British Astronomical Association
Supporting amateur astronomers since 1890

Infinite Worlds

Artists impression of TrES-1b Credit Exokyoto

The e-magazine of the Exoplanets Division Of the Asteroids and Remote Planets Section

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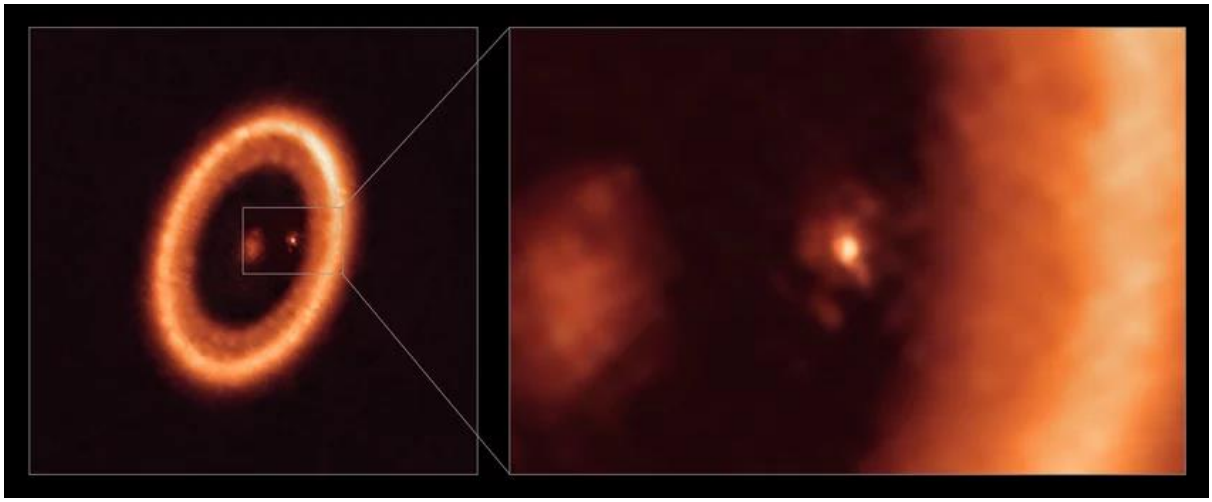
Recent discoveries

Exomoons

An international group of researchers, including astronomers from the Max Planck Institute for Astronomy (MPIA) in Heidelberg, have for the first time unambiguously detected a disk of dust around a planet outside our solar system. The observations from the Atacama Large Millimetre/Submillimetre Array (ALMA), in which the European Southern Observatory (ESO) is a partner, will provide new insights into how moons and planets form in young planetary systems.



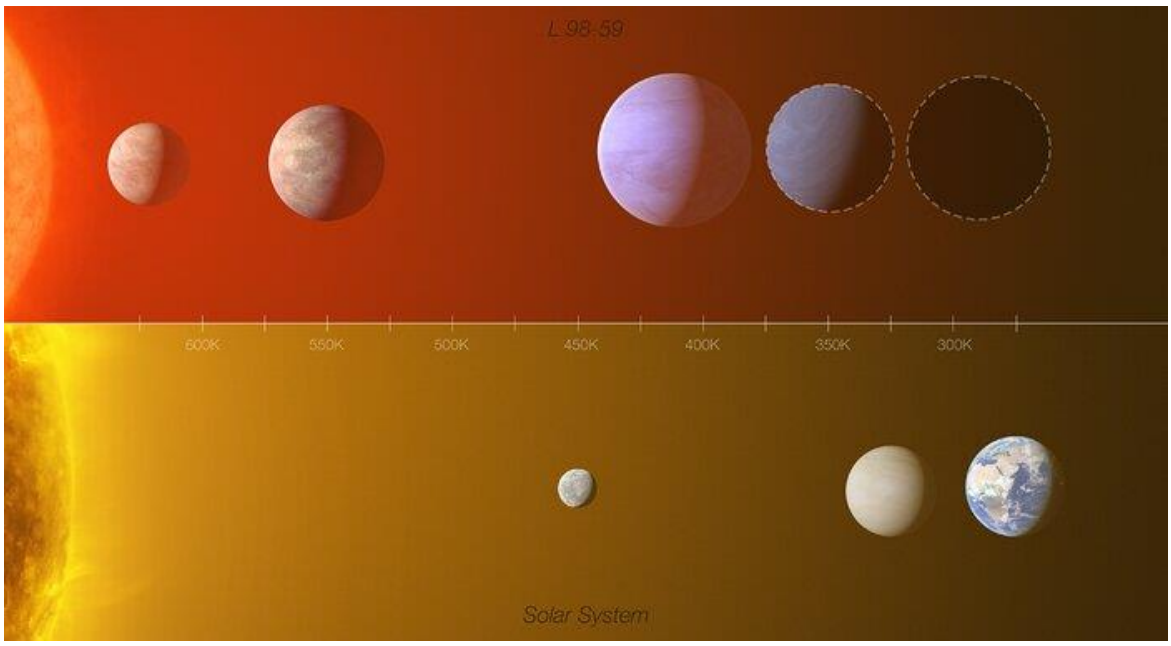
The above image, taken with the Atacama Large Millimeter/submillimeter Array (ALMA), shows wide (left) and close-up (right). Bild: ALMA (ESO/NAOJ/NRAO)/Benisty et al.

