

The Journals

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Here we list recent interstellar-related papers in the Journal of the British Interplanetary Society (JBIS), published since the 1930s, and Acta Astronautica (ActaA), the commercial journal published by Elsevier, with the endorsement of the International Academy of Astronautics.

JBIS

One issue of JBIS (online) has appeared since the report in our last issue, P40. Later issues are in print but not yet online.

Title (open publication)	Author	Affiliation
Abstract/Précis/Highlights		
JBIS VOLUME 75 NO.12 DECEMBER 2022		
Transitioning from First to Second Generation Lunar Infrastructures	Mark Hempzell	Hempzell Astronautics Ltd
<p>At some point the transportation infrastructure that supports the initial phase of human exploration of the Moon should either transition to, or be replaced by, a second generation infrastructure to support early permanent occupation and exploitation. This transition was explored as part of the Scorpion studies, moving from a transport infrastructure based on a single transport system (the Scorpion) which is supported in Low Earth Orbit by the Skylon launch system, to an infrastructure using multiple systems (with several transport and fixed elements) and the exploitation of lunar resources. While most of the conclusions are specific to the assumptions of the study, one conclusion, that second generation landers should be chemical and utilise in-situ lunar oxygen, would seem to apply regardless of other aspects of the infrastructure architecture. More generally, the main study conclusion is that there is considerable value to conducting such second generation studies if they can have a substantive input during the first generation development. They can establish the framework for technology projects conducted during first generation operations, establish the requirements for first generation systems and components that can have a second generation role, and define the hooks and scars needed for the transition from one generation to the next.</p>		
Will Cardiovascular Adaptations to Hypogravity Impair a Human Mission to Mars? An Analysis	Brett Gooden	International Space University
<p>The total exposure to hypogravity of a crew on a Mars landing mission is estimated to be just less than three years. Such a mission could consist of 18 months of weightlessness during the interplanetary transits and 17 months at one third Earth gravity on Mars. The cardiovascular effects of years of continuous hypogravity during such a mission are presently unknown. This paper reviews the current state of research on the cardiovascular adaptations to weightlessness, which is based largely on mission times of up to six months and examines the aetiology of these adaptations. It considers how these adaptations relate to the clinical phenomena of current concern, namely fluid shift, Spaceflight-Associated Neuro-ocular Syndrome (SANS), jugular venous thrombosis and orthostatic hypotension. Methods used in an attempt to prevent or attenuate the occurrence of the cardiovascular adaptations during weightlessness, and orthostatic hypotension on re-entry, landing and post-flight, are examined. Based on this analysis, the potential cardiovascular risks to the crew undertaking a landing mission to Mars are discussed, and possible directions for future research into the effects of years of continuous hypogravity on the cardiovascular system are outlined.</p>		

◀ Acta Astronautica

Title	Number+date	Author	Affiliation
System analysis of an ISRU production plant: Extraction of metals and oxygen from lunar regolith	Volume 203, February 2023, Pages 187-201	Hong-Xin Shen et al	Technical University of Munich, German Aerospace Center
<p>A study was conducted to compare the performance of three different ISRU production plants that extract metals and oxygen from regolith at the lunar South Pole. The processes selected were: (1) hydrogen reduction of ilmenite and carbonylation to produce low-carbon steels, (2) molten regolith electrolysis to produce ferrosilicon alloys, and (3) molten salt electrolysis, in particular the FFC-Cambridge process, together with vacuum distillation, to produce aluminum-silicon alloys. Holistic system sizing models, including excavation, beneficiation, handling, oxygen extraction and purification, metal processing, gas liquefaction and storage, thermal control, and power, were developed to determine the overall ISRU mass and power budgets. The most effective ISRU production plant preliminarily requires 6776 kg of hardware mass to produce 25 t/a of ferrosilicon alloys from Highlands regolith through molten regolith electrolysis. This facility coproduces 23.9 t/a of oxygen, presenting a total mass payback ratio of 0.14 kg of hardware/(kg of product/a). Sensitivity analyses are presented for the initial ilmenite and anorthite concentrations in regolith. The salt ratio (kg of molten salt per kg of regolith) of the FFC-Cambridge process and the degradation rate of the molten regolith electrolysis reactor are identified as key parameters that determine the feasibility of these ISRU processes. The mass and power of the production plants exhibit a slight economy of scale, indicating that larger amounts of metals and oxygen can be produced more efficiently.</p>			
Solar sail with inflatable toroidal shell	Volume 202, January 2023, Pages 17-25	Francisco J Guerrero- Gonzalez, Paul Zabel	City University of New York / Samara National Research University, Russia
<p>In the framework of a strict mathematical approach based on classical theory of elasticity we present an idea of the deployment and stretching of the circular solar sail attached to the inflatable toroidal shell. It is predicted that by introducing the gas into the inflatable toroidal shell one can deploy and stretch a large size circular solar sail membrane. The formulas for the toroidal shell and sail membrane stresses and strains caused by the gas pressure in the shell are derived. The analytical expressions can be applied to a wide range of solar sail sizes. Numerical calculations for the sail of radii up to 100 m made of CP1 membrane and attached to the toroidal shell with the varied cross-section radius are presented. The normal transverse vibration modes of the sail membrane under tension caused by gas pressure in the shell are calculated. The feasibility of deployment and stretching of a solar sail with a large size circular membrane attached to the inflatable toroidal shell is demonstrated.</p> <p>No open access found.</p>			
Pressurized lunar lava tubes for habitation	Volume 204, March 2023, Pages 157-174	Raymond P Martin, Haym Benaroya	Blue Origin, Rutgers (State University of New Jersey)
<p>Lava tubes are subterranean tunnels that form as a result of lava flows and appear to extend for long distances beneath the surface of a planet. They are a naturally occurring feature of the Moon. For decades these cave systems have piqued the interest of researchers, not just for their geological complexity, but also for their potential as a habitation site when humans return to the Moon. The internal environment of a lunar lava tube promises to be a benign alternative to the harsh lunar surface; it can provide natural protection from radiation, micrometeoroids, and extreme temperature fluctuations. This paper furthers the study of lunar lava tubes by presenting the possibility of pressurizing them with breathable air. Using a 2D ANSYS simulation model, a range of lava tube sizes are subjected to varied magnitudes of internal pressurization. It is ultimately concluded that it is possible to pressurize a small lava tube while maintaining its structural integrity.</p> <p>Full text available via: scholar.archive.org/work/4nugy7qwqjadnbtm4bruy14oq/access/wayback/https://rucore.libraries.rutgers.edu/rutgers-lib/67372/PDF/1/</p>			

