Exoplanets and the search for life beyond our solar system

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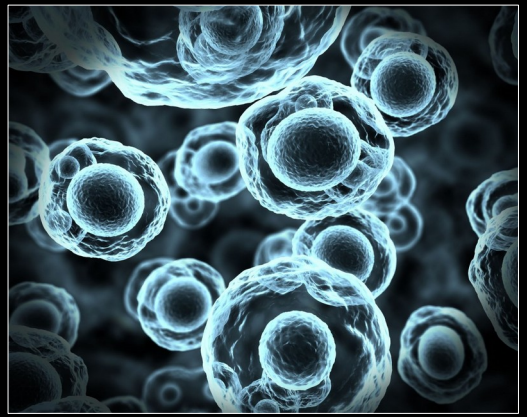
SWITCH TO SPACE 2 • 2020

Is our blue world unique?

Credit: NASA

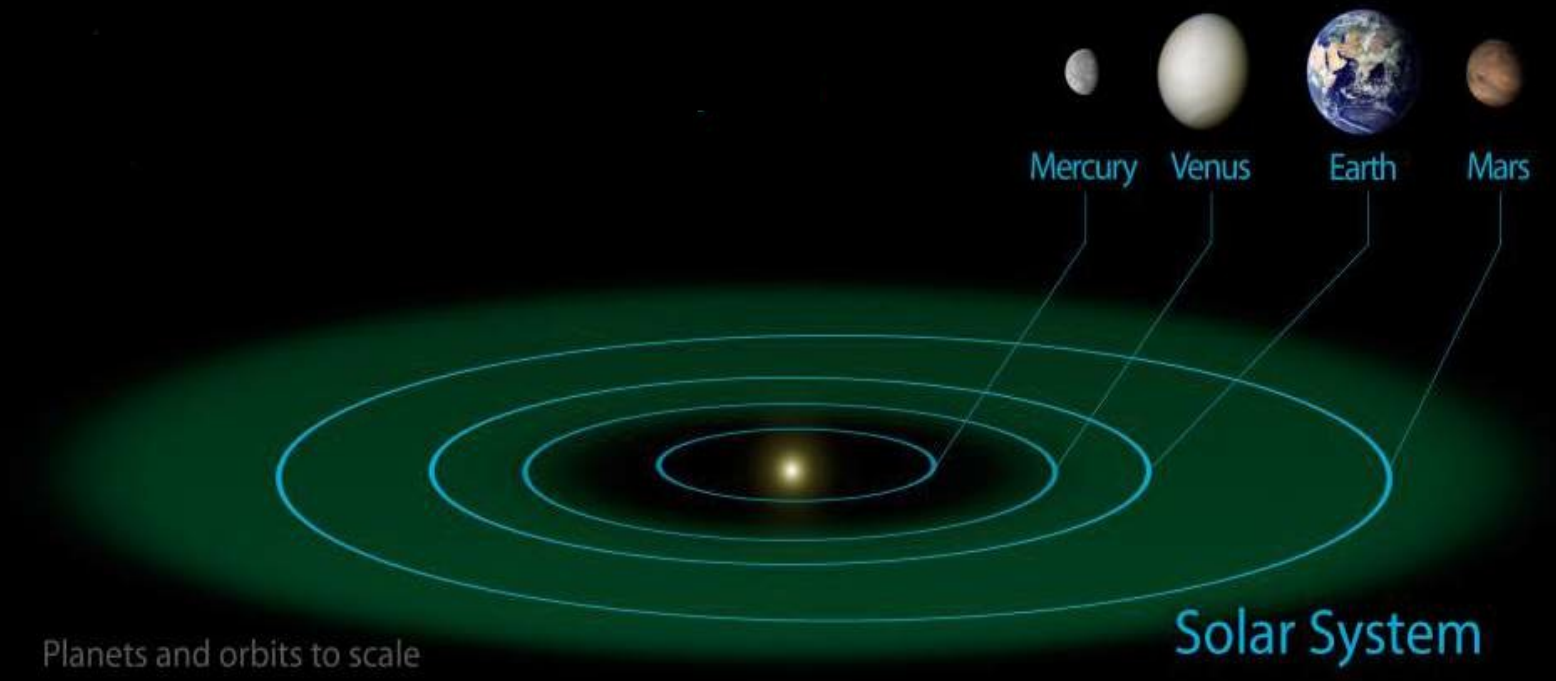
Earth: a rocky planet with liquid water on its surface