Hycean planets

A new class of exoplanet very different to our own, but which could support life, has been identified by astronomers, which could greatly accelerate the search for life outside our Solar System. In the search for life elsewhere, astronomers have mostly looked for planets of a similar size, mass, temperature and atmospheric composition to Earth. However, astronomers from the Institute of Astronomy, University of Cambridge believe there are more promising possibilities out there. The researchers have identified a new class of habitable planets, dubbed 'Hycean' planets – ocean-covered planets with hydrogen-rich atmospheres – which are more numerous and observable than Earth-like planets. The researchers say the results, reported in The Astrophysical Journal, could mean that finding biosignatures of life outside our Solar System within the next few years is a real possibility.

Rocky exoplanet smaller than Venus

A team of astronomers have used the European Southern Observatory's Very Large Telescope (ESO's VLT) in Chile to shed new light on planets around a nearby star, L 98-59, that resemble those in the inner Solar System. Amongst the findings are a planet with half the mass of Venus — the lightest exoplanet ever to be measured using the radial velocity technique — an ocean world, and a possible planet in the habitable zone.



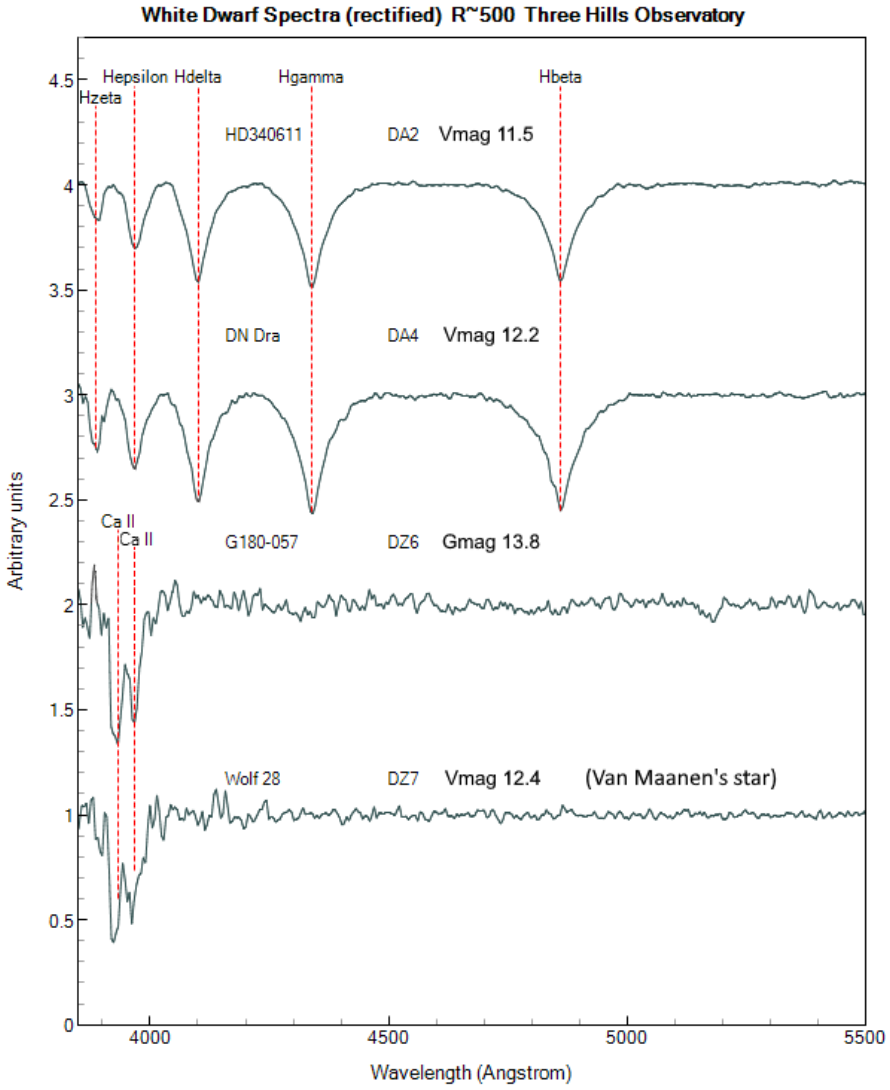
This shows a comparison between the L 98-59 exoplanet system (top) with part of the inner image Solar System (Mercury, Venus and Earth), highlighting the similarities between the two.

Planet eating White Dwarf Spectra – Robin Leadbeater (from the BAA Forum)

Intrigued by the stars featured in Dr Amy Bonser's BAA webinar " Planet Eating White Dwarfs " I thought I would try hunting some down and look for the evidence in the spectra.

