

# Interstellar News

John I Davies reports on recent developments in interstellar studies

## i4is prediction - Up for Refutation!

A paper from the i4is Project Lyra team and associates fluttered a few dovescotes in the science press recently - though its implications are much wider than the headlines.

In universetoday.com "There Should be About 7 Interstellar Objects Passing Through the Inner Solar System Every Year" -

[www.universetoday.com/150478/there-should-be-about-7-interstellar-objects-passing-through-the-inner-solar-system-every-year/](http://www.universetoday.com/150478/there-should-be-about-7-interstellar-objects-passing-through-the-inner-solar-system-every-year/)

What they found was that in an average year, the Solar System would be visited by up to 7 ISOs that are asteroid-like. Meanwhile, objects like 2I/Borisov (comets) would be rarer, appearing around once every 10 to 20 years.

And from *New Scientist* "Seven alien space rocks should pass through our solar system each year" -

[www.newscientist.com/article/2271307-seven-alien-space-rocks-should-pass-through-our-solar-system-each-year/](http://www.newscientist.com/article/2271307-seven-alien-space-rocks-should-pass-through-our-solar-system-each-year/)

An average of seven interstellar objects pass by the sun every year, potentially close enough for us to observe and even visit, according to a new analysis.

This was echoed by a number of other, less scientific, news sources.

The paper in question is - *Interstellar Objects in the Solar System: 1. Isotropic Kinematics from the Gaia Early Data Release 3*, Eubanks et al.

A brief extract from the abstract makes the conjecture about the frequency of interstellar objects (ISOs) very clear -

Finding additional ISOs and planning missions to intercept or rendezvous with these bodies will greatly benefit from knowledge of their likely orbits and arrival rates. Here, we use the local velocity distribution of stars from the Gaia Early Data Release 3 Catalogue of Nearby Stars and a standard gravitational focusing model to predict the velocity dependent flux of ISOs entering the solar system. With an 1I-type ISO number density of  $\sim 0.1 \text{ AU}^{-3}$ , we predict that a total of  $\sim 6.9$  such objects per year should pass within 1 AU of the Sun.

The Gaia astrometry vehicle has produced a wealth of information about our interstellar neighbourhood. More in *News Feature: The 10 parsec sample in the Gaia era* elsewhere in this issue.

The paper by Eubanks et al paper also examines the possible results obtainable from an impactor ejected by a fast flyby vehicle intercepting an ISO.

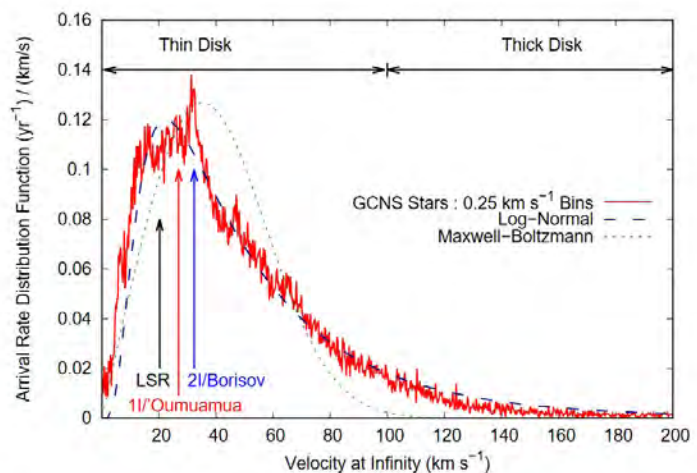


Figure 5. The differential ISO arrival rate at the Earth's orbit (LSR - Local Standard of Rest - the mean motion of near parts of the galaxy).

Credit: T Marshall Eubanks (Space Initiatives Inc and Institute for Interstellar Studies), Andreas M Hein (Initiative for Interstellar Studies), Manasvi Lingam (Florida Institute of Technology and Harvard University), Adam Hibberd (Initiative for Interstellar Studies), Dan Fries (University of Texas at Austin and Initiative for Interstellar Studies), Nikolaos Perakis (Initiative for Interstellar Studies and Technical University of Munich), Robert Kennedy (Institute for Interstellar Studies), W P Blase (Space Initiatives Inc) and Jean Schneider (Observatoire de Paris) [arxiv.org/abs/2103.03289](https://arxiv.org/abs/2103.03289).

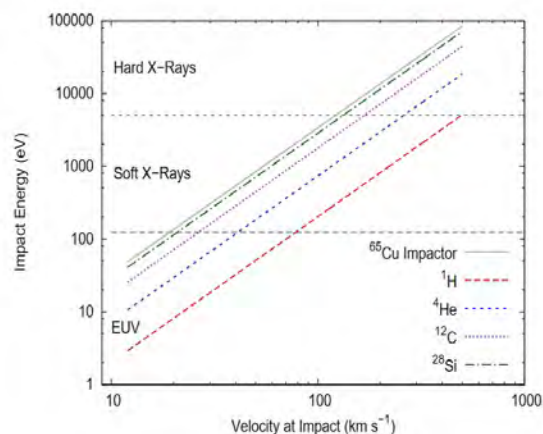


Figure 7: Prompt impact energies as a function of the impact velocity for various atomic species. Credit:Eubanks et al.

