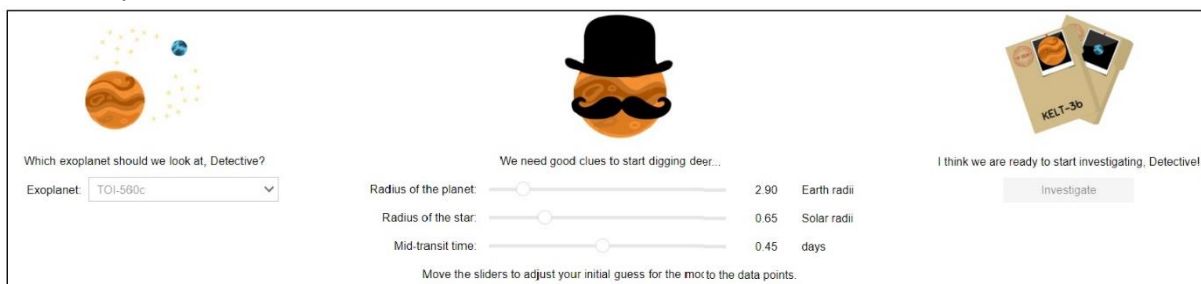


Abstract:

We are from an elementary school in Kolín and we are 14 years old. We were very interested in this hack an exoplanet challenge. Our team has already solved a similar task. The exoplanet XO-6 b and the pulsating variable star RR Lyrae TV Lyn. With the help of Mr. Petr Kabáth and Mr. Marek Skarka from the Academy of Sciences of the Czech Republic, we used the Munivin program to search for parameters and create graphs. This challenge is handled very nicely, and we were happy to add data about the exoplanet TOI-560C and uncover its secrets.

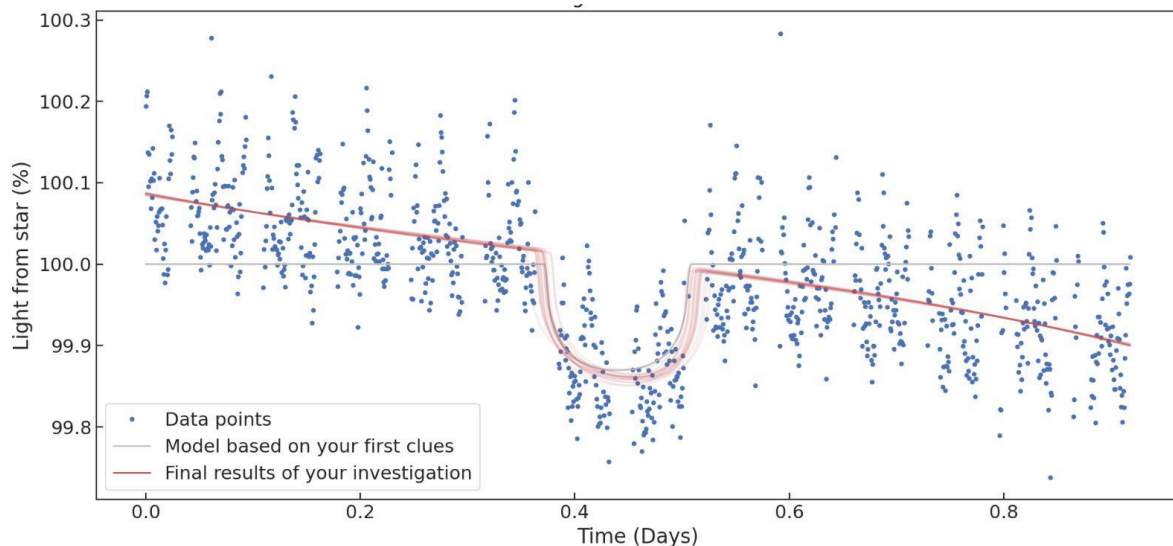
Results

First, we got acquainted with the rules and watched sample videos. According to these samples, we then proceeded to analyze the data. We tried and use the sliders to set the best possible parameters. And we succeeded. We entered the "Radius of the star" parameter from the documentation and set the other parameters to best describe the curve.



We made the calculation and saved all the calculated data. In the following calculations, we worked with this data. We then compared the generated histograms with the values we entered or calculated. We found the Radius of the planet 2.90 that we entered differs from the calculated values of 2.397.

