



ABSTRACT

The team that worked on this project is part of our school's science and technology club named Fizitec, and is composed of three STEM enthusiasts, who embraced this challenge with open arms!

We are fond of astronomy and space exploration, so we were inspired to work on this project by the wonders of the cosmos, and by the possibility of discovering by ourselves the mysteries behind two exoplanets. During the hackathon, we were able to measure and deduce properties of TOI-560c and KELT-3b, orbiting planets of stars TOI-560 and KELT-3.

With the resources ESA provided and the instructions given at a webinar organized by the Romanian Science Festival, and using the values that were put at our disposal after adjusting the transit light curve of TOI-560c, we were able to calculate its size, orbital period and distance, temperature and habitability, along with its composition.

We were particularly interested to learn if the planet we are analyzing is habitable, as humans are now actively searching for planets that could host us sometime in the future. And, knowing the temperature, orbital period, and distance from the star of TOI-560c, we were able to deduce if it's habitable.

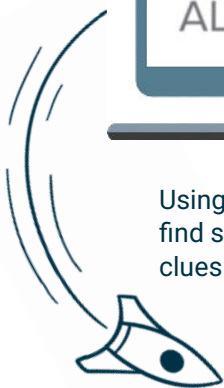
Water, a suitable atmosphere, and a source of energy are necessary for a planet to be able to host life as we know it. The provided information, along with the provided one, allowed us to make a clear statement about the exoplanet's potential.

ANALYSIS & RESULTS

To be able to finish the challenge of analyzing planet TOI-560c, we used the following tools:



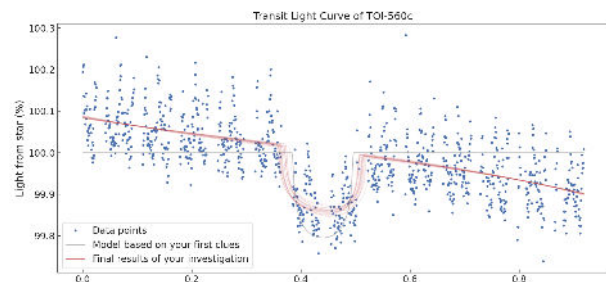
Using Allesfitter, one of the tools astronomers use in order to analyze exoplanets, we were able to find some insight about the exoplanet and the star it's orbiting. After setting the values for the first clues of the investigation, we received other valuable clues.



Radius of the planet:

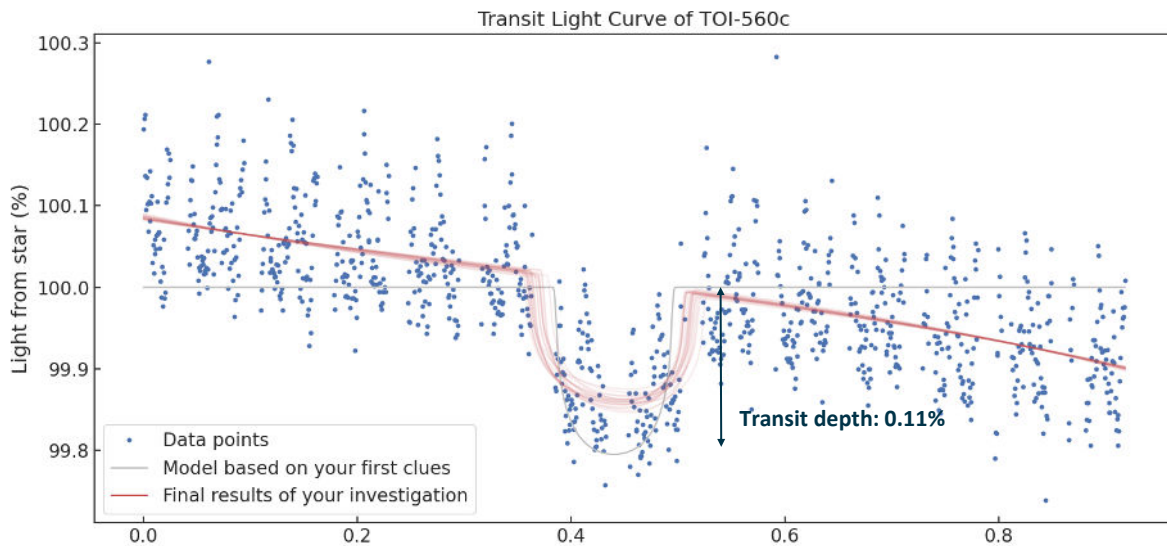
Radius of the star:

