ON NEW MEMBERS OF ASTEROID CLUSTERS SIMILAR TO ASTEROID PAIRS.

E. D. Kuznetsov, M. A. Vasileva, Ural Federal University, Lenina Avenue, 51, Yekaterinburg, 620000, Russia, eduard.kuznetsov@urfu.ru, maxa1907@icloud.com.

Introduction: Here we report about results of search for new members of young asteroid families. We have found six possible new members of Rampo asteroid family and one possible new member of Hobson asteroid family. We also have discovered new asteroid cluster, which includes three asteroids.

Methods: The search of new candidate asteroids within families has been carried out by means of the computation of the values of the natural metrics ϱ_2 and ϱ_5 [1]. The metric ϱ_2 is the distance between two orbits in the five-dimensional space of Keplerian orbits. The metric ϱ_5 is a distance in three-dimensional factor-space of positional orbital elements. Osculating elements of orbits were used to calculate the metric ϱ_2 and proper elements of orbits were used to calculate the metric ϱ_5. Orbital elements of asteroids have been taken from Asteroids Dynamic Site – AstDyS. Criterias for finding the new asteroids within clusters were value of metrics for all pairs in cluster $\varrho_2 < 0.004$ au$^{1/2}$ and $\varrho_5 < 0.001$ au$^{1/2}$.

We will perform numerical integrations of the orbits of all pairs of asteroids within clusters backward in time with the code known as Orbit9. It is necessary to take into account the Yarkovsky effect accurately to carry out precise simulations of the dynamical evolution of asteroid pairs. We estimated the Yarkovsky semimajor axis drift for all asteroids in this three clusters according to [2].

Results and discussions: In our results, six new members of Rampo family (2009 SR371, 2013 RL101, 2013 VC30, 2015 TA367, 2015 TM372, 2017 UH21), not listed in [3], were detected (table 1). One new member of Hobson family (2017 SQ83), not listed in [4], was detected (table 2). The new cluster comprising three asteroids ((381362) 2008 EP15, (405843) 2006 BT227, 2012 XC32), not listed anywhere, was discovered.

Table 1. Keplerian elements of Rampo and six new family members at epoch 58400.0 MJD

Asteroid	H [mag]	a [au]	e	i [deg]	Ω [deg]	ω [deg]	$\lvert\dot{a}\rvert \cdot 10^4$ [au/Myr]
(10321) Rampo	14.2	2.32902	0.094412	6.059	53.930	278.874	0.79
2009 SR371	18.7	2.32898	0.094711	6.070	56.788	274.624	5.01
2013 RL101	18.4	2.32765	0.094099	6.091	61.665	267.151	4.30
2013 VC30	18.4	2.32800	0.094574	6.081	59.355	270.502	4.32
2015 TA367	18.8	2.32921	0.094422	6.056	53.308	279.728	5.12
2015 TM372	18.5	2.32876	0.093933	6.073	57.712	273.399	4.63
2017 UH21	18.4	2.32849	0.093907	6.090	60.373	269.12	4.40

Table 2. Keplerian elements of Hobson and one new family member at epoch 58400.0 MJD

Asteroid	H [mag]	a [au]	e	i [deg]	Ω [deg]	ω [deg]	$\lvert\dot{a}\rvert \cdot 10^4$ [au/Myr]
(18777) Hobson	14.9	2.56213	0.184068	4.323	105.45	180.896	0.94
2017 SQ83	18.4	2.56524	0.179669	4.315	105.60	180.833	3.89

Table 3. Keplerian elements of asteroids from new discovered cluster at epoch 58400.0 MJD

Asteroid	H [mag]	a [au]	e	i [deg]	Ω [deg]	ω [deg]	$\lvert\dot{a}\rvert \cdot 10^4$ [au/Myr]
(381362) 2008 EP15	18.6	2.2386	0.103787	2.048	147.705	309.138	29.04
(405843) 2006 BT227	17.9	2.2381	0.103974	2.059	146.866	310.418	21.04
2012 XC32	18.9	2.2378	0.104567	2.056	147.448	309.818	35.41

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