We were the first to calculate the radius of an exoplanet.



$$R_p = \sqrt{R_s^2 * \frac{\text{depth tranzit}}{100}} \quad R_p = \sqrt{0,4225 * \frac{0,15}{100}} = 0,025174$$

$$0,025174 * 109 = 2,744009 \%$$

$$2,744009 * 6378 = 17\,501,29 \text{ Km} = 17\,501\,287,5 \text{ m}$$

We originally set 2.90 percent and calculated 2.744009 percent

The correct value given by the allesfitter calculation is 2.397%

In the second step, we took the orbital period from the allesfitter program, which is 18.8797 days, and calculated the distance to the parent star. We used Kepler's law 3 to calculate it.

$$\sqrt[3]{\frac{G M_s T^2}{4\pi^2}} = \sqrt[3]{\frac{6,6743 \times 10^{-11} * 1,45 \times 10^{30} * 1631206^2}{4\pi^2}} = 1,86843 \times 10^{10} \text{ Km} = 0,1249 \text{ Au}$$

We calculated that TOI-560C is moving in an orbit 0.1249 Au away. This value differs from the value in the allesfitter program, which counted 0.1242Au.

In the third step, we took into account the stated temperature, which is 225 °C, and calculated the density based on weight and volume:

$$V = \frac{4}{3} \pi R^3 = 4,186666667 * 17501287^3 = 2,24429E^{22} \text{ m}^3$$

$$\rho = \frac{M}{V} = \frac{9,70 * 5,9722^{24}}{2,25^{22}} = 2572 \text{ kg/m}^3 = 2,57 \text{ g/cm}^3$$

Conclusions

When determining the radius size ratio, we had the largest deviations. We originally set 2.90% and calculated 2.744009%. Allesfitter calculated 2.397%. In other calculations, however, we based ourselves on our values.

Next, we calculated that TOI-560C is orbiting 0.1249 Au. There we were very close to the value in the allesfitter program, which calculated 0.1242Au.

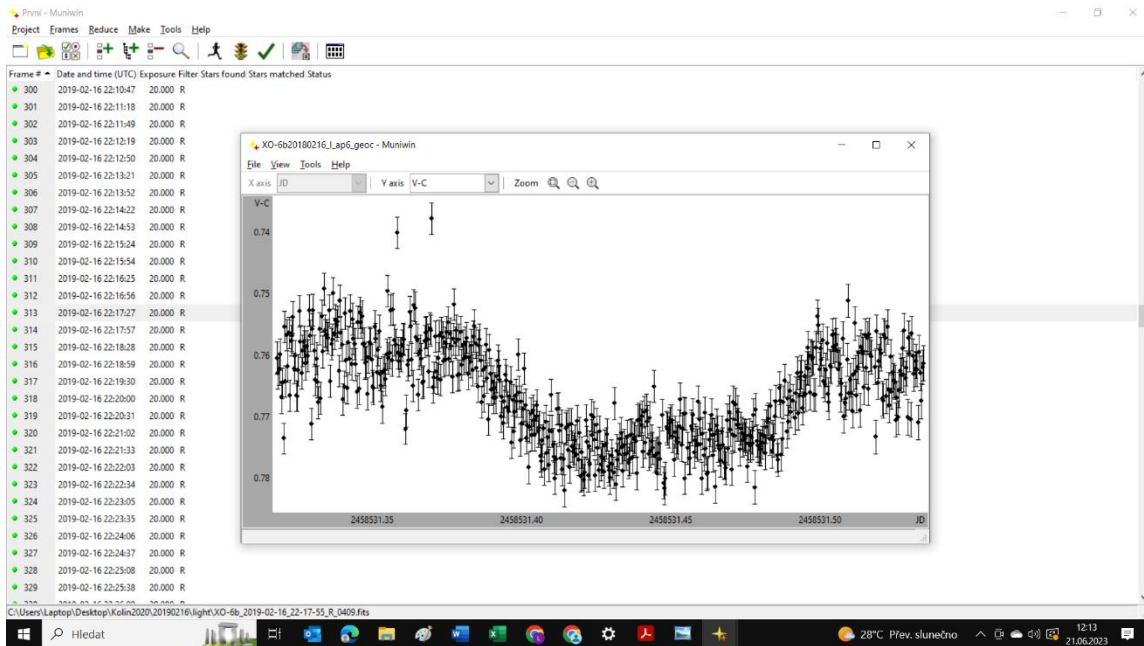
From these values, we found that TOI-510C is somewhere between Earth and Neptune. We also found that it is very close to its host star with a short orbital period. About half the distance of the planet Mercury in our solar system. From this it is clear that the planet cannot be habitable, it is not in the habitable zone. In this vicinity, in addition to the temperature, there will also be considerable radiation from the parent star.

