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Jupiter Trojans: an analysis of family members

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Abstract

A wide observational program has been devoted in last years to the study of Jupiter Trojans, belonging to dynamical families.
Visible and near infrared photometry and spectroscopy has been carried out to infer the taxonomic classification, and to investigate the surface composition of all the observed bodies.
The obtained results will be discussed also in comparison with the other populations of small bodies of the outer Solar System,

1. Introduction

Jupiter Trojans, located in the L4 and L5 Jupiter's Lagrangian points, are among the less known populations of small bodies of the Solar System.

Their origin is still matter of debate, we still do not know whether they formed in the vicinity of Jupiter and were captured on tadpole orbits by the Jupiter gravity and/or gas drag (following the model by Marzari and Scholl 1998a,b; Fleming and Hamilton 2000; Peale 1993); or they formed in the Kuiper belt and were captured during planetary migration, just after Jupiter and Saturn crossed their mutual 1:2 resonances (following the Morbidelli et al. 2005 scenario).
Although their formation has not been definitively assessed, it is widely accepted that Jupiter Trojans formed in the outer Solar System, in regions rich in frozen volatiles.

Several theoretical studies conclude that Jupiter Trojan clouds are at least as collisionally evolved as main belt asteroids and this result is supported by the identification of several dynamical families, both in the L4 and L5 swarms.

On 2002 we started a wide campaign of photometric and spectroscopic observations of Jupiter Trojans belonging to dynamical families. Our aim was to investigate the surface composition of small Jupiter Trojans produced by the catastrophic fragmentation of originally larger objects, in order to provide a glimpse of the internal structure of the larger primordial parent bodies.

Visible spectra of 80 Jupiter Trojans have been collected, for 31 of them also near-infrared observations have been carried out.

2. Results

All the observed targets have spectral behaviour typical of the primitive C, P and D taxonomic classes. Both L4 and L5 clouds are dominated by D-type asteroids, but L4 has a higher presence of C and P-type objects and seems to have a more heterogeneous composition, as compared to the L5 swarm.
In particular L4 guests the peculiar Eurybates family, whose members are characterized by almost flat visible spectra (Fig. 1), with spectral slopes strongly clustered around 2 %/10^3 Å, and spectral behaviours similar to those of C-type main belt asteroids and/or Chiron-like Centaurs.
A model of the surface composition of all the objects observed in both the visible and near infrared ranges has been obtained by applying a radiative transfer model, based on the Hapke theory. Although, as before mentioned, Jupiter Trojans are widely believed to have formed in a region of the solar nebula rich in frozen volatiles, no signatures of ices have been found on the observed spectra.
The obtained results are surprising also in view of the recent detection of water ice and organic material on the surface of the C-type main belt asteroid 24 Themis (Rivkin and Emery, 2010).

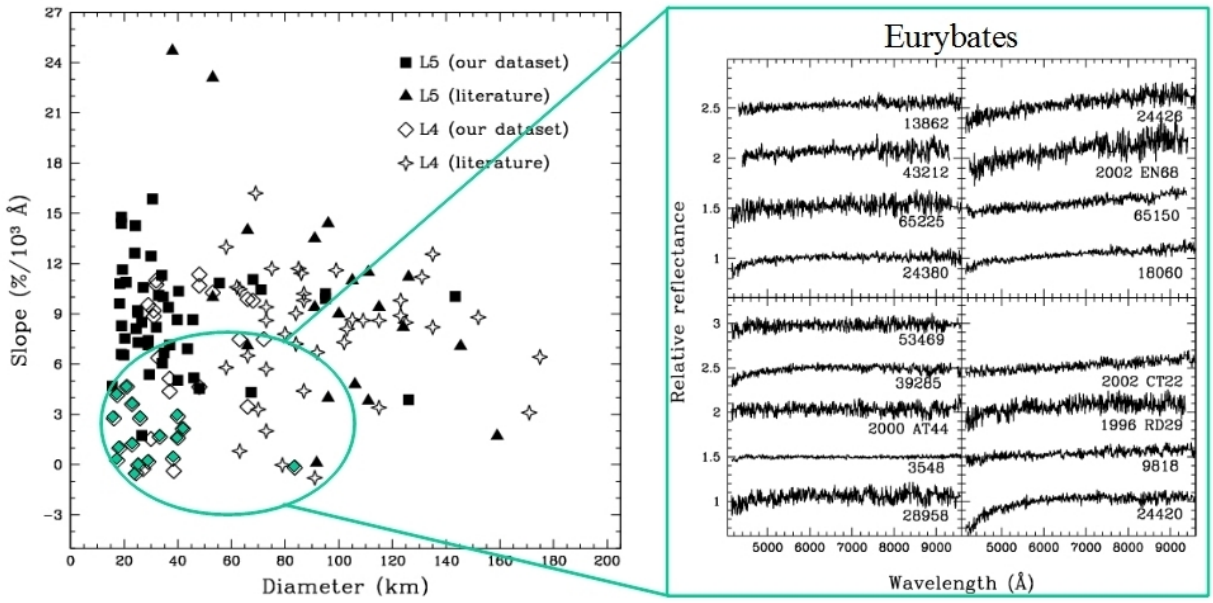

Figure 1: On the left spectral slopes versus the estimated diameter of JTs; on the right the reflectance spectra of the Eurybates family members.

A statistical investigation of the distribution of the spectral properties of Jupiter Trojans, as a function of their orbital and physical characteristics has been performed. A comparison has been also carried out among Jupiter Trojans and the other population of small bodies of the inner and outer Solar System.

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