Because of their small size, White Dwarfs are not very luminous so even those nearby tend to be rather faint. The brightest also tend to be the hottest and show just Hydrogen Balmer lines, designated DA in the spectral classification scheme, while the number indicates temperature. Some cooler ones though show metal lines (designated DZ) and although fainter, a few are accessible to amateurs equipped with spectrographs. I chose two examples showing just Hydrogen (Note how the lines are highly pressure broadened due to the extreme surface gravity) and two cooler ones showing clear Ca II H/K lines in the violet. The spectra were recorded between 2021-07-15 and 2021-08-23

The detection of metals such as Calcium in the photosphere of some white dwarfs is surprising as these heavy elements should have long ago sunk into the stars' interior under the intense gravity. Their presence in the spectra is therefore considered to be evidence that the star has recently accreted material from its planetary system and the relative abundance of the elements gives a clue to the composition of the planets consumed. Perhaps the same fate awaits us, the only trace of our existence just a few lines in the spectrum of the white dwarf remnant that was once our Sun…



White Dwarf Spectra Credit Robin Leadbeater

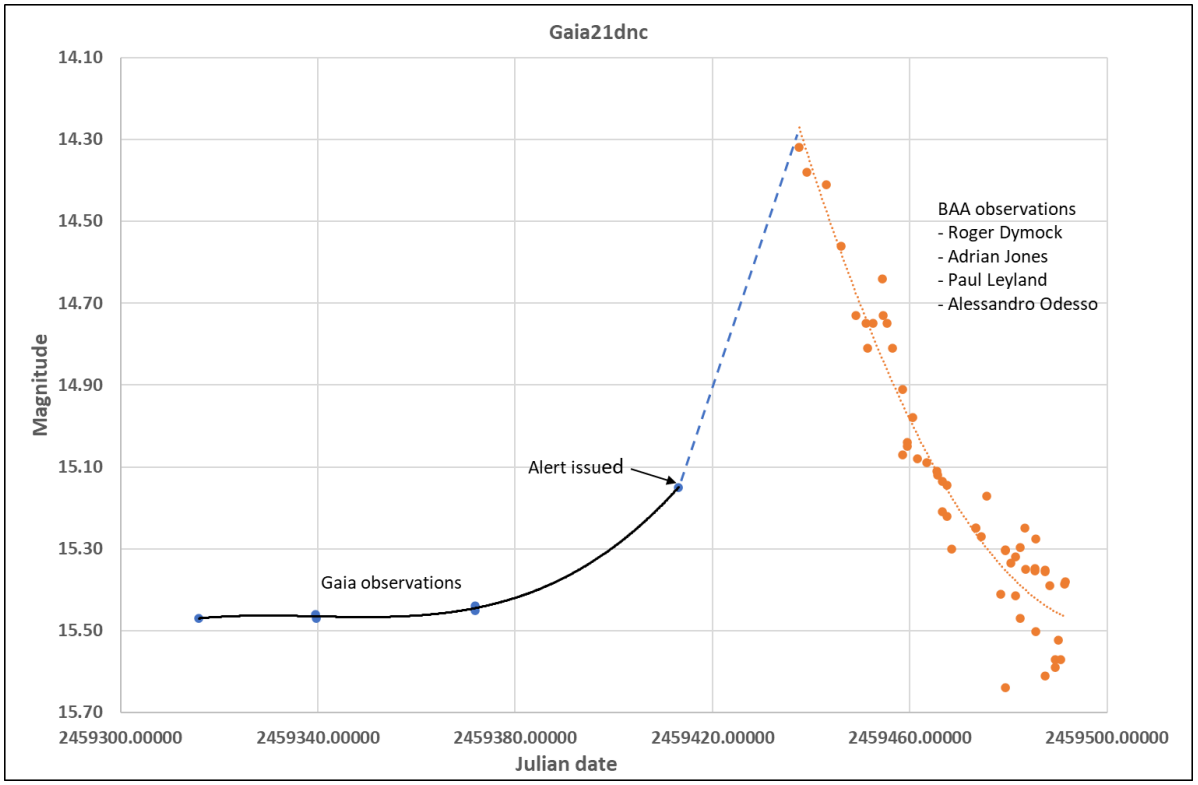
Microlensing search for exoplanets

Microlensing events detected by the Kepler Space Telescope

Short-duration candidate microlensing events from the Kepler K2 mission may be rogue or orphan planets. From late April to early July 2016, Campaign 9 of K2 obtained high temporal cadence observations over a 3.7 deg2 region of the Galactic bulge. Its primary objectives were to look for evidence of a free-floating planet (FFP) population using microlensing, and demonstrate the feasibility of space-based planetary microlensing surveys. Paper here

Exoplanet Division project
The chart below shows the initial Gaia observations, the time an alert was issued and subsequent observations by BAA members. The scatter at the bottom of the curve can be partially explained by the presence of a bright Moon. Some scatter is also due to observations being made through different filters i.e., R, Rc and r'.

