



**British Astronomical Association**  
Supporting amateur astronomers since 1890

# Infinite Worlds



Twinkle satellite

Credit UCL

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

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## Section officers

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## News



[The Blue Marble](#). The first full-view photograph of the planet, was taken by Apollo 17 astronauts en route to the Moon in 1972. We haven't, as yet, found anywhere else like it in our galaxy. When we do, let us hope it is virus-free!!!

### **ASTERIA spacecraft**

This mission was recently in the news for being the smallest telescope to detect an exoplanet – 55 Cancri-e. [Demonstrating high-precision photometry with a CubeSat: ASTERIA observations of 55 Cancri e](#)

Observations made with the European Southern Observatory's Very Large Telescope (ESO's VLT) have revealed the tell-tale signs of a [planetary system being born](#).

### **Meetings**

2020 Sagan Summer Virtual Workshop: Extreme Precision Radial Velocity - <https://nexsci.caltech.edu/workshop/2020/>

EuroPlanet Science Congress 21 Sep – 9 Oct - <https://www.epsc2020.eu/> This is a virtual meeting and Mark Salisbury and Martin Crow will be participating in the main conference and Splinter sessions wrt the ARIEL mission and ExoClock project.

PLATO Week 11 meeting (probably October, date tba). Steve Fitcher will be our representative for the Amateur Observing Program

Exoplanet Demographics Conference November 9-12 - <https://nexsci.caltech.edu/conferences/exodem/>

### **Discoveries – latest news**

#### **NASA Exoplanet Archive**

4171 confirmed planets as of 2020 June 24.

Recent discoveries are listed at

[https://exoplanetarchive.ipac.caltech.edu/docs/exonews\\_archive.html#24June20](https://exoplanetarchive.ipac.caltech.edu/docs/exonews_archive.html#24June20)

#### **Kepler1649-c**

A team of transatlantic scientists, using reanalysed data from NASA's Kepler space telescope, has discovered an Earth-size exoplanet orbiting in its star's habitable zone, the area around a star where a rocky planet could support liquid water. Out of all the exoplanets found by Kepler, this distant world - located 300 light-years from Earth - is most similar to Earth in size and estimated temperature. This newly revealed world is only 1.06 times larger than our own planet. Also, the amount of starlight it receives from its host star is 75% of the amount of light Earth receives from our Sun - meaning the exoplanet's temperature may be similar to our planet's as well. But unlike Earth, it orbits a red dwarf. This type of star is known for stellar flare-ups that may make a planet's environment challenging for any potential life.

<https://www.jpl.nasa.gov/news/news.php?release=2020-072>

#### **Kepler-160**

Among the more than 4,000 known exoplanets, KOI-456.04 is something special: less than twice the size of Earth, it orbits a Sun-like star. And it does so with a star-planet distance that could permit planetary surface temperatures conducive to life. The object was discovered by a team led by the Max Planck Institute for Solar System Research in Göttingen. Its host star, called Kepler-160, actually emits visible light; the central stars of almost all other exoplanets, on the other hand, emit infrared radiation, are smaller and fainter than the Sun and therefore belong to the class of red dwarf stars.

