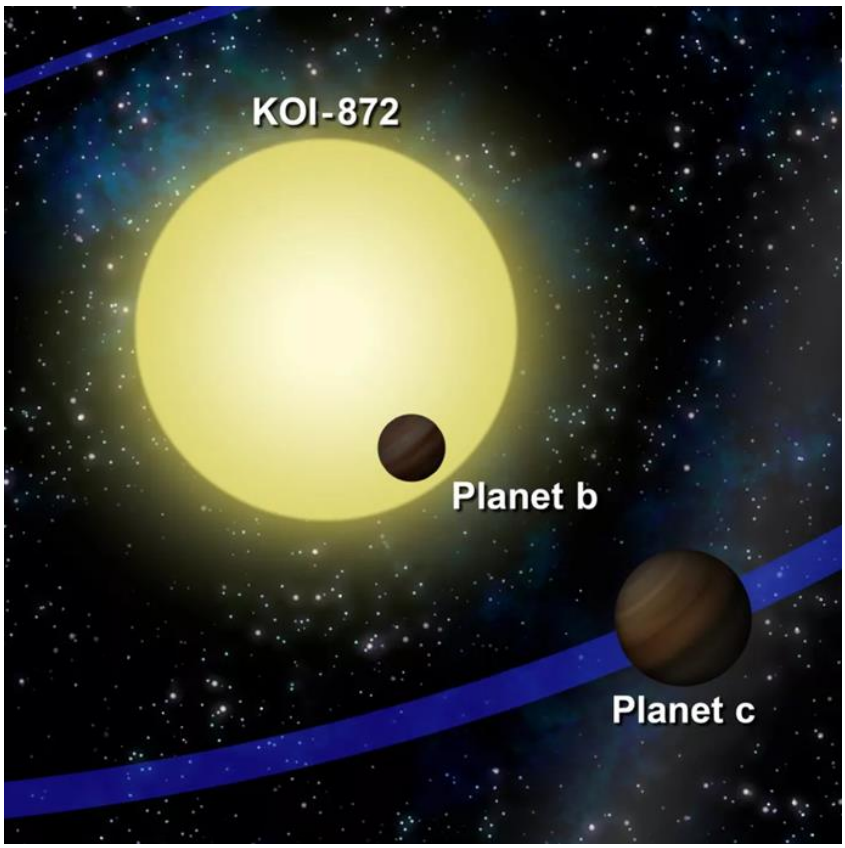
British Astronomical Association
Supporting amateur astronomers since 1890

Infinite Worlds

The e-magazine of the

Exoplanets Division
of the
Asteroids and Remote Planets Section



Artist's concept of KOI-872/Kepler-46, Credit SRI

Issue 19 2023 July

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Section officers

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Exoplanets Division website

Variations on an exoplanet theme

The Exoplanet Division is holding an all-day on-line meeting on 2023 September

Saturday 16th Sep 2023. Please see https://britastro.org/event/exoplanet-2023sep - more details will be added over the next few weeks

Probable speakers include; Rodney Buckland plus five of his OU students, Roger Dymock, Judith Korth, Don Pollacco and Siegfried Vanaverbeke

The meeting will describe the various types of variations, their causes and methods of analysis. Some examples;

Transit Timing or Depth Variations may be due to;

- a decaying or orbit

- a eccentric orbit which may also be precessing

- nodal precession

- additional planets

- presence of an exomoon

- stellar variability and starspots

Using Kepler Telescope transit data of planet “b,” scientists predicted that a second planet “c,” about the mass of Saturn, orbits the distant star KOI-872 - see image on the front page. This research, led by Southwest Research Institute and the Harvard-Smithsonian Center for Astrophysics, is providing evidence of an orderly arrangement of planets orbiting KOI-872, not unlike our own solar system.