## The Wormship: A Dark Energy Ramjet

Dr Stephen Baxter is a physicist and science fiction writer. He has made major contributions to interstellar studies notably *Artificial Intelligence for Interstellar Travel* (JBIS 2019 [arxiv.org/abs/1811.06526](https://arxiv.org/abs/1811.06526) with Dr Andreas Hein of i4is) and 18 other papers in the Journal of the British Interplanetary Society as far back as 2001, most on interstellar subjects.

Stephen will be presenting his idea, *The Wormship: A Dark Energy Ramjet* to BIS West Midlands on 20 November 2021 ([www.bis-space.com/event/the-wormship-a-dark-energy-ramjet-by-stephen-baxter/](http://www.bis-space.com/event/the-wormship-a-dark-energy-ramjet-by-stephen-baxter/)). This is based on his paper with the same title in JBIS V74 #2 February 2021. The abstract announces "a tentative dark energy ramjet design" and cautiously suggests that "this is highly speculative, and depends on the nature of dark energy" but "if it could be built, such a vessel would be well suited to journeys in intergalactic space, and indeed between galactic clusters, where alternate potential fuel media, baryonic and dark matter, reach very low densities". Such propulsion might also provide a technosignature for SETI. This looks like a fascinating talk from a major innovator in interstellar studies.

## Breakthrough Discuss 2021

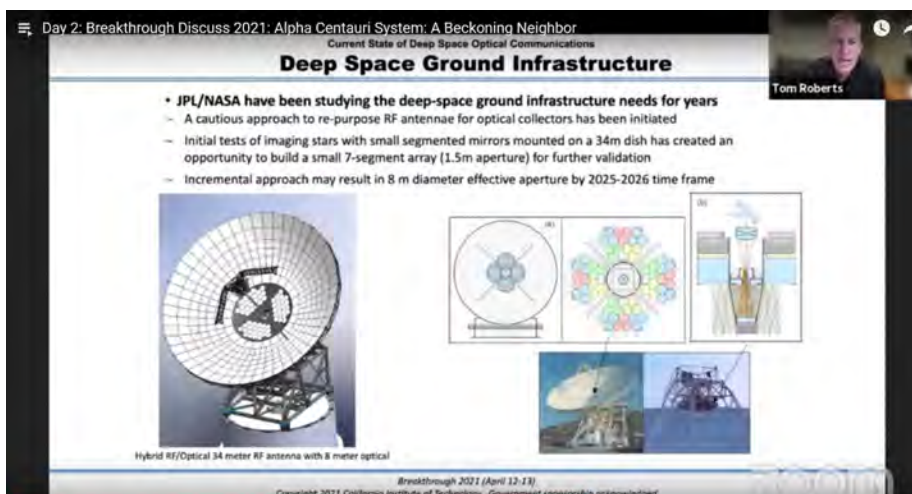
Breakthrough Discuss is an annual academic conference focused on life in the Universe and novel ideas for space exploration. This year the topic was "The Alpha Centauri System: A Beckoning Neighbor" held on April 12-13. The speakers and timetable are at - [breakthroughinitiatives.org/initiative/5/discuss2021](https://breakthroughinitiatives.org/initiative/5/discuss2021). All three sessions are available on Youtube [1] - an example below.

Tom Roberts, JPL, on *Current State of Deep Space Optical Communications* on day 2 of Breakthrough Discuss 2021. Watch out for the first ever joke about dB (that I am aware of!)



## IRG 7th Interstellar Symposium

Principium readers may need no reminding of this year's main event from our friends and colleagues at the Interstellar Research Group (IRG) - the Tennessee Valley Interstellar Workshop, as it was formerly known. Famous speakers announced for the event include Professor Avi Loeb (see the review of his book, *Extraterrestrial: The First Sign of Intelligent Life Beyond Earth* by Patrick Mahon elsewhere in this issue) and Esther Dyson (investor and visionary). The Symposium will be in Tucson, Arizona September 25-27, 2021 (with pre-symposium seminars taking place on the 24th). Details and registration at [irg.space/](http://irg.space/).



Roberts mentioned near term experiments (*Psyche*), pulse-position modulation (see Breakthrough Starshot thinking in Principium 27 page 28, P28 page 17 P31 page 38), forward error correction (FEC), interleaving to combat deep fades and experimental re-purposing a radio dish as a mirror-tiled optical receiver (see his slide, left). The day-night downlink performance differences are striking - order of 10 better at night - but there was no mention of the use of space telescopes - which would not have this handicap.

[1] Breakthrough Discuss 2021 [www.youtube.com/playlist?list=PLYF3OMOIy3nGgq35b5FVqCqSl6CrvHERg](https://www.youtube.com/playlist?list=PLYF3OMOIy3nGgq35b5FVqCqSl6CrvHERg)

## Even at 50 AU New Horizons is "Gonna need a bigger telescope"!

Having recently watched *Jaws* again I'm reminded of Chief Brody's remark to Quint when NASA pointed the telescope on New Horizons in the direction of Voyager 1 but said it was "about 1 trillion times too faint to be visible". NASA's New Horizons probe is now 50 times as far from the Sun as Earth (ie 50 AU) and took the opportunity to point its telescope, the Long Range Reconnaissance Imager ([www.boulder.swri.edu/pkb/ssr/ssr-lorri.pdf](http://www.boulder.swri.edu/pkb/ssr/ssr-lorri.pdf)), towards the location of its predecessor Voyager 1's position. Voyager is now at 152 AU. The image cannot, of course, include Voyager 1. By my calculation it is ten billion ( $10^9$ ) times too far away - and as always the dreaded inverse square law applies.