« Habitable » planet

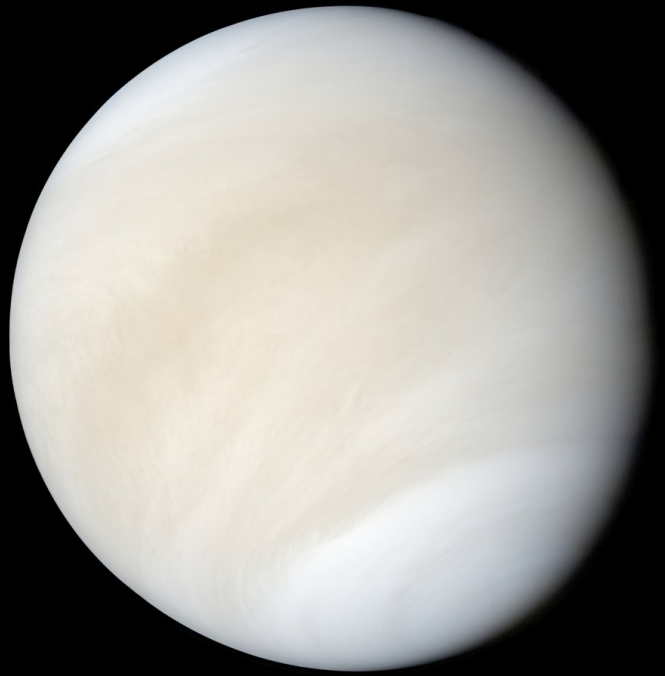
Credits: Howard Perlman, USGS

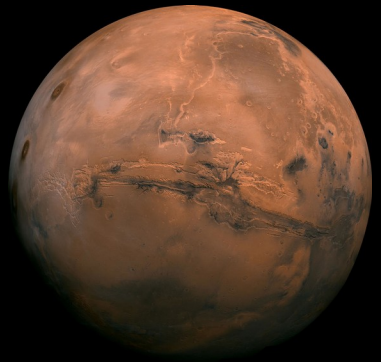
The « habitable zone » of the Sun



Credit: NASA

Venus and Mars: two versions of Hell





Credit: NASA

We must search beyond our solar system

Credit: Ryan Sullivan

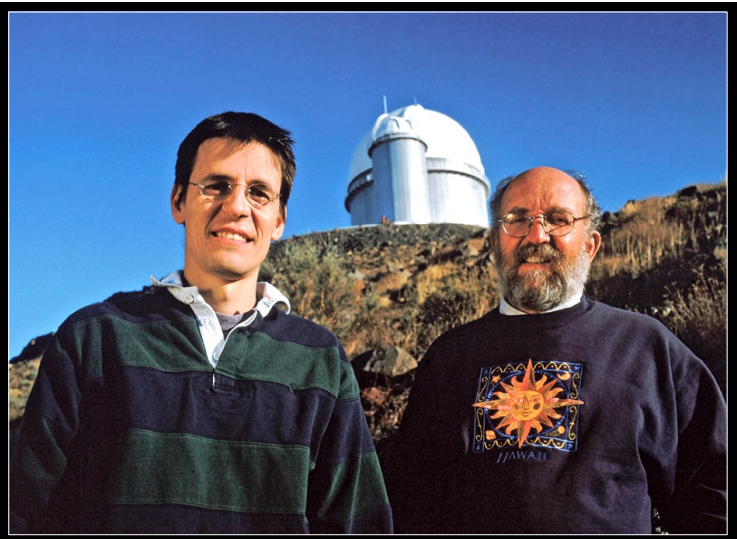
1995: beginning of the exoplanet era

A Jupiter-mass companion to a solar-type star

Michel Mayor & Didier Queloz

Geneva Observatory, 51 Chemin des Maillettes, CH-1290 Sauverny, Switzerland

The presence of a Jupiter-mass companion to the star 51 Pegasi is inferred from observations of periodic variations in the star's radial velocity. The companion lies only about eight million kilometres from the star, which would be well inside the orbit of Mercury in our Solar System. This object might be a gas-giant planet that has migrated to this location through orbital evolution, or from the radiative stripping of a brown dwarf.