An ARPS workshop to be held next year will discuss how to merge such observations and also include a tutorial on the Aperture Photometry Tool.



Microlensing light curve of Gaia21dnc

Conferences/Meetings/Seminars/Webinars/Videos

British Interplanetary Society. Modern Space Elevator: Ready to Initiate Development. 2021 October 21

Gaia Science Alerts Workshop. 2021 November 8-12. Note that the date is incorrect on this webpage.

Video – Planet Hunters: Billions of Habitable Planets in the Universe Thanks to Steve Knight (Hampshire Astronomical Group) for this link. Points of interest raised during the video;
- book 'Strange New Worlds; The Search for Alien Planets and Life beyond Our Solar System' by Ray Jayawardhana. Published in 2013 so a little dated but reviews are very positive.

- Microvariability and Oscillations of Stars (MOST) space telescope. Canada's first space telescope, launched in 2003 that studied physical processes in stars and properties of extrasolar planets. MOST was a small spacecraft that weighed about 60 kg (130 pounds) and

carried a telescope 15 cm (6 inches) in diameter. It discovered that the planet orbiting HD 209458 has a very low albedo. The mission ended in 2019.

- Keck Planet Finder (KPF) is a next-generation optical spectrometer in design for the W. M. Keck Observatory in Hawaii. KPF will discover and characterize extrasolar planets using the radial velocity (RV) or Doppler spectroscopy technique, with a single measurement precision of <50 cm/s, and a goal of 30 cm/s. Drawing on two decades of experience and technical innovation in the field, KPF will be a powerful tool both for the discovery and follow-up of planets, and for unprecedented insight into stellar behaviours.

Keck Planet Finder Credit Howard Group

- MEarth project is an astronomical survey that is using robotic telescopes to observe nearby M dwarf stars in search of new Earth-like exoplanets.

- ExoplanetSat is a cooperative nanosatellite technology demonstration mission (a 3U CubeSat) of MIT (Massachusetts Institute of Technology) and Draper Laboratory, both of Cambridge, MA, USA. The overall objective is to test the ability to use nanosatellites to search for unmapped planets - and to complement existing planet-hunters like NASA's Kepler space telescope.

- Virtual Planetary Laboratory. The Virtual Planetary Laboratory's research is driven by a single scientific question: "How would we determine if an extrasolar planet were able to support life or had life on it already?" To answer this, the VPL develops and combines scientific models from many disciplines to constrain habitability for newly discovered worlds, like those found by NASA's Kepler mission.

Is there anyone out there?

Galileo project launch

The oddly shaped object that came whizzing past the Sun and Earth in 2017 on a trajectory from outside our Solar System prompted wild speculation. Most scientists think the cigar-shaped visitor, less than 1 kilometre long, was a comet or asteroid from a nearby star or some other cosmic flotsam. But theoretical astrophysicist Avi Loeb of Harvard University argued that 'Oumuamua, Hawaiian for "scout," was an alien creation—a light sail, antenna, or even a spaceship. Today he announced a plan to look for more such objects: a philanthropy-backed effort called the Galileo Project.

Others wonder what the Galileo Project will add to ongoing searches for interstellar objects. Alan Fitzsimmons of Queen's University Belfast, co-leader of the 'Oumuamua investigation team organized by the International Space Science Institute, notes that existing alert networks already scour telescope data on an hourly basis in search of incoming interstellar objects. Fitzsimmons adds that the European Space Agency is working on a Comet Interceptor mission to launch in 2028 that will sit in orbit waiting for a suitable target, be it a comet or an interstellar object, before rushing out to meet it. "The community can't wait for the discoveries of the Vera Rubin Observatory," he says.

Publications

'Extraterrestrial – the first sign of intelligent life beyond Earth' by Avi Loeb and published by Mariner Books.

Exoplanet News Issue 147 is available at http://nccr-planets.ch/wp-content/uploads/epn_archive/EPNews147.pdf

Astrobiology

Did penguins colonise Venus? (You cannot be serious as someone once said!!!)

The James Webb space telescope will launch this December, Nasa announced this week, packed with instruments which could detect life on other planets for the first time.

However, British scientists believe that alien lifeforms may already have been detected – and in 2020, astronomers including experts from Imperial College London and Cardiff University discovered traces of phosphine in the clouds of Venus, a chemical that is made by microbes which thrive in oxygen-free environments.

One of the places it is also found is the guano of gentoo penguins, and astronomers are now keen to study the birds to find out if a similar bacterium is living on our planetary neighbour.

Although the finding was disputed by some scientists, Imperial researchers have carried out further studies that back up the original findings, and have worked with chemists and atmospheric physicists to show the chemical could not be produced by other means on Venus. Studying penguins could help to identify the kinds of organisms that exist on other worlds.