News

Today’s score from the NASA Exoplanet Archive, Exoplanet and Candidate Statistics

Total conformed exoplanets;	5463
Kepler candidates yet to be confirmed;	2778
K2 candidates yet to be confirmed;	977
TESS candidates yet to be confirmed;	4416

NASA’s Spitzer, TESS Find Potentially Volcano-Covered Earth-Size World

Astronomers have discovered an Earth-size exoplanet, or world beyond our solar system, that may be carpeted with volcanoes. Called LP 791-18 d, the planet could undergo volcanic outbursts as often as Jupiter’s moon Io, the most volcanically active body in our solar system. They found and studied the planet using data from NASA’s TESS (Transiting Exoplanet Survey Satellite) and retired Spitzer Space Telescope, as well as a suite of ground-based observatories. A paper about the planet – led by Merrin Peterson, a graduate of the Trottier Institute for Research on Exoplanets (iREx) based at the University of Montreal – appears in the May 17 edition of the scientific journal Nature.

LP 791-18 d, shown here in an artist's concept, is an Earth-size world about 90 light-years away. The gravitational tug from a more massive planet in the system, shown as a blue disk in the background, may result in internal heating and volcanic eruptions – as much as Jupiter’s moon Io, the most geologically active body in the solar system. Astronomers discovered and studied the planet using data from NASA’s Spitzer Space Telescope and TESS (Transiting Exoplanet Survey Satellite) along with many other observatories.

Credits: NASA’s Goddard Space Flight Center/Chris Smith (KRBwyle)

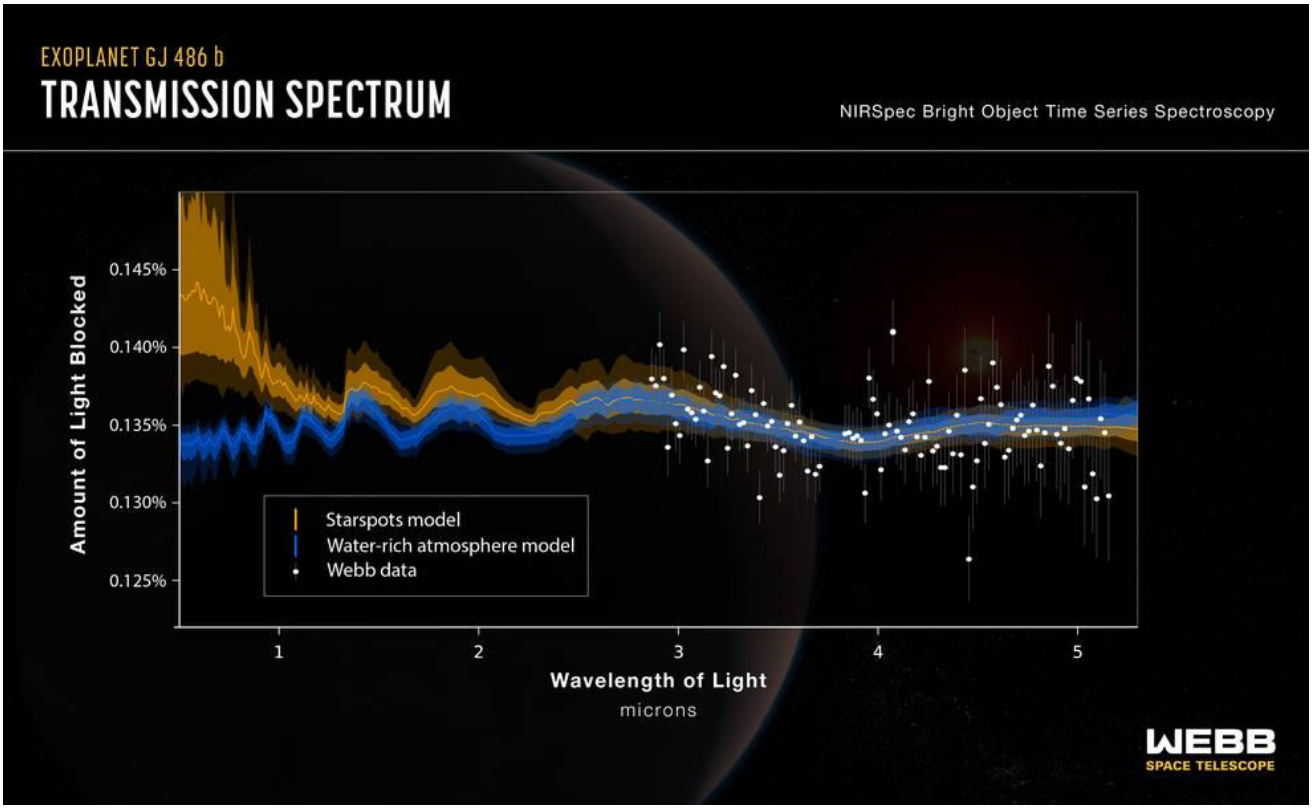
Cheops explores mysterious warm mini-Neptunes