The density of the planet is 2.57g/cm³, which is somewhere between the density of planet Earth and Neptune. From this we conclude that it will have a stone core and a gas envelope. There is no such planet in our solar system. It deviates in many parameters. One could say with great exaggeration "hot Neptune"

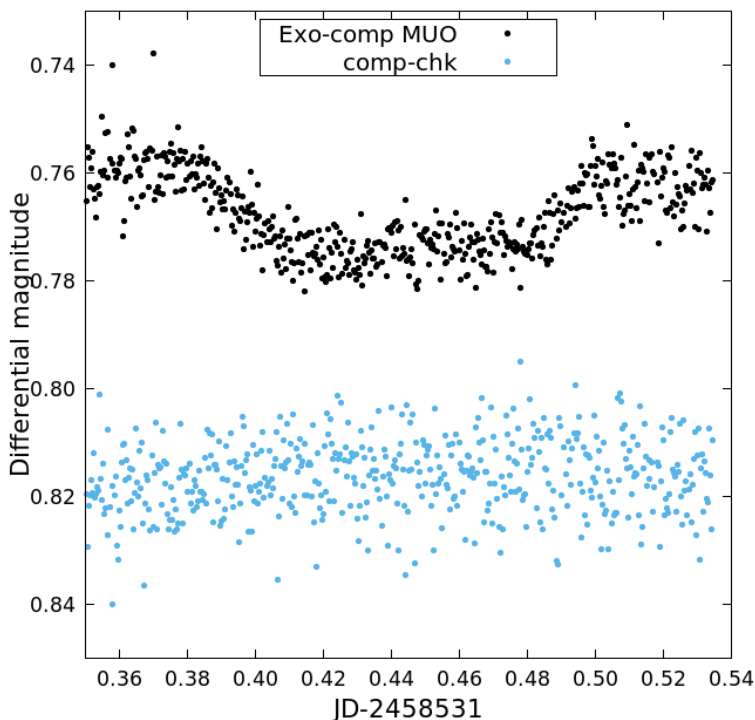
We deepened our knowledge of exoplanets. We enjoyed our work very much. We gained experience with the allesfitter program. Our knowledge was with the program Muniwin, which also processes the results of exoplanet observations.

It is a pity that we could not examine and evaluate, for example, a spectral analysis of a star from these data, which would certainly be interesting. We dealt with examples of shifting spectral lines of star motion and exoplanet motions at the Astronomy Olympiad recently this year.



Our team has been dedicated to astronomy for a long time. We created two projects in the Mission Space Lab: one addressed the amount and changes of phytoplankton in marginal seas, and the other focused on growing plants in space. We cooperate with the observatory in Brno on a 600mm telescope. That's where our idea to observe exoplanets came from. That is why we teamed up with the workplace of the Academy of Sciences of the Czech Republic in Ondřejov and under the kind guidance of RNDr. Petr Kabáth, Ph.D. and Mgr. Marek Skarka, Ph.D. we also investigated the exoplanet XO-6b - one of the largest ever discovered.



XO-6b (V=10.25 mag), 60cm Newtonian, R, exp 20 s, RMS=0.007 mag



We also wanted to try to explore the exoplanet WASP-189 b. We were unable to download the data. So we only got to the initial setup and editing of the chart.



Which exoplanet should we look at, Detective?

