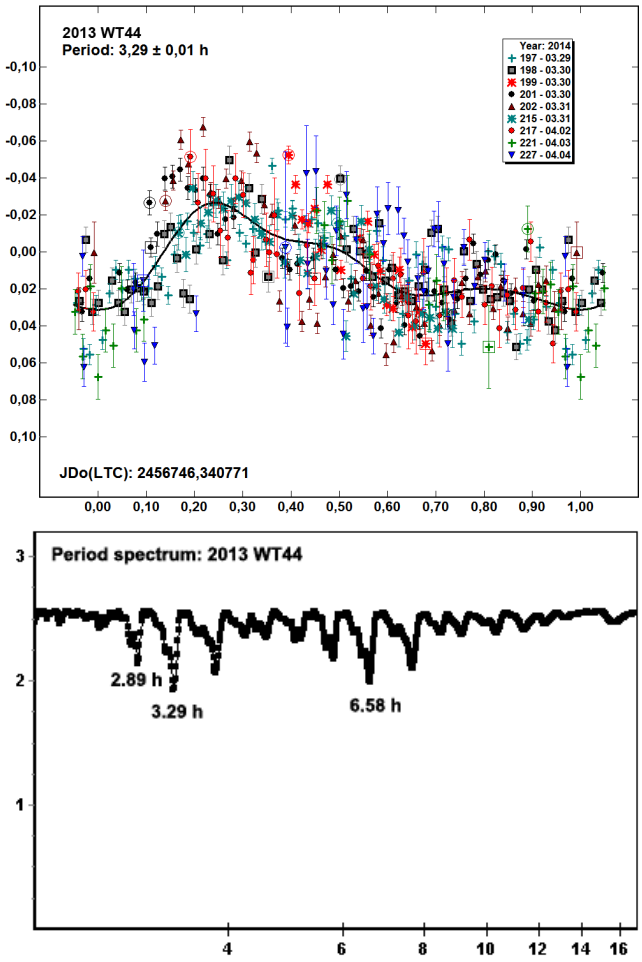

ROTATION PERIOD DETERMINATION FOR THE SLOW ROTATOR 3345 TARKOVSKIJ

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Photometric observations of the main-belt asteroid 3345 Tarkovskij conducted by the authors over more than three months from 2013 December to 2014 March revealed its slow rotation rate and a synodic rotation period of 187.0 ± 0.1 hours. The corresponding bimodal lightcurve has an amplitude of 0.59 ± 0.02 magnitudes.

The main-belt asteroid 3345 Tarkovskij was discovered on 1982 December 23 by L. G. Karachkina at the Crimean Astrophysical Observatory. The asteroid appeared on the list of potential lightcurve targets for 2013 December on the CALL website (Warner, 2013). It reached opposition on 2013 November 27.

Prior to this work there were no published results of the rotation period for this asteroid. Motivated by this fact, in order to determine a synodic rotation period, Benishek began unfiltered photometric observations of 3345 Tarkovskij on 2013 December 10 at the phase angle of 11.0 degrees using a 0.35-m *f*/6.3 Schmidt-Cassegrain (SCT) equipped with SBIG ST-8XME CCD camera. From the beginning it became clear that the asteroid was rotating very slowly and a collaboration with other observers was needed. An invitation for collaboration was extended and Coley kindly offered his participation in the observation campaign. Coley used a 0.35-m *f*/6.6 SCT and a SBIG ST-9XE CCD camera with a clear filter.

As of 2014 March 19, the collaborative observations resulted in 30 data sets, of which 13 were obtained by Coley and 17 were obtained by Benishek. The total interval of phase angles covered by the observations extended from 11.0 to 28.1 degrees. *MPO Canopus* software was used for photometric measurements, period analysis, and data sharing between the authors. Differential photometry with up to five comparison stars of near-solar color was carried out by both authors using the Comparison Star Selector (CSS) feature in *MPO Canopus* by selecting the V-band comparison star magnitudes derived from the hybrid MPOSC3 catalog provided with the program. The individual data sets containing magnitudes obtained using the CSS show a certain misalignment which sometimes can reach up to a few tenths of magnitude. Such discrepancies are most likely to be attributed to catalog magnitude errors. Gradual additional adjustments of the magnitude zero-points for particular data sets were necessary until the best fit in terms of the lowest RMS residual is reached.

The combined data set of 3090 data points was used in the period analysis, which covered a range of 10 to 1000 hours. The synodic period of 187 hours related to a bimodal solution is clearly seen among all the other values in the period spectrum. The Fourier fit amplitude for the corresponding bimodal lightcurve is A = 0.59 ± 0.02 mag. This amplitude, combined with the range of relatively low phase angles, strongly favors a bimodal solution of 187 h over

a monomodal of 93.5 h, which is also possible, although it has a significantly higher RMS residual. The relatively insufficient lightcurve coverage affected the period accuracy, which resulted in adopting the coarse result of 187.0 ± 0.1 hours. A more precise and accurate result would require denser lightcurve data coverage and better zero point linkage among the individual data sets.

