

Searching for Exomoons

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Introduction

Are we alone in this vast and beautiful Universe, or is humanity a coincidence of astronomical proportions? This haunting question, perhaps more than any other, has captivated the hearts and minds of so many great thinkers since the dawn of civilization. What an astounding honour it is to live at a time when we may finally answer this question, for today astronomers are searching for habitable places in the depths of space.

Astronomers have typically conceived of an Earth-like planet representing the best place to look for extraterrestrial life, but with techniques rapidly improving, we now have the audacity to search for the moons of exoplanets, so called "exomoons" [1].

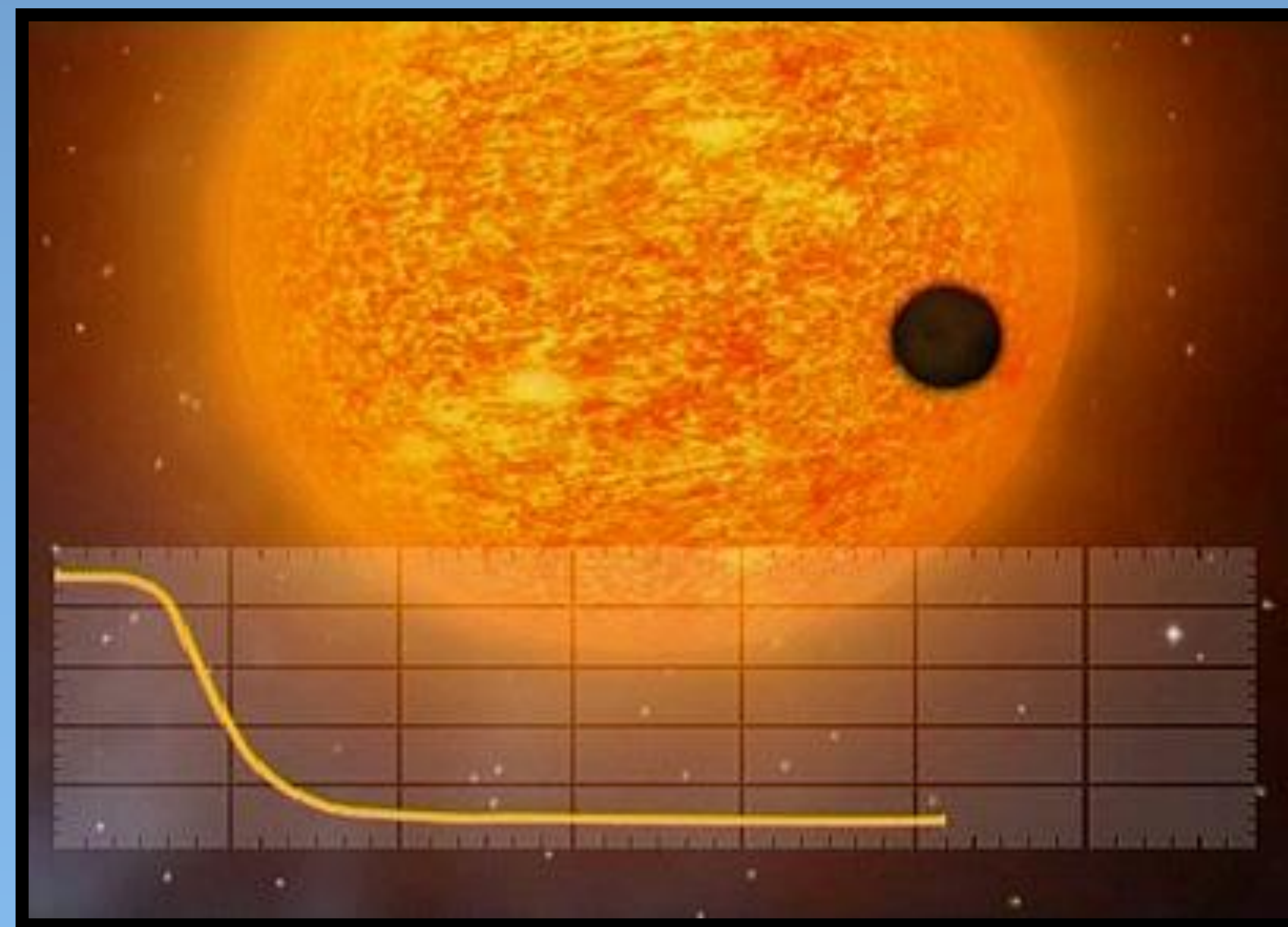


Figure 1 – Illustration of the decrease in luminosity from a star when an exoplanet transits across star's face.

Transiting Exoplanets

When an exoplanet passes in front of the face of its host star it causes the star to appear a little dimmer for a short time, something called a "transit". Transits tell astronomers about how big the planet is [2] and also how fast the planet is moving [3]. Transits occur once every orbital period of the planet, so if we observe several transits, we can look for any tiny changes in the velocity of the exoplanet.

