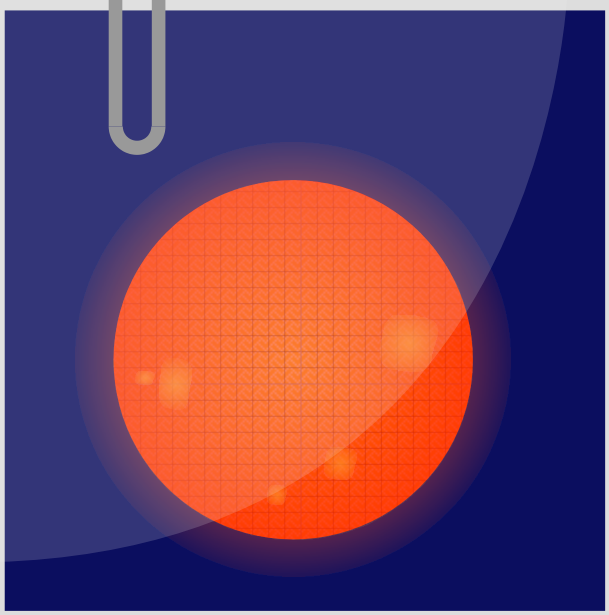
Case: planetary system TOI-560 in Hydra constellation

23/1/2023



TOI-560

Characteristics:

Mass:	0.66 ± 0.02 M_{SUN}
Radius:	0.71 ± 0.02 R_{SUN}
Distance from Earth:	31.6 ± 0.032 pc
Temperature:	4237.85 ± 110 °C
Age:	0.75 ± 0.02 Gyr
Composition:	next page

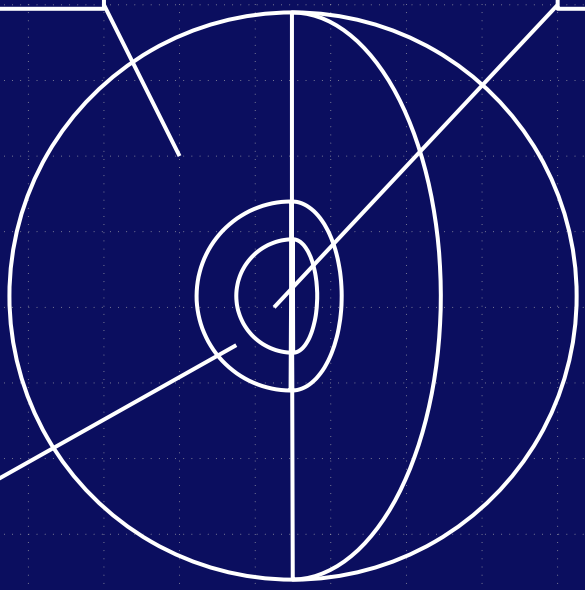
Spectral type: K4V - Orange Dwarf
K-type stars have mass between 0.6 and 0.9 M_{SUN} and surface temperature between 3900 and 5300 K (3600 and 5000 °C).
Specifically type K4 has around 0.73 M_{SUN}, 0.713 R_{SUN}, 0.20 L_{SUN} (luminosity), 4,600 K and color index 1.09, which determines the orange color of the star.
The V stands for the fifth luminosity class, where all the stars are called dwarfs.
Orange dwarfs are perfect for finding alien life, because they have the best from red and yellow dwarfs. They are in larger quantities like red dwarfs, but they have larger habitable zone like yellow dwarfs.

Data from exoplanet.eu and wikipedia

COMPOSITION TOI-560

Stellar envelope made out of cooler hydrogen

Core begins to accumulate helium after some time



A hydrogen fusion is taking place in the core of the star. After some time, when the hydrogen in the core is mostly burned out, the core begins to collapse under the gravity, which creates more heat. This starts fusion in other layers of the star and the outer layers begin to cool down and expand. This whole process creates more light, but decreases the temperature of the star.