Exoplanet:

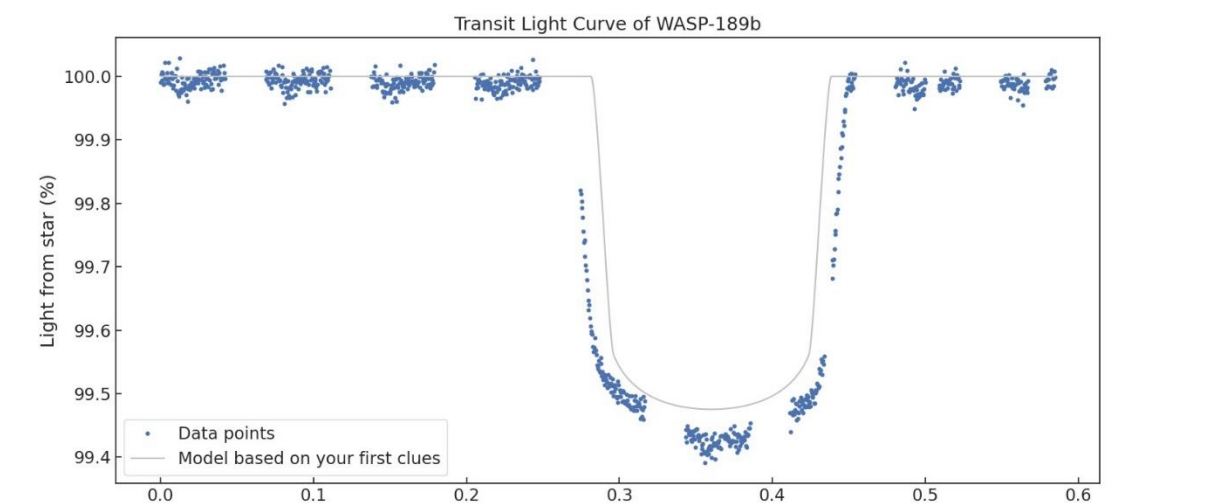
We need good clues to start digging deeper...

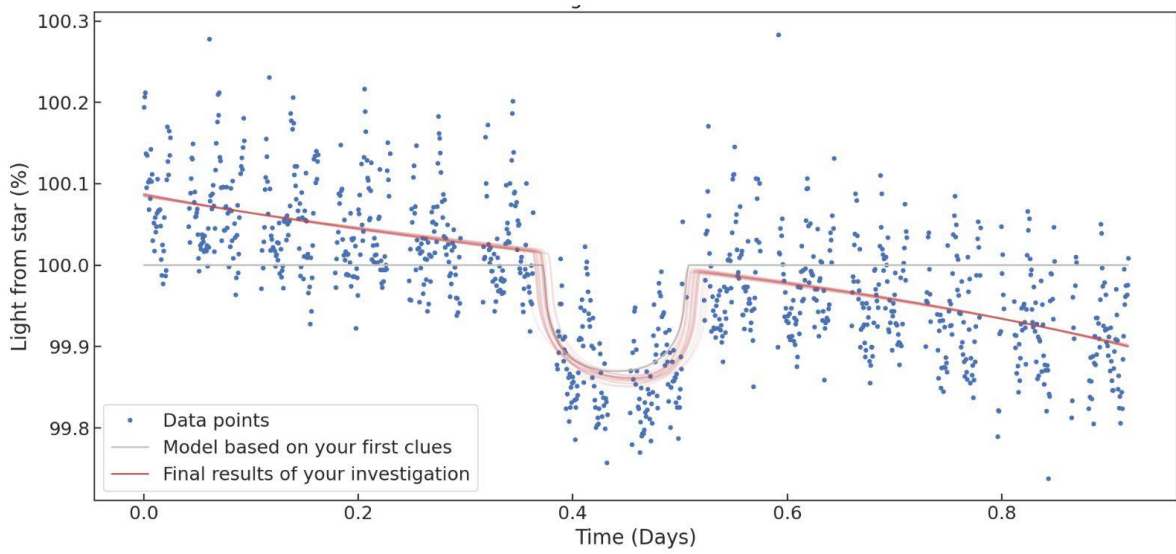
Radius of the planet: 16.10 Earth radii

Radius of the star: 2.10 Solar radii

Mid-transit time: 0.36 days

Move the sliders to adjust your initial guess for the model to the data points.





