164	–61.050872
2016 SV22	2.6345743	0.1987345	0.0679336	84.168480	54.242509	–61.052368
2020 SN11	2.6338791	0.1986060	0.0679811	84.201849	54.207975	–60.984860
2021 RK120	2.6343265	0.1986457	0.0679505	84.180379	54.229850	–61.025030
2021 RY71	2.6344944	0.1985780	0.0679801	84.172327	54.235205	–61.020507

Table A13. Proper orbital elements of Rampo asteroid family ($K_1 = 0.00056$ (au)$^{1/2}$, $K_2 = 0.00086$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
10321	2.3292228	0.0507626	0.0939696	101.259373	35.985053	–37.225899
294272	2.3293934	0.0506660	0.0938643	101.248247	35.993652	–37.231803
451686	2.3283709	0.0508243	0.0939291	101.314961	35.957375	–37.195642
546329	2.3279937	0.0508252	0.0938575	101.339599	35.946838	–37.182406
562123	2.3280912	0.0507845	0.0939294	101.333098	35.949751	–37.184774
601678	2.3285981	0.0509108	0.0938695	101.300133	35.966795	–37.205920
625985	2.3284702	0.0508608	0.0938489	101.308481	35.962936	–37.200675
637548	2.3280426	0.0508542	0.0938899	101.336407	35.948662	–37.184311
675125	2.3290117	0.0506650	0.0938846	101.273145	35.980139	–37.217416
679048	2.3297782	0.0506037	0.0938587	101.223158	36.006793	–37.245214
2005 VO22	2.3281291	0.0507921	0.0938895	101.331087	35.949564	–37.186502
2007 XP67	2.3287345	0.0509553	0.0938700	101.291229	35.971458	–37.211642
2008 GZ170	2.3281198	0.0508265	0.0938699	101.331605	35.947405	–37.186900
2008 SW341	2.3296506	0.0508788	0.0938835	101.231479	36.002107	–37.244334
2009 HD95	2.3284877	0.0509387	0.0938620	101.307338	35.963284	–37.202340
2009 SR371	2.3290056	0.0507594	0.0938952	101.273541	35.979741	–37.218509
2009 WB276	2.3286150	0.0509810	0.0938855	101.299032	35.966970	–37.207484
2010 VP264	2.3278917	0.0508038	0.0939281	101.346257	35.941083	–37.177637
2011 WC22	2.3282336	0.0508290	0.0939322	101.323928	35.952956	–37.190591
2012 VE126	2.3294483	0.0507971	0.0939563	101.244662	35.993140	–37.234889
2013 RL101	2.3281268	0.0508247	0.0938737	101.331209	35.946556	–37.187116
2013 VC30	2.3283648	0.0509405	0.0938829	101.315360	35.958558	–37.197635
2013 VE51	2.3280115	0.0510159	0.0939054	101.338411	35.946548	–37.185474
2014 HN87	2.3279010	0.0508172	0.0938893	101.345647	35.942490	–37.178567
2014 HS9	2.3284484	0.0509723	0.0938873	101.309901	35.961274	–37.201167

2014 ST44	2.3292265	0.0509558	0.0938382	101.259130	35.989062	–37.230183
2015 BB184	2.3281622	0.0507955	0.0939162	101.327847	35.952098	–37.188077
2015 TA367	2.3294755	0.0507905	0.0939813	101.242891	35.993364	–37.235555
2015 VK190	2.3296252	0.0506685	0.0938833	101.233130	36.001008	–37.240252
2016 GJ353	2.3292258	0.0510752	0.0939165	101.259177	35.987003	–37.231198
2016 PR196	2.3299227	0.0508748	0.0938712	101.213736	36.011694	–37.254484
2016 TE87	2.3284305	0.0510126	0.0939004	101.311081	35.960346	–37.200983
2017 UH21	2.3285981	0.0507905	0.0939222	101.300133	35.965199	–37.203608
2018 NN9	2.3284580	0.0507151	0.0939070	101.309279	35.960768	–37.197463
2019 PC41	2.3286434	0.0507177	0.0939026	101.297172	35.967193	–37.204396
2020 MO19	2.3281249	0.0508845	0.0939291	101.331490	35.945424	–37.187183
2020 PJ53	2.3294265	0.0508134	0.0939387	101.246083	35.992914	–37.234488
2021 QC81	2.3285617	0.0508128	0.0938983	101.302514	35.964633	–37.202828
2022 QE61	2.3296583	0.0508417	0.0938992	101.230969	36.001886	–37.243923
2022 QU76	2.3289476	0.0506991	0.0938646	101.277331	35.978506	–37.215793
2022 QY123	2.3279594	0.0508488	0.0939173	101.341838	35.943871	–37.180918
2022 RX76	2.3292454	0.0508009	0.0938796	101.257897	35.988389	–37.228147

Table A14. Proper orbital elements of Rozek asteroid family ($K_1 = 0.00034$ (au)$^{1/2}$, $K_2 = 0.00061$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
63440	1.9380685	0.0754080	0.3616554	133.421626	14.405323	–21.996646
331933	1.9380751	0.0753681	0.3616418	133.420641	14.406582	–21.996542
2008 VS46	1.9373013	0.0754952	0.3615556	133.500882	14.397635	–21.982466
New members of the family						
2009 WQ62	1.9376682	0.0754106	0.3616362	133.462914	14.398350	–21.987965
2015 MF32	1.9388242	0.0754304	0.3617185	133.343630	14.414517	–22.012532