How planets may be seeded with the chemicals necessary for life

Dr John Ilee, Research Fellow at the University of Leeds who led the study, says the findings suggest that the basic chemical conditions that resulted in life on Earth could exist more widely across the Galaxy. The large organic molecules were identified in protoplanetary disks circling newly formed stars. A similar disk would have once surrounded the young Sun, forming the planets that now make up our Solar System. The presence of the molecules is significant because they are "stepping-stones" between simpler carbon-based molecules such as carbon monoxide, found in abundance in space, and more complex molecules that are required to create and sustain life.

Dr Walsh explained that ALMA has allowed us to measure the distribution and composition of material that is actively building planets around nearby young stars for the first time. The telescope is powerful enough to do this even for large complex molecules that are the precursors for life."

Space missions

ARIEL and the ExoClock project

The recordings of the 1st ExoClock Annual mtg held on 2021 Sep 25/26 can be found here In order to access them, viewers have to login or register (for free) at ExoClock if not already members.

ExoClock observing campaign

The ExoClock project is starting a new campaign on a quite well-known planet that many have already observed - TrES-1 b!

Why this planet?

Existing data shows the orbit of TrES-1b seems to be decaying: the time taken to circle its star once is getting shorter by around 11 milliseconds per year. This is an exciting discovery as, although many short period planets are expected to be decaying, evidence for this has only been found for a couple of systems (e.g., WASP-12 b).

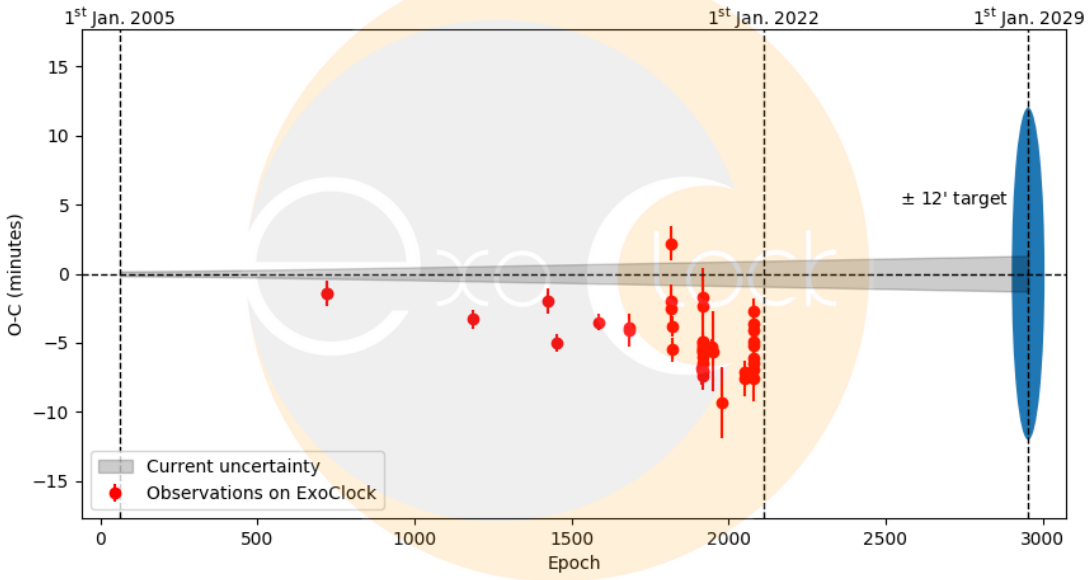
At this rate of change the target will be outside ARIEL's requirement (ellipse on right of diagram) necessitating an ephemerides update and demonstrating the worth of this project to the mission.

Given that TrES-1 b is currently observable, the ExoClock team would like to kindly ask observers to observe a transit of this planet, if possible, over the coming weeks! The more data obtained, the more precisely the decay rate can be restrained.