<https://www.mpg.de/14901977/exoplanet-sunlike-host-star>

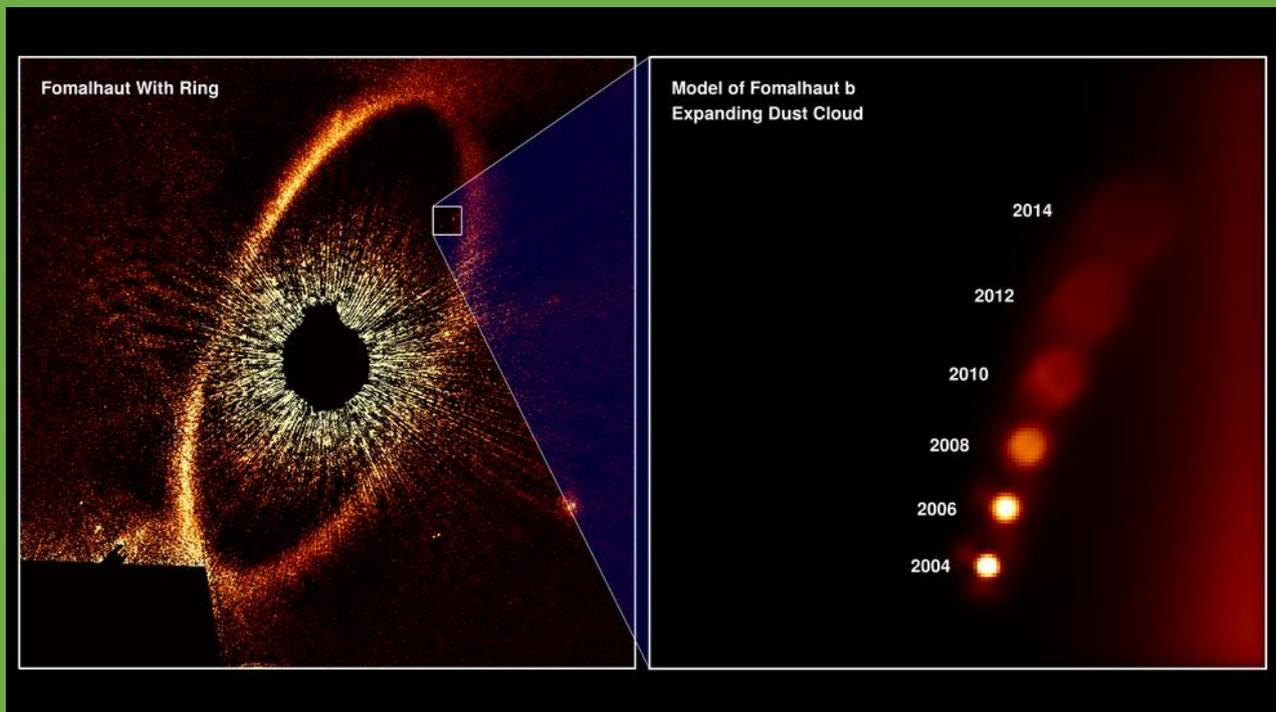
### Proxima Centauri-c

A group led by Mario Damasso of Italy's National Institute for Astrophysics (INAF) have announced they might have found another planet orbiting Proxima Centauri farther out. This group used radial velocity observations, that is, measurements of the star's motion on the sky toward and away from Earth, to deduce the possible planet (dubbed Proxima Centauri c) orbits the star every 1,907 days at distance of 1.5 AU (that is, 1.5 times the distance at which Earth orbits the Sun) - <https://mcdonaldobservatory.org/news/releases/20200602> Data on this, now confirmed, exoplanet can be found at [http://exoplanet.eu/catalog/proxima\\_centauri\\_c/](http://exoplanet.eu/catalog/proxima_centauri_c/)

There may even be a Proxima Centauri-d. Watch this space or that space as the case may be.

