SOME INTERESTING CASES OF CLOSE ASTEROID PAIRS PERTURBED BY RESONANCE. A. E. Rosaev[1], [1]Research and Educational Center "Nonlinear Dynamics", Yaroslavl State University, Yaroslavl, Russia, hegem@mail.ru.

Introduction: Some examples of the resonance perturbations of young families and pairs are known, first of al, it is Datura family in 9:16 resonance with Mars [1]. Pravec et al [2] note that pair (49791) 1999 XF31 and (436459) 2011 CL97 chaotic orbits may be explained by 15:8 mean motion resonance with Mars. Duddy et al [3] pointed that pair (7343) Ockeghem and (154634) 2003 XX38 is in 2-1J-1M three body resonance.

In our previous paper [4] we give the list of close asteroid pairs in vicinity of resonance. Some cases display the jumps in semimajor axis from one side of resonance to another (see Fig.1). In this paper we extend the list and select the most interesting cases.

Method: To study the dynamic evolution of asteroid families in this paper, the equations of the motion of the systems were numerically integrated orbits over 800 kyr using the N-body integrator Mercury [5] and the Everhart integration method.

To the nominal resonance position calculation, we use values of semimajor axis of planets, averaged over time of integration: 1.52368 AU for Mars, 5.20259 AU for Jupiter, 9.5549 AU for Saturn always in this paper.

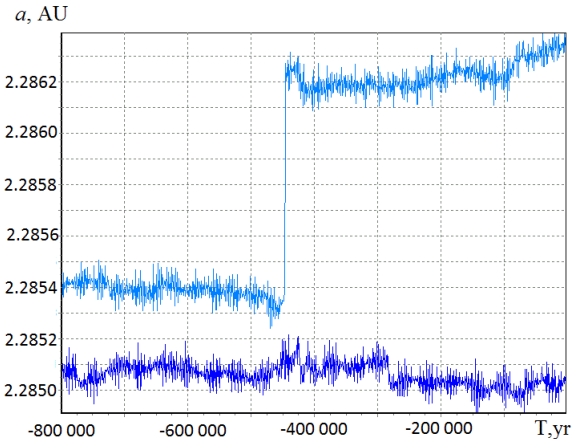

Fig.1. The semimajor axis evolution in pair (80218) 1999 VO123 (dark blue) – (213471) 2002 ES90 (light blue). Resonance 1+6J-6S at 2.219288 AU.

To study interaction considered pair with resonance and to determine position of resonance center (chaotic zone center) we apply integration of orbits of asteroid with significant values of Yarkovsky effect ($A_2=1*10^{-13}$).

The advantage of proposed method is that it connected with concrete numeric integration model.

Results: In result we have found some other close asteroid pairs, strongly perturbed by resonance. On our opinion, the dynamics of such pairs is required more careful studying. In particular, we report that pair 56048 (1998 XV39) – 76148 (2000 EP17) is moved in vicinity of resonance 4-1J-1E.

We have found the resonance perturbations in 15 pairs between 26 studied ones and in 8 cases we note the jumps like in Fig.1.

Conclusions: Resonance perturbations can play an important role in dynamics of close asteroid pairs and can be related with the process of their origin.

References: [1] Nesvorny, D., et al. (2006), Science, 312, 1490. [2] Pravec P., et al. (2019), *Icarus*. 333, 429. [3] Duddy S. R. et al. (2012), *A&A* 539, A36 [4] Rosaev A., et al (2020) *Res. Notes AAS* **4** 239.[5] Chambers, J. E. 1999, MNRAS, 304, 793.