ASYMMETRY BETWEEN THE L4 AND L5 SWARMS OF JUPITER TROJANS. I. G. Slyusarev[1], [1]Astronomical Institute of Kharkiv Karazin National University, Sumska Str. 35, Kharkiv 61022, Ukraine (i_slyusarev@mail.ru).

Introduction: Discovery of Trojans around other than Jupiter planets (Mars, Neptune and Earth) and the new mechanism of chaotic capture onto Trojan orbits from the outer solar system [1] have stimulated new studies of these bodies. Accumulation of new data on physical properties of Jupiter Trojans allowed to raise a number of questions which have no answers in the available models of Trojans origin. One of the most intriguing questions is related to a possible asymmetry between dynamical and physical properties of L4 and L5 swarms. The first discussion of this issue is presented in [2].

Asymmetry between the number of the leading and trailing swarms: The most debated question is a reality of differences in the numbers of bodies in these two groups. This asymmetry is usually considered as due to observational selection effects [2]. Although there were several theoretical papers that indicated on the differences in the size of the stability region in the L4 and L5 due to perturbations of Saturn [3-5], migration [6] or by action of dissipative forces [7-9]. The analysis based on the Sloan Digital Sky Survey (SDSS) has shown that the ratio of the number of bodies in the leading (L4) to the number of bodies in the trailing (L5) swarms equals 1.6 ± 0.1 [10]. Later similar estimates were obtained in the surveys SMBAS [11] and WISE [12]. But, in all these cases, the population of each swarm was calculated by the extrapolation of data of the counting within a small area of the sky to the total area occupied by the L4 and L5. To take into account the effect of observational selection they used models which introduced an additional uncertainty through the model parameters. However, the difference in the number of the L4 and L5 Trojans is observed in the region, that is not distorted by the observational selection effects, i.e. for Trojans with absolute magnitudes brighter 13.9 mag (see Figure 1, 2). It is obvious that the distribution (Figure1) is identical for the swarms L4 and L5, but the number of L4 Trojans exceeds the number of L5 in all this range of the absolute magnitudes (Figure 2). This result requires explanation, regardless a total number of bodies in leading (L4) and trailing (L5) swarms, down to the smallest sizes.

Asymmetry between the distribution of the orbital inclination: The distributions of the mean values of distance, eccentricitiy, and inclination between

the L4 and L5 populations were compared in [19] by a simple statistical test, the Kruskal-Wallis test. They noted the predominance of high inclinations in the L5 swarm as compared to L4. The difference in the distribution of the L4 and L5 inclinations for Trojans, less than 10 km in diameter was mentioned in [20], but for small statistics.
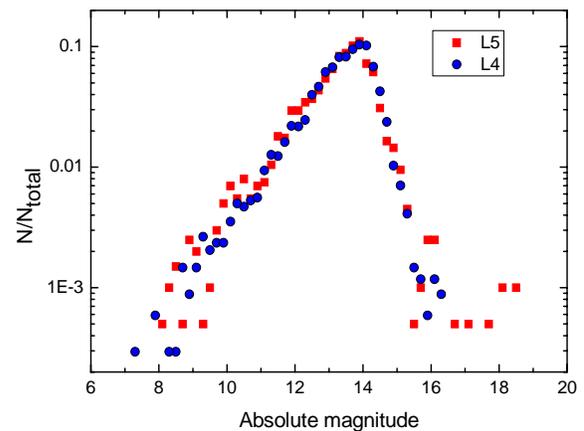

Figure 1: Distribution of the absolute magnitudes of 5427 Jupiter Trojans, that were discovered to 02.01.2013 including 3416 objects in the L4 (blue circles) and 2011 objects in the L5 (red squares) [21].
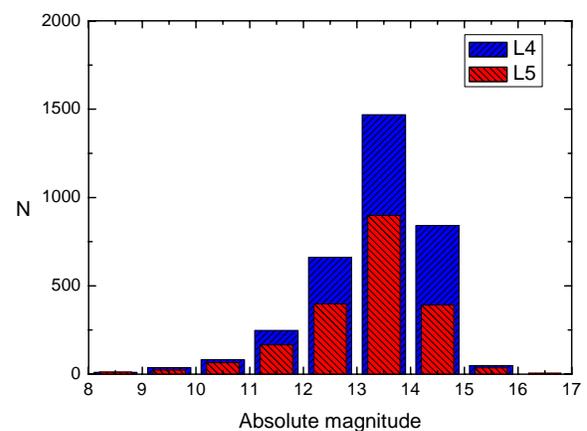

Figure 2: Distribution of numbers of bodies in the L4 (blue) and L5 (red) swarms.