Pynt - Muniwin

Project Frames Reduce Make Tools Help

Frame #	Date and time (UTC)	Exposure	Filter	Stars found	Stars matched	Status
300	2019-02-16 22:10:47	20.000	R			
301	2019-02-16 22:11:18	20.000	R			
302	2019-02-16 22:11:49	20.000	R			
303	2019-02-16 22:12:19	20.000	R			
304	2019-02-16 22:12:50	20.000	R			
305	2019-02-16 22:13:21	20.000	R			
306	2019-02-16 22:13:52	20.000	R			
307	2019-02-16 22:14:23	20.000	R			
308	2019-02-16 22:14:53	20.000	R			
309	2019-02-16 22:15:24	20.000	R			
310	2019-02-16 22:15:54	20.000	R			
311	2019-02-16 22:16:25	20.000	R			
312	2019-02-16 22:16:56	20.000	R			
313	2019-02-16 22:17:27	20.000	R			
314	2019-02-16 22:17:57	20.000	R			
315	2019-02-16 22:18:28	20.000	R			
316	2019-02-16 22:18:59	20.000	R			
317	2019-02-16 22:19:30	20.000	R			
318	2019-02-16 22:20:00	20.000	R			
319	2019-02-16 22:20:31	20.000	R			
320	2019-02-16 22:21:02	20.000	R			
321	2019-02-16 22:21:33	20.000	R			
322	2019-02-16 22:22:03	20.000	R			
323	2019-02-16 22:22:34	20.000	R			
324	2019-02-16 22:23:05	20.000	R			
325	2019-02-16 22:23:35	20.000	R			
326	2019-02-16 22:24:06	20.000	R			
327	2019-02-16 22:24:37	20.000	R			
328	2019-02-16 22:25:08	20.000	R			
329	2019-02-16 22:25:38	20.000	R			

VO-Gb20180216_Lap6_geoc - Muniwin

File View Tools Help

X axis: JD Y axis: V-C

Zoom

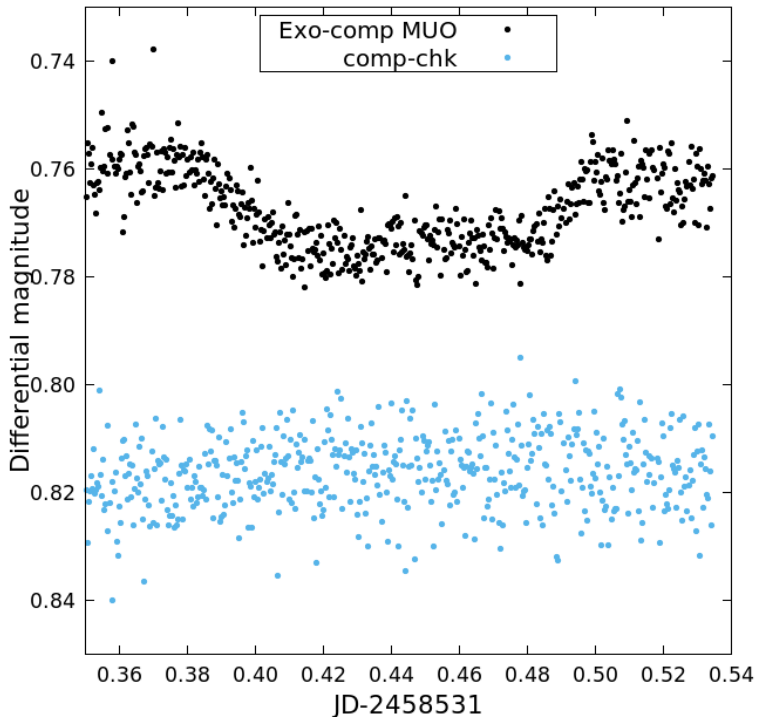
2458531.35 2458531.40 2458531.45 2458531.50 JD

C:\Users\laptop\laptop\Kolin2020\20190216\light\VO-Gb-2019-02-16-22-17-55_R_0409.fits

Hledat

28°C Plev. slunečno 12:13 21.06.2023

XO-6b (V=10.25 mag), 60cm Newtonian, R, exp 20 s, RMS=0.007 mag



Which exoplanet should we look at, Detective?
Exoplanet:

We need good clues to start digging deeper...

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