Exoplanets and their detection methods

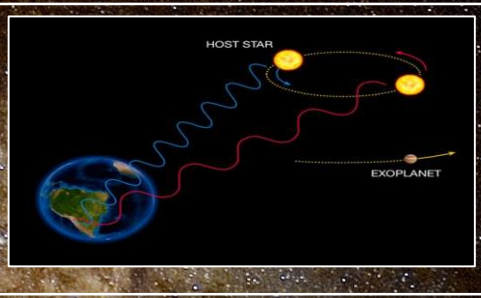
12 students from all over Switzerland (and Dornbirn, Austria) came to ETH Zurich to find exoplanets (extra solar planets) that have been found before. With the help of the extraordinary, associate professor Sascha Quanz and his team we were able to analyse original Kepler satellite data. During the week we learned different methods to detect exoplanets. With these methods various sorts of exoplanets and different planetary characteristics can be detected. Furthermore, our group had the privilege to have an insight in the daily business of ETH Zurich.

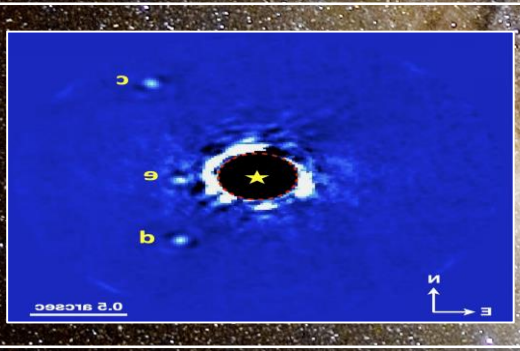
With the discovery of planets outside of our solar system we can have a broader understanding of planets. We can also understand whether or not the properties of our solar system are common in the universe. Moreover we can set terrestrial life in a universal context by quantifying the frequency of planets that have suitable conditions for hosting life.

WHAT ARE STARS, PLANETS AND EXOPLANETS:
Stars are celestial bodies, that make nuclear fusion because they have a lot of mass and density while **planets** don't have enough mass to do so.
Planets orbit around the sun and **exoplanets** orbit around another star.

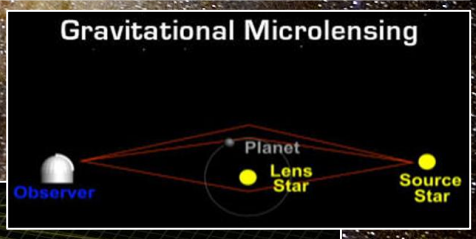
NUCLEAR FUSION is a phenomena in which a reaction happens inside the nuclei of elements. This makes their subatomic particles combine to form other elements.
Stars are very bright because nuclear reactions release a lot of energy.

RADIAL VELOCITY: Stars and their exoplanets revolve around a mutual centre of gravity. That a star which has an exoplanet moves. The observer can measure these movements. If the star comes towards the observer it has another light frequency than if it goes away from the observer. This effect is called **Doppler Shift**. From these two frequencies we can calculate the velocity and period of the exoplanet.

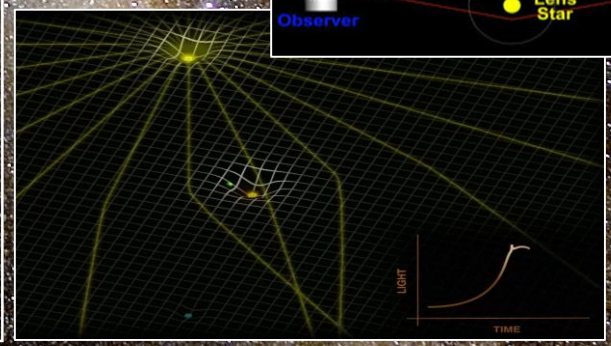




DIRECT IMAGING: Light of a star is reflected by a an exoplanet. Besides confirming the existence of an exoplanet, this light can also be analysed for absorption lines the exoplanets atmosphere has produced, which allows us to have deeper insights.



MICROLENSING: The light of a star is deflected by a star in front of it. The gravity of the star, which deflects the light, acts like a collecting lens. Accordingly, the light collects at one point. We observers perceive this as a brighter point. The intensity increases through this accumulation of light. In the diagram it represents the climax. Now, when an exoplanet rotates around the anterior star, the light is additionally deflected by it. In the diagram this is dated as a lower high point. This it can be proven that this star has an exoplanet.



Method	Advantages	Disadvantages	Number of planets discovered
Radial Velocity	Most effective method	The inclination of the orbit has to be towards us. We can not know the mass.	839
Microlensing	We can find very small planets that are very far away.	Planets can only be observed once. ->We can not find out the period.	96
Direct Imaging	Less Prone to false positives and we can find informations about the composition of the exoplanets' atmosphere. -> We could maybe find a planet with the same atmosphere as the earth.	Very hard to find a planet with this method.	127