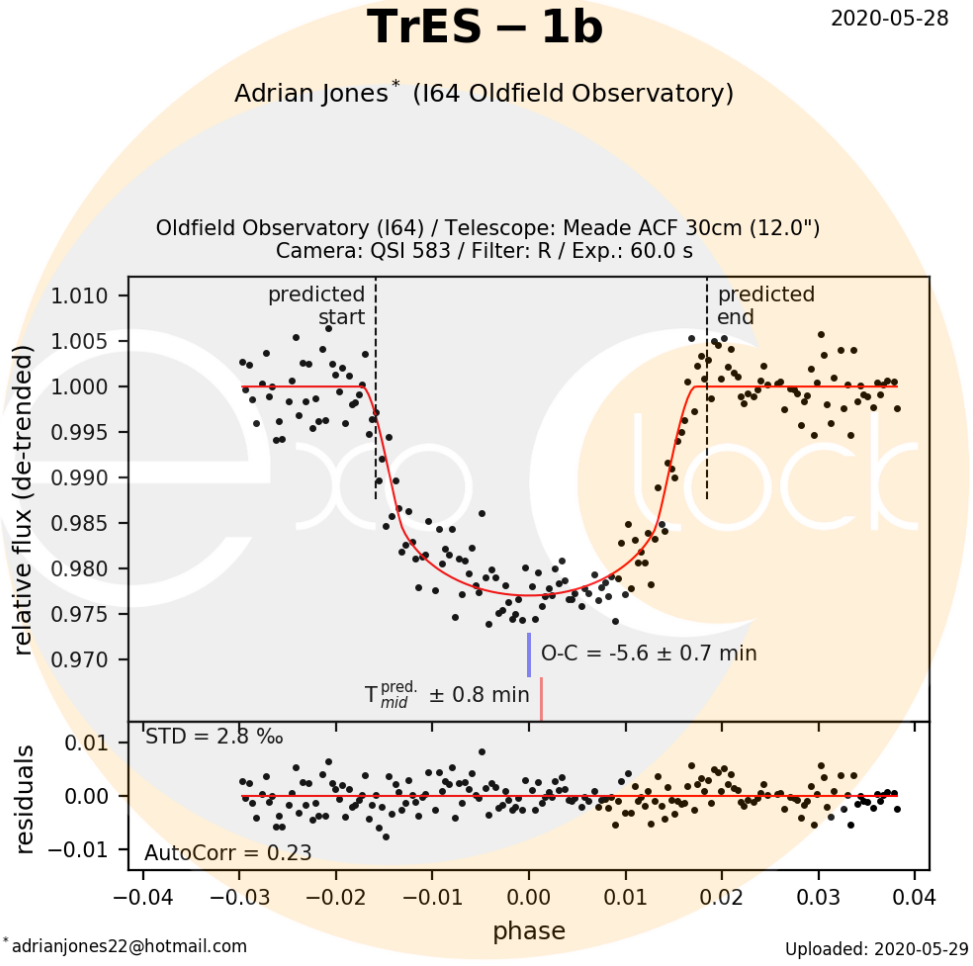
Observations can be uploaded to the ExoClock website

Once all the observations have been gathered, the decay can be analysed and publicised. Anyone who contributes will be invited to co-author this!

Details of the ExoClock project can also be found on the Exoplanet webpage here



Observations showing change in orbital period of TrES-1b Credit ExoClock project



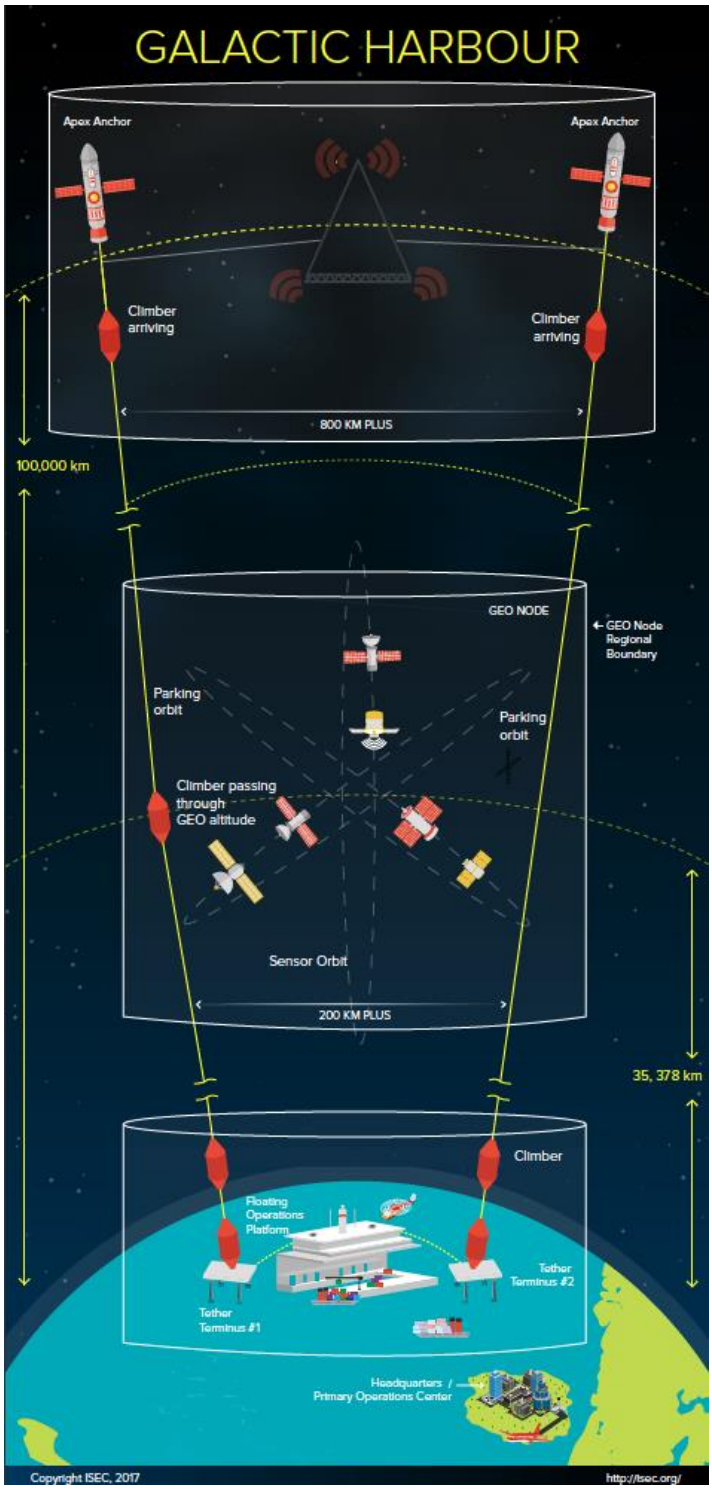
Transit light-curve of TrES-1b Credit Adrian Jones