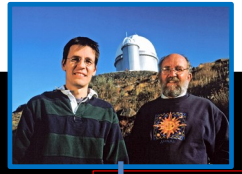


Didier Queloz Michel Mayor

Nobel Price in Physics 2019

Credits: Observatory of Geneva / Nature

The exoplanet revolution



Planets are everywhere

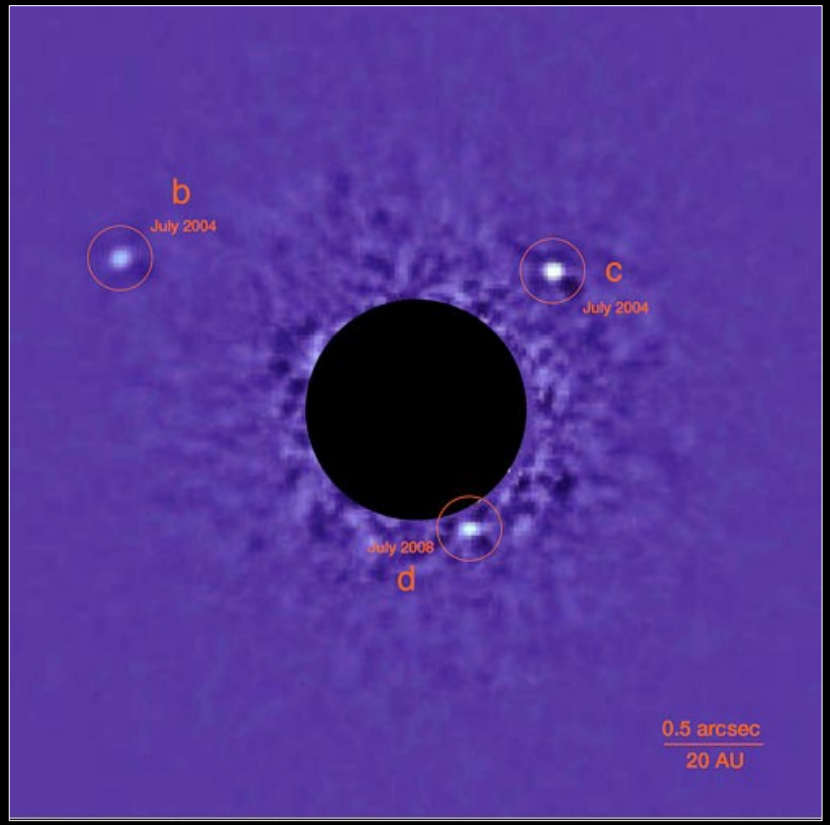
Credits: ESO/M. Kornmesser

Planetary systems are very diverse

Credits: NASA/JPL-Caltech/R. Hurt; Northwestern University; SETI Institute

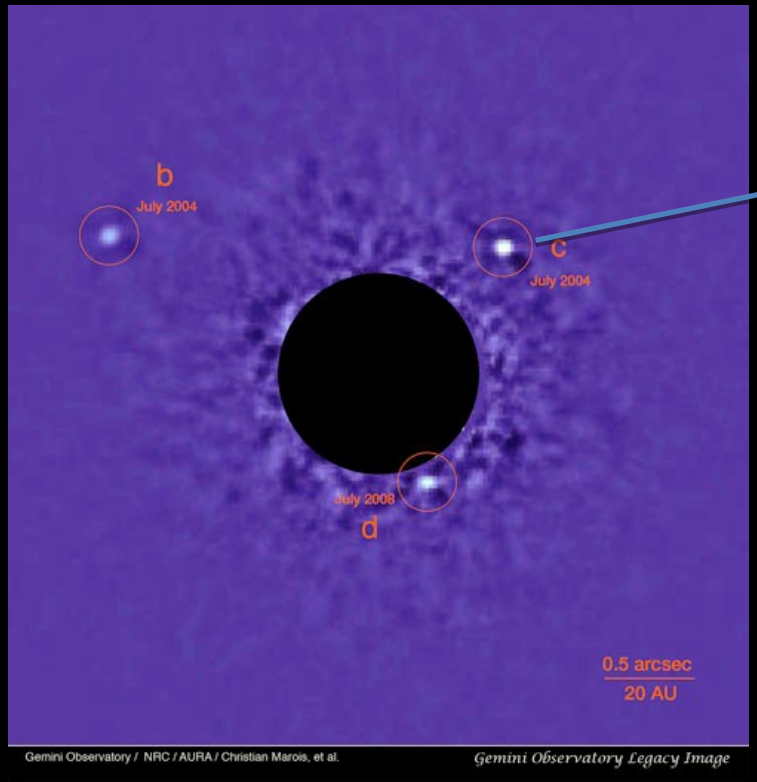
A few dozen possible biospheres

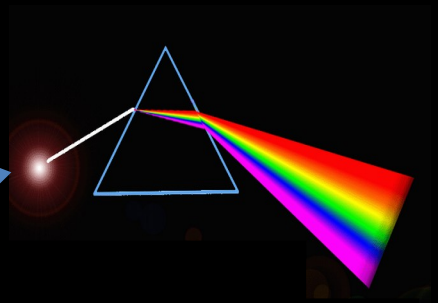
A few exoplanets have been imaged

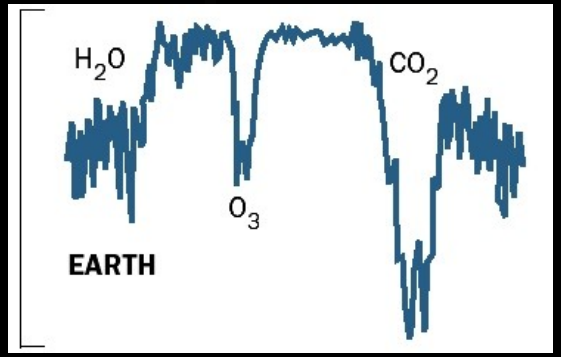


Credits: ESO / Gemini Observatory / NRC /Aura / Christian Marois et al.

