

Acknowledgements

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A PRELIMINARY SHAPE AND SPIN AXIS MODEL FOR 595 POLYXENA

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Photometric observations made at the Palmer Divide Observatory during the 2006 and 2008 apparitions of the main-belt asteroid 595 Polixena were combined with dense lightcurves from 1993 included in the Uppsala Asteroid Photometric Catalog and a sparse lightcurve based on data from the USNO to determine a preliminary shape and spin axis model. Two solutions dominated the result set, one prograde ($\lambda = 42^\circ$, $\beta = 8^\circ$) and one retrograde ($\lambda = 222^\circ$, $\beta = -4^\circ$). The uncertainty in each coordinate is $\pm 5^\circ$. The sidereal period was found to be 11.794162 ± 0.000023 h.

The outer main-belt asteroid 595 Polixena was observed at the Palmer Divide in March 2008 for two reasons: to determine the correct period for the asteroid and to provide a data set for shape and spin axis modeling. A 0.35 m Meade LX-200GPS telescope was equipped with an SBIG ST-9E and Optec focal reducer to obtain 449 data points from 2008 March 19-22. The pixel scale was approximately 2.5 arcseconds/pixel. All images were 120 s, guided, and unfiltered. The images were processed with dark and flat fields and measured in *MPO Canopus*. Period analysis was also done in *Canopus*.

The period of the asteroid had been previously reported as 11.806 h (Hainaut-Rouelle 1995), 8.5 h (Piironen 1998), 15.89 h (Warner 2007), and 46.32 h (Behrend 2008). The lightcurve from the 2006 apparition by the author had an amplitude of only 0.05 mag (Fig. 1) and so could have easily lead to an ambiguous solution. After the period and amplitude were determined with much more certainty using data from the 2008 apparition ($P = 11.801 \pm 0.001$ h, $A = 0.51$ mag; Fig. 2), the 2006 data were re-examined to see if they would fit the new period. The closest match was found at $P = 12.03 \pm 0.02$ h.

In a forthcoming paper (Durech 2008), it has been shown that a few dense lightcurves (those such as shown in Figs. 1 and 2) combined with so-called “sparse” data sets can often successfully lead to a shape and spin axis model. A “sparse” data set is one comprised of calibrated observations taken over a number of years such that they sufficiently cover the asteroid around its orbit. A check on the AstDys web site (<http://hamilton.dm.unipi.it/cgi-bin/astdys/astibo>) showed that data from the USNO were available for Polixena. Durech (2008) has found that, among the current surveys, only USNO data are of sufficient quality for modeling. Fortunately, Hainaut-Rouelle’s data were also available, being in the Uppsala catalog (Lagerkvist 2001). This made for three sets of dense lightcurves and the one sparse set. *MPO LCInvert*, written by the author, was used for the analysis, the first step of which is to find an accurate sidereal period based on the complete data set. This search can take some time, e.g., more than a day for Polixena. Once the period is found, a search routine looks for the best fit among several initial conditions. The search showed seven solutions that were statistically identical and grouped around two

specific pole solutions. Those two solutions are show in Table 1. Note that the first solution is prograde and the second is retrograde. The λ and $\lambda+180^\circ$ solutions are common when the asteroid's orbital inclination is small.

λ	β	Sidereal Period
$42^\circ \pm 5^\circ$	$8^\circ \pm 5^\circ$	11.794162 ± 0.000023 h
$222^\circ \pm 5^\circ$	$-4^\circ \pm 5^\circ$	

Table 1. Poles and periods for the two best shape model solutions.

The use of relative-only data prevents the modeling process from finding a definitive height of the Z-axis, i.e., the a/c or b/c ratios. The two models found an average of $a/b = 1413$. The lightcurves based on both models fit the actual data very well. In particular, they were in perfect phase agreement, indicating that the sidereal period was correct. Both models show a decided flat area at the asteroid's southern pole, possibly indicating a large crater or concavity. Neither the Database of Asteroid Models from Inversion Techniques (DAMIT, <http://astro.troja.mff.cuni.cz/projects/asteroids3D/>) nor the Poznan data base of spin axis solutions (<http://vesta.astro.amu.edu.pl/Science/Asteroids/>) had previously reported solutions.

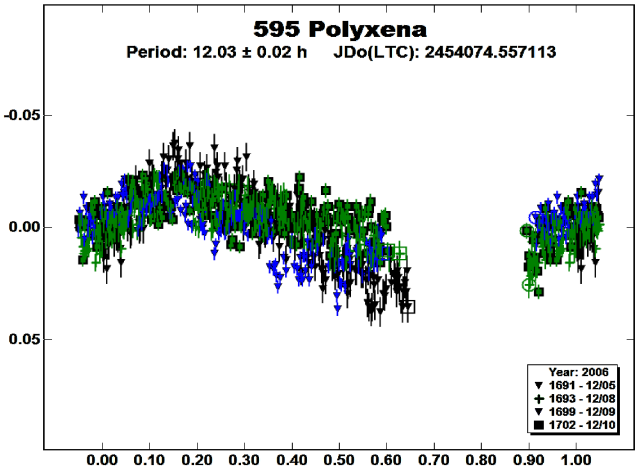


Figure 1. Lightcurve of 595 Polyxena based on data from PDO in 2006.

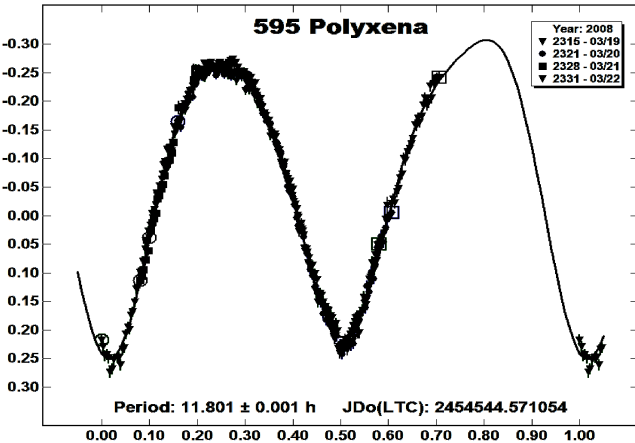


Figure 2. The lightcurve of 595 Polyxena. Palmer Divide Observatory, 2008.

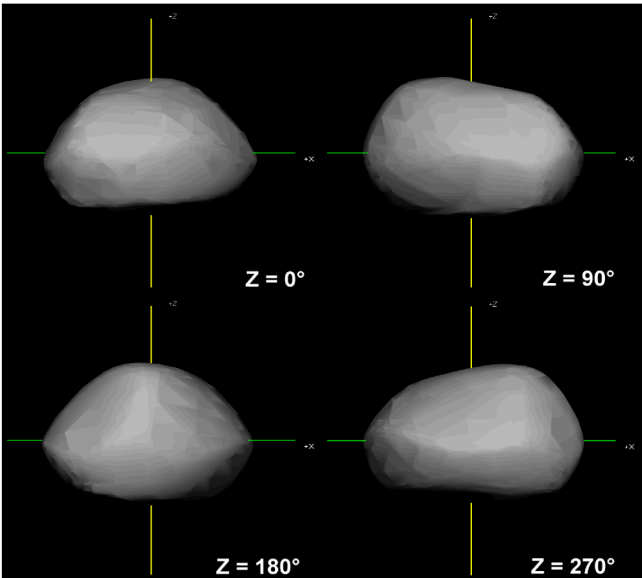


Fig. 3. The 595 Polyxena model showing the asteroid's equatorial view of the ($\lambda = 42^\circ$, $\beta = +8^\circ$) solution.

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