

THE MINOR PLANET BULLETIN

BULLETIN OF THE MINOR PLANETS SECTION OF THE
ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

VOLUME 45, NUMBER 4, A.D. 2018 OCTOBER-DECEMBER

311.

FILTERED PHOTOMETRIC MONITORING OF 1591 BAIZE

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(Received: 2018 May 11)

Broad-band BVR photometry of asteroid 1591 Baize was obtained over four nights in 2017 February and March. We determined a rotation period of 7.788 ± 0.003 hours and typical colors of $B-V = 0.9$ and $V-R = 0.5$. The amplitude of color variations is small, ~ 0.02 mag. These characteristics support the classification of 1591 Baize as an S-type asteroid.

The main-belt asteroid ($a = 2.39$ AU) 1591 Baize was discovered by the Belgian astronomer Sylvain Arend on 1951 May 31. It has an eccentric ($e = 0.176$) and inclined ($i = 24.8^\circ$) orbit that places it among the Phocaea group of asteroids (JPL, 2018). Based on a single night of observations, Barucci et al. (1994) estimated a rotation period of ~ 10 hours. Over a period of two nights, Garlitz (2013) refined the period estimate to 7.78 ± 0.04 hours. Mas et al. (2018) monitored the asteroid on four nights in 2017 Jan-Feb and determined a rotation period of 7.794 ± 0.001 hours.

Photometric monitoring of 1591 Baize was carried out at Georgia State University's Hard Labor Creek Observatory in Rutledge, GA, as part of the course work for ASTR 4100 and ASTR 6100, *Observing Methods and Instrumentation*. Observations were conducted with the 0.6-m Miller telescope, an $f/6.5$ Planewave Corrected Dall-Kirkham Astrograph, equipped with an Apogee Alta camera with 15-micron pixels in a 2048x2048 array. The resultant field of view is 26.3x26.3 arcmin and a scale of 0.77 arcsec/pixel. Broad-band photometry through Johnson B, V, and R

filters was obtained on the calendar nights of 2017 Feb 25, Mar 3, and Mar 4. Photometry in V and R was also obtained on 2017 Feb 10, but observations in B were omitted because of the full Moon. Exposure times were generally 2-4 mins, and the observing sequence cycled through each of the filters, performed a small dither, and then cycled through the filters again. The process was repeated for as long as possible and achieved a total of 5-8 hours of coverage each night.

Data were reduced with *IRAF* following standard procedures. Aperture photometry of 1591 Baize and several field stars was carried out in *IRAF* with a circular aperture of radius 8 pixels. Absolute calibrations were determined using photometry of field stars from the APASS catalog (Henden et al., 2009) for the B and V filters. The transformation equations of Jordi et al. (2006) for Population I stars were used to determine the effective R magnitudes for field stars using the Sloan r' magnitudes and the $g'-r'$ colors from APASS.

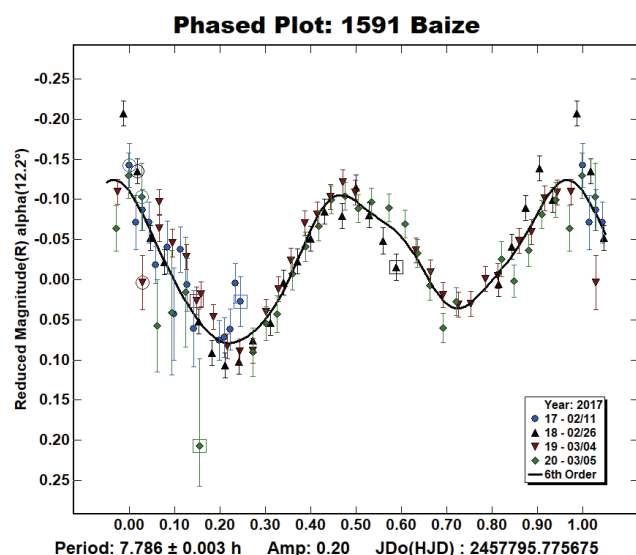
MPO Canopus, which implements the Fourier Analysis of Light Curves (FALC) algorithm of Harris (Harris et al., 1989), was used to determine the rotation period of the asteroid. The best-fit periods and the amplitudes of variation are listed below for each filter. In the summary table, we report the weighted average of these individual fits and the standard deviation as the uncertainty, which are in agreement with the periods determined by Garlitz (2013) and Mas et al. (2018). Below, we show the phased R-band light curve with a 6th order polynomial overlaid.