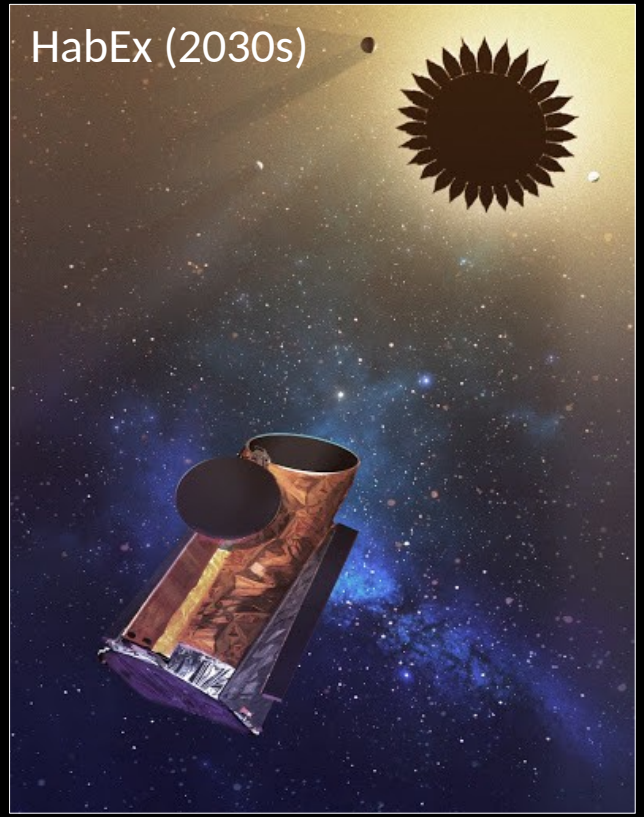
Spectroscopy of exoplanets





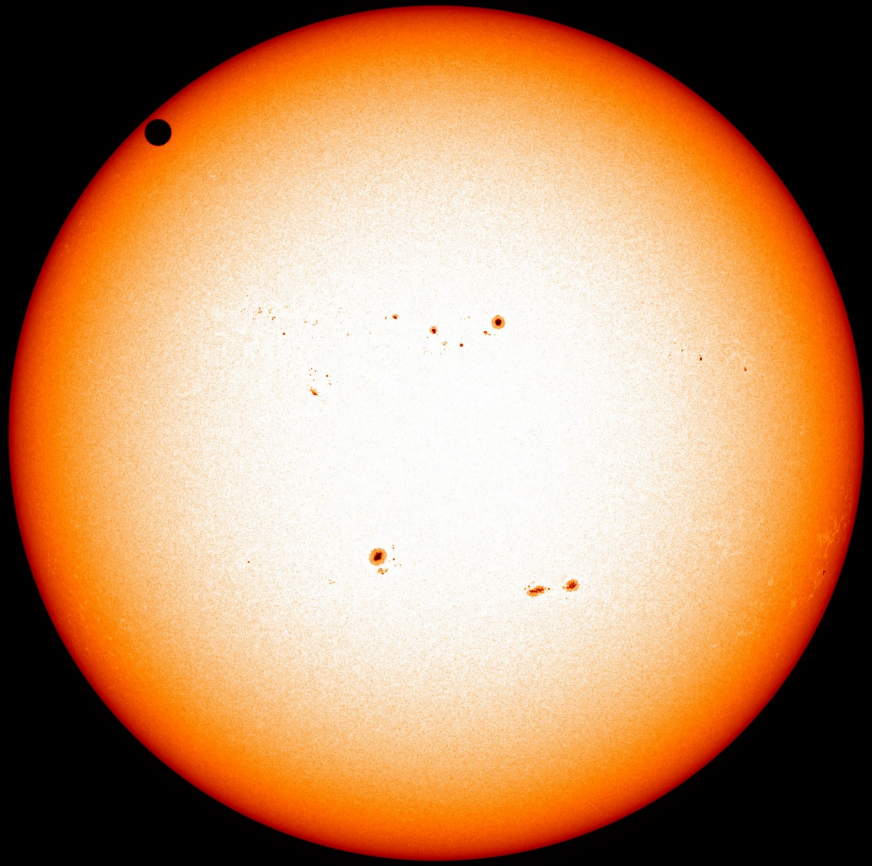


Spectroscopy of habitable exoplanets



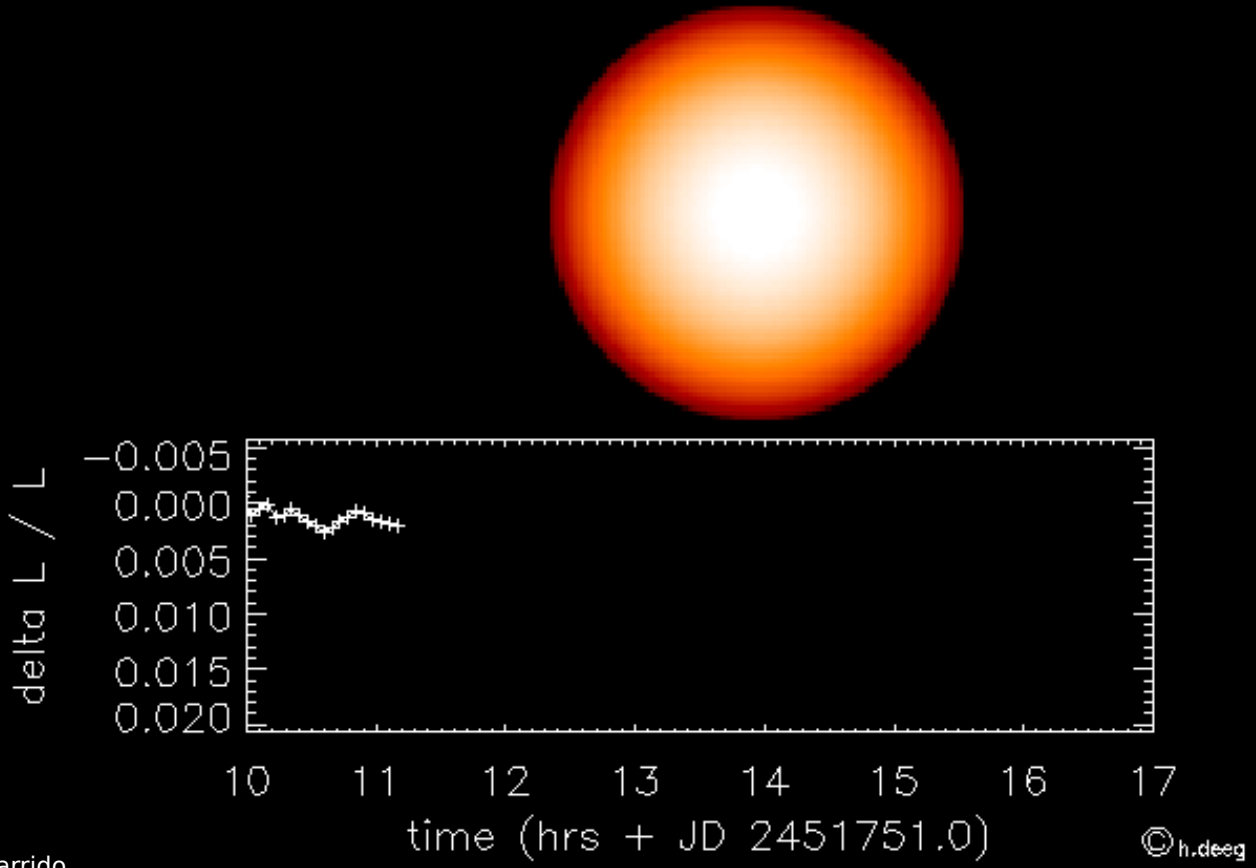
Credits: ESO / NASA

