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The long-term stability of MPC Neptune Trojans

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The orbital region of planet Jupiter is known for being densely populated with swarms of trojan asteroids. With the advance in observational techniques, the orbital region of Neptune is expected to be another sizable reservoir of trojan asteroids that are important to constrain Solar System formation models. Currently, there are 31 Neptune trojans registered in the IAU Minor Planet Center database (MPC). But, although the quantity of registered objects tends to increase in the next few years, a 10 Myr simulation of current MPC Neptune trojans' orbits shows that not all of them are long-term permanent. In fact, after 10 Myr of simulation, only 19 trojans remain librating around their respective Lagrangian equilibrium points, and 12 objects leave the trojan configuration to evolve into horseshoe orbits. In this last group, two objects are especially interesting: 2013 TK227 and 2010 TS191. In about 5 Myr, simulations indicate that both of them not only leave trojan dynamics but also the 1:1 mean motion resonance completely - object 2013 TK227 is ejected beyond Kuiper Belt limits and 2010 TS191 collides with Saturn. This project presents a study of the long-term dynamics of these two apparently unstable Neptune trojans exploring orbital elements' uncertainties. To study long-term dynamics, a series of clones were generated for each of these two MPC Neptune trojans, and the clones' orbital evolutions were analyzed. The results include orbital elements and critical angle time-dependent evolutions, as well as probabilistic conclusions on the long-term stability of 2013 TK227 and 2010 TS191 given the uncertainty limits.

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