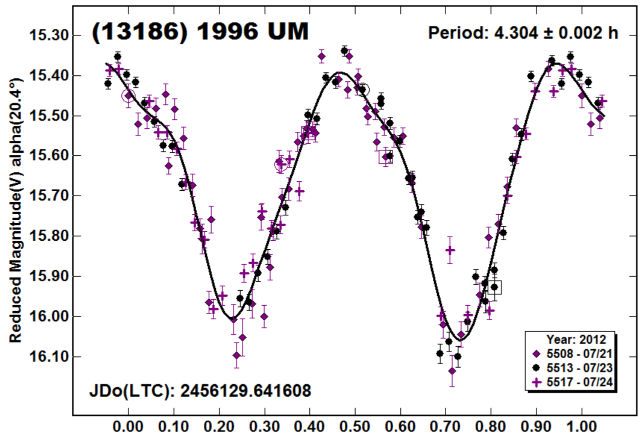

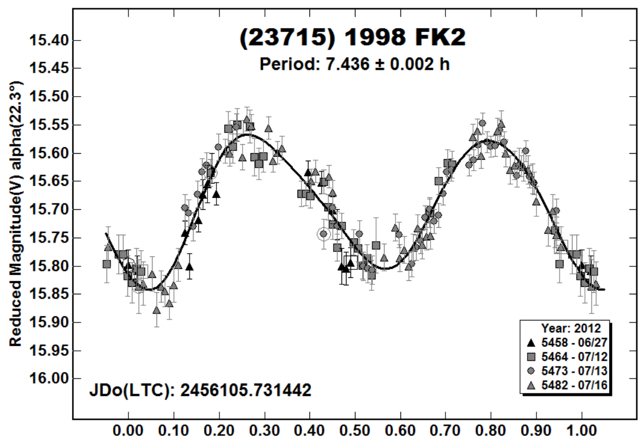

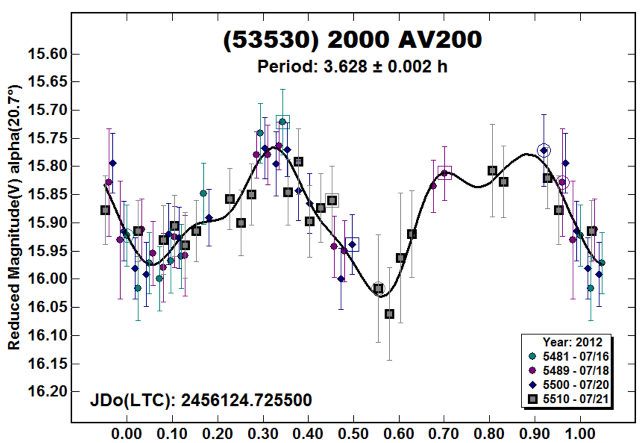

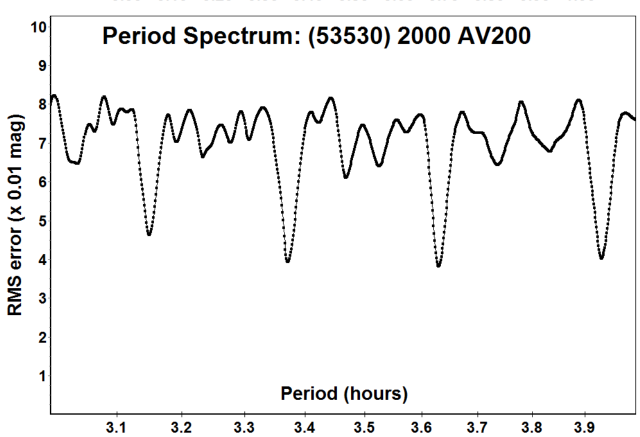

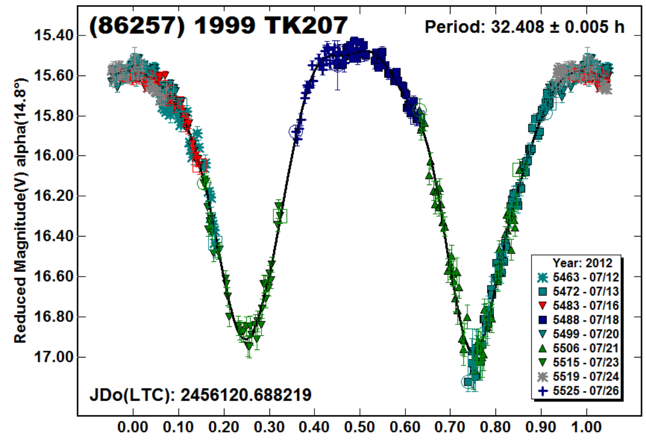

PERIOD DETERMINATION FOR THE SLOW ROTATOR 1954 KUKARKIN

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Lightcurve analysis for 1954 Kukarkin was performed from observations during its 2012 opposition. The synodic rotation period was found to be 136.40 ± 0.03 h and the lightcurve amplitude was 0.80 ± 0.05 mag.

