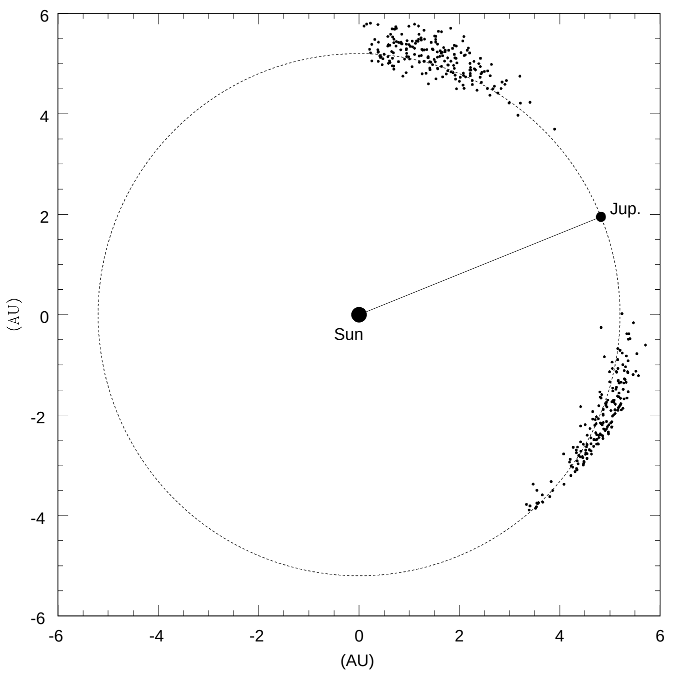

Schematic view of the locations of the two clouds of a large sample of known Jupiter Trojans around the Lagrangian L4 and L5 points at an arbitrary epoch. The locations of the Trojans have been computed according to their known orbital elements. The orbit of Jupiter, for simplicity approximated by a circle of radius 5.2 AU, is also shown, as are the locations of the planet and the Sun.

Uniquely among the minor planets, the so-called Jupiter Trojans are made up of small bodies librating around the stable L4 and L5 Lagrangian points of the Sun–Jupiter system on orbits thought to be stable over the age of the solar system. A few Mars and Neptune Trojans are also known to exist, whereas no results have been obtained from searches for Trojans of other planets.

There are many unanswered key questions related to the peculiar locations and orbital properties of Trojans, on which Gaia may cast some light: (i) Did they accrete from planetary grains in the same region where they are found today or were they trapped there in the early stages of the formation of ther solar system; (ii) Can Trojans be simply considered as a sub-class of the objects that we collectively call 'asteroids', or should we consider them as a separate category of bodies, somehow intermediate between main-belt asteroids and trans-Neptunian objects with distinctive physical properties?

The composition of Trojans constitutes a serious constraint for any study of the original gradient in composition of the planetesimals in the early phase of the solar system. A comparison of their spectral-reflectance properties with those of other classes of minor bodies, including main-belt asteroids, Hildas, Centaurs, trans-Neptunian objects, and comets, is an important task and clearly this is an area where Gaia will contribute significantly.

Another classically-debated problem is the possible systematic difference between the leading (L4) and trailing (L5) clouds. This could reflect a difference in their origin or be the result of a different dynamical and collisional subsequent history. In principle, there should be no difference in the dynamics of the two groups, but it happens that the L4 objects discovered so far are about 1.5 times as numerous as those at L5 (the census as of late July 2009 includes 1850 L4 objects compared with 1404 L5 objects). There are also claims that the distribution of orbital inclinations could be not identical between the two clouds.

Gaia observations of Trojans should help disentangle pieces of the puzzle. Precise astrometric measurements will produce significant improvements in the accuracy of the derived orbits of these objects, leading to the refinement of the statistics of the distribution of orbital elements. The systematic and homogeneous survey of the spectrophotometric properties of Trojans will make it possible to investigate the spectral diversity among Trojans, and to detect possible systematic differences in surface reflectance between the two clouds, as suggested by recent ground-based observations. Moreover, Gaia's photometric data is expected to produce reliable estimates of rotation periods, spin axis orientations, and overall shapes for a statistically significant sample of the whole population. Regarding object sizes, the large heliocentric distance will restrict that determination to the largest members of the population, such as 624 Hektor and 911 Agamemnon, which have diameters exceeding 100 km.

Gaia: Trojans