The National Schools' Observatory and Institute of Physics present:

Hunting Asteroids

Advanced task – Estimating the speed of an asteroid

The following ten steps will allow you to estimate how far an asteroid has travelled between observations. Also, by knowing the time separation between each observation, you can try to work out how fast the asteroid appears to be travelling:

1. Open the 'Astro' menu on the main tool bar of the '*LTImage'* window and then select 'Size and Distance'.

2. Select the first image store by holding the 'Alt' key and pressing '1', i.e. Alt-1.

3. Locate the moving object (asteroid) and place the mouse pointer over it. Don't click the mouse button at this stage.

4. Leaving the mouse pointer where it is, press 'Alt-2' on the keyboard to select the second image store. The object will now have moved.

5. Now carefully click and hold the left mouse button then move it to the new location of the object. A yellow triangle will appear.

6. When the mouse pointer is over the new position, release the left mouse button and the triangle should turn blue.

7. On the right side of '*LTImage'*, you can find the total number of pixels between the two positions. Write this value down:
   _____

Your images are made up of many thousands of pixels (image elements) or dots, but to calculate how far the asteroid has moved in units we can more easily understand, we need to find out the pixel scale, i.e. the real distance that one pixel represents. To do this;

8. Select 'Image Properties' from the main 'Astro' menu and then click on the 'Calibration' circle to the right of the screen. Write down the pixel scale value (km/pixel): _____

9. Multiply the pixel scale value by the number of pixels the object moved (the value you wrote down) to find the distance travelled: _____

10. You can find the time that each observation was taken by clicking on the little button by "The Observation" and selecting the two images in turn.

    Time Observation 1: _____   Time Observation 2: _____

11. Since speed = distance / time, divide the distance by the time between the observations in seconds to see how many km the asteroid moves every second.

    Time difference between observations: _____

    Speed of asteroid: _____

For the 'DEMO' image set, you should have got an answer close to 6 km/s. For comparison, an airplane would fly at around 0.2 km/s - about 30 times slower. Now that's a fast asteroid! If you're lucky enough to find an asteroid in any of the other image sets, try to calculate how far and fast that asteroid travels.

Critical Thinking – How accurate is your answer?

Whenever scientists make a measurement they have to think carefully to understand exactly how accurate the measurement is, and whether they are really measuring the right thing. You should now do that with your experiment.

Some of the questions you should discuss are:

- How accurately do you think you measured the number of pixels that the asteroid had moved?

- How do you think that "Calibration" value to convert from pixels to kilometres was calculated? Could it be wrong or inaccurate?

- The asteroid appears to have moved compared to the very distant stars, but is that only to do with the actual movement of the asteroid?

- What else is moving that could change the way that the asteroid *appears* to move across the sky?

You may find the diagram below helps you when thinking about these questions, and you may also want to look at the Electric Orrery on the website:
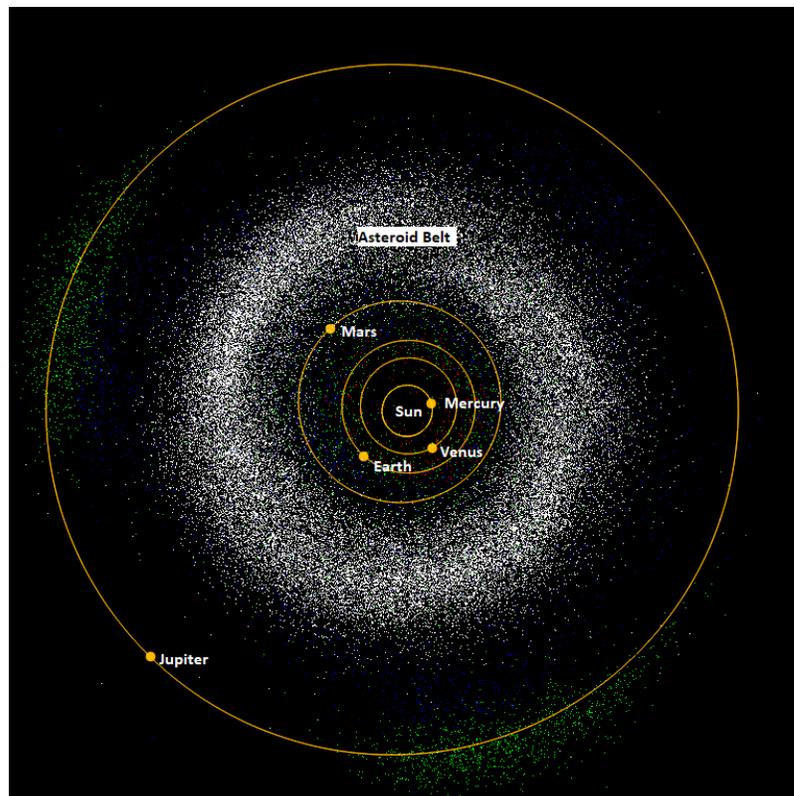https://www.schoolsobservatory.org/learn/astro/solsys/orrery

Figure 1. Simple diagram of the inner Solar System showing the position of the asteroid belt