TOI-560 b

Characteristics:

Mass:	10.201 M_{EARTH}
Radius:	2.728 R_{EARTH}
Density:	2.761 g/cm^3
Orbital period:	6.398 Days
Distance to host star:	0.0604 AU
Composition:	next page
Temperature:	447.85 ± 21 °C
Discovered:	2021

Planet type: Mini-Neptune

Mini-Neptune is a type of Super Earth. Super Earth is anything more massive than earth but lighter than ice giants like Neptune or Uranus (from 1 to 10 M_{EARTH}). So it doesn't mean that it is like our Earth. Mini-Neptune is at the upper limits of Super Earth, from 1 to 20 M_{EARTH} and from 1.7 R_{EARTH} to 3.9 R_{EARTH}.

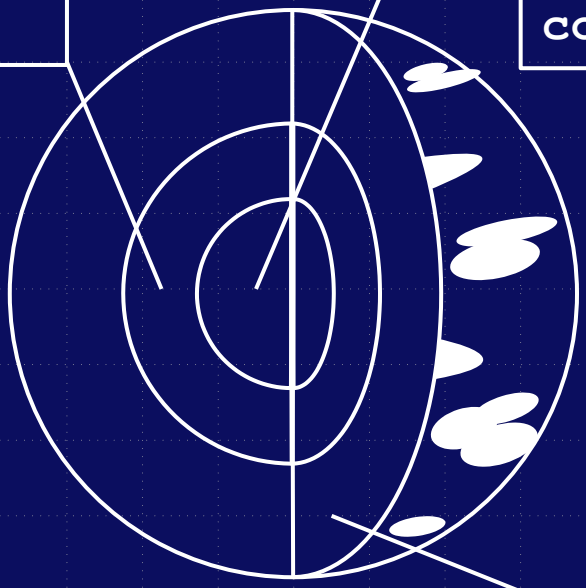
It is also known as a transitional planet, because somewhere in between the lower and upper limit of Mini-Neptune there is the transition from rocky planet to gaseous planet. Estimates say that it is somewhere between 1.6 and 2 R_{EARTH}.

Data from exoplanet.eu, exoplanets.nasa.gov and wikipedia

COMPOSITION TOI-560b

We can expect some sort of core covering made out of ice, water or compressed gasses.

In the center of the planet there should be a rocky mass as its core.



Some sort of atmosphere is to be expected, as its mass and radii can’t be that of a rocky planet without an atmosphere. Typical for Mini-Neptunes is an atmosphere made out of hydrogen and helium. These gasses are warmed up to 450˚C. This temperature is similar to that of Venus.

TOI-560 c

Characteristics:

Mass:	$9.7^{+1.80}_{-1.70}$ M_{EARTH}
Radius:	$2.384^{+0.066}_{-0.071}$ R_{EARTH}
Density:	$3.934^{+1.173}_{-0.945}$ g/cm^3
Orbital period:	18.8797 Days
Distance to host star:	$0.124^{+0,0011}_{-0.0012}$ AU
Composition:	next page
Temperature:	225 ± 15 °C
Discovered:	2021 by the TESS survey

Planet type: Mini-Neptune

As previously mentioned it's a type of Super Earth.

What planet from the Solar system resembles it the most?

Compared with the density of other planets in the Solar system, TOI-560c is similar to Mars, however its radius is nearly five times greater and its mass is nine times larger than that of Mars.

When is it visible?

We know that if the planet passed in front of the star on 23 January 2023 at 13:12 CET, the next transit happened again on 11 February 2023 at 10:18 CET. From June 14 2023, the nearest transit for us should be June 23 at 14:06 CET.