## China aims beyond the Solar System

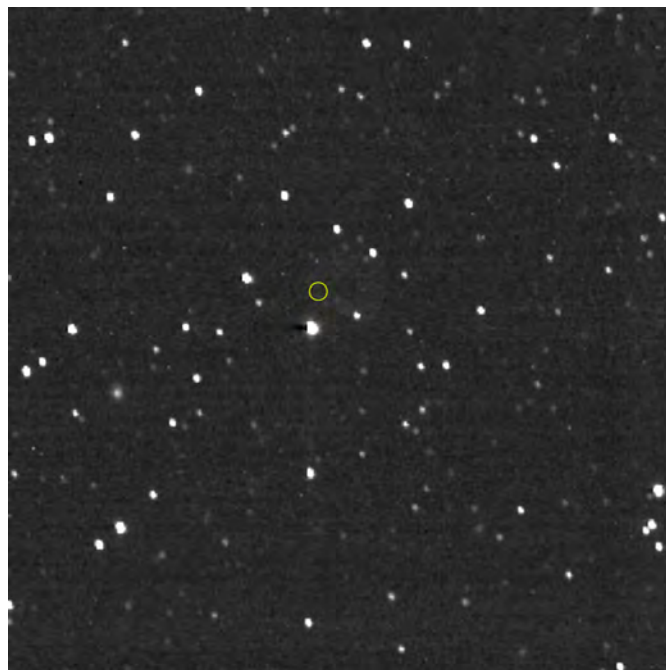
As reported in Space Daily and elsewhere, China intends to send two spacecraft to 100 AU, about 2/3 of the distance currently achieved by Voyager 1. The target arrival date, 2049, is the centenary of the founding of the current state, the Peoples Republic of China. These Interstellar Heliosphere Probes (IHPs) are planned to launch around 2024 ([meetingorganizer.copernicus.org/EPSC-DPS2019/EPSC-spaceneews.com/DPS2019-1986-1.pdf](http://meetingorganizer.copernicus.org/EPSC-DPS2019/EPSC-spaceneews.com/DPS2019-1986-1.pdf)), one towards the leading edge of the heliopause and the other in the opposite direction. This looks like a rival, or possibly complement, to the Johns Hopkins University - Applied Physics Lab (APL) project for a near-term, "pragmatic" Interstellar Probe aiming to launch around 2030 with the more ambitious target of 2,000 AU ([interstellarprobe.jhuapl.edu/](http://interstellarprobe.jhuapl.edu/)) - as reported in several previous issues of Principium. The JHU-APL probe aims to use a solar Oberth manoeuvre to achieve a much higher final velocity - as explained by Adam Hibberd in *The Equation used in the Benkoski Paper* in Principium 28.

More about the China proposal at spaceneews.com ([spaceneews.com/china-to-launch-a-pair-of-spacecraft-towards-the-edge-of-the-solar-system/](http://spaceneews.com/china-to-launch-a-pair-of-spacecraft-towards-the-edge-of-the-solar-system/)).

## Positive Energy Warp Drive

In *Positive Energy Warp Drive from Hidden Geometric Structures* ([arxiv.org/abs/2104.06488](https://arxiv.org/abs/2104.06488)), Shaun D B Fell and Lavinia Heisenberg challenge the assumption that negative energy densities are a requirement of superluminal motion. They claim a tremendous improvement on the classical configurations with their numerical analysis of a set of example configurations finding total energy requirements three orders of magnitude smaller than the solar mass.

This remains a staggering energy requirement but if these physicists at ETH Zurich have found a way of achieving such a massive reduction of the warp drive energy requirement then perhaps, one day, we may find solutions that would allow Scotty to tell Captain Kirk that he is no longer asking his chief engineer to change the laws of physics!



Hello, Voyager! From the distant Kuiper Belt at the solar system's frontier, on Christmas Day, Dec. 25, 2020, NASA's New Horizons spacecraft pointed its Long Range Reconnaissance Imager in the direction of the Voyager 1 spacecraft, whose location is marked with the yellow circle. [www.nasa.gov/sites/default/files/thumbnails/image/voyager1look\\_4x4\\_041421.png](http://www.nasa.gov/sites/default/files/thumbnails/image/voyager1look_4x4_041421.png).

Voyager 1 was 11.2 billion miles (18 billion kilometers) from New Horizons when this image was taken. Voyager 1 itself is about 1 trillion times too faint to be visible in this image.

Image and caption credit: NASA

## Expanding ESA's Deep Space Communications

The European Space Agency (ESA) has announced plans to build a second deep space dish at New Norcia, Western Australia. It will be ESA's second 35-metre antenna at the site and its fourth in total. The three sites of the ESA deep space ground station network are in Spain, Argentina and Australia - about 120° apart in longitude to provide continuous coverage as the Earth rotates. All are controlled from the European Space Operations Centre (ESO) at Darmstadt, Germany. Missions currently supported include the Gaia astrometry observatory at the Earth-Sun L2 point, Mars Express, Exomars and the European-Japanese Bepi-Colombo mission to Mercury.