### Formalhaut-b RIP

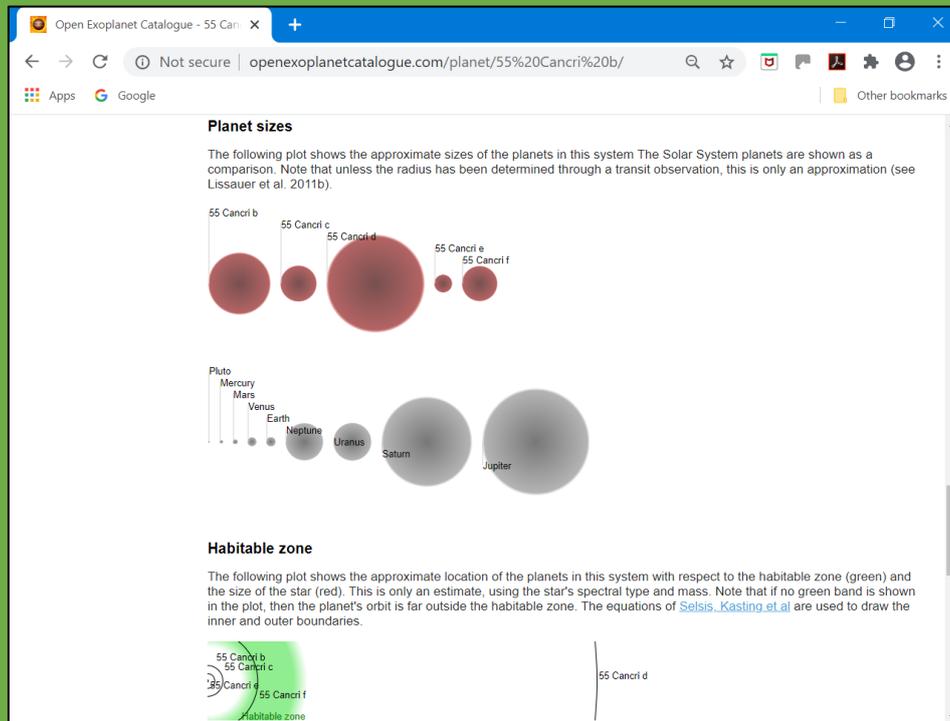
What astronomers thought was a planet beyond our solar system has now seemingly vanished from sight. One interpretation is that, rather than being a full-sized planetary object it could instead be a vast, expanding cloud of dust produced in a collision between two large bodies orbiting the bright nearby star Fomalhaut. The exoplanet was first announced in 2008. It was clearly visible in several years of Hubble observations that revealed it was a moving dot. The object was unusually bright in visible light, but did not have any detectable infrared heat signature when observed by NASA's Spitzer Space Telescope. Astronomers conjectured that the added brightness came from a huge shell or ring of dust encircling the planet that may possibly have been collision-related. <https://www.nasa.gov/feature/goddard/2020/exoplanet-apparently-disappears-in-latest-hubble-observations>



Formalhaut then and now. Credit NASA, ESA, and A. Gáspár and G. Rieke (University of Arizona)

## Web sites of interest

[The Open Exoplanet Catalogue](https://openexoplanetcatalogue.com/) contains a wealth of information on all discovered exoplanets.



Example screenshot of the 55Cancri system.

## Publications

### **BAA Handbook**

This will be the first year that the BAA Handbook has include exoplanet data compiled by Richard Miles and myself – comments welcome. The AREL webpage is being updated and will eventually include finder charts for all the exoplanets listed in the 2021 Handbook

### **Papers**

Utilizing Small Telescopes Operated by Citizen Scientists for Transiting Exoplanet Follow-up - <https://arxiv.org/abs/2003.09046> The author was prompted to give both the BAA and the ARIEL ExoClock project a mention as they were not referred to in the original paper and kindly did so.

## Astrobiology

### **Many Earth-like planets but few civilisations like us**

There may be as many as one Earth-like planet for every five Sun-like stars in the Milky way Galaxy, that is 6 billion planets, according to [new estimates by University of British Columbia astronomers](#) using data from NASA's Kepler mission. To be considered Earth-like, a planet must be rocky, roughly Earth-sized and orbiting Sun-like (G-type) stars. It also has to orbit in the habitable zones of its star—the range of distances from a star in which a rocky planet could host liquid water, and potentially life, on its surface.

A [new study](#) led by the University of Nottingham and published today in [The Astrophysical Journal](#) has taken a new approach to this problem. Using the assumption that intelligent life forms on other planets in a similar way as it does on Earth, researchers have obtained an

estimate for the number of intelligent communicating civilizations within our own galaxy - the Milky Way. They calculate that there could be over 30 active communicating intelligent civilizations in our home Galaxy.