The above plot shows the deviation of actual from predicted transit time.

Twinkle

The latest info on this mission can be found here. Twinkle will provide high-quality infrared spectroscopic characterisation of the atmospheres of a population of exoplanets, covering a wide range of planetary types. Additionally, the mission will be able to provide phase curves for hot, short-period planets around bright stars and ultra-precise spectrophotometric light curves to accurately constrain orbital parameters, including ephemerides and TTVs/TDVs present in multi-planet systems.

Space – stepping stones to other star systems



Near Earth

International Space Elevator Consortium

The Galactic Harbour will be the volume encompassing the Earth Port and stretching up in a series of cylinders to include two tethers and the region just beyond the Apex Anchors.

In summary, customer product/payloads will enter the Galactic Harbour at the Earth Port and exit at some point along the tether. Along the way, there will be tremendous enterprise development such as easy assembly at GEO, refuelling operational satellites and construction, among other things, and release from the Apex Anchor for trips to interplanetary destinations.

Mars

Will it be safe to fly to Mars

A University of California, Los Angeles paper. Sending human travellers to Mars would require scientists and engineers to overcome a range of technological and safety obstacles. One of them is the grave risk posed by particle radiation from the Sun, distant stars and galaxies. Answering two key questions would go a long way toward overcoming that hurdle: Would particle radiation pose too grave a threat to human life throughout a round trip to the red planet?

Is Mars too small for long-term habitability?

That's the conclusion of a study in the Proceedings of the National Academy of Sciences that used stable isotopes of potassium in 20 confirmed Martian meteorites to estimate the presence, distribution and abundance of volatile elements. The isotopic composition is an indicator of more volatile elements and compounds like water – Astronomy Now

Mars Beckons: The 2021 Humans to Mars Summit

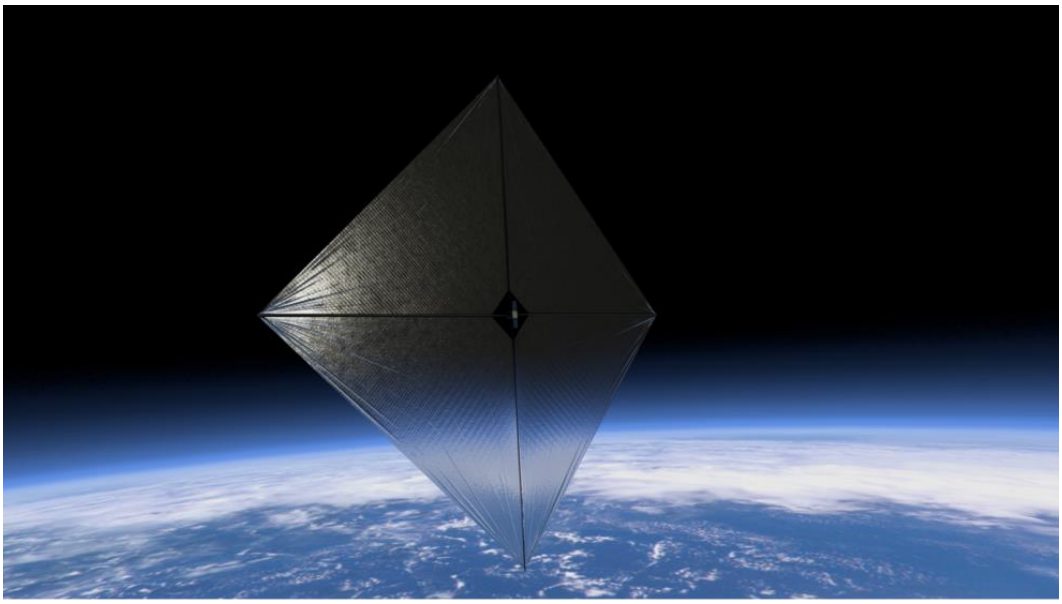
Planetary Radio brings you the highlights of the recent Humans to Mars summit (67 mins) which brought together the world's experts on the effort to send astronauts to the Red Planet. Find out how science, robotics and even blockchain technology all have a role to play in this ambitious endeavour.

