EPSC Abstracts
Vol. 9, EPSC2014-123-1, 2014
European Planetary Science Congress 2014

Photometric observations of the Baptistina asteroid family

M.-J. Kim (1,2), Y.-J. Choi (1) and H.-K. Moon (1)
(1) Korea Astronomy and Space Science Institute, Daejeon, Republic of Korea, (2) Yonsei University, Republic of Korea
(skarma@kasi.re.kr / Fax: +82-42-865-3358)

Abstract

The Baptistina family is one of the typical young asteroid families with an age estimated to be about 140-320 Myrs old [1]; considered to have not enough time to experience a significant collisional and dynamical evolution since it was formed. Therefore, it may offer a unique insight into spin rate distribution of relatively fresh fragments and physical mechanism of a family break-up event. We carried out time series photometric observations for the family members to obtain their physical properties, including sizes, shapes, rotational periods, spin axes, colors, and H-G parameters based on near round- the-clock observations, using several 0.5-2 meter class telescopes. This study is expected to find some important clues on the collisional history and transport mechanism of the members from the resonance region in the Main-belt to the near Earth space.

1. Introduction

An asteroid family is a clustering of bodies in the proper orbital element space (a, e, i), which is thought to have been produced by the disruption of a large parent body, presumably through a catastrophic collision [2, 3]. When a large asteroid breaks up, it produces a huge number of fragments with similar taxonomy type, physical properties, and with a same age [4, 5]. The study of the origin and evolution of an asteroid family is essential in understanding the nature of the early collision dominated epoch and subsequent evolution of the Solar System. The Baptistina family members are regarded as C/X-type, and located within the Flora family in the proper orbital element space however they are expected to be taxonomically different from the S-type Floras. This family was once considered as a probable source of the Cretaceous- Paleogene (K-T) impactor [6], however new albedo measurements from WISE observations suggested that its age is approximately two times younger than the previous estimation [7]. Physical characteristics of the family members, such as rotational periods, are known only for 77 objects (LCDB, Feb. 2014) out of a total of 3,551 known members [8], which accounts for less than 3 percent.

2. Observations

Observations of the Baptistina family asteroids were conducted during 73 nights from 2013 Oct. to 2014 May, using 0.5 m- to 2 m- class telescopes at 6 observatories in the northern hemisphere. We used CCD cameras on the the Tubitak Ulusal Gozlemevi (TUG) 1.0 m telescope in Bakirlitepe, Turkey, the Bohyunsan Optical Astronomy Observatory (BOAO) 1.8 m telescope on Bohyunsan, Korea, the Sobaeksan Optical Astronomy Observatory (SOAO) 0.6 m telescope on Sobaeksan, Korea, the Lemmonsan Optical Astronomy Observatory (LOAO) 1.0 m telescope on Mt. Lemmon, USA, the National Astronomical Research Institute of Thailand (NARIT) Observatory 2.4 m telescope on Mt. Doi Inthanon, Thailand, and the McDonald Observatory 2.1 m Otto Struve Telescope on Mt. Locke, USA. The details of the observatories and instruments are shown in Table 1.

Table 1: Observatory and Instrument Details

Telescopes	Observing date range	Instruments
SOAO 0.6 m		e2v 2K CCD
LOAO 1.0 m	2013 Oct. –	e2v 4K CCD
TUG 1.0 m	2014 May	SI 4K CCD
BOAO 1.8 m		e2v 4K CCD
McDonald 2.1 m	2014 May 1 – 6	CQUEAN[a] 1K
NARIT 2.4 m	2014 Feb. 19 – 24	ULTRACAM 1K

[a]Abbreviations: CQUEAN = Camera for QUasars in EArly uNiverse

3. Methodology

For the sake of efficiency of observation and data reduction, we implemented an observation scheduler, SMART (Scheduler for Measuring Asteroid's RoTation) that is designed to conduct follow-up observations in a timely manner. It automatically updates small body catalogs, generates ephemerides, prepares target lists, and sends a suite of scripts to site operators. We also developed a photometric analysis software subsystem, ASAP (Asteroid Spin Analysis Package) that aids to find appropriate comparison stars in an image and to derive spin parameters and lightcurve simultaneously in a semi-autonomous manner. Here we present sample plots for 11129 Hayachine and 34572 (2000 SY310) which have been drawn as composite lightcurves folded at their synodic rotational period (see Fig. 1), by using ASAP.