Filter	Pts	Period (hr)	Amp. (mag)
B	79	7.791 ± 0.006	0.20
V	127	7.788 ± 0.002	0.18
R	98	7.786 ± 0.003	0.20

The photometric colors were found to be $B-V = 0.9$ and $V-R = 0.5$. These colors are usual for S-type, or silicaceous, asteroids (Dandy et al., 2003) and agree with the reported membership of 1591 Baize in the Phocaea family. The amplitude of color variations is quite small, only ~ 0.02 mag, which is typical of most asteroids (e.g., Szabo et al., 2004).

Number	Name	2017 mm/dd	Pts	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
1591	Baize	02/10-03/04	304	12.15,16.46	140	26	7.788	0.003	0.19	0.02	PHO

Table I. Observing circumstances and results. Pts is the number of data points. The phase angle is given for the first and last date. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude and latitude at mid-date range (see Harris et al., 1984). Grp is the asteroid family/group (Warner et al., 2009).



Acknowledgements

IRAF is distributed by the National Optical Astronomy Observatory, which is operated by the Association of Universities for Research in Astronomy (AURA) under cooperative agreement with the National Science Foundation. This research was made possible in part based on data from the AAVSO Photometric All-Sky Survey (APASS), funded by the Robert Martin Ayers Sciences Fund.

References

- Barucci, M.A., di Martino, M., Dotto, E., Fulchignoni, M., Rotundi, A., Burchi, R. (1994). "Rotational Properties of Small Asteroids: Photoelectric Observations of 16 Asteroids." *Icarus* **109**, 267-273.
- Dandy, C.L., Fitzsimmons, A., Collander-Brown, S.J. (2003). "Optical colors of 56 near-Earth objects: trends with size and orbit." *Icarus* **163**, 363-373.
- Garlitz, J. (2013). Posting on CALL website. <http://www.minorplanet.info/call.html>
- Harris, A.W., Young, J.W., Scaltriti, F., Zappala, V. (1984). "Lightcurves and phase relations of the asteroids 82 Alkmene and 444 Gytis." *Icarus* **57**, 251-258.
- Harris, A.W., Young, J.W., Bowell, E., Martin, L.J., Millis, R.L., Poutanen, M., Scaltriti, F., Zappala, V., Schober, H.J., Debehogne, H., Zeigler, K.W. (1989). "Photoelectric Observations of Asteroids 3, 24, 60, 261, and 863." *Icarus* **77**, 171-186.
- Henden, A.A., Terrell, D., Levine, S.E., Templeton, M., Smith, T.C., Welch, D.L. (2009). <http://www.aavso.org/apass>
- Jordi, K., Grebel, E.K., Ammon, K. (2006). "Empirical color transformations between SDSS photometry and other photometric systems." *Astron. Astrophys.* **460**, 339-347.
- JPL (2018). Small-Body Database Browser. <https://ssd.jpl.nasa.gov/sbdb.cgi>
- Mas, V., Fornas, G., Lozano, J., Rodrigo, O., Fornas, A., Carreño, A., Arce, E., Brines, P., Herrero, D. (2018). "Twenty-One Asteroid Lightcurves at Asteroids Observers (OBAS) – MPPD: Nov 2016 – May 2017." *Minor Planet Bull.* **45**, 76-82.
- Szabo, Gy.M., Ivezić, Z., Juric, M., Lupton, R., Kiss, L.L. (2004). "Colour Variability of Asteroids in the Sloan Digital Sky Survey Moving Object Catalog." *Mon. Not. Royal Ast. Soc.* **348**, 987-998.
- Warner, B.D., Harris, A.W., Pravec, P. (2009). "The Asteroid Lightcurve Database." *Icarus* **202**, 134-146. Updated 2018 June. <http://www.minorplanet.info/lightcurvedatabase.html>