## Extreme Metamaterial Solar Sails for Breakthrough Space Exploration

In a recent paper Artur Davoyan, UCLA, ([www.nasa.gov/directorates/spacetech/niac/2020\\_Phase\\_I\\_Phase\\_II/Extreme\\_Metamaterial\\_Solar\\_Sails/](http://www.nasa.gov/directorates/spacetech/niac/2020_Phase_I_Phase_II/Extreme_Metamaterial_Solar_Sails/)) suggests that extreme metamaterial solar sails may enable numerous low cost and high speed missions to be launched at speeds  $>60$  AU/year when coupled to low mass spacecraft and diving to extreme proximity to the sun (2-5 solar radii). His NASA NIAC study challenges the limits of materials, paving the way for development of high endurance ultrathin film architectures that can handle extreme environments manifested by solar radiation and plasma in addition to providing spacecraft control. Potentially Jupiter in 5 months, Neptune in 10 months, surpassing Voyager 1 in 2.5 years and getting to the solar gravity lens location in 8.5 years.

### FarFarOut is a long way away

A team of researchers including Carnegie astronomer Scott Sheppard have confirmed the most distant object ever observed in our Solar System ([epl.carnegiescience.edu/news/farfarout-officially-added-count-dwarf-sized-planets-distant-solar-system](http://epl.carnegiescience.edu/news/farfarout-officially-added-count-dwarf-sized-planets-distant-solar-system)). The dwarf planet officially named 2018 AG37, but nicknamed FarFarOut, is 132 AU away and the researchers have kindly provided a nice visualisation of the distance (below). Note how the planets are crammed into less than one quarter of this linear scale.

FarFarOut - image credit: Roberto Molar Candanosa, Scott S. Sheppard from Carnegie Institution for Science, and Brooks Bays from University of Hawai'i

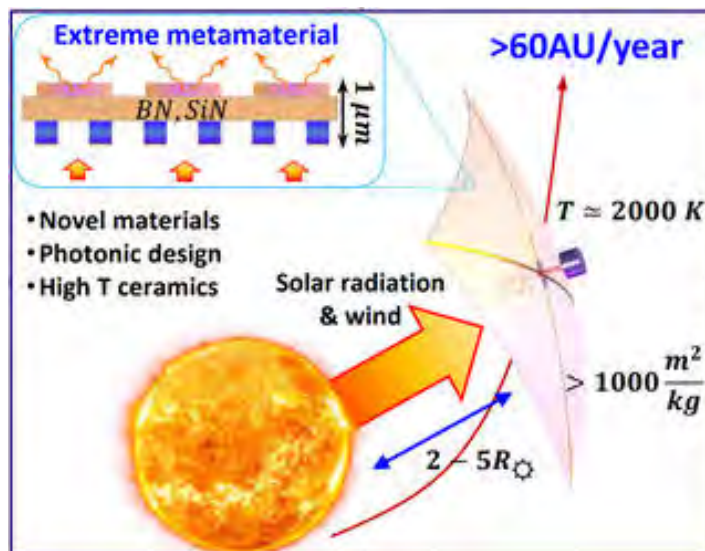
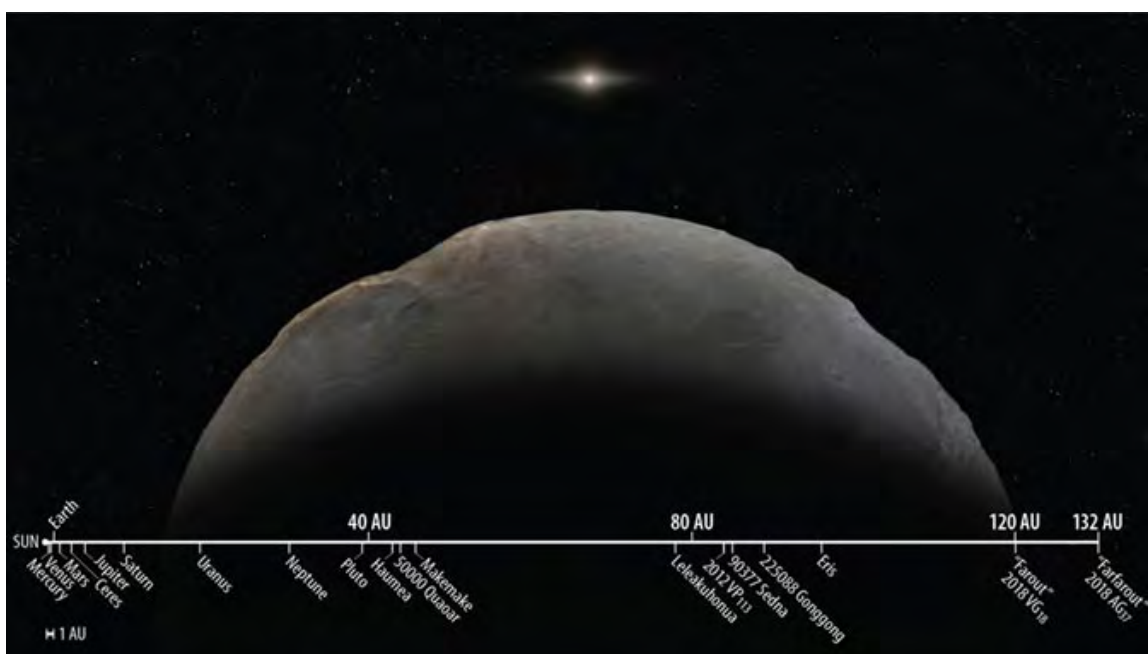


