

A new example of stable chaotic orbit in asteroid belt: 2022 QB59 and 2022 RM50

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Abstract. We report about a new example of stable chaotic motion. Two asteroids (2022 QB59 and 2022 RM50) are moving in an almost identical orbit, close to a 3:11 resonance with Earth. The orbits are very stable, despite the chaotic fluctuations of the semi-major axis.

Introduction

(5026) Martes and 2005 WW113 are listed in the paper by Vokrouhlicky and Nesvorny between pairs with a low relative velocity [1]. Later, Pravec, Vokrouhlicky [2] noted that the pair is perturbed by irregular jumps over a weak mean motion resonance. Briefly, identification with 3:11 E resonance was mentioned in paper by Rosaev, Plavalova [3].

Recently, three asteroids close to this pair have been discovered: 2011 RF40, 2022 QB59 and 2022 RM50 (Vokrouhlicky, et al, (2024)). Consequently, the group associated with 5026 Martes becomes a very young family. The discovery is very important for understanding the origin of this cluster because the direct separation of 2005 WW113 from 5026 Martes requires notably large relative velocity or unrealistic values of the Yarkovsky effect.

1. Result of the new members of Martes family orbits integrations

Here we study these new members with an emphasis on their resonant perturbations. First, we integrate the orbits of the new members with the perturbations of the large planets only. Note that the three of new members (2011 RF40, 2022 QB59 and 2022 RM50) orbited closer to the 3:11E resonance as well as 5026 Martes. Therefore their separation is easier than 2005 WW113. Two new members (2022 QB59 and 2022 RM50) are moving in an almost identical orbit. The result is shown in fig 1. The minimum distance between 2022 QB59 and 2022 RM50 is

about 4500 km in the epoch 17.003 thousand years ago. Despite the intersection of the resonance about 3, 6, 16, 21 thousand years ago, the distance between them does not exceed 0.28 AU during the entire considered interval (Fig.2). This means that 2011 RF40, 2022 QB59 and 2022 RM50 orbited in a very stable region of phase space which is interesting in itself. However, the closest encounter with 5026 Martes occurred an about 17.45 kyr ago.

This conclusion is confirmed by our integration with Ceres and Vesta effect. The orbits of 2022 QB59 and 2022 RM50 remain unchanged, while the orbits of 2011 RF40 and 5026 Martes slightly change the mean semimajor axis.

Moreover, the orbit of 2011 RF40 in the time interval between 31 and 24 thousand years ago becomes the same as the orbits of 2022 QB59 and 2022 RM50. The minimum distance between 2022 QB59 and 2022 RM50 is about 1720 km at 17.075 kyr. However, the closest encounter with Martes takes place an about 15.45 kyr ago for this case.

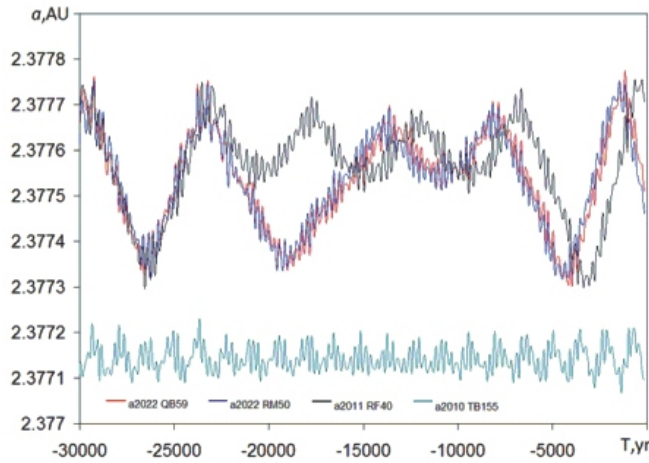


FIGURE 1. The semimajor axis evolution of 2011 RF40, 2022 QB59 and 2022 RM50

Conclusion

In the paper we report about a new example of stable chaotic motion. Two asteroids (2022 QB59 and 2022 RM50) are moving in an almost identical orbit, close to a 3:11 resonance with Earth. The orbits are very stable, despite the chaotic fluctuations of the semi-major axis.

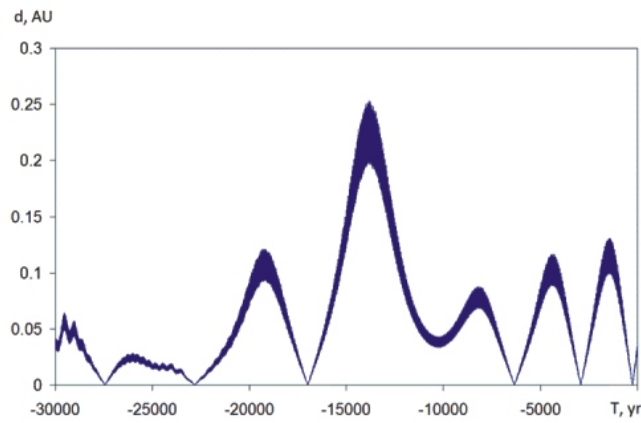


FIGURE 2. Distance between 2022 QB59 and 2022 RM50 evolution

References

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