Wobbling Planets

- Transits allow astronomers to look for tiny changes in the velocity of an exoplanet, but why would a planet's velocity be changing?
- If a planet has a moon, they both orbit a common centre of gravity.
- Because the planet is much heavier than the moon, the planet only moves a small amount, making it wobble about during its orbit.
- This wobbling causes the planet to appear to speed up and slow down slightly, as seen from the Earth.

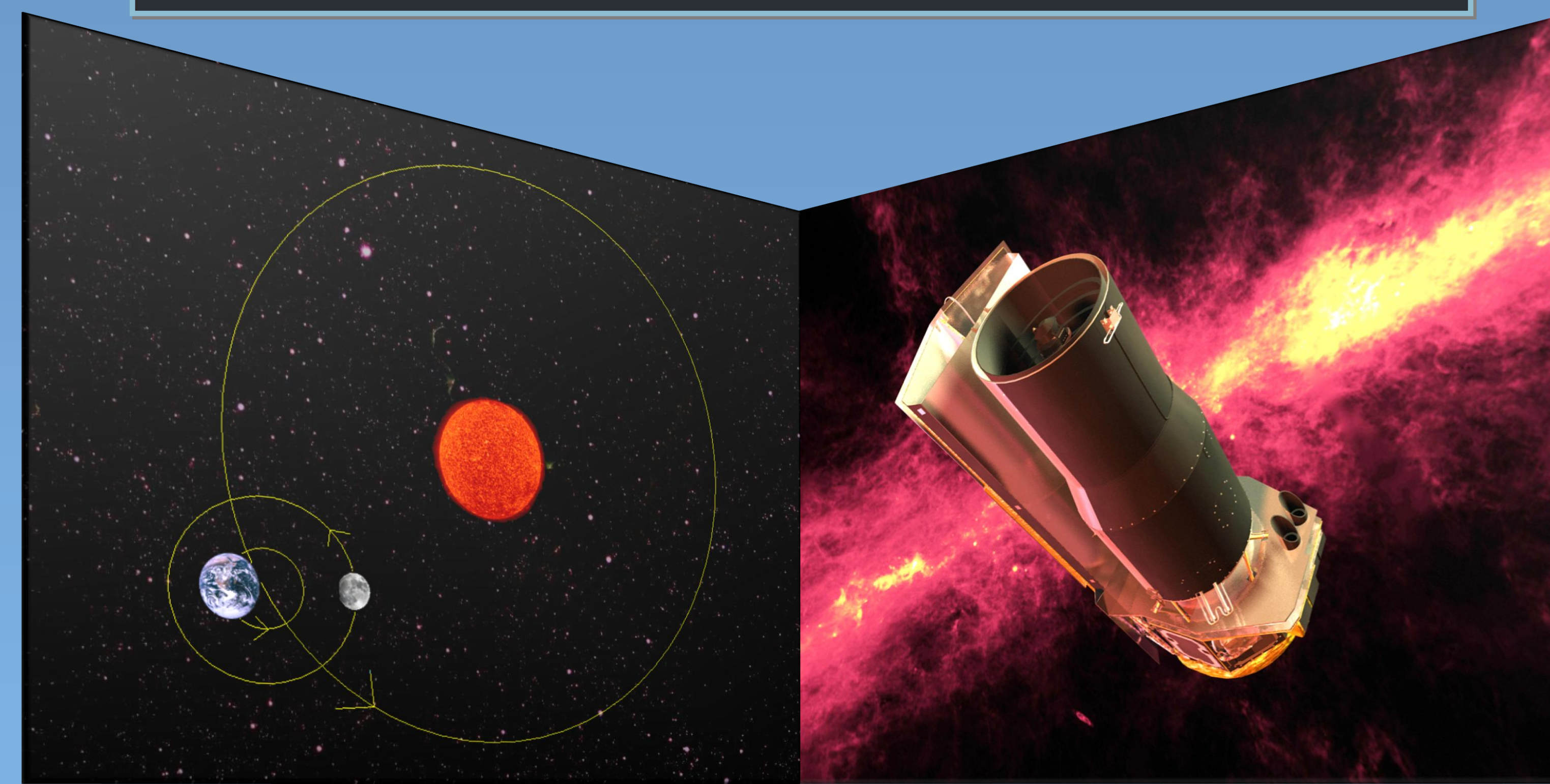


Figure 2 – The Moon makes the Earth wobble about during its orbit. This wobbling can be detected from both ground and space-based telescopes, like Spitzer (right).

UCL Leads The Hunt

Even though exomoons are too small to directly detect, their presence perturbs the host planet's motion and this can be detected. The theory of how to detect exomoons was developed here at UCL a recent paper by Kipping (2009) [3]. Now, UCL is leading observations in La Palma, Tenerife with the 2.0 metre Liverpool Telescope to look for exomoons in the first dedicated search.

The current search is sensitive down to an Earth-mass moon around a Neptune-like planet. However, as techniques develop we will soon be able to search down to masses comparable to the moons of our own Solar System.