Image credit: Artur Davoyan

### Latest news from IRG

Our friends at the Interstellar Research Group (IRG, formerly TVIW) have published their latest newsletter ([irg.space/wp-content/uploads/2021/03/IRG\\_Newsletter\\_N22.pdf](http://irg.space/wp-content/uploads/2021/03/IRG_Newsletter_N22.pdf)) featuring a review of *Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity* in which Daniel Deudney, a political scientist at Johns Hopkins University, argues that humanity's expansion into space will decrease the probability of human survival. Reviewer Ken Roy tells us that most of Deudney's arguments cite technologies that have no direct connection with expansion into space. And David Fields laments what we have lost with the demise of the Arecibo telescope and argues not for a direct replacement but for creating better instruments based on the Arecibo experience.

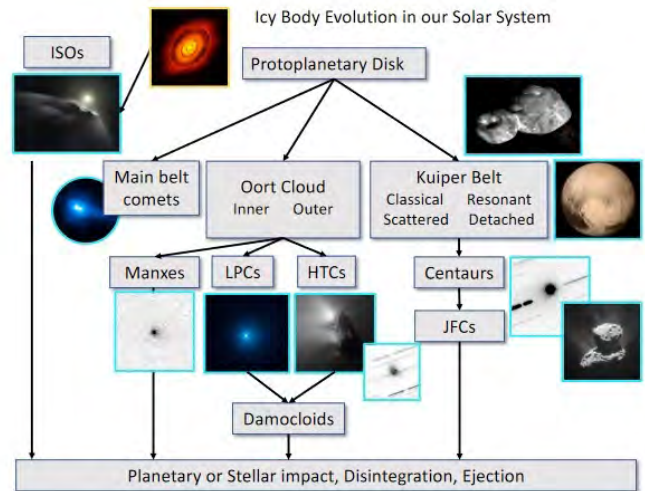


## Oort Comet Objects - InSitu Exploration

A paper, *In-Situ Exploration of Objects on Oort Cloud Comet Orbits: OCCs, Manxes and ISOs* ([baas.aas.org/pub/2021n4i282/release/1](https://baas.aas.org/pub/2021n4i282/release/1)) by lead authors Karen J Meech, University of Hawai'i and Julie Castillo-Rogez, JPL, points out that NASA's competitive mission calls are not compatible with missions that are responsive to new discoveries such as potentially hazardous Near Earth Objects (Oort Cloud comets or OCCs and Manx comets) and interstellar objects (ISOs). They report two suggested responses; spacecraft in storage, ready to launch, and spacecraft in standby orbit such as the ESA Comet Interceptor. They explore both the science needed for quick reaction missions and the technologies to achieve them.

## Locating deep space nodes

Michael Hippke presents *Interstellar communication network. III: Locating deep space nodes* he suggests that an interstellar communication network would benefit from relay nodes placed in the gravitational lenses of stars ([arxiv.org/abs/2104.09564](https://arxiv.org/abs/2104.09564)). The signal gains would be of order  $10^9$  with optimal alignment, allowing for GBit/sec connections at kW power levels with metre-sized probes over parsec distances. He asks - If such a network exists, there might be a node in our solar system: where is it? His paper suggests that, with some assumptions on the network topology, candidate sky positions can be calculated.

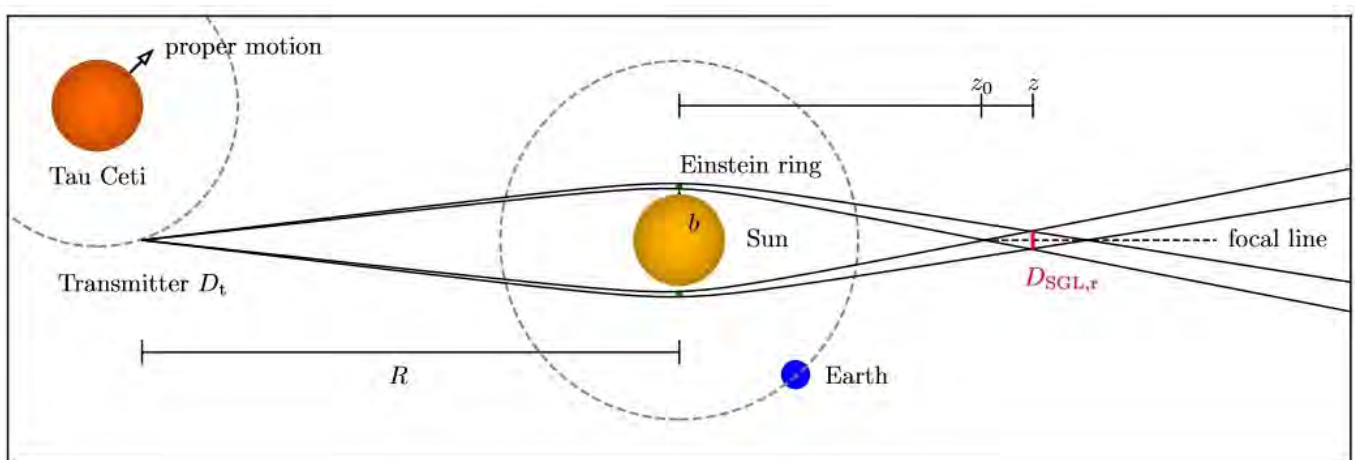


Meech/ Castillo-Rogez target object taxonomy - caption quote - Figure 1: Genetic relationships of early solar system planetesimals. The Oort cloud is the largest reservoir of objects that has not been explored with an in situ mission. HTC = Halley Type comet, JFC = Jupiter Family Comet, ISO = Interstellar Object, arriving from another solar system.)

