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#### 1] Space innovation is high and on the rise- but innovation could tank in the absence of private companies

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After publicly stalling out due to cost concerns circa 2011, America’s space race is quickly heating up again. Only instead of NASA, this time it’s being spearheaded through private space exploration by three billionaire investors and the companies that mirror these entrepreneurs’ out-of-this-world ambitions: Richard Branson (Virgin Galactic), Elon Musk (SpaceX) and Jeff Bezos (Blue Origin). Expected to be a $1.4 trillion market by 2030, according to analysts at Bank of America, private space exploration and tourism are already ushering in a host of new innovations outside of traditional aerospace and defense realms. For example: Morgan Stanley suggests that the business world’s growing rush to reach orbit may also help sate the world’s ever-growing appetite for high-speed satellite broadband technology and data, kick-start rocket-fueled delivery services and even enable asteroid mining in years to come. Here, we take a closer look at the field’s three front-runners, how each is pioneering new scientific advancements, and various trickle-down innovations that private space exploration may soon bring back to dozens of industries on planet Earth. Virgin Galactic On July 11—just 17 years after announcing the company—Virgin Group founder Richard Branson took his inaugural trip 53 miles above the Earth’s surface in Virgin Galactic’s suborbital, rocket-powered space plane VSS Unity. Capable of holding six passengers and two pilots, the craft isn’t likely to be earthbound for very long; the company has already sold around 600 tickets for flights at the princely sum of $200,000 to $250,000 apiece. As of early August, more tickets were available starting at $450,000 each. The increasing desire for private space exploration points to companies’ growing desire to more cost-efficiently use resources, leverage emerging or preexisting technology in new ways, optimize processes and workflows, and pioneer new markets by democratizing access to resources and equipment. The first of the billionaire space company founders to reach the edge of space (depending on the definition), Branson did so thanks to myriad scientific and business innovations made by his firm. Advancements not only include a new high-speed aircraft design that leverages modular technology to improve flight rate and maintenance access. They also incorporate a livery design built from a mirrorlike material that provides heightened thermal protection and color-changing potential, a spectacular display of the plane’s advanced capabilities in keeping with Branson’s notoriously flashy brand of showmanship. These upgrades have helped power Virgin Galactic’s ongoing push to capture public and media attention, enticing armchair astronauts to fulfill childhood dreams and fueling a booming business in space tourism. Moreover, unlike traditional crewed rockets, which launch from ground-based locales, Virgin’s ships lift off from bigger planes that drop them off in midair. It’s a highly efficient technique that consumes less fuel and reduces the need for custom launch pad infrastructure. Passengers, who can enjoy three to five minutes of weightlessness, will soon include scientists who can run experiments midflight, as opposed to primarily using traditional suborbital space testing methods—i.e., spacecraft without a crew. SpaceX Tesla founder Elon Musk’s SpaceX is an all-purpose space technology firm that designs and manufactures myriad cutting-edge rockets and spacecraft. Case in point: Its Dragon capsule has already proved it can cost-efficiently carry crew and cargo to the International Space Station. The company’s Starship large-scale rocket and spacecraft system is also designed to carry massive payloads into orbit—and, thanks to NASA’s support, is expected soon to land the first astronauts on the moon since the Apollo program. Not yet 20 years old, SpaceX is additionally focused on introducing more dependable equipment at a fraction of standard production and operating costs. Other innovations include the Falcon 9, a reusable two-stage rocket for repeatedly transporting people and equipment into space, and Falcon Heavy, the world’s most powerful rocket today, which can carry twice as much weight as its closest competitor. SpaceX’s ambitions even extend to commercial space flight and ride-sharing