THE UNIVERSITY OF BRITISH COLUMBIA
Physics and Astronomy
Faculty of Science

2022 Virtual UBC Physics Olympics – Exoplanet Transit Lab

Welcome to the Transit Lab activity. The questions will be provided one at a time, with no back-tracking. We provide two handouts to help you with these questions.

Handout 1: Transit curves [link]. This handout has five transit curves.

Handout 2: Equations and reference tables [link]. Table (1) from this handout provides constants and equations that may be of use for this part of the activity. Table (2) provides information for the host star of each system shown in the corresponding light curves. This information includes the radius of the star, the flux of the star as measured from Earth, and the star's distance from the Sun (essentially the distance from Earth). Flux is the amount of power (energy per unit time) incident per unit area (common units for flux are Watts/m^2). In the case of visible light, flux is related to brightness. Formulas, constants and other additional data can also be found in the handout.

In the quiz instructions above, you have been provided with five sets of transit light curves.

- *For the binary star system option, the stars may not have the same brightness; may not be of similar size; and/or may not pass perfectly in front of each other from our point of view.*

Which one of the descriptors best describes the light curve shown for System #1?

Transit curve of one exoplanet around its star

Transit curve of two exoplanet planets of different sizes and orbits

Transit curve of more than two exoplanets around its star

Transit curve of a binary star system

Nonsense/random noise transit curve

Which one of the descriptors best describes the light curve shown for System #2?

Transit curve of one exoplanet around its star

Transit curve of two exoplanet planets of different sizes and orbits

Transit curve of more than two exoplanets around its star

Transit curve of a binary star system

Nonsense/random noise transit curve

Which one of the descriptors best describes the light curve shown for System #3?

Transit curve of one exoplanet around its star

Transit curve of two exoplanet planets of different sizes and orbits

Transit curve of more than two exoplanets around its star

Transit curve of a binary star system

Nonsense/random noise transit curve

Which one of the descriptors best describes the light curve shown for System #4?

Transit curve of one exoplanet around its star

Transit curve of two exoplanet planets of different sizes and orbits

Transit curve of more than two exoplanets around its star

Transit curve of a binary star system

Nonsense/random noise transit curve

Which one of the descriptors best describes the light curve shown for System #5?

Transit curve of one exoplanet around its star

Transit curve of two exoplanet planets of different sizes and orbits

Transit curve of more than two exoplanets around its star

Transit curve of a binary star system

Nonsense/random noise transit curve

System #3 contains *one* exoplanet. What is the period of this planet?

Express your answer in days, to three significant figures.

2.2 with error margin 0.1

Following up on the previous question...

System #3 contains *one* exoplanet. What is the orbital distance, *a*, of the planet from its star?

Express your answer in astronomical units (au, the average distance between the Earth and Sun), to three significant figures.

Between 0.037 to 0.04

System #3 contains *one* exoplanet. What is the radius of this planet?

Express your answer in km, to the nearest 100 km

114,200 with error margin 2,200

Following up on the previous question...

System #3 contains *one* exoplanet. Based on its size, which Solar System planet or object does this exoplanet resemble the most?

This exoplanet is larger than any of the listed Solar System objects

With help from the information provided in Table 3 from the handout with equations and reference tables,

Determine the luminosity of the star associated with the light curve for System #3.

Express your answer to three significant figures in units of the sun's luminosity, L_{sun}. Thus a star with a luminosity of $3.8x10^{26}$W would have a luminosity of $L_{star}/L_{sun} = 1.00$.

5.8 with error margin 0.01

Following up on the previous question...

With the help of Figure 1 from the handout with equations and reference tables, where is the System #3 exoplanet located relative to its star's Habitable Zone?

Closer than its star's Habitable Zone

The remaining questions will focus the transit curves for System #4.

System #4 contains *two* exoplanets. What is the period of the exoplanet with the shorter (smaller) period?

Express your answer in days, to three significant figures

7.65 with error margin 0.02

System #4 contains *two* exoplanets. What is the period of the with the longer (larger) period?

Express your answer in days, to three significant figures.

14.82 with error margin 0.1

Following up on the previous question...

System #4 contains *two* exoplanets. What is the orbital distance, *a*, of the planet with the longer (larger) period from its star?

Express your answer in astronomical units (au, the average distance between the Earth and Sun), to three significant figures.

0.12 with error margin 0.01

System #4 contains *two* exoplanets. What is the radius of the exoplanet with the shorter (smaller) period?

Express your answer in km, to the nearest 100 km

38,600 with error margin 1,500

With help from the information provided in Table 3 from the handout with equations and reference tables,

Determine the luminosity of the star associated with the light curve for System #4.

Express your answer to three significant figures in units of the sun's luminosity, L_{sun}. Thus a start with a luminosity of $3.8x10^{26}$W would have a luminosity of $L_{star}/L_{sun} = 1.00$.

0.97 with error margin 0.01