Callisto

Colonising Jupiter's moon (22 min video thanks to Steve Knight, Hampshire Astronomical Group). Includes; possible locations, constructing bases, food, water and oxygen supplies, solar panels for energy and human space flight and survival on Callisto.

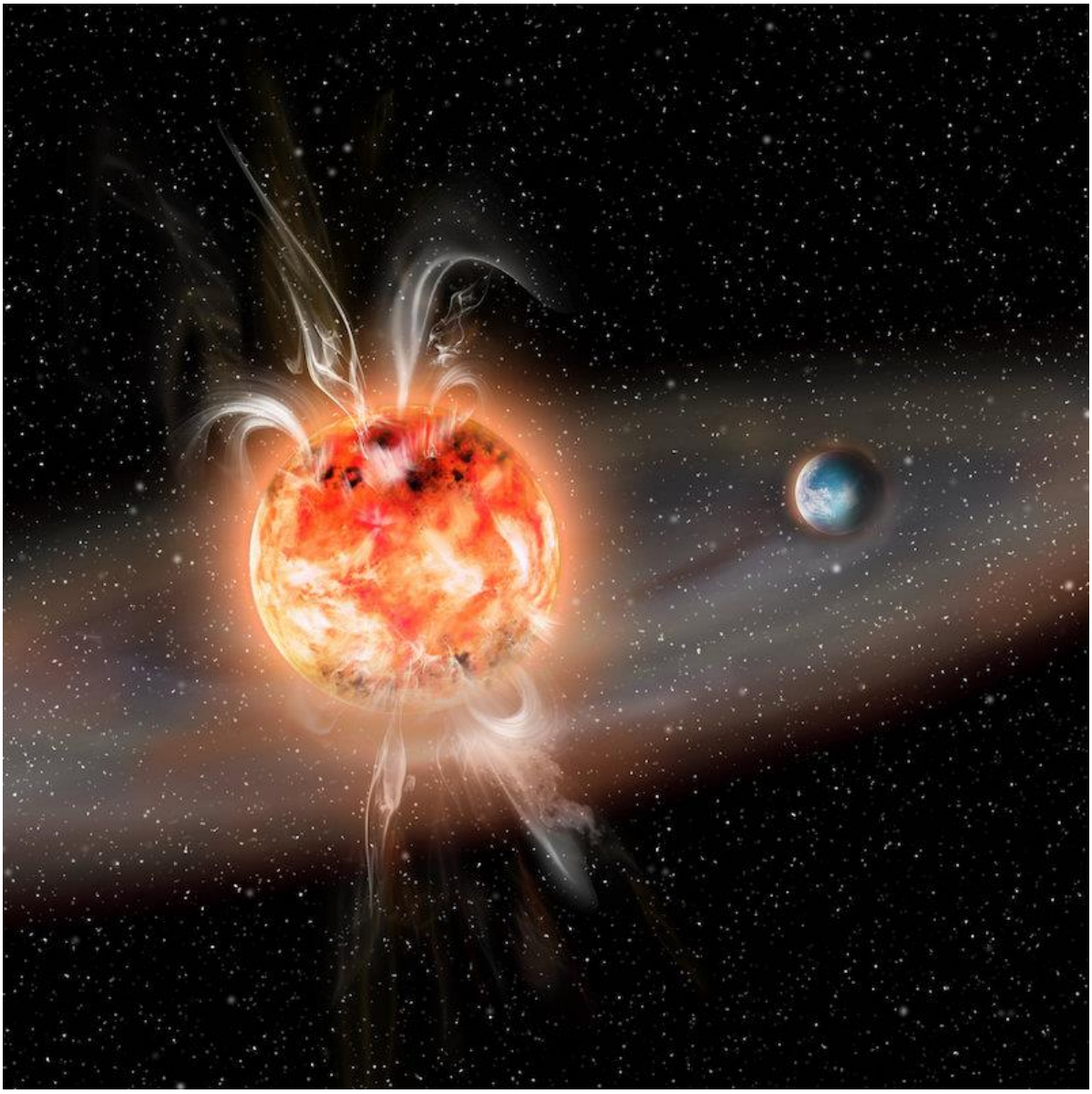
Exoplanets

Solar sails (image below) have been touted as one propulsion method for reaching exoplanets. NASA is developing new deployable structures and materials technologies for solar sail propulsion systems destined for future low-cost deep space missions.



Red dwarfs

Planets around Red Dwarfs may not be such dangerous places as previously thought. Large flares originate near the star's poles and thus planets orbiting in the plane of the star's equator are less likely to be irradiated. Paper here.



An artist's illustration of superflares on a red dwarf star. Credit AIP/ J. Fohlmeister/ Phys.org.

The ethics of colonising other worlds

Many influential thinkers have turned their attention to the colonisation of other planets (usually Mars), including Tesla founder Elon Musk, and the groups behind Mars One. But while the search for extraterrestrial life is fascinating, our interplanetary exploration raises some interesting ethical questions.

Roger Dymock
ARPS Assistant Director Exoplanets