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A Preliminary Shape Model of 27 Euterpe

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Abstract

We obtained *dense* rotational lightcurves for the Main-Belt asteroid (27) Euterpe during three apparitions in 2000, 2009 and 2010 with planned observations in the summer of 2011. These were combined with *sparse* lightcurve data from the USNO to determine a preliminary spin vector and model shape (see Durech *et al.* [2] for a discussion regarding the differences between dense and sparse data sets). The analysis suggests that Euterpe has albedo features making the determination of an unambiguous spin vector and model shape difficult. So far, Euterpe's near spherical shape, low inclination, pole within 30 degrees of the plane of the solar system, and possible albedo features cause multiple pole and shape solutions to be present.

1. Introduction

The Main-Belt Asteroid (27) Euterpe has long been an enigma to observers. It wasn't until 2000 that Stephens [5] published an accurate period for Euterpe. Its shape frustrated the attempt of many observers to determine a rotational period. Euterpe has also been suspected of having albedo features. Bus [1] reports disparities in spectra and ECAS reported colors for Euterpe.

2. Preliminary Results

In our analysis, we use the available dense and sparse lightcurve data to find a probable period. The dense data were obtained from apparitions in 2000, 2009 and 2010. The sparse data came from the USNO. Figure 1 shows the PAB Longitude Distribution of both the dense and sparse data.

We started with the periods derived from the dense lightcurves used to indicate a search range. Then, including the sparse data, we generated 264 models using fixed, discrete longitude –latitude pairs, but allowing the period to float slightly. The log (chi-square) values are then plotted to give a visual indication of the quality of various possible solution. Hanuš and Durech [3] give a set of analytical rules to determine which, if any, period and subsequent pole solutions might be reliable.

Our searches for a sidereal period lead to several solutions. The best solution using both sparse and dense data was 10.40894444 hours. The best period solution using just our dense lightcurves was 10.40799803 hours. All of the possible models suggest the pole is within 30 degrees of the plane of the solar system. The strongest of the models resulted in a Lambda of 0 and a Beta of 15. However, this result was not significantly better than other solutions. The modeling was complicated by apparent albedo features resulting in us having to increase the weighting on the dark facets used to close the convex hull in order to create a model.

Figure 3 shows of the plot of the log (chi-square) values. Dark blue represents the lowest chi-square value. Figure 4 shows the shape model with the lowest chi-square. It is the best of several pole and shape solutions suggested by the data, but does not stand out as clearly superior to the others.

The preliminary model is a fair match on a 1993 occultation profile obtained by Dunham [1]. Those nine observed chords yielded an ellipse whose major and minor axes were 124 km and 75 km. In order to reconcile radar observations with this occultation profile, Magri [4] modeled Euterpe as a triaxial ellipsoid with an a/b = 1.15 ± 0.15 and b/c = 1.3 ± 0.3 resulting in major and minor axis of 127 x 110 x 85 km.

3. 2011 Observing Plans

A favorable opposition of Euterpe will occur in September 2011, with observations starting as early as July. The authors are planning an extended observing campaign and will obtain lightcurves starting at 25 degrees phase angle in order to improve the model. In addition, an H-G plot will be created to compare to the one obtained from the USNO data. Finally, as a test of albedo features, observations will be obtained in V, Rc, and Ic filters calibrated to the standard system in order to search for changes in color during the rotational period.

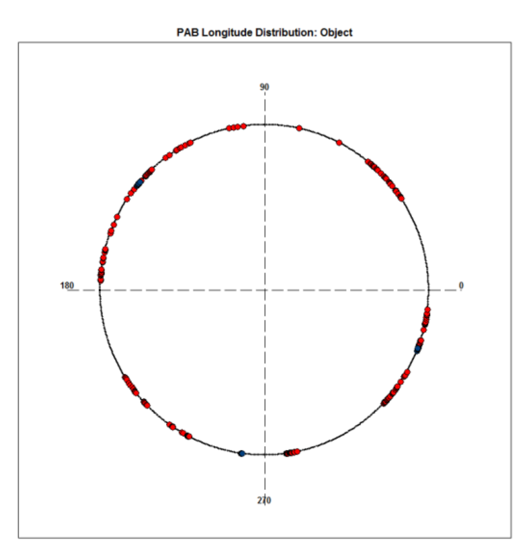

Figure 1: PAB Longitude Distribution of Sparse (red) and Dense Datasets (blue).

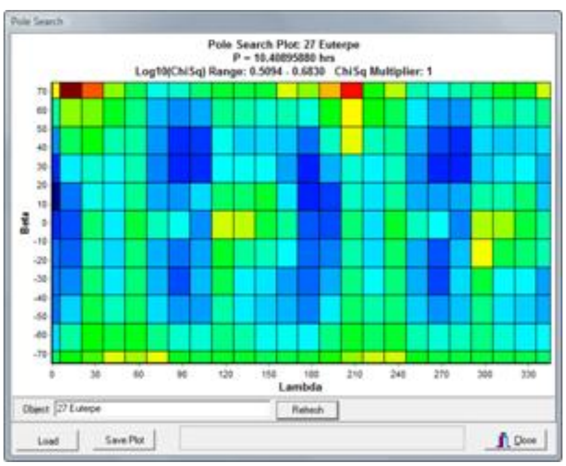

Figure 2: Pole search using both sparse and dense data.

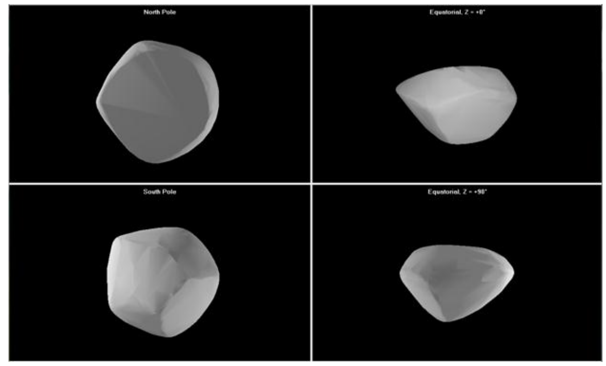

Figure 3: The shape model for (27) Euterpe with the lowest Chi-Square.

6. Summary and Conclusions

Combining sparse and dense lightcurves yielded an inconclusive shape model and pole position whose basic shape is similar to occultation profiles and radar results obtained in the past. Observations planned for the summer of 2011 may help constrain some competing shape models and yield a definitive solution.

References

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