Planetary transit



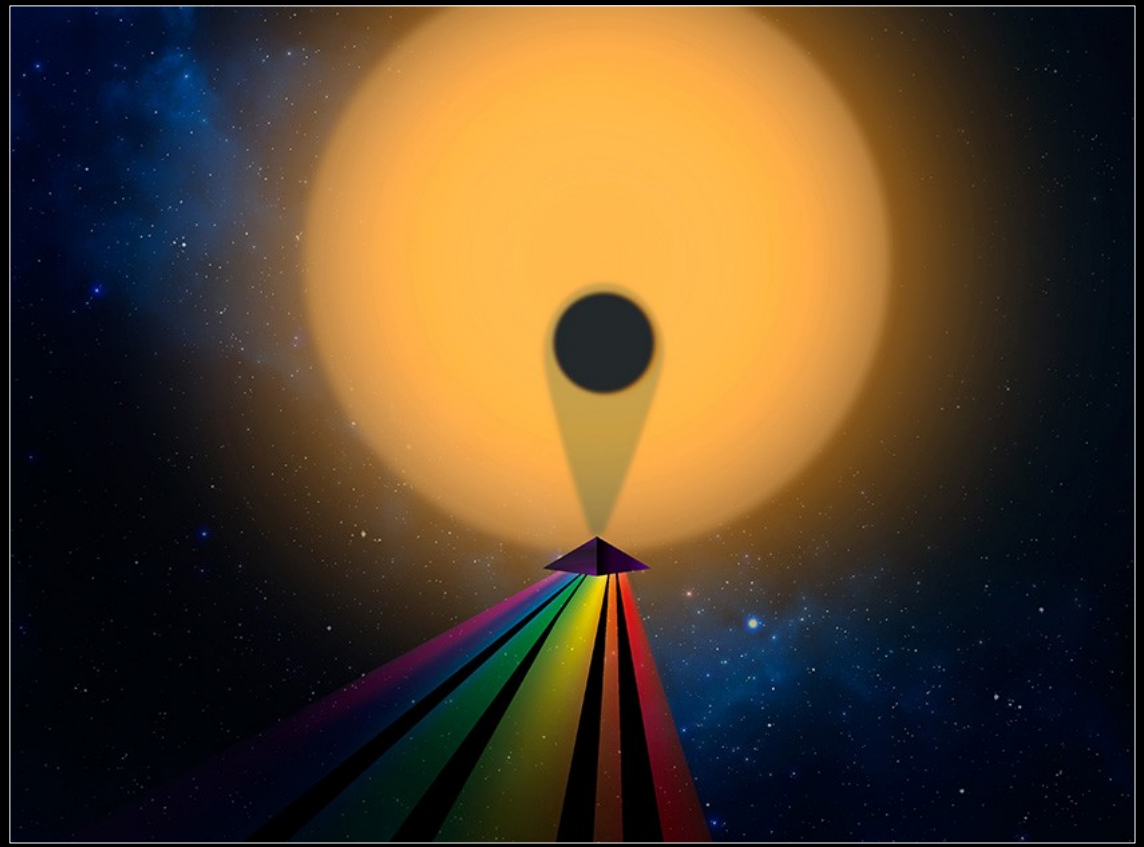
Credits: NASA / SDO

Transit of an exoplanet



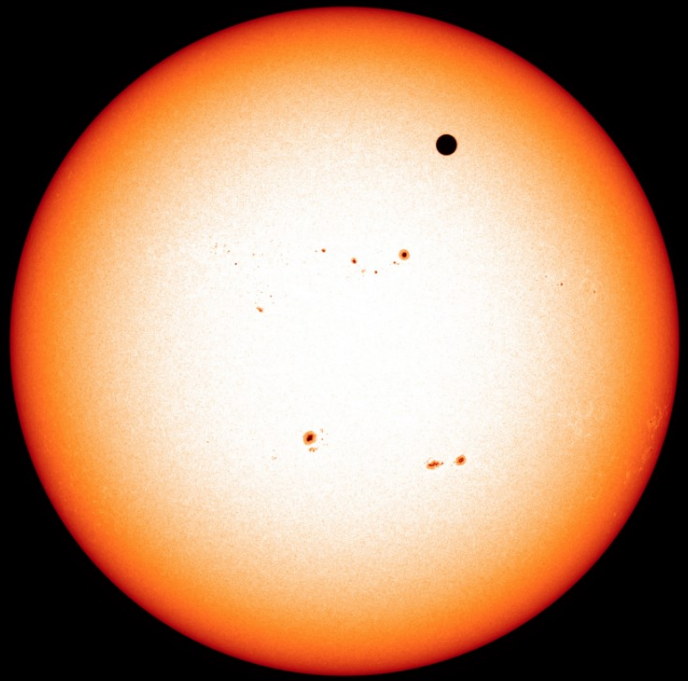
Credits: Deeg & Garrido

Atmospheric study of a transiting exoplanet



