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Selection effects in spins and shapes of asteroids

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Abstract

A problem of observing selection effect in photometric studies of asteroids is sketched. An observing campaign aimed to reduce these effects is described, with its first results concerning corrected period determinations.

Introduction

Physical studies of asteroids strongly depend on lightcurve data. However the abundance of lightcurves for a particular object strongly depends on its physical features like brightness, period of rotation, and lightcurve amplitude.

When the period of rotation is much longer than typical observing run, or the amplitude is close to the noise level, there are difficulties in determining the unique synodic period. However, thanks to the work of dedicated observers, practically all larger main belt asteroids (with absolute magnitude H≤11 mag) have their synodic periods determined with a certain level of confidence (LCDB, [1]). But once the period of rotation is established, and is known to be long, such targets are avoided by most of further observing studies due to instrumental or time limitations. This way their synodic periods often remain unconfirmed by an independent source.

Observing selection effects

Due to such selection effects asteroids with slow rotation (P≥12 hours) and/or rounded shape (a_{max} ≤0.25 mag) rarely have enough data to be spin and shape modelled, because there is a lack of data from multiple apparitions and viewing geometries, or the data are of insufficient quality. In spin and shape studies of asteroids, targets with short periods of rotation and large lightcurve amplitudes are thus preferred. This led to the situation displayed in the figure, where a large fraction of population of targets easy to observe and analyse is spin and shape modelled, while the remaining populations are spin and shape modelled in much smaller fraction. As a consequence knowlegde on e.g. spatial spin axis distributions or on asteroid shapes elongation and internal structure can be biased by these selection effects.

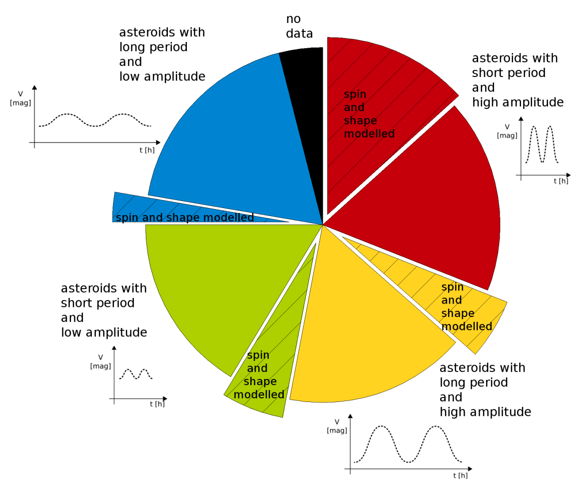

Figure 1: Distribution of periods and amplitudes among all bright (H≤11mag) main-belt asteroids, based on these two parameters simultaneously. A number of spin and shape modelled targets is marked within each group [2].

Initial results

We are conducting an observing campaign of a few dozens of long-period (P$\geq$12 hours) and low amplitude (a_{max} $\leq$0.25 mag) asteroids, aiming to decrease these selection effects. First results of our campaign show that a substantial fraction of periods longer than 12 hours and considered reliable, have actually different values [2]. Around one quarter of studied population displays longer synodic periods than previously accepted, which can somewhat alter e.g. the widely known frequency-diameter plot. Since this fact was found among bright targets, even more profound biases are expected in the range of fainter (smaller) asteroids where observing selection effects are stronger.

We will also present first spin and shape models of our long-period and low-amplitude targets. As judged from their lightcurves, the shapes of these asteroids must be irregular with global asymmetries.

Acknowledgements

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References

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