→ Activity 3: Star light analysis

After completing the construction of their exoplanet in a box students should measure the light curve for their "exoplanetary system" transit.

Equipment

- Exoplanet in a box built in Activity 2
- Light meter (e.g. smartphone with app or datalogger)
- Program to analyse graphs

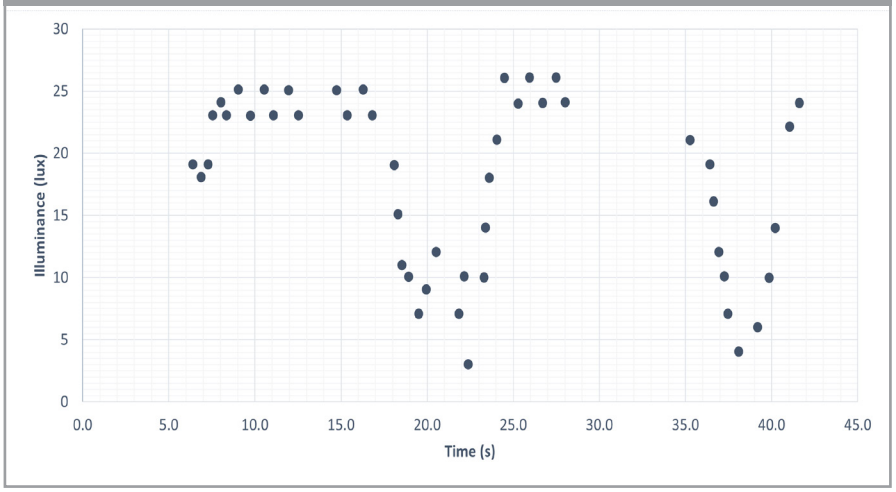
Exercise

Scientists measure star light as a function of time to detect variations on the measurements caused by transiting exoplanets. These graphs are called light curves.

In this exercise students will replicate the construction of a stellar light curve using their exoplanet in a box model. Figure 2 presents an example of a light curve for a setup like the one described in Annex 1

Note: For this example, we have used the free app Physics Toolbox Sensor Suite (vieyrasoftware.net). In this app the available light meter measures illuminance, in units of lux (lx), over time. Most light meters provide a measurement of illuminance. This is not the case for telescopes, which normally provide a measurement of apparent brightness or flux, of a star, so in this activity we will consider illuminance as an approximation to flux, to exemplify the method.

Figure 2



↑ Example of a light curve created using Physics Toolbox app

The light curve we constructed using our model exoplanet system shows two transits. For this example, the illuminance measured before the model exoplanet began transiting is approximately 25 lx, with a maximum change in illuminance of approximately 20 lx.

Multiple graphs can be obtained for analysis by varying the size of the transiting model exoplanet. Students should be able to use their results to demonstrate that a larger model exoplanet will lead to a deeper dip in the illuminance.

The orbital period varies with the distance between the model exoplanet and the detector. A short orbital period means that transits occur frequently because a planet completes more orbits in a given time frame. To dive deeper into this topic it is recommended the check the didactic resource ***Exoplanets in Motion***.

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You are now ready to analyse the light curve for your model exoplanet transit. A light curve shows the measured star light as a function of time. In your model the star light will be represented by the light source used.

Exercise

1. Simulate an orbit of your "exoplanet" around your light source and analyse the data. You should have obtained a graph similar to the one represented on Figure 1, Activity 2.

2. For your "exoplanet" transit model measure and record in the table the:

   a. Illuminance out of transit (exoplanet model not transiting light source)

   b. Maximum change in illuminance that you measured during the model exoplanet transit

   Change the size of your model exoplanet and repeat.

Star light analysis		
Exoplanet	**Illuminance out of transit (lx)**	**Maximum change in illuminance during transit (lx)**

3. Did you observe any differences in the light curves between the model exoplanets?