if you or your company’s inventory need to catch a quick lift into the atmosphere. Almost as curious as the company’s public-facing creations are those powering its operations behind the scenes, including a fleet of autonomous drone ships that catch rockets as they hurtle back to earth, landing in the ocean. SpaceX is also heavily investing in building out Starlink, a broadband internet service powered by thousands of satellites that has the potential to bring high-speed connectivity to remote and rural areas around the globe. In short, by leveraging a host of leading-edge technical advancements to power practical innovations in communications, transport and aerospace operations, SpaceX aims to privatize the field of space flight as a whole. No wonder NASA ranks among the company’s biggest customers. Blue Origin The brainchild of Amazon founder Jeff Bezos, Blue Origin was founded in 2000 with the mission of expanding humanity’s reach into space, fueling interstellar exploration, and powering the search for new material and energy resources. It hopes to do so by delivering low-cost, fully or partly reusable orbital launch vehicles that can serve the needs of businesses and individuals alike. One person recently paid an astounding $28 million for a ticket. Unlike Virgin Galactic, Blue Origin makes spacecraft that are able to cross the Kármán line—the 62-mile-high measurement that most countries consider to be the boundary of outer space. (The U.S. uses 50 miles as a benchmark instead.) The company’s mantra is “Launch, Land, Repeat,” a testimonial to its commitment to drastically lower expenses associated with space travel, and to the built-in vertical takeoff and landing technology that allows used vehicles to be quickly refurbished and once again take flight. Note that Blue Origin is also experimenting with oversized lunar landers designed to ferry astronauts and equipment affordably to and from the moon. Investment Opportunities and New Innovations The increasing desire for private space exploration points to companies’ growing desire to more cost-efficiently use resources, leverage emerging or preexisting technology in new ways, optimize processes and workflows, and pioneer new markets by democratizing access to resources and equipment. Each of the big three players has sought to tap into a mix of proprietary and community knowledge bases, leverage new high-tech and engineering advancements to lower overhead and operating costs, and boost the accessibility of space travel. Likewise, all have looked to raise public awareness, amortize their investments in new innovations and extend potential revenue streams by finding new business applications for their proprietary solutions at every turn. To read more about the commercialization of space, read “Commercial Space Is Becoming Big Business.” Virgin Galactic is publicly traded, Blue Origin and SpaceX are not. However, more than 10,000 companies (42% of which are American), worth upward of $4 trillion in total, are now pioneering space-based business solutions. In addition, many of these firms—which are looking to make plays in many fields, like telecom, tourism, artificial intelligence and robotics—are investor-friendly startups helping to further capitalize or expand upon the innovations that the big three players are ushering in. Key areas of growth going forward for space-based business are expected to include navigation and mapping, satellite communications, cloud-based applications, manufacturing, and health care/medicine. And that’s before you factor in potential research and scientific applications. Example: the University of Florida researching plants’ changing gene activity in weightless environments via experiments conducted in partnership with Virgin Galactic. It’s yet to be determined whether billionaire-funded private space exploration spaceflight firms will successfully deliver on their aim to democratize space travel, or such trips will remain a prohibitively pricey luxury for most aspiring voyagers. Regardless of whether casual flights into space and stargazing business or research contracts become more commonplace, it’s clear that this nascent field has a promising future. While a Jetsons-style culture of weekend jaunts into orbit is still the stuff of science fiction for now, don’t forget: Succeed or fail, to their credit, all of these firms are helping expand businesses’ ambitions to the stars and beyond and helping illustrate a multitude of potential new uses for aerospace solutions.