### **SETI**

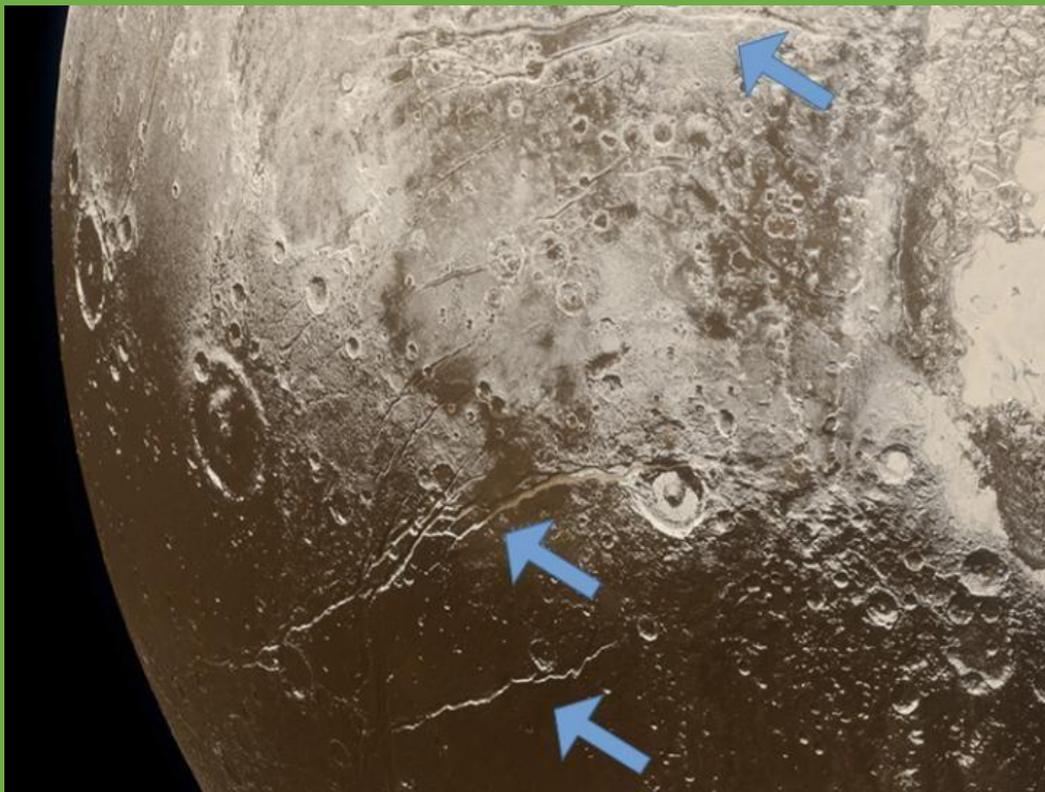
On the question of SETI, the Breakthrough Listen project did recently examine 1300 stars for radio signals, but nothing (of interest) was found - <https://www.syfy.com/syfywire/seti-project-searched-1300-stars-for-aliens>. My thanks to John Fairweather for this link.

The SETI@home project is being shut down as the amount of data being collected far exceeds the capabilities of that application but [SETI 2.0](#) lives.

### **Pluto**

Though Pluto is now it may have started off as a hot world that formed rapidly and violently, a new study finds. This result suggests Pluto may have possessed an underground ocean since early on in its life, potentially improving its chances of hosting life -

<https://www.space.com/pluto-hot-formation-subsurface-ocean.html#:~:text=Pluto%20as%20seen%20by%20NASA's,dwarf%20planet%20in%20July%202015.&text=This%20result%20suggests%20Pluto%20may,of%20hosting%20life%20researchers%20said>.



Arrows mark the location of extensional faults on the surface of Pluto that indicate expansion of its crust, which scientists think is due to the freezing of a subsurface ocean. (Image credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute/Alex Parker)

## **Pro-am projects**

### **ARIEL**

BAA members are making a significant contribution, much appreciated by the ARIEL team, to this project – you are encouraged to join them. The HOPS software is one of the easiest packages to use that I have come across (although installation has been problematic for some of us – but the instructions do have to be followed to the absolute letter). Feedback on uploaded observations is instantaneous so you immediately know how good, or bad, is your transit light-curve.

Presentations made at the ARIEL: Science Mission and Community 2020 conference that took place on 2020 January 14-16 are available at <https://www.cosmos.esa.int/web/ariel/conference-2020>

### **Twinkle**

The following two paragraphs were taken from the paper [TWINKLE – A Low Earth Orbit Visible and Infrared Exoplanet Spectroscopy Observatory](#) Related publications can be found at <http://www.twinkle-spacemission.co.uk/publications/>

Twinkle is a space mission designed for visible and near-IR spectroscopic observations of extrasolar planets. Twinkle's highly stable instrument will allow the photometric and spectroscopic observation of a wide range of planetary classes around different types of stars, with a focus on bright sources close to the ecliptic. The planets will be observed through transit and eclipse photometry and spectroscopy, as well as phase curves, eclipse mapping and multiple narrow-band time-series. The targets observed by Twinkle will be composed of known exoplanets mainly discovered by existing and upcoming ground surveys in our galaxy (e.g. WASP, HATNet, NGTS and radial velocity surveys) and will also feature new discoveries by space observatories (K2, GAIA, Cheops, TESS).