ESA's exoplanet mission Cheops confirmed the existence of four warm exoplanets orbiting four stars in our Milky Way. These exoplanets have sizes between Earth and Neptune and orbit their stars closer than Mercury our Sun.

These so-called mini-Neptunes are unlike any planet in our Solar System and provide a 'missing link' between Earth-like and Neptune-like planets that is not yet understood. Mini-Neptunes are among the most common types of exoplanets known, and astronomers are starting to find more and more orbiting bright stars.

JWST finds Water Vapor, But from a Rocky Planet or Its Star?

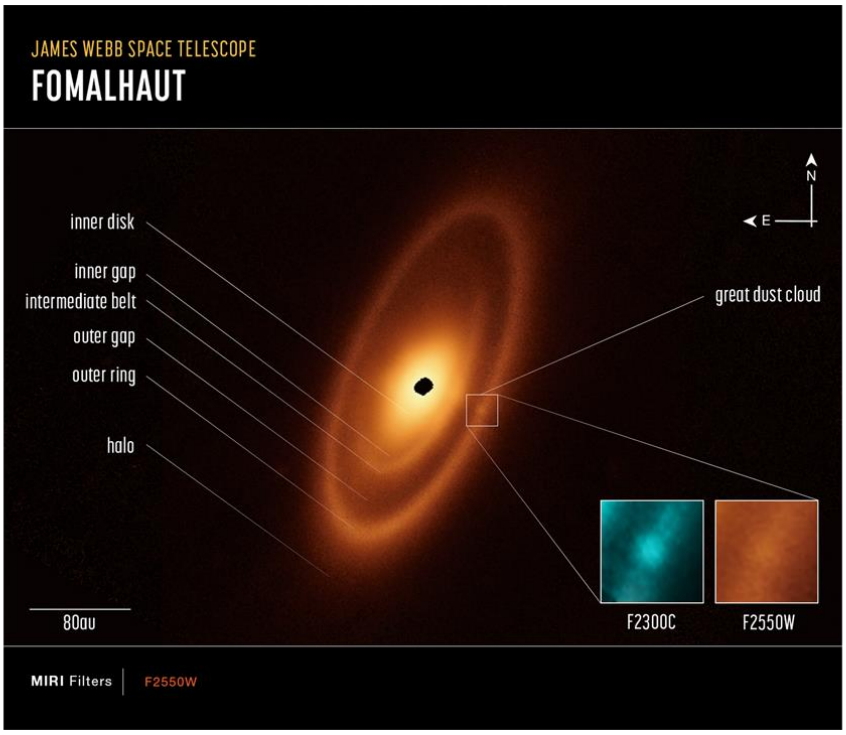
To help answer that question, astronomers used NASA's James Webb Space Telescope to study a rocky exoplanet known as GJ 486 b. It is too close to its star to be within the habitable zone, with a surface temperature of about 800 degrees Fahrenheit (430 degrees Celsius). And yet, their observations using Webb's Near-Infrared Spectrograph (NIRSpec) show hints of water vapor. If the water vapor is associated with the planet, that would indicate that it has an atmosphere despite its scorching temperature and close proximity to its star. Water vapor has been seen on gaseous exoplanets before, but to date no atmosphere has been definitely detected around a rocky exoplanet. However, the team cautions that the water vapor could be on the star itself – specifically, in cool starspots – and not from the planet at all.