## Andreas Hein briefs German Federal Ministry of the Environment

i4is Executive Director Dr Andreas M Hein was invited to a discussion on space resource utilization with the German Federal Ministry of the Environment, Nature Conservation, and Nuclear Safety (BMU) on the 25th March 2021. He presented the prospects of space resource utilization and space settlements. The results of the discussion will inform future German federal government policy-making.

Hippke - caption quote- Figure 1. Cartoon diagram of the solar gravitational lens configuration. The receiver with aperture  $D_{SGL,m}$  on the focal line (right) observes the flux at distances from the sun which comes through the Einstein ring from the transmitter at distance.



## KEEP AN EYE ON OUR FACEBOOK PAGE

Our Facebook page at - [www.facebook.com/InterstellarInstitute](https://www.facebook.com/InterstellarInstitute) - is the place for up to date announcements of our work and of interstellar studies in general. It's a lively forum much used by our own Facebookers and others active in our subject area.

If you prefer a more professionally focused social network then our LinkedIn group provides this - [www.linkedin.com/groups/4640147](https://www.linkedin.com/groups/4640147)

## Introducing physical warp drives

Longer term Principium readers will be familiar with the ideas of Miguel Alcubierre [1] A new paper in *Classical and Quantum Gravity* by Alexey Bobrick and Gianni Martire of the Advanced Propulsion Laboratory at Applied Physics, New York ([appliedphysics.org](http://appliedphysics.org)), titled *Introducing physical warp drives*, observes that, since it allows for superluminal travel at the cost of enormous amounts of matter with negative mass density, the Alcubierre solution has been widely considered unphysical. They aim to show that their model of a general warp drive spacetime in classical relativity encloses all existing warp drive definitions and allows for new metrics without the most serious issues present in the Alcubierre solution. There is an open access version of their paper at - [arxiv.org/abs/2102.06824](http://arxiv.org/abs/2102.06824).

Does their idea work? And, if so, is the result significant enough to bring Alcubierre's ideas nearer to feasibility?

## JWST first programme announced

scientificamerican.com examines the proposals selected for the General Observer (GO) programs for the first year of operation of the James Webb Space Telescope ([www.scientificamerican.com/article/the-james-webb-space-telescopes-first-year-of-extraordinary-science-has-been-revealed/](http://www.scientificamerican.com/article/the-james-webb-space-telescopes-first-year-of-extraordinary-science-has-been-revealed/)). This will start after deployment of the 6.5-meter segmented mirror and even larger sun shield and a subsequent six-month phase of commissioning its instruments. SciAm reports that study items were chosen by panels of scientists in a double-blind process with about 1,200 proposals received and 266 selected, a third of them led by women, and about a third from ESA member states but the majority from US scientists.

It's worth noting that this will be one of the last launches by the European Ariane 5 rocket before it is superseded by the more economically efficient Ariane 6. Ariane 5 has been one of the most reliable launchers so far developed but there is only one JWST. So a lot of people worldwide, including the i4is team, will have fingers crossed for a flawless launch (and, of course, deployment).

JWST in Ariane 5 - launch currently (20/5/21) uncertain  
Credit: Arianespace - ESA - NASA



[1] see Twaites, *Warp drive is possible*, P13 May 2016, and Mehta, *Is the Alcubierre Drive the answer to Interstellar Travel?* P17 May 2017, several reports in our *News Feature: Foundations of Interstellar Studies Workshop 2019* in P26 August 2019 and *News feature: FISW2 videos and presentations on the i4is website* in P30 August 2020. See also the report of propulsion technology presentations by Dan Fries, Deputy Director of the i4is Technical team to i4is-led masters electives at the International Space University in P31 November 2020 and upcoming reports from this year's elective.

## Revised 2I/Borisov mission paper

Adam Hibberd has revised the i4is mission planning paper, *Sending a Spacecraft to Interstellar Comet 2I/Borisov*, [arxiv.org/abs/1909.06348](http://arxiv.org/abs/1909.06348) ([v2] Sat, 1 May 2021 10:10:54 UTC) using more up-to-date orbital data. It has a more detailed examination of the viability of a mission, including the calculation of the declination of the escape asymptote at Earth, a parameter with implications for a launch trajectory.

## Near-term self-replicating probes

In *Acta Astronautica*, a paper by Olivia Borgue and Andreas M Hein of i4is, *Near-term self-replicating probes - A concept design* ([www.sciencedirect.com/science/article/abs/pii/S009457652100117X](http://www.sciencedirect.com/science/article/abs/pii/S009457652100117X)) demonstrates that 70% replicability is already practicable and provides a technology roadmap to achieving full replication and interstellar exploration. Open publication [arxiv.org/abs/2005.12303](http://arxiv.org/abs/2005.12303).