The Twinkle design will enable the observation of the chemical composition and weather of at least 100 exoplanets in the Milky Way, including super-Earths (rocky planets 1-10 times the mass of Earth), Neptunes, sub-Neptunes and gas giants like Jupiter. It will also allow the follow-up photometric observations of 1000+ exoplanets in the visible and infrared, as well as observations of Solar system objects, bright stars and disks.

## **Space – stepping stones to other star systems**

### **The Moon**

At the 290th ESA Council meeting held on 2020 June 24 the Council approved a Memorandum of Understanding with NASA concerning Cooperation on the Civil Lunar Gateway taking a step towards sending the first European to the Moon.

NASA has selected Masten Space Systems of Mojave, California, to deliver and operate eight payloads – with nine science and technology instruments – to the Moon's South Pole in 2022, to help lay the foundation for human expeditions to the lunar surface beginning in 2024.

<https://www.nasa.gov/press-release/nasa-awards-contract-to-deliver-science-tech-to-moon-ahead-of-human-missions>

NASA's [Lunar Gateway](#) will be a small spaceship in orbit around the Moon that will provide access to more of the lunar surface than ever before with living quarters for astronauts, a lab for science and research, ports for visiting spacecraft, and more.

NASA's [Project Artemis](#) is the first step to begin the next era of exploration. Together with commercial and international partners, NASA will establish a sustainable human presence on the Moon in preparation for sending astronauts to Mars.

From human waste to superplasticiser, astronaut urine could become a useful resource for making a robust type of concrete on the Moon - [http://www.esa.int/Science\\_Exploration/Human\\_and\\_Robotic\\_Exploration/Astronaut\\_urine\\_for\\_building\\_a\\_Moon\\_base](http://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Astronaut_urine_for_building_a_Moon_base) That's why they should send us older guys as we tend to produce more of the stuff!!!

ESA's design for a laser-powered rover to explore Moon's dark shadows - [http://www.esa.int/Enabling\\_Support/Space\\_Engineering\\_Technology/Laser-powered\\_rover\\_to\\_explore\\_Moon\\_s\\_dark\\_shadows](http://www.esa.int/Enabling_Support/Space_Engineering_Technology/Laser-powered_rover_to_explore_Moon_s_dark_shadows)