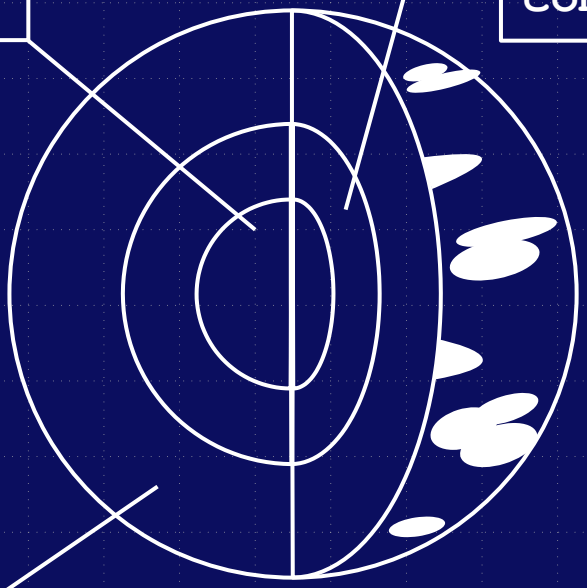
Data from hackanexoplanet.esa.int

COMPOSITION

TOI-560c

There is most likely a rocky core in the center of the planet.

The core could be protected by an envelope made out of water, ice or compressed gas.

