

Team RTG

ESA – Hack an Exoplanet

Analyse TOI-560c

From the case file:

$$m_{\text{Planet}} = 9,70 \cdot m_{\text{Earth}}$$

$$T = 225 \pm 15^\circ \text{C}$$

$$M_{\text{Star}} = 0,73 \cdot M_{\text{Sun}}$$

$$r_{\text{Star}} = 0,65 \cdot r_{\text{Sun}}$$

Data from allesfitter:

$$r_{\text{Planet}} = 2,381 \cdot r_{\text{Earth}}$$

$$t_{\text{Transit}} = 0,4414 \text{ d}$$

$$T_{\text{Planet}} = 18,8797 \text{ d}$$

$$(a = 0,1242 \text{ AE}) \leftarrow \text{as reference}$$

Radius from the „Dip“:

from allesfitter: 0,15% *hidden*

$$\text{Formula: } \% = \frac{\pi r_{\text{Planet}}^2}{\pi r_{\text{Star}}^2} \cdot 100$$

$$\rightarrow r_{\text{Planet}} = \sqrt{\frac{\%}{100} \cdot r_{\text{Star}}^2} = \sqrt{\frac{0,15}{100} \cdot (0,65)^2} \cdot r_{\text{Sun}} = 0,025 r_{\text{Sun}} = 2,75 r_{\text{Earth}}$$

$$\cdot r_{\text{sun}} : r_{\text{Earth}} = \cdot 695700 \text{ km} : 6378 \text{ km}$$

Distance:

$$\frac{T^2}{a^3} = \frac{4\pi^2}{GM_{\text{Star}}} \rightarrow a = \sqrt[3]{\frac{GM_{\text{Star}} T^2}{4\pi^2}}$$

$$a = \sqrt[3]{\frac{G \cdot 0,73 \cdot 1,99 \cdot 10^{30} \text{ kg} \cdot (18,8797 \cdot 24 \cdot 3600 \text{ s})^2}{4\pi^2}} = 1,87 \cdot 10^{10} \text{ m} = 0,125 \text{ AE}$$

→ The Planet is nearer to the star than Mercury to the Sun, but the star is weaker than the sun. The temperature is too high for life as we know it. Water has the form of steam and because of the low distance from the star, there might be a high radiation.

Density:

$$\rho = \frac{m}{V} = \frac{9,7 \cdot 5,9722 \cdot 10^{24} \text{ kg}}{\frac{4}{3} \pi (2,75 \cdot 6378000 \text{ m})^3} = 2563 \frac{\text{kg}}{\text{m}^3} = 2563 \frac{\text{g}}{\text{dm}^3} = 2,563 \frac{\text{g}}{\text{cm}^3}$$

We used the radius from the dip-calculation.

- Very dense gasplanet; possible stone core
- Mostly hydrogen and helium

Conclusions:

1. ..., TOI-560c is a hot Neptun with a very low distance to its star (0,125AE – about 1/3 of the distance Mercury – sun). Its orbital periode is 18,88 days. Despite its relatively small star, TOI-560c is too near to it .This is why the temperature is too high to contain life as we know it, because there is only watervapor and proteins would be destroyed. Also the radiation would be very high. Because of the high density (for a gas planet) it is likely that there is a stone core.

2. ...Despite its low distance to its star(~1/3 Mercury-Sun), the temperature (225°C) is only slightly above the average temperature of Mercury and it is colder than Venus (extreme greenhouse effect). The density of TOI-560c is higher than the densities of all the gas planets in our solar system but lower than those of the stone planets