Rover testing by night

Credit ESA

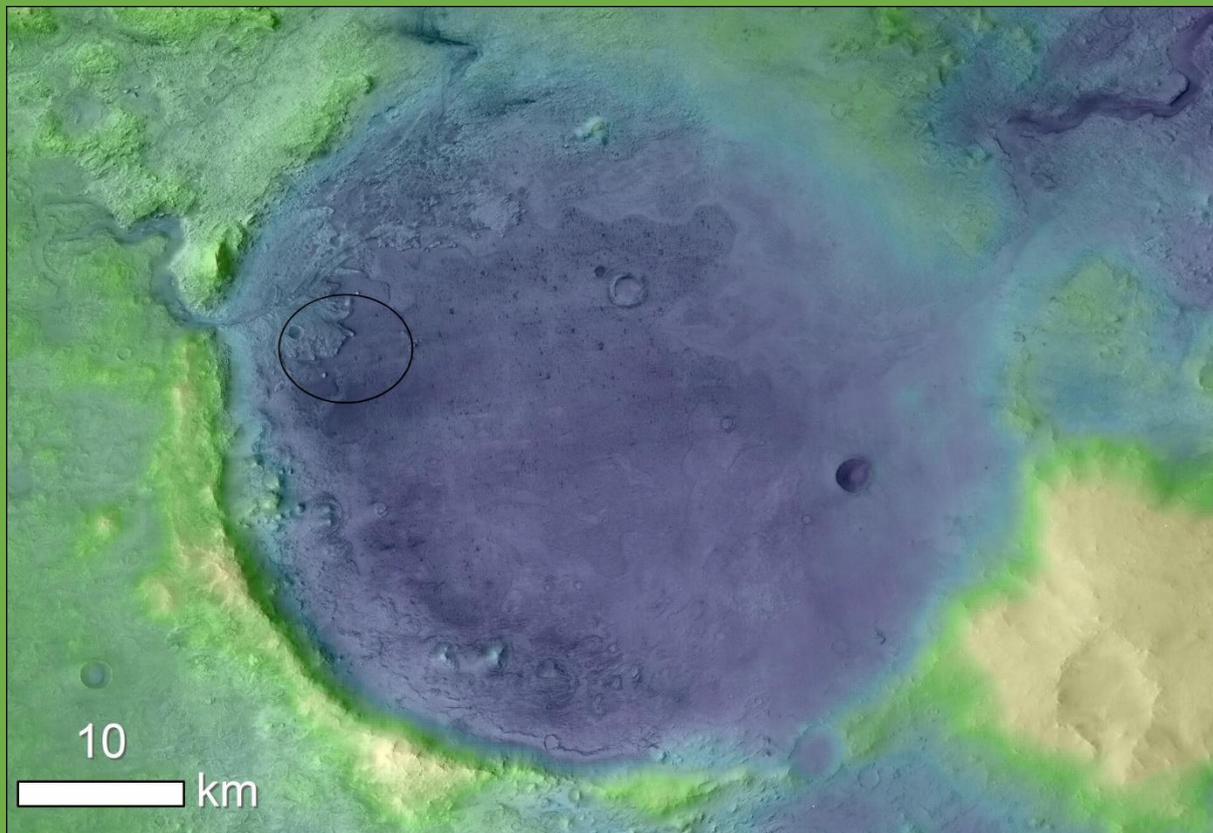
Third European Service Module for mission to land astronauts on the Moon - [http://www.esa.int/Science\\_Exploration/Human\\_and\\_Robotic\\_Exploration/Orion/Third\\_European\\_Service\\_Module\\_for\\_mission\\_to\\_land\\_astronauts\\_on\\_the\\_Moon](http://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Orion/Third_European_Service_Module_for_mission_to_land_astronauts_on_the_Moon)

Development of Europe's first ever lunar lander was agreed upon by ESA Member States in 2019 [http://www.esa.int/Science\\_Exploration/Human\\_and\\_Robotic\\_Exploration/Get\\_your\\_ticket\\_to\\_the\\_Moon\\_Europe\\_s\\_lunar\\_lander\\_for\\_science\\_and\\_more](http://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Get_your_ticket_to_the_Moon_Europe_s_lunar_lander_for_science_and_more)

## Mars

### NASA's Mars Perseverance rover

Two studies based on [ESA's Mars Express observations of Jezero crater](#), the future landing site for NASA's 2020 Mars Perseverance rover, have shed light on how and when this intriguing area formed – and identified the regions most likely to reveal signs of ancient life.



NASA's 2020 Mars Perseverance rover landing site – ringed in above image.  
Credit NASA/JPL-Caltech/MSSS/JHU-APL/ESA

[Mars helicopter](#) and Perseverance. <https://mars.nasa.gov/news/8645/mars-helicopter-attached-to-nasas-perseverance-rover/>

At the 290th ESA Council meeting held on 2020 June 24 the Council approved a Memorandum of Understanding with NASA concerning the Flight elements of the Mars Sample Return Campaign, consolidating the ambitious schedule towards the first-ever 'round trip' to Mars with return of pristine Martian soil samples.

ESA's Martian Sample Fetch Rover will need to navigate autonomously, detect tubes of samples collected and packed by an earlier NASA rover, pick them up and return them to Earth. [http://www.esa.int/Science\\_Exploration/Human\\_and\\_Robotic\\_Exploration/Martian\\_rover\\_motors\\_ahead](http://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/Martian_rover_motors_ahead)

Video 'Packing for Mars' <https://www.youtube.com/watch?v=ba8MHq8hXp4&t=7s> (53 mins). Thanks to Steve Knight of the Hampshire Astronomical Group for this link.

## **Beyond**

[World Ships: Feasibility and Rationale](#). World ships are hypothetical, large, self-contained spacecraft for crewed interstellar travel, taking centuries to reach other stars.

[Ultra-thin sails](#) could speed journey to other star systems but [nuclear-powered rockets](#) may be the answer.

Roger Dymock  
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