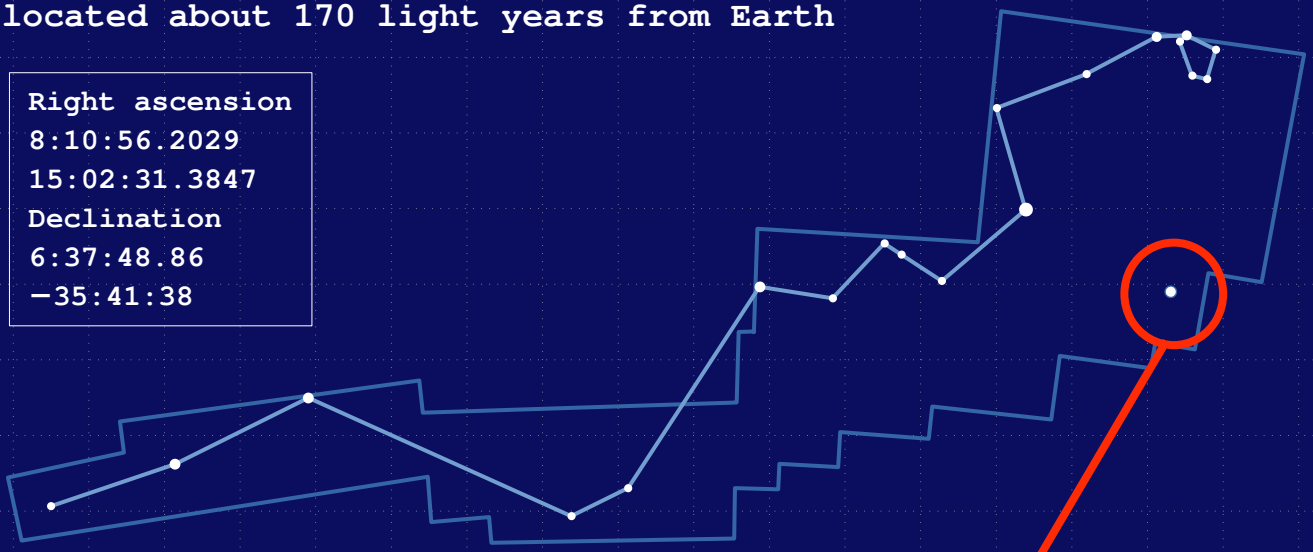


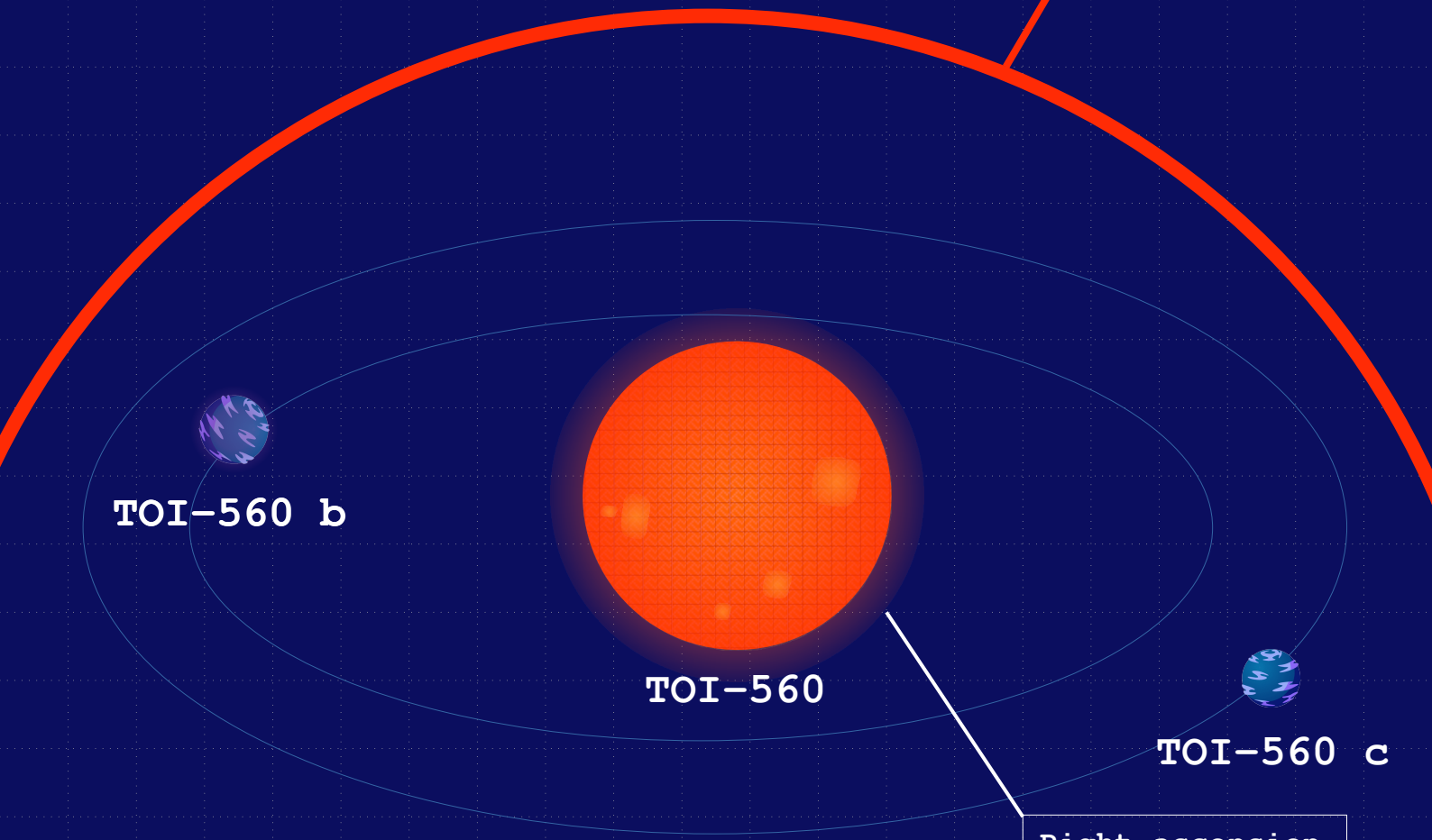
The outer layer is nearly certainly made out of gas, in this case hydrogen and helium. This means that the planet has an atmosphere, however the close proximity to the star keeps it warm at nice 225 °C, which rules out any chance of potential life.

The Hydra constellation

- the largest of the 88 modern constellations (1303 square degrees) and also the longest (over 100 degrees)
- lies in the second quadrant of the southern hemisphere
- located about 170 light years from Earth

Right ascension
8:10:56.2029
15:02:31.3847
Declination
6:37:48.86
−35:41:38





Right ascension
08:38:45.0
Declination
-13:15:24

Not to scale