teach with space

USER GUIDE

ALLESFITTER: STEP-BY-STEP GUIDE

Modelling exoplanet transit data in the classroom

Allesfitter is an online application that helps you to derive properties of exoplanets from their light curves. It can be accessed from a desktop browser. This step-by-step guide will show you how to get started.

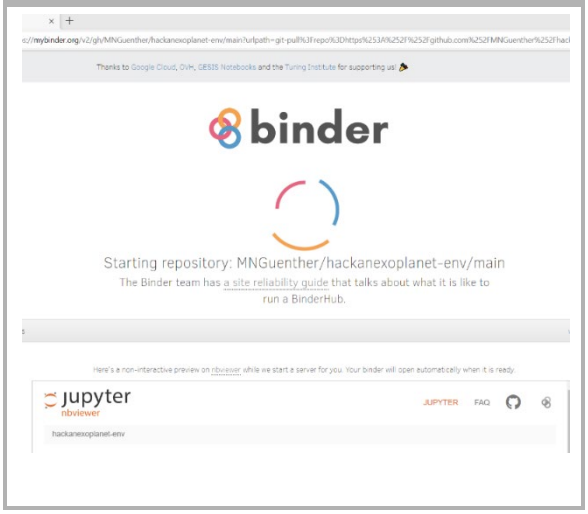
Launch and Load

1. Open *allesfitter* in a browser following this link: hackanexoplanet.esa.int/allesfitter

2. When *allesfitter* first launches, it opens as a *binder* project (see Figure 1). It may take some time for the software to load, but if after five minutes the software has not yet loaded, try to open it again using a different browser or device.

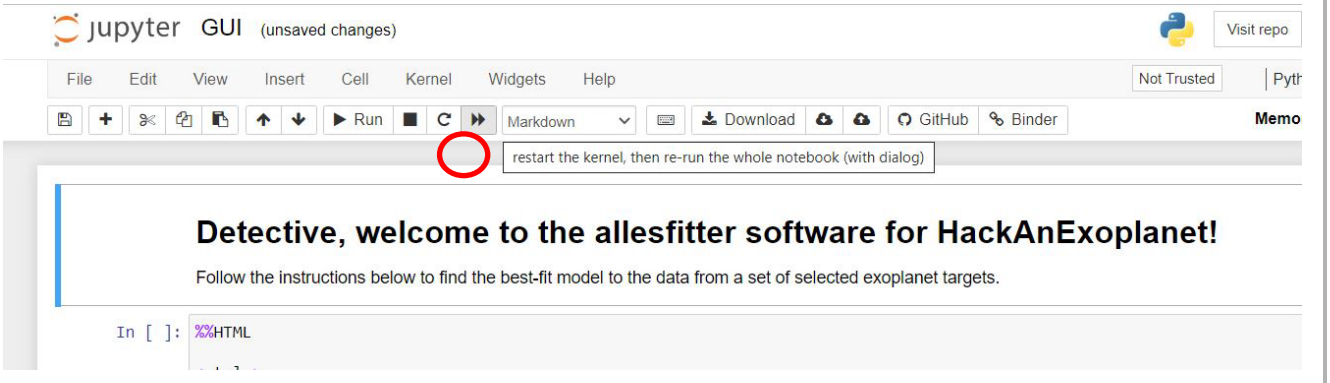
3. Once the software has loaded, a screen of code will appear. Click the fast forward button on the toolbar at the top of the screen in order to hide the code and load the Hack an Exoplanet mode (see Figure 2).

Figure 1



↑ *Allesfitter* landing page.

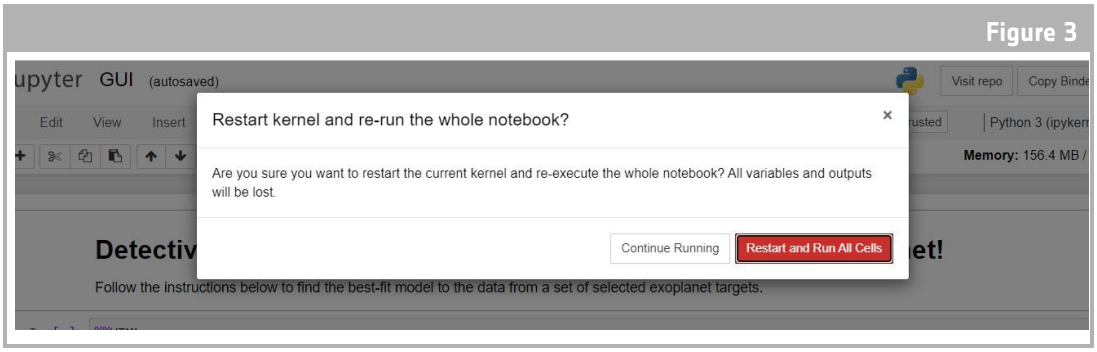
Figure 2



↑ Press the fast forward button to load the Hack an Exoplanet mode.

4. Once the fast forward button is clicked, a pop-up warning will appear asking to “Restart kernel and re-run the whole notebook”. To load the software, be sure to click the red button to “Restart and Run all Cells” (see Figure 3).

Figure 3



↑ Restart and Run All Cells to load the software.