This graphic shows the transmission spectrum obtained by Webb observations of rocky exoplanet GJ 486 b. The science team's analysis shows hints of water vapor; however, computer models show that the signal could be from a water-rich planetary atmosphere (indicated by the blue line) or from starspots from the red dwarf host star (indicated by the yellow line). The two models diverge noticeably at shorter infrared wavelengths, indicating that additional observations with other Webb instruments will be needed to constrain the source of the water signal.

Credits: NASA, ESA, CSA, Joseph Olmsted (STScI)

JWST Looks for Fomalhaut's Asteroid Belt and Finds Much More



This image of the dusty debris disk surrounding the young star Fomalhaut is from Webb's Mid-Infrared Instrument (MIRI). It reveals three nested belts extending out to 14 billion miles (23 billion kilometers) from the star. The inner belts – which had never been seen before – were revealed by Webb for the first time. Labels at left indicate the individual features. At right, a great dust cloud is highlighted and pullouts show it in two infrared wavelengths: 23 and 25.5 microns.
Credits: NASA, ESA, CSA, A. Gáspár (University of Arizona). Image processing: A. Pagan (STScI)

Conferences/Meetings/Seminars/Webinars/Videos

The Interstellar Research Group (IRG) 8th Interstellar Symposium

IRG's 8th Interstellar Symposium, in collaboration with the International Academy of Astronautics and Breakthrough Initiatives, will take place July 10 – 13, 2023 (with pre-symposium seminars taking place) in Montreal, QC, Canada at McGill University. This symposium will feature many of the leading voices in space exploration, culture, and more.

European Astronomical Society Annual Meeting, 202 July 10-14, Krakow, Poland. Special Session SS12, Planets not orbiting main sequence stars

Extrasolar planetary science does not end when host stars leave the main sequence! Studies of planetary systems found within off-main sequence stellar environments represent an under-explored yet essential area of research within exoplanet science, which provides chemical and dynamical information not attainable in main-sequence planetary systems.

Special Session SS6 10 July 2023, Formation of planetary systems: connecting theory and observations

The new observations of young stars with their surrounding disks and the raising number of known exoplanets bring new constraints on the planet formation process. Thus, in recent years the planet formation theory is undergoing major changes. The goal of this special session is to facilitate discussion between observers and theorists working on planet formation.

Towards Other Earths III: The Planet-Star connection, 17-21 July 2023, Porto, Portugal

Planetary systems result from the synergy between the stars and the planets they host. It can be convenient, at first, to consider them in isolation, but the links between them affect all aspects of exoplanetary sciences. Stars can be a hurdle to exoplanetary sciences. The precision and accuracy of our knowledge of stellar parameters is often a major driver for the precision and accuracy of the respective planetary parameters. Stellar activity and its impact on planet detection and characterisation is one of the significant challenges for the next decade. But stars can also be facilitators to exoplanetary sciences. The correlation between stellar metallicity and the frequency of giant planets is well established and the link between stellar and planetary composition is an active topic. In the next few years we also have a lot to learn from the dynamical interactions between stars and planets.

2023 July 24-28 Sagan Summer Hybrid Workshop

Characterising Exoplanet Atmospheres: The Next Twenty Years

Observations of an exoplanet’s atmosphere provide the best hope for distinguishing the makeup of its outer layers, and the only hope for understanding the interplay between formation, natal composition, chemical and disequilibrium processes, and dynamics & circulation. The field is entering a revolution in our understanding of exoplanet atmospheres thanks to measurements from the ground, from space, and

particularly from the new JWST – the superlative facility for exoplanet studies. In the longer term, such observations will also be essential for seeking signs of biosignature gasses in nearby exoplanets using future, next-generation observatories.

This year's workshop will cover theoretical modelling, interpretation, and observations of exoplanets using a variety of telescopes, techniques, and hands-on exercises, presented by leading experts in the field.

