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New census of Hilda, Jovian Trojan, Centaur and transneptunian object light curves from K2 measurements

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Abstract

Here we present a large number of new light curves of solar system small bodies from the K2 mission of the Kepler Space Telescope. The new light curves of Hildas, Jovian Trojans, Centaurs show an overabundance of spin periods longer than the median values obtained in previous studies, mainly from ground based observations. A large fraction of Hildas and Jovian Trojans show contact binary-like light curves, in many cases with very long rotation periods. We also present light curves of transneptunian objects with previously unknown spin characteristics.

Introduction

The Kepler Space Telescope had a major impact on the studies of exoplanets, and also improved our understanding of astroseismology. Due to the failure of two reaction wheels, the original science goal had to be changed. The K2 mission [1] has become fully operational in June 2014 and targeted fields along the Ecliptic plane, to minimise the torque exerted on the spacecraft by solar wind pressure. These observations offered long (up to ∼80 days), uninterrupted photometry of solar system targets with a 30-min cadence, including main belt, Hilda and Jovian Trojan asteroids, Centaurs, transneptunian objects, and irregular satellites of the giant planets Uranus and Neptune.

Results

We derived new light curves and obtained rotation characteristics for 108 Hilda and 25 Jovian Trojan asteroids, 10 Centaurs and 73 transneptunian objects based on data acquired in the C03-C18 campaigns of the K2 mission. This large number of light curves provides a completely new picture about the rotation properties of these distant small body populations.

As already discussed in previous publications (e.g. [4, 2]) the long, uninterrupted light curves allow a detection of rotation period notably longer than what can be reached by ground based measurements (typically $<$12 h). Our samples show an overabundance of long rotation periods for Hildas, Jovian Trojans and Centaurs, underlining the importance of space based missions in asteroid light curves studies [3]. Due to their faintness ($>$20 mag) detection of long, P $\gtrsim$1 d spin periods of transneptunian objects are heavily affected by the presence of low frequency systematics, and allowed a proper rotation period determination for a limited sample only.

We found a large number asteroids with high amplitude (Δm $\gtrsim$ 1 mag) light curve among Hildas and Jovian Trojans, with light curve shapes similar to that expected from contact binaries, and some of them with very long, P $>$ 100 h rotation periods. We investigated the possibility of binarity and also of alternative explanations to explain the observed light curves of these targets.

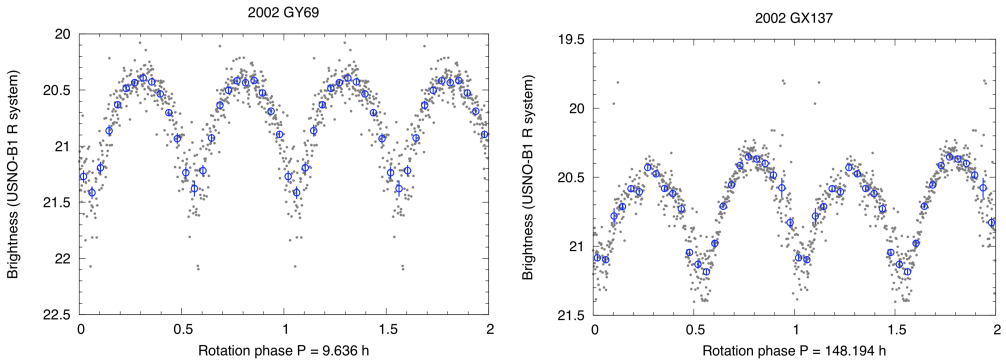

Figure 1: Folded light curves of the Hilda asteroids 2002 GY_{69} and 2002 GX_{137}. The folding periods are shown at the horizontal axes. Note the very different rotation periods and the similar light curve shapes and amplitudes.

Acknowledgements

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