#### 2] Private space firms are key to promote competition and drive innovation

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On 11 July UK billionaire businessman Richard Branson travelled to the edge of space in a spaceplane developed by his company, Virgin Galactic. On Tuesday this week, the billionaire founder of Amazon, Jeff Bezos, will take a similar trip to space aboard the New Shepherd rocket built by his Blue Origin company. Elon Musk’s SpaceX will soon begin sending paying civilians into Earth orbit with the company’s Falcon 9 rocket. The ability of such billionaires to afford private spaceflight trips or invest in heavy-lift rockets, while paying a smaller fraction of income in tax than the average American, reflects inequality in America. This inequality has been made especially stark during the COVID-19 pandemic with billionaires’ wealth increasing while many others experienced financial hardships. Increasing wealth and reaching for space has not purchased popularity for these billionaires. Ahead of Bezos’ upcoming suborbital flight, a petition to “not allow Bezos to return to Earth” gained more than 160,000 signatures. Richard Branson has been criticized for using his wealth to go to space rather than addressing more terrestrial problems like climate change. But after half a century of government-led exploration beyond earth, why are billionaires now at the forefront of our minds when we think about space travel, and what do they mean for how we go to space? The private sector has always had a close involvement with space Billionaire interest in space is not new. Historically, science research funding for observatories in the 19th and 20th centuries was typically provided through endowments from wealthy individuals. Institutions such as the Smithsonian and the Guggenheim family were the early donors of Robert Goddard’s ambitious projects to develop rockets and space technology. Following 1980s initiatives like MirCorp’s plan to provide privately owned space stations, the 1990s and 2000s saw commercial space efforts like Peter Diamandis’ introduction of the Ansari X Prize (1996), the US government’s Alternate Access to [the International Space] Station Program (2000-2002), and the founding of Mojave Aerospace Ventures (2004). Between 2001 and 2009 seven wealthy people went to space as paying customers on Russian Soyuz rockets including Dennis Tito, Iranian American businesswoman Anousheh Ansari and Cirque du Soleil founder Guy Laliberte. More recently, aside from Jeff Bezos and Richard Branson, other billionaires have also planned trips to space, including Jared Isaacman and Yusaku Maezawa. The wave of billionaires now seemingly interested in space exploration is a return to a past trend. Space exploration is expensive Private actors and the government think differently when it comes to what type of space programs to prioritize. The government prioritizes aspects of a space program that are in the public-interest such as national security and Earth sciences, while wealthy individuals that enter the space sector are interested in personal and financial endeavors that involve space exploration, such as making life multiplanetary for Elon Musk and space tourism for Richard Branson and Dennis Tito. The Apollo program which ultimately sent astronauts to the moon in 1969 is thought of as the height of US government leadership in space. But the massive investment which made the first moon landing possible was an anomaly that had been driven by political necessity given the climate of the Cold War. As Figures 1 and 2 show, by 1965, the US government had begun to cut NASA’s budget to the point that by the 1970s it made up only about 0.5-1 percent of the total federal budget. According to Dr. John Logsdon of George Washington University’s Space Policy Institute: “From 1970 onward, NASA has not had a budget adequate to support a robust program of human exploration.” Figure 1 – NASA’s budget from 1959 – 2025 Source: The Space Report Figure 2 – NASA’ share of US federal Budget 1959-2018 Source: The Space Report The lackluster interest in space exploration by the US government since the 1970s sits alongside with a similar lack of enthusiasm by the American public. In a 2018 survey conducted by Pew Research Center, a majority of American adults believed that that monitoring Earth’s climate system should be the highest priority and sending astronauts to Mars and the Moon the lowest (Figure 3). Figure 3 – Americans’ views on policy priorities Source: Pew Research Center, 2018 Re-emergence of commercial space At the same time, many wealthy individuals have been dissatisfied with the lack of public enthusiasm and the lack of progress in recent years due to the government’s traditional view of space operations, and failures of the Space Shuttle. Wealthy individuals like Musk believed that they could spur a robust marketplace for providing access to space which could work alongside and provide services for government space agencies by leveraging reusable technologies, lean manufacturing, and vertically integrated production to enable cheap space access. Because typical debt and equity investors are unwilling to finance the risks of space exploration and the government is unable or uninterested in large up-front investments, it is natural for private space exploration to be funded out of billionaire’s own wealth initially, with government support through development contracts. Government support and US Commercial Space Policy Without the government, the private sector cannot thrive in space. The government supports the private sector by adopting regulatory reforms or creating contracts and awards. Early attempts to invigorate the commercial space industry include the 1984 Commercial Space Launch Act, which was unsuccessful as US launch firms were unable to compete against NASA’s Space