Astrobiology and the search for life elsewhere

JWST makes first detection of crucial carbon molecule in a planet-forming disc

An international team of scientists have used data collected by the NASA/ESA/CSA James Webb Space Telescope to detect a molecule known as the methyl cation (CH_3^+) for the first time, located in the protoplanetary disc surrounding a young star. The vital role of CH_3^+ in interstellar carbon chemistry was predicted in the 1970s, but JWST's unique capabilities have finally made observing it possible — in a region of space where planets capable of accommodating life could eventually form.

NASA Cassini Data Reveals Building Block for Life in Enceladus' Ocean

Using data collected by NASA's Cassini mission, an international team of scientists has discovered phosphorus – an essential chemical element for life – locked inside salt-rich ice grains ejected into space from Enceladus.

How did Earth get its oxygen?

Our planet is covered in liquid water and harbours an oxygen-rich atmosphere that has allowed a multitude of plants and animals to evolve — including us. It wasn't always that way. If you could travel back in time to early Earth, your lungs would choke on an atmosphere devoid of oxygen. The gas that humans need to survive didn't appear in significant quantities until roughly halfway through our planet's current lifespan

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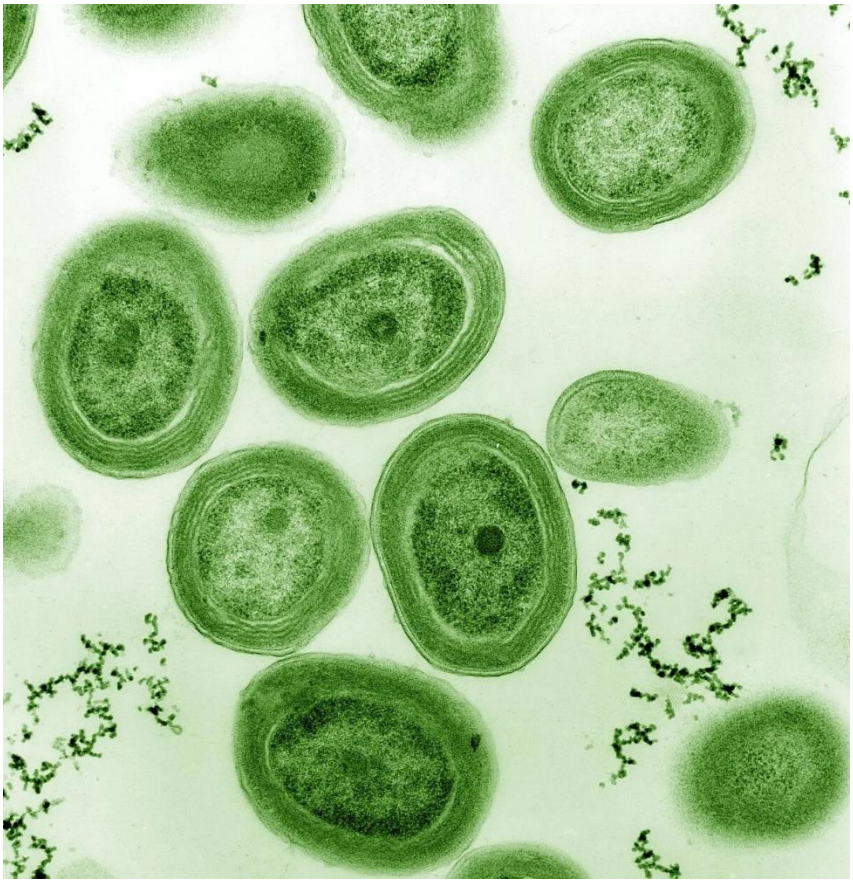


CYANOBACTERIA UNDER THE MICROSCOPE Cyanobacteria are responsible for the production of Earth's early oxygen. This type of cyanobacteria, Prochlorococcus, produces 20% of the oxygen in our biosphere. Credit MIT

UCLA SETI

The mission of UCLA SETI is to find evidence of other civilizations in the universe and extract information encoded in extraterrestrial signals.

