

LIGHTCURVE FOR KORONIS FAMILY MEMBER (1363) HERBERTA

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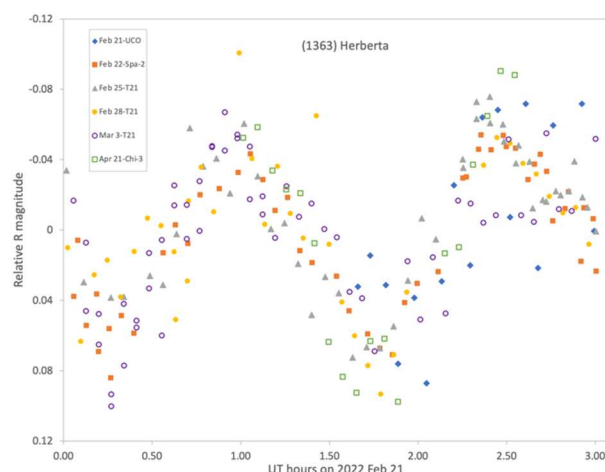
We present our composite lightcurve for Koronis family asteroid (1363) Herberta. Based upon six nights in 2022 we obtained an improved rotation period of 3.016 ± 0.002 h with amplitude 0.13 ± 0.02 mag.

We have begun a program to observe members of the Koronis asteroid family in order to determine improved periods for use in obtaining spin solutions and shape models (Kaasalainen et al., 2001; Slivan et al., 2003).

Observation planning used the Koronisfamily.com web tool (Slivan, 2003), and images were obtained using four telescopes including the Union College Observatory and remote access through the networks iTelescope.net (T21) and Telescope.Live (Spa-2 and Chi-3; see Table 1). Exposure times were generally 240 s and binning 2×2 except on Chi-3 where they were 180 s and 1×1 respectively. All observations used a red filter but specific filters varied by observatory due to availability.

A total of six observing nights spanning approximately 40 days was obtained. The specific nights are indicated by the legend of the lightcurve figure, and parameter values for phase and phase angle bisector appearing in Table II were found using the NASA Horizons ephemeris tool. Images were processed for bias, dark, and flat field corrections. We used *AstroImageJ* software (Collins et al., 2017) to process the Union College images and to perform photometry on all images. Light-time corrections were applied using NASA Horizons ephemerides.

Because the individual nights were not calibrated to a common brightness zero-point, constant brightness offsets were used to shift each night's data to arrive at a self-consistent lightcurve. We obtained a best fit synodic period $P = 3.016 \pm 0.002$ h, in agreement with the previous value of 3.015 ± 0.005 (Black et al., 2016). The amplitude (from trough to peak) is 0.13 ± 0.02 mag.



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References

- Black, S.; Linville, D.; Michalik, D.; Wolf, M.; Ditteon, R. (2016). "Lightcurve Analysis of Asteroids Observed at the Oakley Southern Sky Observatory: 2015 December - 2016 April." *Minor Planet Bull.* **43**, 287-289.
- Collins, K.A.; Kielkopf, J.F.; Stassun, K.G.; Hessman, F.V. (2017). "AstroImageJ: Image Processing and Photometric Extraction for Ultra-precise Astronomical Light Curves." *Astron. J.* **153**, 77-89.
- Kaasalainen, M.; Torppa, J.; Muinonen, K. (2001). "Optimization methods for asteroid lightcurve inversion. II. The complete inverse problem." *Icarus* **153**, 37-51.
- NASA Horizons. <https://ssd.jpl.nasa.gov/horizons/app.html#/>
- Slivan, S.M. (2003). "A Web-based tool to calculate observability of Koronis program asteroids." *Minor Planet Bull.* **30**, 71-72.
- Slivan, S.M.; Binzel, R.P.; Crespo de Silva, L.D.; Kaasalainen, M.; Lyndaker, M.M.; Krčo, M (2003) "Spin vectors in the Koronis family: comprehensive results from two independent analyses of 213 rotation lightcurves." *Icarus* **162**, 285-307.

Name	Site	Telescope	Camera	Array	Filter	FOV(')	Scale ("/pix)
UCO	Schenectady, NY	0.50-m RC f/8.1	SBIG STXL-11002	2004×1336×9μm	R	30×20	0.93
T21	Mayhill, NM	0.43-m CDK f/6.8	FLI-PL6303	3072×2048×9μm	R	33×49	1.92
Spa-2	Oria, Spain	0.70-m RC f/8	FLI-PL16803	2048×2048×9μm	r'	29×29	0.86
Chi-3	Rio Hurtado, Chile	1.0-m RC f/6.8	FLI-PL16803	4096×4096×9μm	Red	19×19	0.27

Table I. Telescopes and Cameras: RC=Ritchey-Chrétien. CDK = Planewave with f/4.5 focal reducer. UCO = Union College Observatory.

Number	Name	yyyy mm/dd	Phase	L _{PAB}	B _{PAB}	Period(h)	P.E.	Amp	A.E.	Grp
1363	Herberta	2022 02/21-04/21	0.5, 17.3	151	-1	3.016	0.002	0.13	0.02	Kor

Table II. Observing circumstances and results. The phase angle is given for the first and last dates. L_{PAB} and B_{PAB} are the approximate phase angle bisector longitude/latitude at mid-date range.