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ROTATION PERIOD OF KORONIS FAMILY MEMBER 1840 HUS

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We report rotation lightcurves of 1840 Hus observed during its apparition in 2020. The constraints from our data, combined with a reanalysis of published lightcurves recorded in 2009, yield a secure rotation period of 4.7483 ± 0.0008 h.

Koronis family member 1840 Hus was observed in 2020 as a "target of opportunity" during an ongoing observing program to study rotation properties of the family's brighter objects (Slivan et al., 2008). In the literature we find lightcurves of Hus from only a single previous apparition in 2009, with considerable noise in the data and an uncertain derived rotation period of 4.780 h (Clark, 2010). Subsequent statistical analyses of "sparse data" from photometric surveys suggest a slightly shorter period of 4.749 h (Erasmus et al., 2020) and report a sidereal period and spin vector (Durech et al., 2016).

Observations were made on 14 nights over a 34-night interval in 2020 (Table I) using 0.36-m telescopes at the Wallace Astrophysical Observatory in Westford, MA. Each system imaged a 22 arcmin square field of view at a resolution of 1.3 arcsec per pixel, using an SBIG STL-1001 CCD camera and *R* filter. Image processing and measurement were as described by Slivan et al. (2008), except that for Hus as a fainter object observed with smaller telescopes, we chose synthetic aperture sizes guided by the experience of Howell (1989) for the on-chip relative photometry.

The lightcurves show that Hus completes either four, five, or six rotations in about 23.7 hours; all three candidate periods yield credible doubly-periodic composites. However, these data cannot further distinguish the true period from the aliases because the individual unbroken spans of lightcurve are too short relative to the periods, a consequence of Hus's southern declination in 2020 during northern hemisphere summer, combined with a zone of obstructed telescope view across the meridian at low altitudes.

To resolve the ambiguity, we reanalyzed the published lightcurves from the 2009 apparition, which include spans of nightly coverage that are longer than the candidate periods. Given the noise in these data we used a "noise spectrum" approach, fitting a Fourier series model including through the 2nd harmonic to the lightcurves in order to test a range of trial rotation periods that includes the three candidates. The resulting graph (Fig. 1) shows that 4.748 h is the only period that is consistent with the lightcurves from both 2009 and 2020. Our final result of 4.7483 ± 0.0008 h (Fig. 2) is consistent with the published periods based on "sparse" data.

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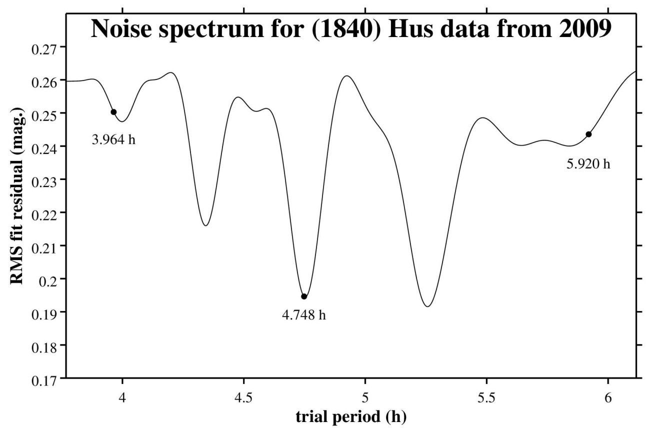

Figure 1. "Noise spectrum" graph for the lightcurves of (1840) Hus recorded during the 2009 apparition by Clark (2010). The candidate periods allowed by the 2020 lightcurves are highlighted; only 4.748 h is consistent with the data from both apparitions.

Number	Name	yyyy mm/dd	Phase	L_{PAB}	B_{PAB}	Period(h)	P.E.	Amp	A.E.
1840	Hus	2020 07/21-08/23	*9.1,4.0	321	-3	4.7483	0.0008	0.42	0.05

Table I. Observing circumstances and results. Solar phase angle is given for the first and last dates; the asterisk indicates that the phase angle reached a minimum within that interval. L_{PAB} and B_{PAB} are the phase angle bisector longitude and latitude at mid-date range.

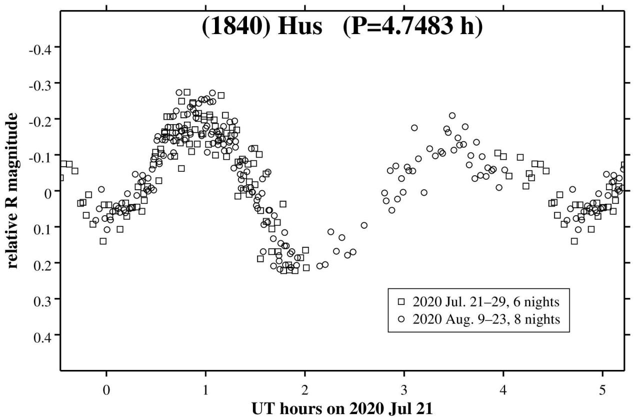

Figure 2. Folded composite lightcurve of (1840) Hus during its 2020 apparition, showing one rotation period plus the earliest and latest 10% repeated. The data are relative photometry only, and have been shifted in brightness to form a self-consistent composite.

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VISUAL OBSERVATION OF 3000+ MINOR PLANETS

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The author describes the results of visually observing 3,028 distinct minor planets over a 54-year period.

Unlike most celestial objects, the minor planets of our Solar System are both faint and constantly on the move, so that finding them is a challenge to the skill of visual observers. Tracking these small objects requires planning and perseverance.

The methods used to plan, prepare, observe, confirm, and record the author’s observations of minor planets are described in Salthouse (2019). He started observing the major planets as a teenager in 1965, beginning with Jupiter and Saturn in a small refractor. His first minor planet observations began in late 1966 with a 4-inch reflector, and by the spring of 1967 he had captured 1 Ceres, 2 Pallas, 3 Juno, and 4 Vesta. These observations were enabled by charts in *Sky & Telescope* magazine (2020). Over the ensuing decades the author observed these four objects about one hundred times each.

Note that the author started this process before the internet, personal computers, spreadsheets, or even calculators. He performed all his calculations on blue-lined paper with a slide rule. Today, when he shows the latter to his colleagues, they have no idea how it works, but it is one of his favorite reminders of those days.

The process of tracking down minor planets was very haphazard for the next couple of decades, as the author was hampered by two key factors: a lack of information about where to locate many asteroids, and a lack of sufficient aperture to observe most of them.

Fortunately, the *RASC Observer’s Handbook* (2020) and *Sky & Telescope* (2020) provided just enough information to track down a handful of bright asteroids over the years. Consequently, by 1990 the author had observed 35 distinct minor planets, a rather unimpressive result after 24 years of effort.

As with many amateurs, the author caught “aperture fever” and continually upgraded the size of his telescopes. He used a 10-inch equatorial reflector throughout the 1970s and 1980s but eventually purchased a 17-inch Dobsonian reflector in 1989. This was donated to a local community college and replaced by an 18-inch Dobsonian in 2007. Thus, all searching and tracking operations were fully manual.

Commencing in August 1990, the author had a private observatory to house his new reflector. Up to that point he had made only 190 observations of 35 different objects, but he used his new facilities to systematically re-observe every asteroid that he had seen before. More than 99% of all minor planet observations were made from this home observatory in central New Jersey.

Also, in 1990, the author was directed to Brian Warner, who was publishing the *Minor Planet Observer* print edition, which replaced by a web-only version in 2000 (Warner, 2020). This finally gave the author the means to begin a thorough and systematic search for every minor planet within the magnitude limit of his telescopes.