Analyzing the engineering feasibility of the direct fusion drive	Volume 206, May 2023, Pages 57-71	Yuvraj Jain, Priyanka Desai Kakade	Manipal Institute of Technology (India). Sheffield Hallam University (UK)
<p>The Direct Fusion Drive (DFD) and its terrestrial counterpart, the Princeton Field Reversed Configuration (PFRC) reactor, have seen significant developments in the past decade. Various groups conducted detailed research on the required specifications of the engine and associated technology for power delivery to onboard avionics and payloads. Multiple studies have also addressed the thrust generation mechanism using empirical specific power scaling relations and plasma flow simulations. Recent studies have designed spacecraft for missions to Earth's second Lagrange point, Mars, transneptunian bodies like Pluto, and the neighboring star systems Alpha Centauri A and B. However, significant work is needed to design the engine components in detail using scientific scaling relations and ab initio calculations to develop the physical systems for prototyping and testing. After critically analyzing the reference design of the DFD and the underlying fusion reactor, this paper addresses the technological gaps and suggests avenues to improve specifications toward targets outlined in previous studies while considering costs. Further, the authors present a prototype engine and magnetohydrodynamic power conversion system design to study the engineering hurdles relevant to the practical implementation of the DFD.</p> <p>No open access found.</p>			

Near-term strategies to rendezvous with an interstellar object	Volume 206, May 2023, Pages 133-143	Damon Landau, Benjamin Donitz, Reza Karimi	JPL
<p>Interstellar Objects (ISOs) offer a unique opportunity to answer fundamental questions about the nature of objects that originate outside our Solar System. Only two members of this new class of mission target have been identified: asteroid 1I/'Oumuamua in 2017 and comet 2I/Borisov in 2019. Many more are expected to be found with the introduction of the Vera C Rubin Observatory motivating the formulation of mission concepts to investigate future ISOs. While fast flyby missions are technically feasible today, rendezvous missions that orbit or even land offer the only means for literal ground truth into the nature of these objects. Mission design and propulsion capability are current challenges due to the brevity of ISO paths through the Solar System. These challenges may be overcome with a trade space of detection capabilities, launch vehicles, trajectory designs, and near-term spacecraft technology development. In particular, the combination of Jupiter gravity assist and nuclear electric propulsion provides the highest likelihood of delivering a spacecraft to match the orbit of an ISO.</p> <p>No open access found.</p>			

The inferred abundance of interstellar objects of technological origin	Volume 208, July 2023, Pages 124-129	Carson Ezell, Abraham Loeb	Harvard University
<p>Interstellar objects discovered crossing through the solar system can either be natural objects or technological artifacts from extraterrestrial civilizations. Evidence from our own civilization suggests that early-stage technological civilizations are already able to launch artificial objects beyond their star system, and early-stage to late-stage technological civilizations in the Milky Way may have an interest in exploring potentially habitable regions throughout the galaxy. Based on our rate of detection for both natural and artificial populations of interstellar objects, we can estimate their respective local number densities and the total quantity of such objects bound by the Milky Way thin disk. We propose a model for calculating the quantity of such objects based on their observed velocity and number density. We consider the relevance of our model given several detections of interstellar objects over the past decade, and we discuss the implications of the estimated quantity of both natural and artificial objects for understanding their nature and origin.</p> <p>Full text available via: arxiv.org/abs/2209.11262</p>			