## Photonic phase sensing and control for laser propulsion

In the *Journal of the Optical Society of America B* Bandutunga et al have *Photonic solution to phase sensing and control for light-based interstellar propulsion* (Vol. 38, Issue 5) [www.osapublishing.org/josab/fulltext.cfm?uri=josab-38-5-1477&id=450064](http://www.osapublishing.org/josab/fulltext.cfm?uri=josab-38-5-1477&id=450064).

Breakthrough Starshot proposes a ground-based laser array to accelerate a gram-scale spacecraft.

This requires around 100 GW and the coherent combination of many lasers to achieve. The paper presents a photonic solution for optical phase sensing and control to enable the coherent combination of many lasers (scalable to  $10^8$ ), including the ability to sense and compensate for atmospheric distortions. The proposed solution avoids the limitations of previous methods based on sensing backscatter from the sail. This is increasingly impractical for solutions envisaging a large distance between laser array and sail because of the delays involved. They suggest use of multiple satellite-based laser "guide-stars" to detect the effects of the part of the optical path within the Earth's atmosphere.

Of course a space based laser array would not require this.

## A philosopher looks at Oumuamua

In *The 'Oumuamua Encounter: How Modern Cosmology Handled Its First Black Swan*, ([www.mdpi.com/2073-8994/13/3/510](http://www.mdpi.com/2073-8994/13/3/510)) Les Coleman of the Department of Finance, The University of Melbourne, gives a comparative study of techniques used by cosmologists versus those used by financial economists in qualitatively similar situations where data conflict with the current paradigm. Coleman invokes the Duhem-Quine (DQ), or joint test, problem of interpreting observations relying on untested theory. One example he suggests is the refusal of a contemporary philosopher to look through Galileo's telescope - essentially because he distrusted the ability of this new-fangled device to tell him the truth.

The issue is underdetermination. For example the Stanford Encyclopedia of Philosophy quotes John Stuart Mill ([plato.stanford.edu/entries/scientific-underdetermination/#FirLooDuhQuiProUnd](http://plato.stanford.edu/entries/scientific-underdetermination/#FirLooDuhQuiProUnd)) -

...an hypothesis...is not to be received as probably true because it accounts for all the known phenomena, since this is a condition sometimes fulfilled tolerably well by two conflicting hypotheses... while there are probably a thousand more which are equally possible, but which, for want of anything analogous in our experience, our minds are unfitted to conceive.

When dealing with partial knowledge as in the case of 1I/Oumuamua, interstellar studies needs all the help it can get - and philosophical economists are a welcome addition to our intellectual team!

## Recent Interstellar papers in JBIS

2021 has already been a bumper year for interstellar papers in the Journal of the British Interplanetary Society. There have been two General Interstellar Issues and at least one other paper of interstellar interest.

**JBIS**  
Journal of the British Interplanetary Society

VOLUME 74 NO. 2 FEBRUARY 2021

**General Interstellar Issue**

- DEFINING INTELLIGENCE-FAVOURING GALACTIC PARAMETERS for targeted SETI searches**  
Gary S. Robertshaw
- STRATEGIES FOR THE DETECTION OF ET PROBES Within Our Own Solar System**  
John Gartz
- THE WORMSHIP: A DARK ENERGY RAMJET – Engineering, SETI Detectability, and Implications for Cosmic Expansion**  
Stephens Baxter
- EXOTIC FLUIDS MATCHING THE STRESS-ENERGY TENSOR OF ALBUQUERQUE WARP DRIVE SPACETIMES**  
Willie Bilatrix-Draufart
- HOW MANY ALIEN PROBES COULD HAVE COME FROM STARS PASSING BY EARTH?**  
James Benford

**JBIS**  
Journal of the British Interplanetary Society

VOLUME 74 NO. 5 MAY 2021

**General Interstellar Issue**

- GENETIC EVOLUTION OF A MULTI-GENERATIONAL POPULATION in the context of interstellar space travel**  
Frédéric Marin, Corinne Beluffi & Frédéric Fischer
- MULTI-PERCEPTUAL MODALITIES MESSAGE DELIVERY MODULE: MAILbox**  
Suchetan Mummigatti
- FROM THE SPACEX STARLINK MEGACONSTELLATION TO THE SEARCH FOR TYPE-I CIVILIZATIONS**  
Z. N. Osmanov
- WAS THE WOW! SIGNAL DUE TO POWER BEAMING LEAKAGE?**  
James Benford

**JBIS**  
Journal of the British Interplanetary Society

VOLUME 74 NO. 4 APRIL 2021

**General Issue**

- SURVEYING THE LAUNCHER MARKET**  
Vadim Zaitsev et al
- ACCESS TO ORBIT FROM UNST – a worked example**  
Robin Braint & Scott Hammond
- WHAT DO WE NEED TO ASK BEFORE SETTLING SPACE?**  
James Schwartz et al
- QUENCHING SUPERCONDUCTOR ROCKETS: Blasting to the Limits of Chemical Rocketry**  
David Negretti et al
- TERRAFORMING MARS: an Investigation into the Feasibility of Transforming the Red Planet to Support a Biosphere**  
Benjamin Kanda

