

# 木星特洛伊小行星研究进展与展望\*

黄海涛<sup>1,2</sup>, 吴昀昭<sup>2</sup>

(1.中国科学院紫金山天文台, 南京, 210034; 2.中国科学技术大学天文与空间科学学院, 合肥, 230026)

**摘要:** 木星特洛伊小行星(Jupiter-Trojan asteroids)是位于木星稳定拉格朗日点上与木星以相同周期围绕太阳稳定运行的小天体。木星特洛伊小行星作为行星形成过程的活化石记录了行星起源、类地行星有机物与挥发物来源及行星系统整体演化的独特信息。迄今仅通过地基望远镜或空间望远镜对它们进行过远距离光谱观测, 它们仍是太阳系最神秘的天体群之一。在物质成分上, 细粒硅酸盐被认为是构成特洛伊小行星的重要物质。过去认为特洛伊小行星形成在 5AU 附近, 新的动力学模型认为特洛伊小行星来自柯伊伯带。NASA 的“露西”小行星探测任务(Lucy)将首次近距离探索这些神秘的小天体, 有望为解开特洛伊小行星的身世之谜提供重要证据。本文梳理了木星特洛伊小行星的观测历史、物理性质、光谱性质、物质组成以及形成和演化, 并介绍了“露西”的探测任务与目标, 为未来我国深空探测计划中的小行星探测提供支撑。

**关键词:** 木星特洛伊小行星; 光谱性质; 物质组成; 形成演化

## The progress and prospect of Jupiter-Trojan asteroids research

HAUNG Haitao<sup>1,2</sup>, WU Yunzhao<sup>1</sup>

(1. Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210023, China;

2. College of Astronomy and Space Science, University of Science and Technology of China, Hefei 230026, China)

**Abstract:** Jupiter-Trojan asteroids, as fossils of planet formation, orbiting the Sun in Jupiter's stable Lagrange points, provide a unique and critical insight into planetary origins, the sources of volatiles and organics on the terrestrial planets, and the evolution of the planetary system as a whole. Until now Jupiter-Trojan asteroids have only been observed through remote spectroscopic measurements using ground-based telescopes or space telescopes, and they still remain one of the most enigmatic groups of celestial bodies. In the past decade, significant advances have been made in understanding physical properties and spectral properties, and there has been a revolution in thinking about the origin and evolution of Trojans. In terms of surface composition, fine-grained silicates that appear to be similar to cometary silicates have gradually replaced water ice and organics as a significant part of Trojan asteroids surface compositions, and a color bimodality may indicate distinct compositional groups among the Trojans. Whereas Trojans had traditionally been thought to have formed near 5 AU, a new paradigm has developed in which the Trojans formed in the proto-Kuiper Belt, and they were scattered inward and captured in the Trojan swarms as a result of resonant interactions of the giant planets. There are significant differences between current physical properties of Trojans and those of Kuiper Belt objects. These differences may be indicative of surface modification due to the inward migration of objects that became the Trojans. The upcoming Lucy mission will provide a unique opportunity to conduct a close-up exploration of these enigmatic small celestial bodies, potentially yielding important evidence for unraveling the mysteries surrounding the origin and evolution of Jupiter-Trojan asteroids. This paper provides a comprehensive overview of the observational history, physical and spectral properties, material composition, formation and evolution of Jupiter-Trojan asteroids, as well as an introduction to the goals and objectives of the Lucy mission. This study serves as a support for potential future deep space exploration missions which

---

\* 国家自然科学基金资助项目 (12150009)

may have the capacity of exploring asteroids.

**Keywords:** Jupiter-trojan asteroids; spectroscopy; composition; formation; evolution

**作者简介:**

**黄海涛** (2000-), 男, **硕士研究生**, 主要研究方向: 小行星遥感与深空探测。

通信地址: 安徽省合肥市金寨路 96 号中国科学技术大学 (230026)

电话: 15716066122

E-mail: [ht.huang.pmo@qq.com](mailto:ht.huang.pmo@qq.com)

**吴昀昭** (1977-), 男, **研究员, 博士生导师**, 主要研究方向: 行星遥感与深空探测。

通信地址: 江苏省南京市栖霞区元化路 10 号中国科学院紫金山天文台 (210023)

电话: 13814014001

E-mail: wu@pmo.ac.cn