

# Search for possible differences in dynamical and physical properties of L4 and L5 Jupiter Trojans

Ivan Slyusarev (1,2), Daniella Glezina (1) and Irina Belskaya (1,2)

(1) Department of Astronomy and Space Informatics, V.N. Karazin Kharkiv National University. (2) Institute of Astronomy, V.N. Karazin Kharkiv National University. Kharkiv, Ukraine ([i.slyusarev@karazin.ua](mailto:i.slyusarev@karazin.ua))

## Abstract

We search for possible differences in rotational frequencies, diameters, albedos and orbital parameters between Trojans belonging to the L4 and L5 swarms using our own observations and literature data. With increasing number of observational data it becomes evident that the L4 and L5 populations have very similar distributions of most parameters with an exception of orbital inclination distribution.

## 1. Introduction

In the second half of 2000's, after the emergence of new class of models of evolution of the early Solar system (Nice, Nice2, Grand Tack) [1,2] interest to Jupiter Trojans increased. The mechanism of Trojans capture and the place of their origin (outer part of Solar system) was the significant part of these models. Therefore, investigation of this population is necessary to the testing of these models. New surge of interest to this resonance group of minor bodies is caused by the future space mission "Lucy" (NASA) in 2021 which is aimed to study Trojans in both swarms [3]. Probably the most intriguing characteristic of the Jupiter Trojans is the observed asymmetry between the populations in L4 and L5. From the beginning of the study of Jupiter Trojans, there is a well-known difference in number of objects between L4 and L5 groups. For a long time, this difference has been attributed to the observational selection effect. However, as the number of discovered Trojans increase the difference become even more noticeable. At present, there are 4599 objects known in L4 and 2433 in L5 population, i.e. L4 Trojans are more numerous than L5 in 1.9 times. Except this well-known asymmetry in the number of bodies between L4 and L5 swarm [4], in our previous work [5] we found possible difference in orbit inclinations distribution. Here we search for possible differences in dynamical and physical properties using increasing set of observational data.

## 2. Physical and dynamical properties of Jupiter Trojans

Thanks to the all-sky surveys Pan-STARRS, Palomar Transient Factory and Kepler K2 mission large extent of data about Trojans rotational properties were obtained. There are more than 400 Trojans with rotational periods and lightcurve amplitudes known to date. This data taken from [6] after qualification analysis for each asteroid and our own unpublished data allows us to perform the comparative analysis of rotational frequency distribution in both swarms (Fig.1.). Also we have compared distributions of albedos and diameters using data from WISE database [7] (Fig.2, 3).

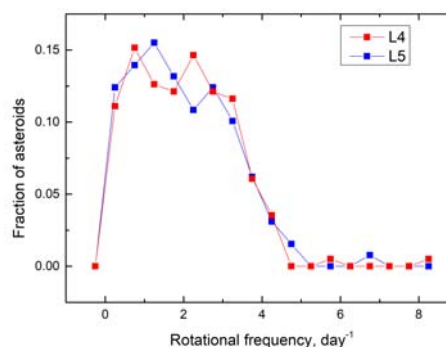


Figure1: Rotational frequency distribution.

## 3. Summary and Conclusions

The excess of the number of asteroids in L4 over the number of asteroids in L5 is observed in the entire range of absolute magnitude values, including the area that not distorted by the effect of observational selection ( $H < 14$ ).

There are possible slight differences in the diameter and albedo distribution.

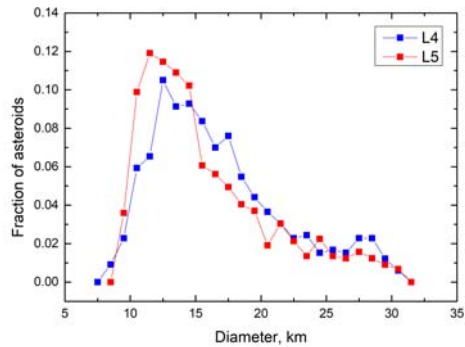


Figure 2: Diameter distribution.

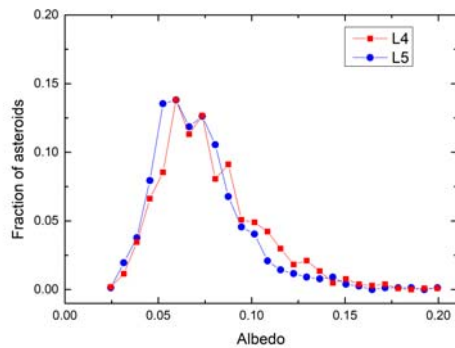


Figure 3: Albedo distribution.

Updated plot of the distribution of orbital inclinations is shown in Fig.4.

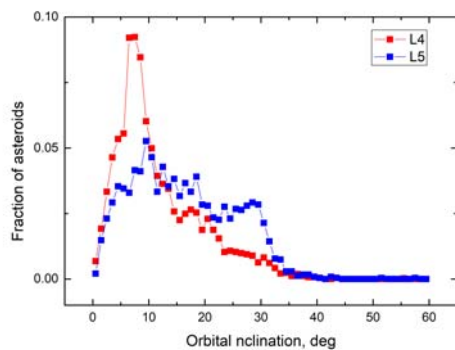


Figure 4: Orbital inclinations distribution.

There is no significant difference between L4 and L5 swarms in distribution of their rotational properties.

As for the orbital inclinations distribution in the L4 and L5 swarms (Fig.4) the differences in their shape is evident. The L5 population shows significantly wider distribution with a plateau in the range from  $5^\circ$  to  $17^\circ$  and a weak maximum at  $27^\circ$ . The distribution of the L4 population demonstrates a sharp maximum at  $7^\circ$ , after which the number of Trojans with specified inclinations decreases exponentially. Thus, in L4 bodies with small inclinations dominate in range  $5^\circ$ - $10^\circ$ , in L4 and L5 also there is a weak maximum near  $18^\circ$ . The distribution of eccentricities is identical in both subgroups.

## References

[1] Morbidelli, A., Levison, H.F., Tsiganis, K., and Gomes, R., Chaotic capture of Jupiter's Trojan asteroids in the early solar system, *Nature Lett.*, Vol. 435, pp. 462–465.2005.

[2] Nesvorný D., Vokrouhlický D., Morbidelli A., The Capture of Jupiter Trojans, *ApJ*, Vol. 768, 8 pp. 2013.

[3] Levison, H. F., Olkin, C., Noll, K.S., Marchi, S. [Lucy: Surveying the Diversity of the Trojan Asteroids, the Fossils of Planet Formation](#). 48th Lunar and Planetary Science Conference. 20–24 March 2017. The Woodlands, Texas. LPI Contribution No. 1964, id. 2025.

[4] Szabo G. M. et al. The properties of Jovian Trojan asteroids listed in SDSS Moving Object Catalogue 3. *MNRAS*, Vol. 377, pp. 1393-1406, 2007.

[5] Slyusarev I.G. Asymmetry Between the L4 and L5 Swarms of Jupiter Trojans. 44th Lunar and Planetary Science Conference, held March 18-22, 2013 in The Woodlands, Texas. LPI Contribution No. 1719, p.2223.

[6] <http://alcddef.org/>

[7] Mainzer, A.K., Bauer, J.M., Cutri, R.M., Grav, T., Kramer, E.A., Masiero, J.R., Nugent, C.R., Sonnett, S.M., Stevenson, R.A., and Wright, E.L., NEOWISE Diameters and Albedos V1.0. EAR-A-COMPIL-5-NEOWISEDIAM-V1.0. NASA Planetary Data System, 2016;