**JBIS**  
Journal of the British Interplanetary Society

2021 covers V74.2, V74.4 and V74.5

[www.bis-space.com](http://www.bis-space.com)

## Recent Interstellar papers in JBIS

V74 #2 Feb 2021			
Defining Intelligence-Favouring Galactic Parameters for targeted SETI searches	Gary S Robertshaw	Innovation Centre, York Science Park, UK	The dark matter (DM) dense galactic mid-plane (GMP) may cause cyclical extinction events (CEEs) on transiting life-bearing planets. This may foster the emergence of intelligent life. Robertshaw hypothesises that the probability of intelligent life emerging is proportional to the number of GMP transits concluding that the emergence of intelligent life is rare, cyclical and confined to specific host stars. Observations of signal beacons from specific types of stars could provide indirect evidence of alien transmissions.
Strategies for the Detection of ET Probes within our own Solar System	John Gertz	Zorro Productions, Berkeley, CA	Are ETs more likely send physical probes to our Solar System to communicate with Earth rather than to communicate from afar? An intentional hunt for those probes would sacrifice SETI sensitivity in favour of a widened field-of-view. The paper suggests strategies to detect local ET probes.
The Wormship: A Dark Energy Ramjet – Engineering, SETI Detectability, and Implications for Cosmic Expansion	Stephen Baxter	UK, contact via agent Selectric Artists, USA	Baxter suggests a tentative dark energy ramjet design, the Wormship. See BIS West Midlands talk 20 November, The Wormship: A Dark Energy Ramjet announced elsewhere in this Interstellar News.
Exotic Fluids Matching the Stress-Energy Tensor of Alcubierre Warp Drive Spacetimes	Willie Béatrix-Drouhet	Paris	Seeking insights into the source of the Alcubierre warp drive, this paper looks for an orthogonal basis from the metric expression finding that exotic fluids can produce the same stress-energy tensor as the Alcubierre warp drive. Some configurations exhibit non-exotic equations of state for warp velocities smaller than 0.004c and seem able to sustain warp velocities up to 2,200c with exotic equations of state.
How Many Alien Probes Could Have Come From Stars Passing By Earth?	James Benford	Microwave Sciences, CA, USA	The paper tells us that about two stars per million years come within a light year of our solar system and a passing ET civilisation, seeing our ecosystem, would send probes to investigate. The estimated probe frequency from passing stars, and their current locations, suggests close inspection of bodies at the Moon and the Earth Trojans in a Search for Extraterrestrial Artefacts (SETA).

In JBIS V74 #4 Apr 2021 Schwartz et al asks *What do we need to ask before Settling Space?* Advocating a “humanitarian review” of proposals, examining the cultural and ethical questions raised by five rationales/objectives for settlement (long-term human survival, resources, scientific knowledge, adventure and spiritual insights) and asking who will participate - arguing for thorough scrutiny of cultural and ethical questions during all phases of settlement.



V74 #5 May 2021			
Genetic Evolution of a Multi-Generational Population in the context of interstellar space travel	Frédéric Marin, Camille Beluffi & Frédéric Fischer	Université de Strasbourg, CASC4DE Strasbourg, Université de Strasbourg	Updating the agent based Monte Carlo code HERITAGE simulating human evolution within restrictive environments such as interstellar, sub-light speed spacecraft to include effects of population genetics incorporating a simplified representative model of the human genome, each individual with his/her own diploid genome. Mimicking gamete production (sperm and eggs), simulating meiosis and mutation of the genetic information from cosmic ray bombardments. A second paper will demonstrate how genetic patrimony of multi-generational crews can be affected by genetic drift and mutations and demonstrating that Hardy-Weinberg equilibrium[1] is reached for starting crews >100 people with larger departing crews (500) showing more stable equilibria over time.
Multi-Perceptual Modalities Message Delivery Module:MAILbox	Suchetan Mummigatti	Cranfield University UK	Updating the idea of the Voyager Golden Records and Pioneer Plaque intended to carry basic information about humanity and planet Earth insights from astrolinguistics, astrosociology, astronautics, and astrobiology, this paper considers the design of a message delivery module: <i>Messaging All Intelligent Lifeforms box (MAILbox)</i> incorporating perceptual modalities avoiding assumptions that the species has similar senses to humans and spaceflight capability while not appearing intimidating, provocative, or misleading about humanity and the Earth.
From the Spacex Starlink Megaconstellation to the Search for Type-I Civilizations	Z N Osmanov	University of Tbilisi, Georgia	Extrapolating from the SpaceX's Starlink satellites to building planetary megastructures (solid objects or a web of satellites) by Type-I civilizations and the consequent detection of their techno-signatures. Showing that the Very Large Telescope Interferometer (VLTI) can potentially observe the emission patterns.
Was the WOW! signal due to power beaming leakage?	James Benford	Microwave Sciences, CA, USA	The Wow Signal, 1977, might credibly have been leakage from an interstellar power beam, perhaps from launch of an interstellar probe, explaining the power density, duration and frequency - and why the Wow source has not been observed again, Such power beams would be visible over interstellar distances but transient and non-repeating. All-sky surveys in both the microwave and laser bands might detect more power beam leakages.

[1] [https://en.wikipedia.org/wiki/Hardy%E2%80%93Weinberg\\_principle](https://en.wikipedia.org/wiki/Hardy%E2%80%93Weinberg_principle)