Table A15. Proper orbital elements of Schulhof asteroid family ($K_1 = 0.00033$ (au)$^{1/2}$, $K_2 = 0.00064$ (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
2384	2.6099191	0.1625711	0.2307330	85.366677	41.319945	–50.983957
81337	2.6094294	0.1626777	0.2307303	85.391171	41.310966	–50.968915
271044	2.6094931	0.1625342	0.2307250	85.388143	41.311845	–50.961784
286239	2.6095577	0.1626341	0.2307329	85.384719	41.313010	–50.972334
457075	2.6103866	0.1623871	0.2307170	85.344189	41.329595	–50.996066

484810	2.6097728	0.1625719	0.2307299	85.374300	41.317044	–50.978351
508193	2.6094547	0.1627268	0.2307185	85.389921	41.313075	–50.974350
593122	2.6098627	0.1625466	0.2307325	85.369906	41.318599	–50.980973
626315	2.6099662	0.1624688	0.2307295	85.364813	41.320421	–50.980548
664500	2.6099688	0.1624822	0.2307393	85.364691	41.319680	–50.981251
2008 GW33	2.6093794	0.1624548	0.2307041	85.393625	41.310980	–50.951296
2012 FM46	2.6100490	0.1625337	0.2307328	85.360764	41.322209	–50.989270
New members of the family						
538410	2.6098568	0.1623637	0.2307339	85.370202	41.316992	–50.967276
583004	2.6092535	0.1627262	0.2307179	85.399801	41.308985	–50.964302
583246	2.6090839	0.1626000	0.2307363	85.408136	41.303181	–50.945887
583459	2.6092290	0.1625779	0.2307362	85.401013	41.305850	–50.951510
633027	2.6098486	0.1624606	0.2307350	85.370589	41.317419	–50.973854
676281	2.6092670	0.1625708	0.2307273	85.399138	41.307326	–50.953205
658039	2.6094427	0.1625145	0.2307202	85.390528	41.311140	–50.958110
2001 BB85	2.6099644	0.1624996	0.2307177	85.364900	41.321630	–50.983122
2005 EB352	2.6095592	0.1625792	0.2307169	85.384889	41.313903	–50.968670
2008 FF47	2.6095062	0.1625143	0.2307200	85.387395	41.312281	–50.961210
2012 FW85	2.6096734	0.1625304	0.2307161	85.379182	41.316066	–50.970950
2013 EQ37	2.6093441	0.1626925	0.2307135	85.395361	41.310849	–50.966423
2013 GV46	2.6092850	0.1625357	0.2307249	85.398263	41.307582	–50.951605
2015 GB17	2.6098350	0.1625363	0.2307195	85.371258	41.319201	–50.979333
2015 HB205	2.6097289	0.1625295	0.2307156	85.376502	41.317336	–50.973772
2015 RD144	2.6103249	0.1623847	0.2307290	85.347212	41.327039	–50.992283
2016 DE45	2.6093404	0.1624180	0.2307273	85.395542	41.307447	–50.945685
2016 DY45	2.6092788	0.1624764	0.2307143	85.398557	41.308054	–50.947434
2016 EF9	2.6092737	0.1625349	0.2307018	85.398816	41.309791	–50.951968
2016 ES280	2.6096909	0.1625420	0.2307084	85.378331	41.317297	–50.973017
2016 FT28	2.6091782	0.1625956	0.2307421	85.403509	41.304405	–50.949996
2018 FK55	2.6097147	0.1625393	0.2307141	85.377195	41.317279	–50.973883
2019 FD26	2.6096137	0.1625117	0.2307136	85.382092	41.314798	–50.966681
2022 EU8	2.6090854	0.1625926	0.2307338	85.408060	41.303202	–50.945459

Table A16. Proper orbital elements of Wasserburg asteroid family (K_1 = 0.00018 (au)$^{1/2}$, K_2 = 0.00018 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
4765	1.9454533	0.0767560	0.3622059	132.662551	14.301524	–22.103732
350716	1.9455520	0.0767527	0.3622268	132.652455	14.301373	–22.105328
2012 KH56	1.9456094	0.0767642	0.3622685	132.646620	14.299538	–22.105886
2016 GL253	1.9455584	0.0767658	0.3621964	132.651835	14.303288	–22.106139
2017 DU131	1.9456005	0.0767684	0.3622489	132.647529	14.300599	–22.106103
2017 KO46	1.9454994	0.0768455	0.3622348	132.658133	14.299848	–22.105113
2018 YF16	1.9456290	0.0767573	0.3622452	132.644620	14.301162	–22.106608
2020 HF21	1.9454753	0.0768823	0.3622382	132.660527	14.299884	–22.105090

Table A17. Proper orbital elements of 2002 PY38 asteroid family (K_1 = 0.000078 (au)$^{1/2}$, K_2 = 0.000078 (au)$^{1/2}$)

Asteroid	a_p, au	e_p	sini_p	n, °/year	g, "/year	s, "/year
338073	2.1966777	0.1163795	0.0194060	110.562983	32.675167	–34.442169
529915	2.1967793	0.1164262	0.0194153	110.555299	32.678419	–34.446634
2016 SQ14	2.1966402	0.1163985	0.0194120	110.565811	32.673942	–34.441819
New members of the family						
2015 TO83	2.1966688	0.1164132	0.0194474	110.563654	32.674585	–34.443716