



Asteroid Rotation



Las Cumbres Observatory Global Telescope

Asteroid Rotation

Background Science



FAULKES TELESCOPE

Author: Daniel Duggan

Asteroid Rotation

Background Science

Introduction

What is rotation rate?

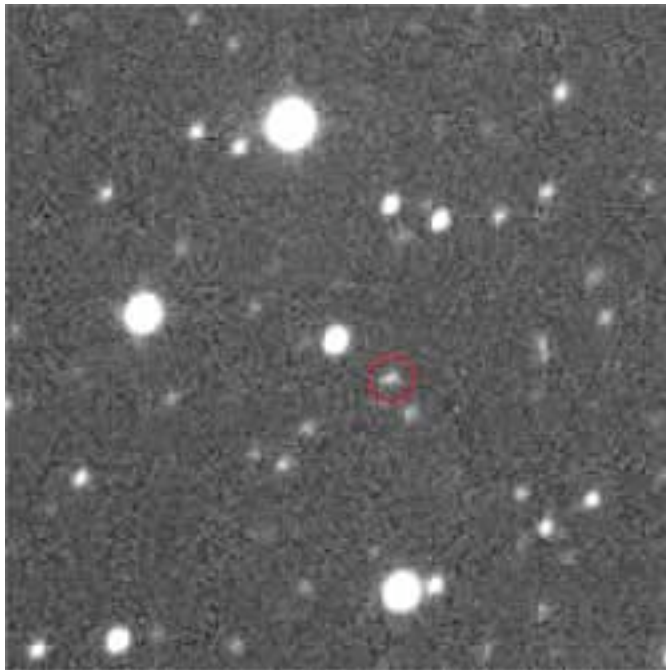
The rotation rate (or period) of a body is the amount of time it takes to complete one revolution on its rotation axis. For example the Earth has a rotation period of approximately 23 hours and 56 minutes - one sidereal day.

For solid objects such as planets and asteroids, the rotation period is a single value. For gaseous objects such as stars and gas giant planets, the period varies slightly from the poles to the equator. This is called *differential rotation*; it does not apply to this project so we won't dwell on it.

Calculating the rotation period of the Earth is fairly straight forward since we are sat on its surface! But how does one go about working out how quickly an asteroid rotates?

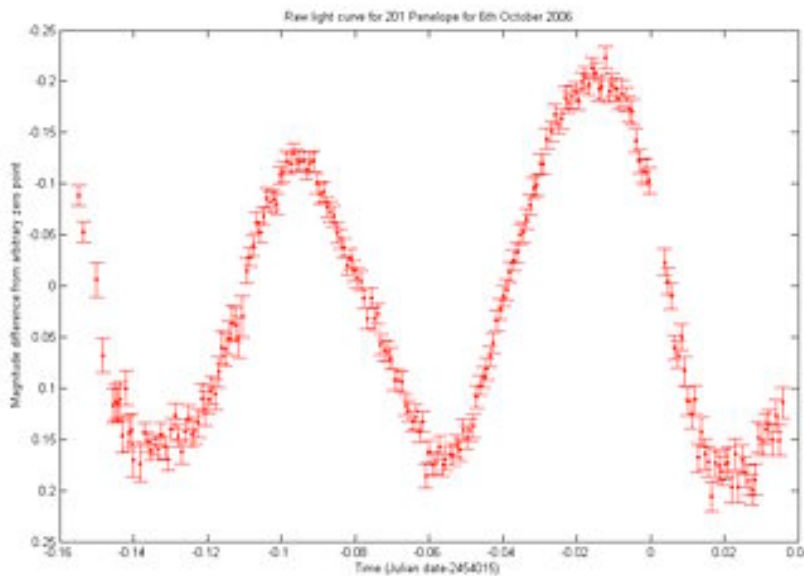
When we look at other planets in our Solar System such as Jupiter, we see significant changes on its surface. On some days we will see features such as the Great Red Spot and on other days we won't. Meaning that surface features move to the other side of the planet where we can't see them as the planet rotates. Jupiter is significantly large enough for us to distinguish features like this on the surface.

Asteroids however are relatively tiny - only a few kilometres in diameter and when we image them through a telescope we only ever see a small white blob. It is far too small for us to see features on its surface from this distance and therefore we cannot use this method of just looking at it to ascertain a rotation period.



Asteroid Bluepeter

One option would be to send probes to the asteroids and image them as they rotate and calculate it that way, but there is a far easier and cheaper method - using light curves.



Light curve of asteroid 201 Penelope

A light curve is a graph that plots the intensity of light from an object against time. Looking for peaks in the curve can produce estimates of the rotation rate of an object; because asteroids are generally non-uniform in shape as they rotate, their surface will reflect different amounts of light as different areas of its surface faces us.

Because the rotation period of a body goes unchanged (unless it undergoes an interaction with another body which is rare) the same pattern of light intensities occur as we watch the asteroid, as shown by this light curve of asteroid 201 Penelope.

In theory, that's all very well and good but the question is "how" do you actually do that?

Well the first step is to find and image an asteroid which is easy enough, the challenge comes when you want to measure the amount of light that was recorded on the CCD during the exposure of the asteroid.

We do this using a method called photometry.

Photometry

In astronomy the basic technique of photometry is the measuring of the total value of the intensity of the pixels in the image that make up your object.

You do this using the astronomical FITS files, which is produced by the telescope and they can be downloaded from your account. If you want to know more about FITS files then visit the Planning section of the Faulkes Telescope website.

Each pixel in a FITS file that makes up an image has its very own pixel value that is proportional to the intensity of the light falling on it. This value can be anything between 0 and 65535; also there are 1048576 pixels in an image - so lots of data and lots of numbers.

The process is not as daunting as you think as asteroids only appear as very small blobs in these images, about 5 pixels square perhaps and to make things easier, we don't even have to measure each pixel individually or even manually!

The software that we are going to use for this project is free, and it will calculate the magnitude (measure of the brightness of an astronomical object) of the asteroid once it is successfully identified.

So in a nutshell this project involves the following:

- Image an asteroid a 3 or 4 times during your session
- Download the FITS files
- Find the intensity of the asteroid in each image
- Plot a graph of intensity against time

What could be easier...?

The software we are going to use for this project is called Astrometrica - it will allow us to identify the asteroid in the images and to measure it's brightness.

If you have never used Astrometrica, you will have to take some time to set it up on your computer first. There is a document already written to do this as part of our asteroids project, which can be found at: <http://faulkes-telescope.com/asteroids>

There is also a set of instructions for using Astrometrica solely for this project, which can be found on the page you got this document from.
