

PROPER ELEMENTS AND STABILITY OF THE TROJAN ASTEROIDS

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Up to now ~ 400 asteroids are known which move close to the Lagrangian equilibrium points L_4 (246) and L_5 (167) of Jupiter. In this investigation the orbits of all known Trojans were integrated numerically for 10 million years using the Lie Series integrator with adaptive stepsize (Hanslmeier and Dvorak, 1984) in the dynamical model of the outer planetary system. The goal of the study was to extend the computation of the proper elements for all known Trojans for a longer time interval; the respective results are compared to already existing ones (e.g. Bien & Schubart, 1987; Milani, 1993).

The determination of the characteristic quantities proper eccentricity e_p , proper inclination i_p and libration D was done by numerical filtering techniques using the method of Labrouste (Burger, 1998) and by a very precise frequency analysis (Chapront, 1997). Our results differ from the ones calculated for a shorter time interval by Milani (1993) between 5 % and 10%. In Fig.1 we plotted the nomogram for the three proper elements mentioned above for L_4 and the e_p for L_5 . As a new interesting result we found Trojans with $0.15 < e_p < 0.22$ for L_4 (upper left) and L_5 (upper right) which answers an open question of an existing gap in this range of the e_p . For L_4 Trojans there is a well defined maximum in the nomogram for $e_p \sim 0.06$; for the L_5 Trojans the maximum is flat and shifted versus $e_p \sim 0.07$. The proper elements $\sin(i_p)$ for L_4 (bottom left graph) show a maximum for Trojans moving in the plane of Jupiter's orbit and a decrease versus larger inclinations, although a plateau for $14^\circ < i < 27^\circ$ is visible; this confirms that the Trojan orbits are more inclined than the orbits of the main belt asteroids.

One more point to report is, that about 10 % of the orbits escaped from their orbits close to the Lagrangian points within the 10 million years integration, but this happened primarily for asteroids with orbital elements determined after one single opposition.

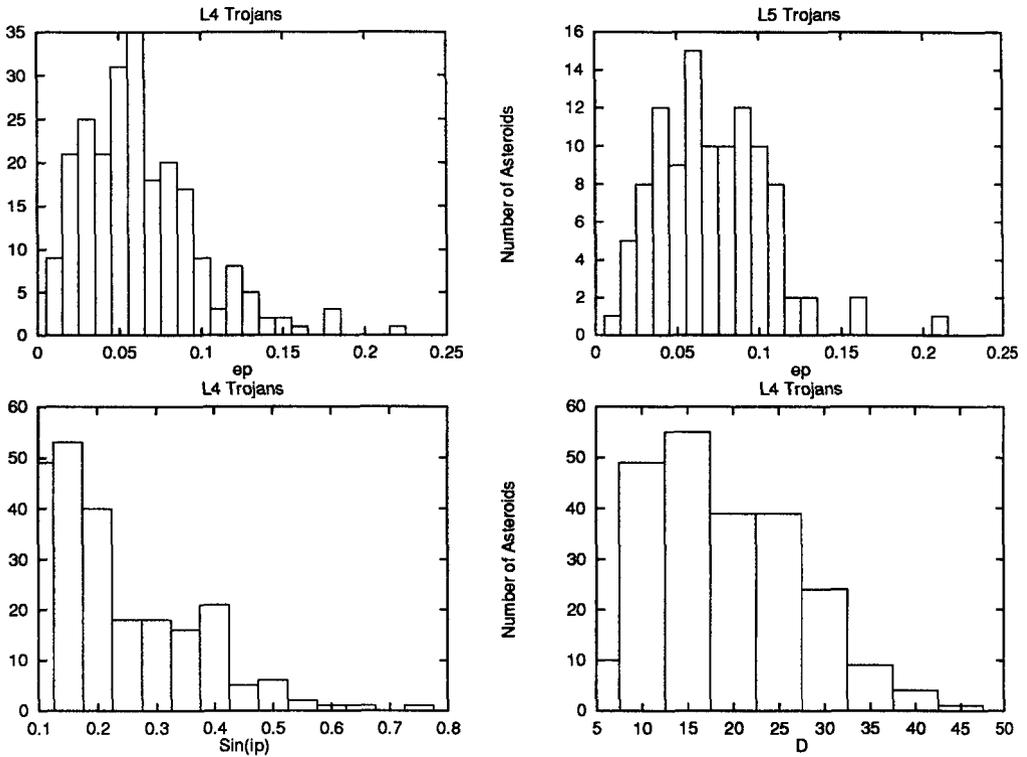


Fig. 1. Nomogram of the proper elements for L_4 Trojans: e_p (upper left), $\sin(i_p)$ (lower left), libration D (lower right) and for e_p of the L_5 Trojans (upper right).

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