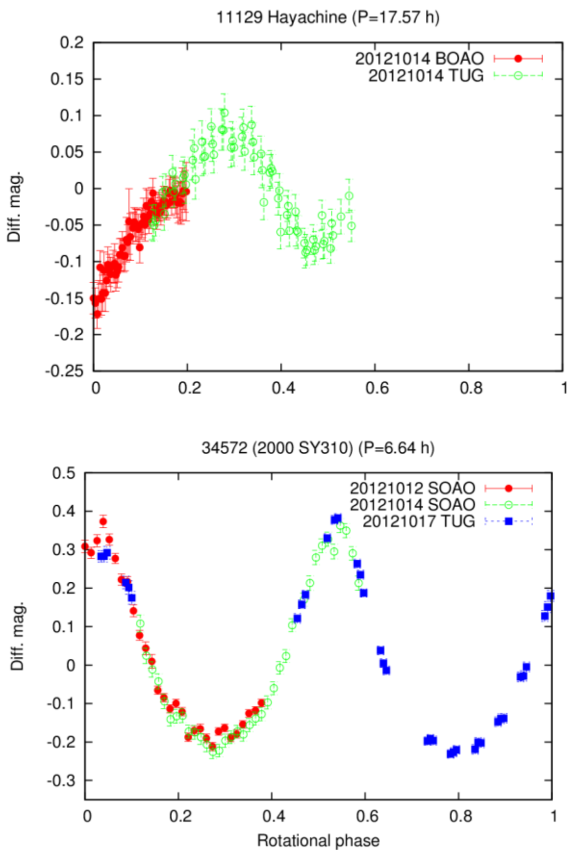

Figure 1: Composite lightucrves of asteroids 11129 Hayachine (Left) and 34572 (2000 SY310) (Right) obtained using the network observation from Korea to Turkey [9].

4. Discussions

There are a number of observational studies on rotational properties of old-type asteroid families [9, 10, 11]. On the other hand, little is known about young asteroid families to date. Ito and Yoshida [12] analyzed photometric data of the Karin and Veritas families that are considered to have undergone only little collisional and orbital evolution, but they concluded that more lightcurve data should be acquired to confirm the results.

In particular, spin rate and pole orientation distribution on the Baptistina asteroid family will allow us to better constrain to measure the non-gravitational forces, such as the Yarkovsky and YORP effect. It could decrease the uncertainty in measuring the break-up age of the Baptistina family.

References

[1] Masiero, J. R., Mainzer, A. K., Grav, T., et al. 2012, ApJ, 759, 14. [2] Hirayama, K. 1918, AJ, 31, 185. [3] Cellino, A., Dell'Oro, A., & Tedesco, E. F. 2009, Planet. Space Sci., 57, 173. [4] Cellino, A., Bus, S. J., Doressoundiram, A., & Lazzaro, D. 2002, in Asteroid III, ed. W. Bottke, A. Cellino, P. Paolicchi, & R. Binzel (Tucson, AZ: Univ. Arizona Press), 633. [5] Zappala, V., Cellino, A., Dell'Oro, A., & Paolicchi, P. 2002, in Asteroid III, ed. W. Bottke, A. Cellino, P. Paolicchi, & R. Binzel (Tucson, AZ: Univ. Arizona Press), 633. [6] Bottke, W. F., Vokrouhlicky, D., & Nesvorny, D. 2007, Nature, 449, 48. [7] Masiero, J. R., Mainzer, A. K., Grav, T., et al. 2011, ApJ, 741, 68. [8] Nesvorny, D. 2012, Nesvorny HCM Asteroid Families V2.0. EAR-A-VARGBDET-5-NESVORNYFAM-V2.0. NASA Planetary Data System. [9] Kim, M.-J., Choi, Y.-J., Moon, H.-K., et al. 2013, AJ, 147, 56. [10] Slivan, S.M., Binzel, R. P., Crespo da Silva, L. D., et al. 2003, Icarus, 162, 285. [11] Kryszczynska, A., Colas, F., Poli´n, M., et al. 2012, A&A, 546, 72. [12] Ito, T. & Yoshida, F. 2010, AdvGeo, 25, 161.