The main-belt asteroid 1954 Kukarkin was discovered in 1952 and named in honor of the prominent Soviet astronomer Boris Vasilevich Kukarkin (1909-1977). He was the initiator and one of the compilers of the *General Catalogue of Variable Stars*, served as Vice President of the Astronomical Council of the U.S.S.R. Academy of Sciences from 1947 to 1960, as Vice President of the IAU from 1955 to 1961, and as President of IAU Commission 27 from 1951 to 1958.

1954 Kukarkin appeared in the 2012 April-June list of asteroid photometry opportunities for objects reaching a favorable apparition and having no or poorly-defined lightcurve parameters (Warner *et al.*, 2012). Unfiltered CCD photometric images were taken at Observatorio Los Algarrobos, Salto, Uruguay (MPC Code I38) from 2012 June 23 through July 28 using a 0.3-m Meade LX-200R reduced to f/6.9. The CCD imager was a QSI 516wsg NABG (non-antiblooming gate) with a 1536 x 1024 array of 9-micron pixels. 2x2 binning was used, yielding an image scale of 1.77 arcseconds per pixel. Imaging exposures increased from 60 to 120 seconds as the asteroid faded past opposition (see Table I). The camera was always worked at –15°C and off-axis guided by means of a SX Lodestar camera and *PHD Guiding* (Stark Labs) software. All images were dark and flat-field corrected and then measured using *MPO Canopus* (Bdw Publishing) version 10.4.0.20 with a differential photometry technique. The data were light-time corrected. Night-to-night zero point calibration was accomplished by selecting up to five comp stars with near solar colors according to recommendations by Warner (2007) and Stephens (2008). Period analysis was also done with *MPO Canopus*, which incorporates the Fourier analysis algorithm developed by Harris (Harris *et al.*, 1989).

A total of 25 nights were exclusively devoted to observe this asteroid over a total span of 36 days, making it by far our longest one-target campaign. About 133 hours of effective observation and more than 5,400 data points were required in order to solve a noisy lightcurve obtained from a heavily contaminated star background. Over the span of observations, the phase angle varied from 2.14º to 16.90º, the phase angle bisector ecliptic longitude from 268.9º to 270.3º, and the phase angle bisector ecliptic latitude from –3.1º to 0.0º.

The rotational period for 1954 Kukarkin was determined (for the first time) to be 136.40 ± 0.03 h along with a peak-to-peak amplitude of 0.80 ± 0.05 mag. The period spectrum showed three other plausible solutions (68.15 h, 204.69 h, and 272.93 h, those being, respectively, half, 3/2, and twice the adopted period. All of them were almost equally acceptable mathematically. However, not only were the three solutions slightly worse than the chosen period, given the amplitude of 0.8 mag and low phase angle, they also represented physically unlikely asteroid lightcurves, i.e., monomodal, trimodal, or a complex quadramodal.

Harris (1994) found that small and slow rotating asteroids might show tumbling motion. Despite the fact that the mean diameter of 1954 Kukarkin is not actually known, it is conceivable that given its long period it could be a non-principal axis rotator (NPAR). However, no clear evidence of tumbling was seen in the lightcurve. Unfortunately, the tumbling likelihood was not further investigated since the analysis software used (*MPO Canopus*) is capable of handling only summed curves (the typical case for a binary asteroid) but not the product from two rotation actions (the typical case for a tumbling asteroid). Therefore, whether or not 1954 Kukarkin is a tumbler still remains an open question.

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Sessions	Dates	Exp	Phase	V mag
89-96	06/23-07/06	60	2.1-7.7	14.5-14.8
97-101	07/07-07/12	80	8.2-10.4	14.8-14.9
102-108	07/13-07/22	100	10.9-14.7	14.9-15.1
109-113	07/23-07/28	120	15.0-16.9	15.1-15.2

Table I. Observing circumstances. All dates are in 2012. The exposure times are in seconds.