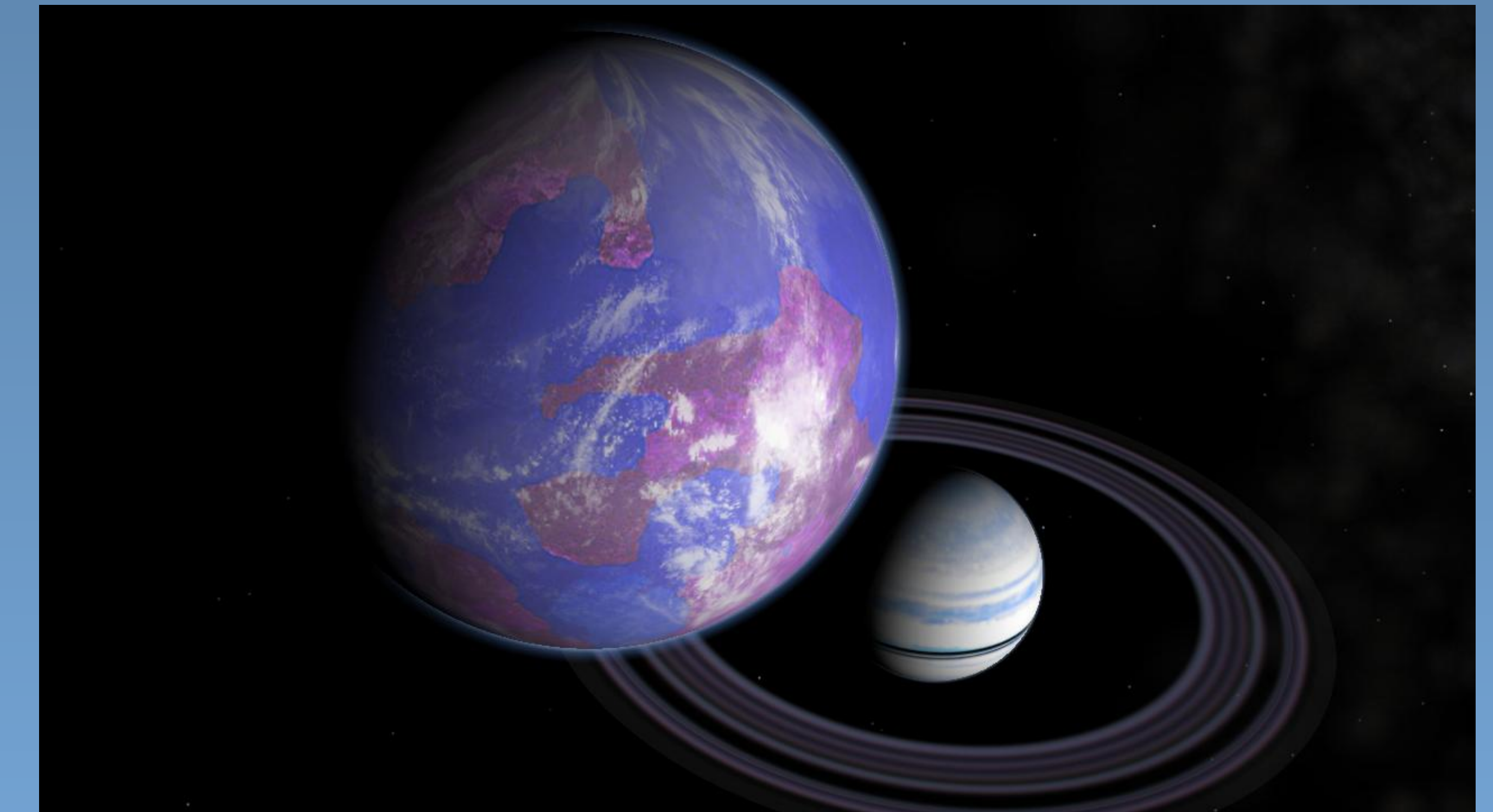


Figure 3 – Artist's impression of a habitable exomoon around a Saturn-like exoplanet. We may be just a couple of years away from such a discovery.

Habitable Exomoons

Could life be found on exomoons? Actually, life may be more common on exomoons than exoplanets! So far we have found over 300 exoplanets but they are almost all gas giants planets. 30 of these gas giants are in the habitable zone [4], which means that if they had a moon then it would be habitable.

Further, life on the Earth may not even exist without the Earth's moon [5]. The Moon stabilises the axial tilt of our planet, which is crucial to a stable climate. It seems moons could be key in the search for life.

The wobbling planets method only tells us the mass and orbit of the moon and so we are some way off detecting life on such bodies. However, the detection of a habitable exomoon would certainly galvanize more dedicated telescopes to begin to characterise them.



Figure 4 – The Moon places a crucial role in the development of life on the Earth due to its stabilising effect on the Earth's axial tilt.

References

- [1] Sartoretti, P. & Schneider, J. 1999, A&AS, 14, 550
- [2] Brown et al., ApJ, 2001, 552, 699

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- [4] <http://www.exoplanet.eu>
- [5] Laskar et al. 1993, Nature, 361, 615

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More Information

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