Modelling Binary Light Curves

- Exercise 1: Binary Stars - investigate a spectroscopic binary system

Binary stars are of great importance to astronomers as they provide virtually the only means of directly determining the masses of stars other than our Sun. On this page you will find two Java based exercises that allow you to investigate binaries using computer simulations to together with links to other binary star software for download or online use. The first two exercises have been adapted with kind permission from originals by Sandra Woodward. You can download her original worksheets and web links presented at the Science Teachers Workshop at University of Sydney in 2004 as a pdf file here.

Exercise 1: Binary Stars

For this exercise you need to open a Java applet by Cornell University. Click here for the mirror site at Melbourne University. To change your view quickly between the two pages you can use ALT+TAB keys held down simultaneously.

This exercise allows you to alter parameters to see the effect on a binary star system. You can see privileged and Earth views of the system, the orbit of each of the stars (blue for star 1 and red for star 2), the spectrum from the system and the radial velocity plot. Your applet window gives you control over the following parameters:

Symbol	Quantity	Explanation
M1 or M2	Mass 1 or Mass 2	The mass of each of the two stars
a	Separation	The distance between the two stars in solar radii
e	Eccentricity	Eccentricity of the orbit (e = 0 is a circular orbit).
i	Inclination angle	Angle of the orbital plane of the stars to our line-of-sight. • 0° - face on • 90° - edge on Note that this is the opposite from the Eclipse simulation (2nd exercise below).
w	Node angle	Angle of the major axis as measured in the orbital plane (see privileged view).

Read the instructions on the applet page before proceeding to work through the steps and questions below.

Procedure and Questions

1. Set the parameters to: M1 = 1, M2 = 1, a = 0.7, e = 45, i = 45 and w = 0.
2. Describe the view from Earth in terms of motion and position of the two stars.
3. How does this convert to the graph?
4. Explain the effect on the motion if the masses are changed. Try the following combinations:

M_1	M_2
1	2
2	1
4	1
1	8

5. Explain what the spectra is telling you about the stars in this system. Relate your description to the positions of the stars in their orbits.
6. How can the period of the stars be determined?
7. Define what is mean by the term *spectroscopic binary stars*.
8. Using Kepler's Laws explain how the mass of the system can be determined.

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