The asteroid 3345 Tarkovskij will have another favorable opposition in late 2017, which could be a great opportunity for a broader collaboration between observers in order to improve the rotation period.

References

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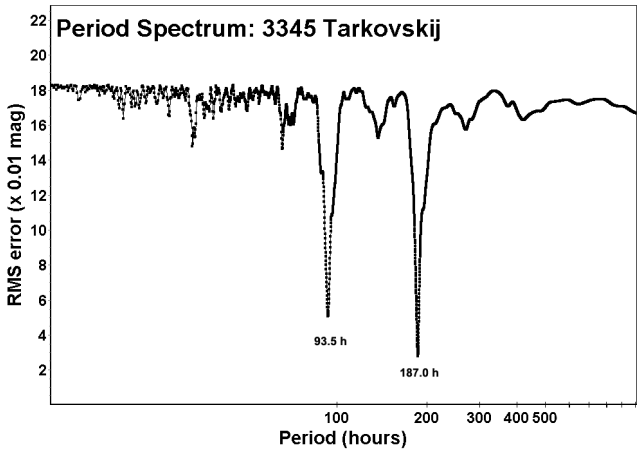

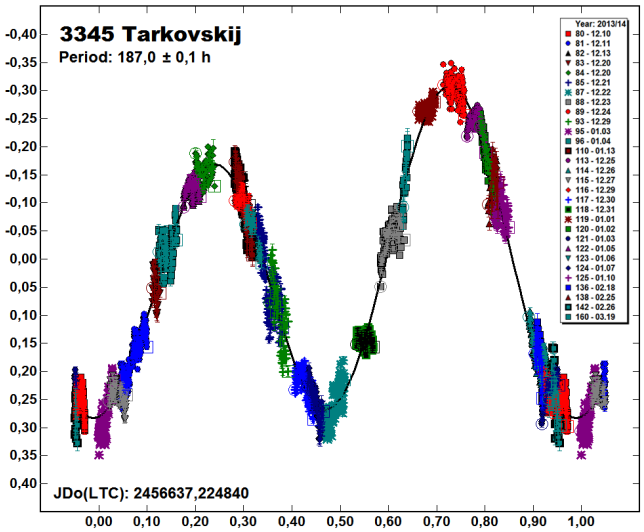

ROTATION PERIOD DETERMINATION FOR 671 CARNEGIA

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Analysis of photometric observations of the main-belt asteroid 671 Carnegia from 2014 January-March revealed a bimodal lightcurve with a period of 8.332 ± 0.001 hours as the most likely solution. However, a trimodal solution of 12.50 hours still could not be formally ruled out.

The main-belt asteroid 671 Carnegia was discovered by Austrian astronomer Johann Palisa on 1908 September 21 in Vienna. The asteroid was listed as a potential lightcurve target in February 2014 on the CALL website (2014). No previous rotation period determination results have been published.

In order to determine its synodic rotation period, the initial photometric observations were started by Benishek on 2014 January 13, slightly more than a month before the opposition date on 2014 February 15. Benishek used a 0.35-m Meade LX200 GPS Schmidt-Cassegrain (SCT) operating at *f*/6.3 and SBIG ST-8XME CCD camera in 2x2 binning mode. With the exactly same goal, Papini independently began photometric observations on 2014 February 23 using a 0.25-m *f*/10 SCT and SBIG ST-9XE CCD camera. Soon afterwards, Papini kindly made his data available to Benishek and the collaboration between two authors was successfully established. The exposures were unfiltered for both authors, unguided (Benishek) and guided by employing a built-in TC-237H guiding CCD (Papini).

As of 2014 March 20 the collaborative observations resulted in 9 sessions with a total of 1061 data points, of which 6 were obtained by Benishek and 3 by Papini. Over the time interval of more than two months, the data covered a range of phase angles ranging from 11.6 degrees before to 12.7 degrees after the opposition.

Data sharing between the authors, as well as data processing and period analysis were performed using *MPO Canopus* software by BDW Publishing (2012). Differential photometry measurements were performed using the Comparison Star Selector (CSS) procedure in *MPO Canopus* that allows selecting of up to five comparison stars of near-solar color. Subsequently, the additional adjustments of the magnitude zero-points for the particular data sets were carried out in order to achieve the best alignment between them, i.e., to reach the minimum Fourier RMS residual.

The period analysis yielded several possible solutions that clearly stand out in the period spectrum with nearly comparable RMS residuals, but only some have a valid physical justification. The complex lightcurve solutions with multiple minima and maxima phased to periods of over 20 hours were immediately ruled out as physically unreasonable and the three remaining solutions were taken into further consideration: the bimodal lightcurve phased to 8.332 hours, the double value of this period, i.e., a quadramodal