Shuttle. President Reagan’s 1986 US Space Launch Strategy reduced NASA’s ability to provide commercial launches, which led to the re-emergence of commercial space activities. The limitations provided by the 1986 policy led to the first commercial space launch by Space Services, Inc. in 1989. The US government under the Obama administration made policy reforms such as introducing fixed price contracting to support development of commercial services. An example of this was a request for over $6 billion to subsidize commercial crew vehicles to visit the International Space Station for the Commercial Crew Resupply (CRS) program. Congressional appropriators in the Senate created a “Dual-track” approach, exemplified by the 2010 NASA Authorization Act, which calls for commercial cargo development. The bill shows that policymakers were willing to compromise on certain aspects of the space program such as CRS to support private space launch companies. By 2010, commercialization was well underway with Obama’s National Space Policy that emphasized supporting a “competitive US commercial space sector.” As of 2011, NASA had paid SpaceX $181 million for 14 Commercial Resupply Missions and $298 million under the Commercial Orbital Transportation Services Demonstration Agreement. The Trump Administration increased public investment in private space actors further and established a series of Space Policy Directives that were meant to bolster the commercial sector. Government support to the private sector further comes in the form of NASA- approved loans, loan guarantees, and tax credits. Firms can also receive tax exemptions through facility constructions, discounted loans, and environmental credits. It is estimated that all of Musk’s ventures, not limited to SpaceX, received at least $4.9 billion in government support through tax breaks, factory construction, discounted loans, environmental credits, facility loans, and rebates to product buyers. Photo by SpaceX on Unsplash How billionaires support the space industry Private investment in space has created competition and reduced space launch costs. New space actors began to challenge the government-created monopoly, United Launch Alliance (ULA), for contracts, creating competition and introducing a market for small-medium class reusable launch. SpaceX’s Falcon 9’s average cost is $62 million, while ULA’s Atlas V starts at $110 million per launch. Commercial actors enable the government to have multiple competitive proposals to select from during project development. NASA would pay less money upfront for a service, while private companies can operate and have autonomy over their final product. The government can act as a buyer of commercial services, which allows NASA to be more efficient and cost-effective, as the agency can cut costs by only developing projects it has expertise and funding for. Such competition has dramatically changed space technology. New players that enter the space industry are able to embark on ambitious projects at a greater scale and faster pace. Innovative concepts such as reusable rocket stages has shifted the launch industry into integrating reusability into vehicle design and the proliferation of ridesharing missions has decreased the costs of space launch. This has lowered barriers to enter the space industry, making small satellites rideshare as low as $1 million per mission. Innovations in space launch have further changed the policy environment and streamlined launch and reentry regulations. Billionaires in space are here to stay Investment from wealthy individuals in recent decades have stimulated private markets and paved the way for many startups to enter the industry. As more new players join the commercial space industry, access to space becomes cheaper, resulting in an explosion of proposed satellite constellations and small launch vehicle concepts. Wealthy entrepreneurs have seen an opportunity to take advantage of a lack of government interest in space exploration funding. The high-risk nature of space exploration requires substantial upfront investment that only wealthy individuals can provide before any pay-off. Private investments in space promote competition and innovation. Billionaires providing upfront investments has stimulated the space market and made space more accessible – and profitable.

#### 3] Space innovation is key to colonizing outer space- scientific discovery promotes breakthroughs that benefit society

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Every once in a while, a confluence of discoveries, events and initiatives results in a breakthrough so significant that it propels the entire world to a higher level, redefining what is possible in so many different fields. This breakthrough is taking centerstage now, as the new era of space exploration — catalyzed by increasing launch access — dawns upon us. The surge of innovation that comes with this will create new opportunities and inspire the next generation of doers. When this happens, boundaries between scientific and social impact are blurred. Innovation leading to scientific discovery can benefit society in the same way that social innovation can diversify and support scientific innovators, who can contribute to global progress. To ride this wave of progress, we must all participate and innovate in the new era of space exploration. The intersection of space exploration, innovation and impact isn’t a new phenomenon. In the past, technology developments and spin-offs from space research have consistently found their way into communities worldwide sometimes with lifesaving benefits. The International Space Station supports experiments that have led to discoveries and inventions in communication, water purification, and remote guidance for health procedures and robotic surgeries. Satellite-enabled Earth observation capabilities that