In the Sun-Jupiter system, Trojan asteroids flank either side of Jupiter at points of stability known as Legrange points - L4 and L5. Asteroids can orbit around these points, following contours of constant comoving potential. Trojans orbiting around one of these points (called Tadpoles) are incredibly stable. Trojan horseshoes orbit around both points and are in a quasi stable pursuit orbit with Jupiter – none currently exist. This work looks to investigate aspects of the elusive Trojan Horseshoe orbit.

The Jupiter/Sun mass ratio is close to the critical ratio for the existence of horseshoes. A monte carlo simulation of initial positions shows that the regions for their existence roughly follow equipotential contours and are very narrow – an explanation as to why none exist.

Trojan horseshoe orbits have a theoretical maximum lifetime of 1 million years. The orbits eventually destabilise as the closest approach to Jupiter decreases with time – as shown by the outward-oscillating velocity/distance graph of a horseshoe.

In the future, comet impacts or slow-moving solar effects, such as the Yarkovsky effect, could perturb a tadpole into a horsehoe.