To date, the number of discovered Trojans has increased in a factor of 5.5 compared to [19], which allows us to apply more powerful statistical tests to search for possible differences. We used the Smirnov's
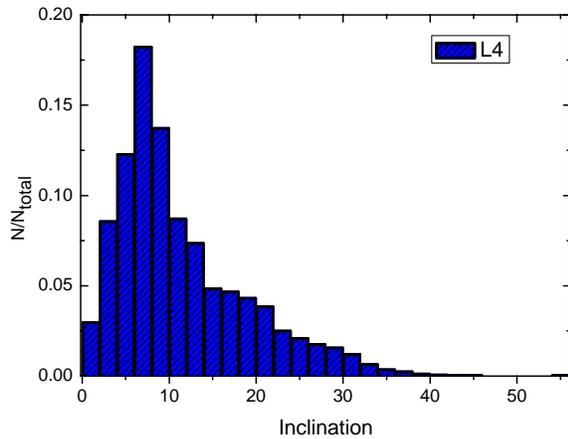
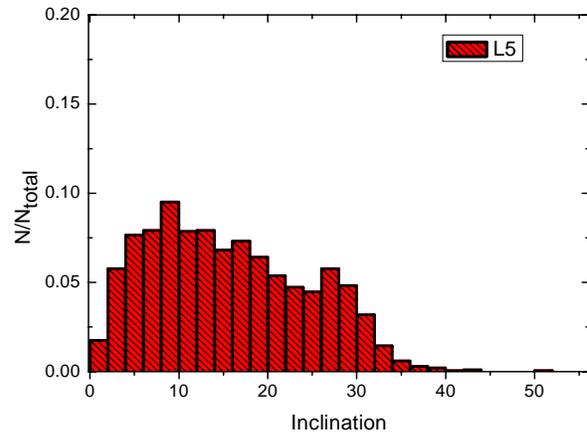Figure 4: Distribution of the orbital inclinations of Trojans in the L4 swarm.

criterion to examine an homogeneity in the distribtions of eccentricities and inclinations for the L4 and L5 Trojans. We found no significant difference in the distribution of eccentricities (Figure 3) while the L4 distribution of the orbital inclinations is essentially different from the L5 distribution (Figure 4,5). This conclusions are confirmed by Smirnov's statistical test at the 99% confidence level.
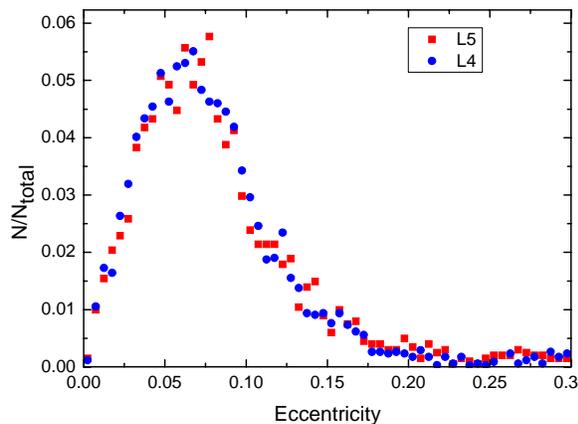

Figure 3: Distribution of eccentricities of Trojans in the L4 (blue circles) and L5 (red squares) swarms.

Conclusions: There are two significant differences in the L4 and L5 swarms of the Jupiter Trojans populations undistorted by observational selection effect (H <13.9 mag):

1) a greater number of bodies belonging to the L4 in the considered range of absolute magnitudes,

2) a different distribution of the orbital inclinations.

Figure 5: Distribution of the orbital inclinations of Trojans in the L5 swarm.

These two manifestations of asymmetry in the L4 and L5 swarms should be taking into account in hypotheses of Jupiter Trojans origin.

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[21]www.minorplanetcenter.net/iau/lists/JupiterTrojans