

Asteroids of Few Hundred Meter in Size Have More Super-Fast Rotators?

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Abstract

We applied the Hough Transform, an algorithm to detect linear detections, to the high-cadence PS1 observation which was conducted in October 2016 for asteroid light curves collection and rotation period measurements. The algorithm were able to discover new asteroids which are one magnitude fainter (i.e., > 21.5 mag) than Chang et al. (2019)[1] and, therefore, we were able to measure the rotation periods for the main-belt asteroids of few hundred meter in size. From the study, we found 15 super-fast rotators (i.e., $P < 2$ hr; SFRs) out of 130 reliable rotation periods. This suggests that asteroids of few hundred meters in size could have more SFRs.

1. Introduction

Super-fast rotator is a kind of asteroid which has a rotation period of $P < 2$ hr. It is unexpected for asteroids with diameters larger than few hundred meters because they are believed to have the rubble-pile structure and can be destroyed under a rotation of $P < 2$ hr. However, more and more large SFRs (i.e., diameter of few hundred meter or larger) were discovered in the past few years using the wide-field high-cadence surveys (Chang et al. (2019)[1] and references therein) and they become a new puzzle to asteroid interior structure. Therefore, finding more large SFRs to study their physical properties is important to understand asteroid interior structure.

Using the PS1, Chang et al. (2019)[1] conducted a rotation period survey in October 2016 in which only the asteroids of 21.5 mag were discovered and used. However, the actual limiting mag of that survey was ~ 22.5 mag and, therefore, still a lot of unknown asteroids of > 21.5 mag wait to be discovered. Since it was a high-cadence observation, an asteroid had multiple detections within a night and these detections would line up as a straight line (hereafter, intra-night detec-

tions). Thus, we used the Hough Transform to detect these line-up intra-night detections and found more than 3000 new asteroids of > 21.5 mag which have a diameter range from few tens meter to ~ 1 kilometer. Among these asteroids, we obtain ~ 130 reliable rotation periods and 15 of them are SFRs. Under the same survey condition with Chang et al. (2019)[1], our result suggest that asteroids of few hundred meter in size could have more super-fast rotators.

2. Figures

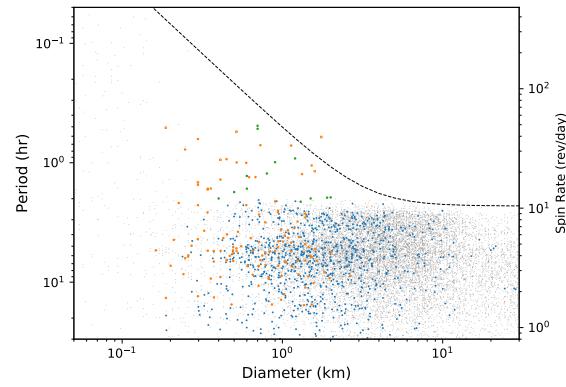


Figure 1: Asteroid rotation period vs. diameter. The blue, green, and orange filled circles are the asteroids with reliable rotation periods from [1], reported SFRs, and newly discovered asteroids with reliable rotation periods, respectively. The gray dots are the LCDB objects of $U \geq 2$. The dashed line is the spin-rate limit with internal cohesion adopted from [2].

Acknowledgements

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References

- [1] Chang, C.-K., Lin, H.-W., Ip, W.-H., et al. 2019, ApJS, 241, 6.
- [2] Holsapple, K. A. 2007, Icarus, 187, 500