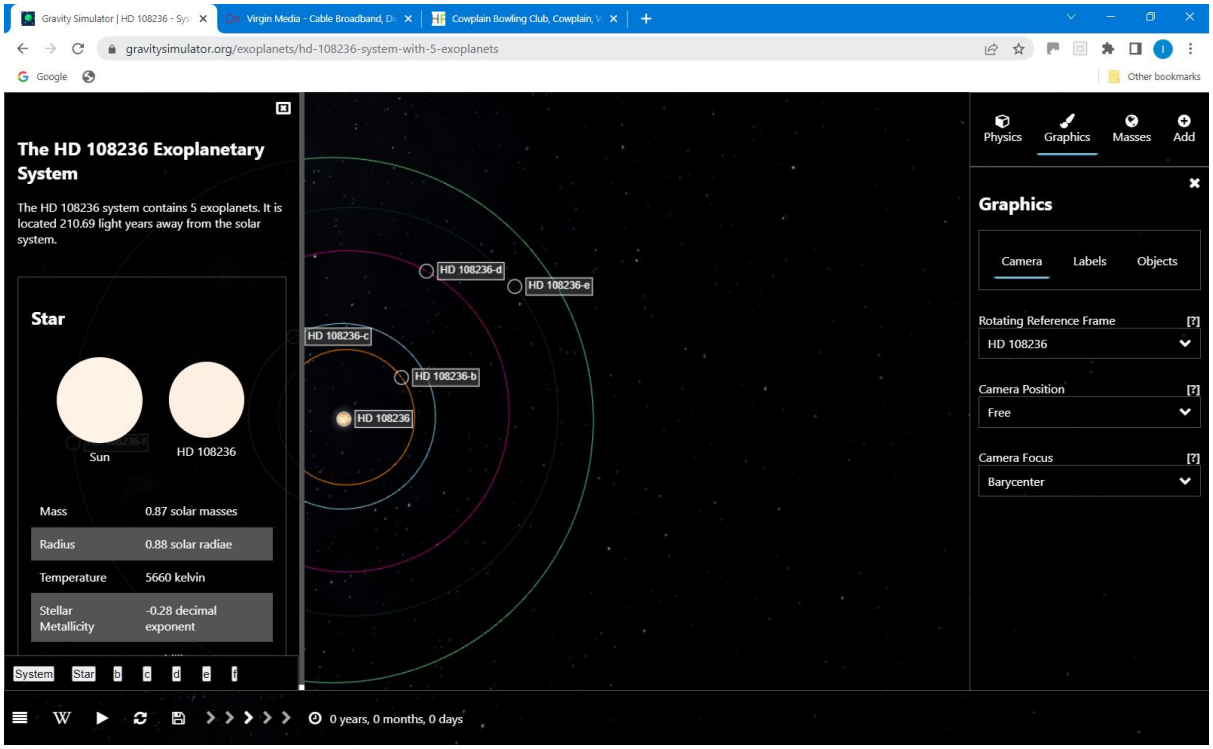
Zooniverse project 'Are we alone in the universe'

UCLA SETI uses the largest fully steerable telescope on Earth to search for evidence of civilizations in the Galaxy. They observe stars and their planetary systems at radio frequencies with the goal of detecting signals emitted by radio beacons or other powerful radio emitters. So far, they have observed 42,000 stars and detected over 64 million radio signals. You can help them identify the most promising signals in them data.

