Determining the Rate of Rotation of a Near Earth Asteroid

Robert Halvorsen and Claud Lacy– Physics Department and Arkansas-Oklahoma Center for Space and Planetary Science

Arkansas - Oklahoma Center for Space & Planetary Sciences

Eros—taken by the NEAR Shoemaker Spacecraft

Purpose

To find the rate of rotation of a Near Earth Asteroid (NEA) using the University of Arkansas URSA Telescope

Why is Spin Important?

•Of the 10,000 NEAs with well determined orbits, only about 700 have spins that have been measured
•The spin of an asteroid is important data for any future spacecraft missions—particularly sample return missions
•The large number of Near Earth Asteroids available for study allows for a statistical approach to studying asteroid characteristics, such as spin, that give us information on how they may formed and interact

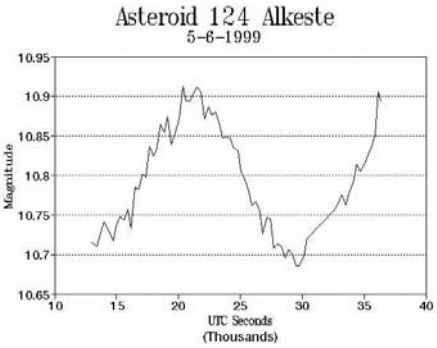
Research Procedure

•Pick a suitable NEA for Study
•Make several observations of the NEA using the URSA Telescope
•Use the resulting images to create a light curve of the asteroid which can be used to find the rate of rotation
•Observations are taken on the University of Arkansas Undergraduate Research Studies in Astronomy (URSA) telescope a Meade LX200 10in. f/6.3 telescope equipped with a SBIG ST8EN camera and UBVRI filters.
•Image processing was achieved using the CCDOPS software for PC available free for download from sbig.com

Assumptions--The Spinning Spud Model

•Asteroids are ellipsoidal, potato shaped bodies
•Asteroids rotate about their shortest axis
•The albedo of an asteroid is roughly constant

Series of Images showing the rotation of Eros—taken by the NEAR Shoemaker Spacecraft



Sample Light Curve of 124 Alkeste—Created by John E. Hoot, SSC Observatory

Dr. Claud Lacy and the URSA Telescope

Selecting an Asteroid for Observation

An asteroid must meet several criteria for ease of observation and usefulness:
•An apparent magnitude of less than 17—Calculations made using the CCDOPS software and stellar images reveals that the limiting magnitude of the URSA telescope is around 17. Any asteroids for observation must be brighter than this.
•Near opposition—The asteroid should be as close as possible to opposition to ensure both that it will be as high as possible in the sky to avoid city light pollution and that it will be high in the sky for as long as possible each night.
•Unknown Rotational Rate
•Near Earth Asteroid orbital parameters and current observability data can be found using the NeoDys site, an online dynamic database of Near Earth Asteroids.

Processing the Data

•Due to possible error introduced from variations in weather conditions or a change in temperature of the CCD camera, only relative magnitudes can be observed. That is, the magnitude of the target asteroid is compared to the magnitude of known stars in the same image using the CCDOPS software. In this way, the apparent magnitude of the asteroid can be found. A plot of this data results in a light curve of the asteroid.
•Note that as the asteroid spins, its light curve will show *two* maxima for each complete rotation—alternating between the "front" and "back" of the asteroid

Current Candidates for Observation

Object	V mag	Declination (deg)	Right Ascension (deg)	Comments
(1866) Sisyphus	16.12	11.7871	206.274	Too low in the sky
(4587) Rees	16.99	33.645	200.816	Dim/Too low in the sky
1999GJ2	16.9	12.708	269.305	Dim/Good sky position
1998FH12	15.6	11.0388	348.576	Bright/Low in the sky
2001LF	16.17	0.46758	308.63	Too low in the sky

Acknowledgements

•NSF REU Astronomy Program
•John E. Hoot—SSC Observatory

References

•John E. Hoot - *Photometric Determination Of The Rotational Period of Asteroids* - http://68.5.152.104:800/observatory/asteroid/rotation.html
•NeoDys website - http://newton.dm.unipi.it/cgi-bin/neodys/neoibo