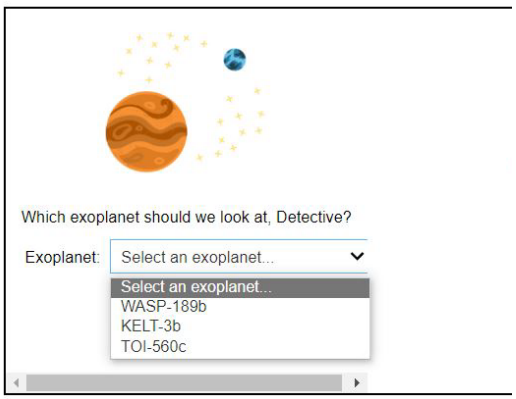
Note

If the software is left unattended for too long, it will time out and display a “Dead kernel” error message. If this happens, the only way to reload the software is to navigate to the software again using the original link and follow the steps from the beginning. Clicking “Try Restarting Now” or simply reloading the page will not resolve the issue. Any progress will not be saved, so be sure to make a note of the values used for each parameter and download results when available.

Start your investigation

5. Now the tool is ready to start your investigation. Select your exoplanet. To do so, use the drop-down menu (see Figure 4).

Figure 4



↑ Choose the exoplanet to start.

6. Once an exoplanet has been selected, a light curve of the data collected from the exoplanet during the observation of the transit should appear at the bottom of the screen. The blue dots represent the individual data points during the observation, and the grey line represents the current model fit using the parameters inputted.

7. The values for the different parameters can be adjusted by sliding the sliders left and right to increase or decrease the value (see Figure 5). The values that will need to be adjusted are:
   - Radius of the exoplanet (in units of Earth radius)
   - Radius of the star (in units of solar radius)
   - Mid-transit time (days)

8. Observe how each parameter changes the fit of the model, and once the parameter values that provide the best fit to the data have been found, click the “Investigate” button that appears (see Figure 5).

Figure 5

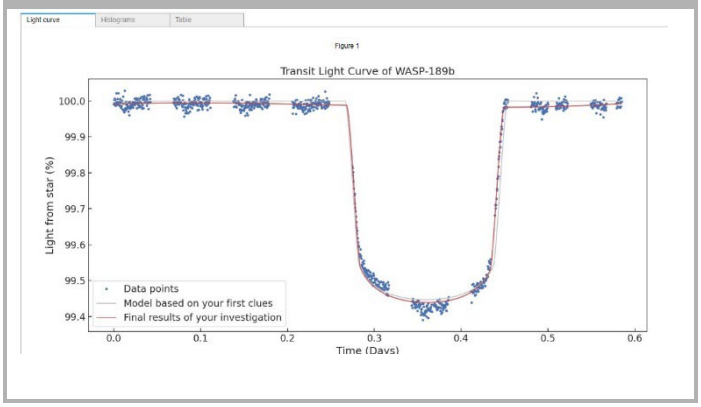
↑ *Allesfitter* interface.

Results

9. The software will now fit the model to the data to find the best fit. This can take a few minutes to complete, and the progress can be tracked as the software runs. The model fit is created using a **Markov chain Monte Carlo** statistical method.

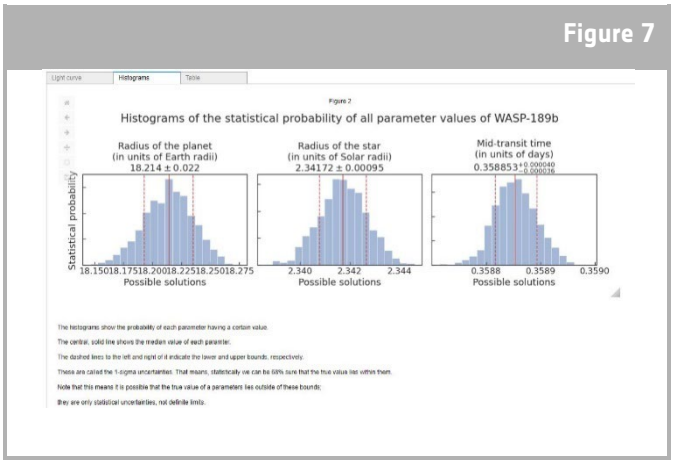
10. Once the results are ready, a message will display, and two new tabs will appear next to the light curve tab: Histograms and Table (see Figures 6, 7 and 8).

Figure 6



↑ Transit light curve best fit model.

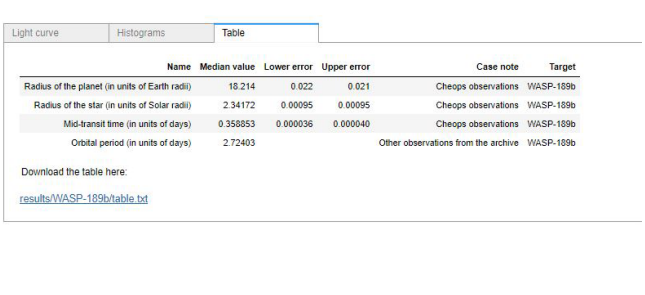
Figure 7



↑ Best fit model uncertainties.

11. After you have completed the investigation and the light curve results have been produced, you can analyse the data to determine certain characteristics of the exoplanets.

Figure 8



↑ Table with the best fit model parameters.

12. To download the results you have collected, go to the relevant tab for the data you wish to download: light curve, histogram, or table. Under the displayed data, you can find a link to download the figure. Click the link and a document with the results will open in a new tab. Download this document to your device.