Mid-transit time:



Name	Median value	Lower error	Upper error
Radius of the planet (in units of Earth radii)	2.394	0.070	0.069
Radius of the star (in units of Solar radii)	0.654	0.017	0.016
Mid-transit time (in units of days)	0.4405	0.0052	0.0057
Orbital period (in units of days)	18.8797		
Orbital semi-major axis (in units of AU)	0.1242		

We estimated the transit depth as being 0.11%, as seen below.



Then, we calculated the planet's radius in Sun radii units using the following formula and converted it to Earth radii units.

$$R_s = 0.654 R_{sun}$$

$$transit\ depth = 0.11\%$$

$$R_p = \sqrt{R_s^2 \times \frac{transit\ depth}{100}}$$

$$R_p = \sqrt{0.427716 \times 0.0011}$$

$$R_p = \sqrt{0.0004704876}$$

$$R_p = 0.0216 R_{sun}$$

$$R_p = 0.0216 \times 109 = 2.364 R_{Earth}$$



The next step was calculating the distance between the planet and the star, using Kepler's Third Law:



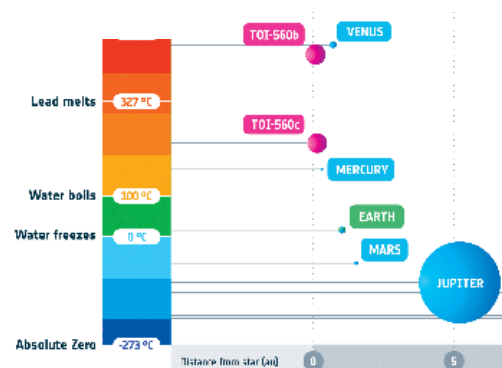
$$T = 18.8797\ days = 1631206\ s$$

$$M_s = 0.66\ M_{sun}$$

$$d = \sqrt[3]{\frac{6.67430 \times 10^{-11} \times 1.30 \times 10^{30} \times 2.66083301 \times 10^{12}}{4 \times 3.14^2}}$$

$$d = 0.1204\ au$$

From our calculations, we can deduce the fact that TOI-560c is extremely close to its star, TOI-560. From its file, we know that its temperature is 327° C (the temperature at which lead melts). With all that in mind, we believe that TOI-560c is not habitable, as most organic molecules like amino acids wouldn't survive at such a high temperature because they would undergo thermal decomposition.

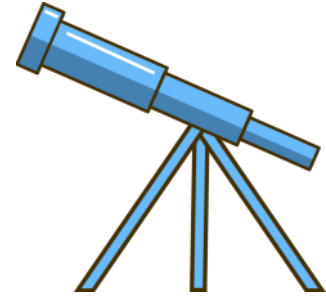


With the information from its file, we could calculate the planet's mass, volume, and density:

$$M_p = 10 \times M_{Earth} = 5.97 \times 10^{28} g$$

$$V = \frac{4}{3} \pi \times R_p^3 = 1.083 \times 10^{27} cm^3$$

$$\rho = \frac{M_p}{V} = 55.12 g \times cm^{-3}$$



CONCLUSIONS

During this challenge, we were able to explore new horizons and get an insight into how specialists discover and analyze planets that are far away from us. After practicing on KELT-3b, we were able to calculate the distance from the star, radius, density, and mass of TOI-560c.

In the end, we came to the conclusion that this planet is unfortunately not habitable, however, the search definitely won't stop here!

TOI-560c properties	Numeric values
Distance from the star	0.1204 au
Radius	2.364 R_{Earth}
Density	55.12 $g \times cm^{-3}$
Mass	10 $\times M_{Earth}$