Credits: C. Daniloff/MIT, J. de Wit

The smaller the star, the better



The habitable zone of hot and cold stars

Credits: NASA

2021: the James Webb Space Telescope

Credits: NASA

Discovering the best targets for JWST

SPECULOOS

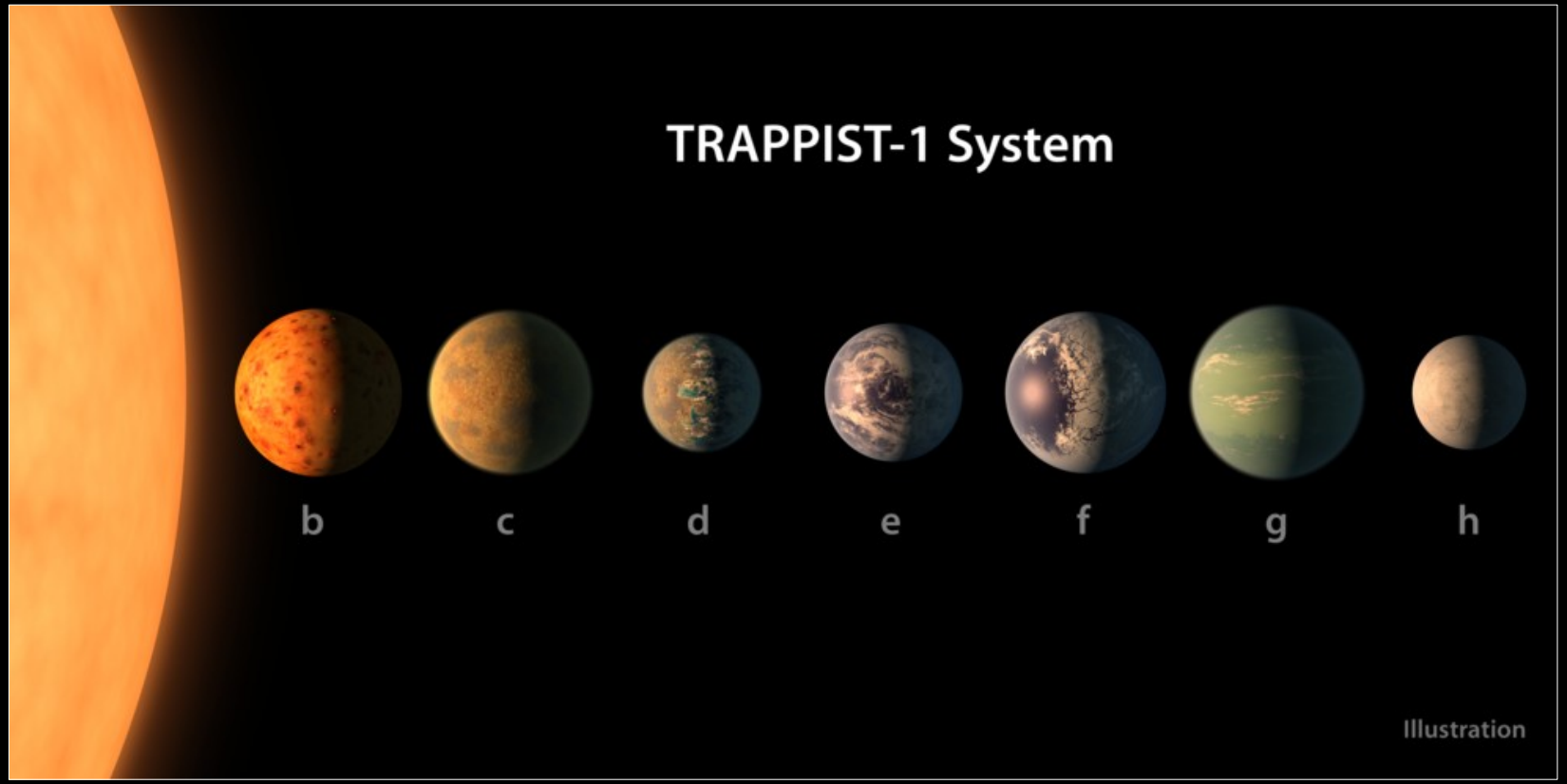
Satellite with four 10cm telescopes
High-Earth orbit
MIT (lead) + NASA
Cost: ~200M$
Start of operations: August 2018
~200,000 targets