Web sites of interest

Gravity Simulator

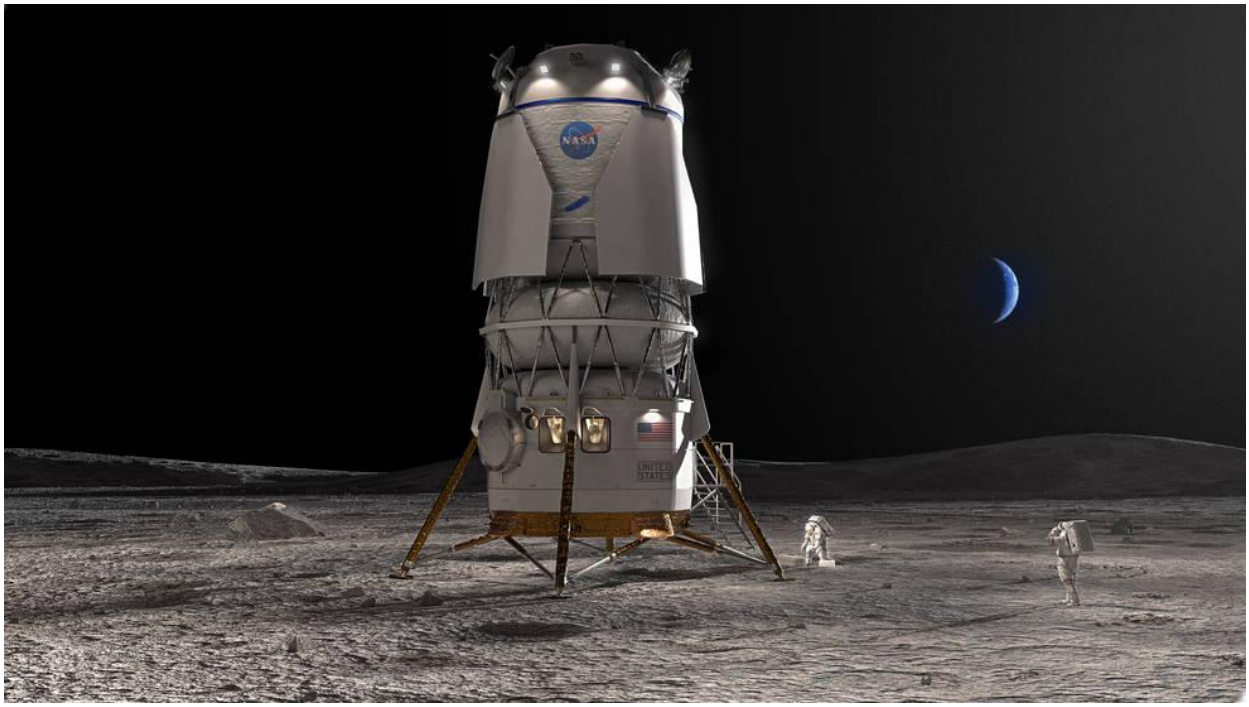
Simulations of a multiplicity of objects and systems including exoplanets Example screen shot below – looks very interesting.



Space – stepping stones to other star systems

The Moon

NASA has chosen Blue Origin as the second lunar lander provider for the Artemis program



Artist's concept of the Blue Moon lander. Credits: Blue Origin

To develop a human landing system for the agency's Artemis V mission to the Moon, NASA has selected Blue Origin of Kent, Washington. Through Artemis, NASA will explore more of the Moon than ever before, uncovering more scientific discoveries, and preparing for future astronaut missions to Mars. Blue Origin will design, develop, test, and verify its Blue Moon lander to meet NASA's human landing system requirements for recurring astronaut expeditions to the lunar surface, including docking with Gateway, a space station where crew transfer in lunar orbit. In addition to design and development work.

Mars

The 'Humans to Mars 2023 Summit' took place in Washington, D.C., earlier this year. Recordings of all the sessions are available here

A deep underground lab could hold key to habitability on Mars

Researchers at the University of Birmingham have launched the Bio-SPHERE project in a unique research facility located 1.1 km below the surface, in one of the deepest mine sites in the UK. The project investigates how scientific and medical operations would take place in the challenging environments of the Moon and Mars.

Other Martian simulations

Mars 500 , ESA undertook a cooperative project with the Russian Institute for Biomedical Problems (IBMP) in Moscow, called Mars500.

Crew Health and Performance Exploration Analogue (CHAPEA)

CHAPEA's Mars Dune Alpha is a unique 3D printed habitat designed to serve as an analog for one-year missions to the Martian surface.

Mars Desert Research Station

The Mars Desert Research Station (MDRS), owned and operated by the Mars Society, is a space analog facility in Utah that supports Earth-based research in pursuit of the technology, operations, and science required for human space exploration.

I do recommend **'The Martian'** a novel by Andy Weir

Roger Dymock
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