New observations of (4179) Toutatis from the Chang'e-2 flyby mission and future Chinese missions to asteroids

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Primitive asteroids are remnant building blocks in the Solar System formation. They provide key clues for us to reach in-depth understanding of the process of planetary formation, the complex environment of early Solar nebula, and even the occurrence of life on the Earth. On 13 December 2012, Chang'e-2 completed a successful flyby of the near-Earth asteroid (4179) Toutatis at a closest distance of 770 meters from the asteroid's surface. The observations show that Toutatis has an irregular surface and its shape resembles a ginger-root with a smaller lobe (head) and a larger lobe (body). Such bifurcated configuration is indicative of a contact binary origin for Toutatis. In addition, the images with a 3-m resolution or higher provide a number of new discoveries about this asteroid, such as an 800-meter basin at the end of the large lobe, a sharply perpendicular silhouette near the neck region, and direct evidence of boulders and regolith, indicating that Toutatis is probably a rubble-pile asteroid. The Chang'e-2 observations have provided significant new insights into the geological features and the formation and evolution of this asteroid. Moreover, a conceptual introduction to future Chinese missions to asteroids, such as the major scientific objectives, scientific payloads, and potential targets, will be briefly given. The proposed mission will benefit a lot from potential international collaboration in the future.

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