Network of 1m robotic telescopes
Liege (lead) + Cambridge + MIT + Bern + Birmingham + IAC
Cost: ~7M€
Start of operations: Jan 2019
~1,400 targets

SPECULOOS

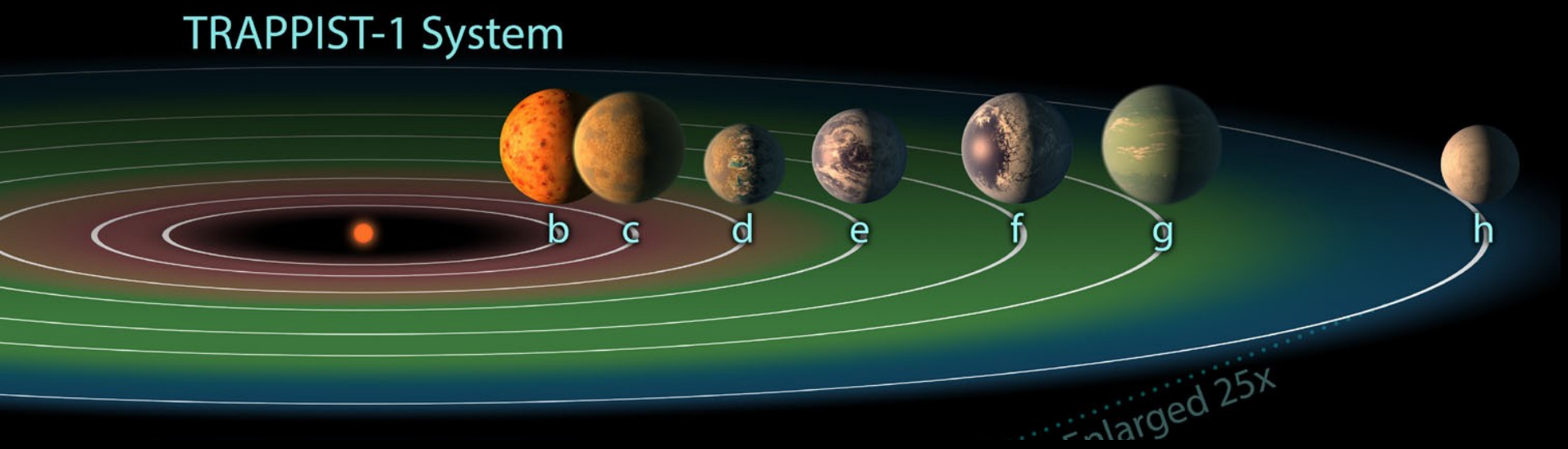
Credits: tau-tec GmbH / IAC– D. Lopez / U. Bern / UNAM / B.-O. Demory

The seven wonders of TRAPPIST-1



Credits: NASA / JPL

At least three planets in the habitable zone



Credits: R. Hurt / JPL / NASA

Life beyond our solar system: an answer could be close