monitor natural disasters, climate and crops often support early warnings for threats and mitigation strategies. Space exploration has always been relevant to everyone no matter the discipline or interest. Commercialization of space has been key in many ways to the current boost in “firsts” over the last few years. It has spurred innovation in launch vehicles and related technologies that led to firsts in vertical-takeoff-vertical landing rocket technology, reusability of rocket boosters and privately developed crewed missions to orbit. Concurrently, NASA has continued to captivate our imagination with the first flight of a helicopter in another world, a mission to return an asteroid sample to Earth and sending a probe to make the closest ever approach to the sun. While we celebrate the scientific progress, there is a vastly important question that we all need to focus on: How can we drive the surge in innovation offered by increased access to space, to benefit humankind? Access to low-Earth orbit, and eventually human exploration of space, is a portal to achieve many impactful outcomes. The numbers and completion rate of microgravity experiments conducted by scientists will be greatly increased as a range of offerings in suborbital flights provide more opportunities to advance critical research in health, agriculture, energy, and more. Lunar, planetary, and even asteroid exploration may lead to discoveries of new materials — busting the limitations now imposed on capabilities for energy, transportation, and infrastructure or creating new sensors and devices that enhance safety on Earth. Space tourism —one can hope — has the power to potentially create an awareness of our oneness that may lead to social change. But much like all scientific endeavors, we cannot ignore the importance of pre-emptively identifying and mitigating negative impacts of new ventures some of which may have already taken shape. We need to consider space debris that threatens the very access that facilitates it, safety and rescue readiness to support increased crewed missions and space tourism, national security, and effects of light pollution on astronomy. Much of these can be approached and mitigated with new concepts and ideas that have already been set in motion. One thing is for certain, space has always been the inspiration for the next generation of innovators and creative thinkers. Architects of new ideas in this era will inspire many more. Ingenuity must also come from academic and research institutions building a new space-ready generation through innovative curriculum, scholarships, and research opportunities for key fields at all levels. Most of all, engaging participation is a responsibility anyone can take by steering the conversation and gathering ideas on how we can make this era one of positive benefit for all, while making opportunities inclusive to all.

#### 4] Private space firms are on the verge of colonizing outer space- the plan stops them now by cutting competition

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Humans have long desired to explore the vast realms of space. Today, we are finally poised to send people out into the cosmos. Indeed, a number of private and public space companies are gearing up for Space Race 2.0 — a (very expensive) competition that inches us closer to uncovering answers about our universe and exploring new realms of our own humanity. Though they are still in the race, shifting priorities and limited budgets have undermined NASA’s lead in exploring the solar system and beyond. In the meantime, private entities like SpaceX and Virgin Galactic are flush with cash, and they are stepping up to try and engineer better, bigger, and faster rockets. And this is a good thing because, if humans are to find life on other planets, or perhaps a new planet for ourselves, more work needs to be done. Engineers and scientists need to develop life support systems, find reliable sources of water and fuel, overcome the negative effects living in space has on the body, and find a faster way to travel. There is still much to be done, but sending the average person to the Moon and beyond no longer seems so far out of reach. Yet, when will it finally happen? When will humans finally roam across an alien world? Here’s a comprehensive timeline of our future beyond Earth. Late 2017: Heavy Falcon Launch SpaceX plans to launch the Falcon Heavy for the first time before the end of 2017. Because the rocket can be reused, the Falcon Heavy rocket can deliver its payload into space at only a third of the cost of the next closest operational vehicle, the Delta IV Heavy. This lower upfront cost means that more organizations can carry out experiments in outer space. One of these experiments is the Planetary Society’s LightSail 2 solar sail that will launch on board a Heavy Falcon in early 2018. SpaceX’s Falcon Heavy rocket lives up to its name. 27 rocket engines weigh down the 70-meter (229-foot), 1.4-metric-ton (3.1-million-pound) rocket. That’s a lot of extra weight, but the payload makes it worthwhile — the rocket can launch 63,800 kg (140,660 lbs) of equipment, cargo, and passengers into orbit around Earth. That’s more than double the weight that the Space Shuttle can haul to the same altitude. 2018: Preparing For Space Tourism In 2018, SpaceX plans to launch more than ever before, sending 30 rockets into orbit (up from 20 in 2017). More attempts give the company more data to show how it can perfect its technology to launch rockets cheaply and securely. Eventually, this inexpensive and safe spaceflight will make space tourism finally viable. In fact, just this year, SpaceX announced that they would be sending two humans to orbit the Moon in 2018. Image Credit: Virgin Galactic Virgin Galactic is gearing up to launch its first astronauts into space before the end of February 2018. Before it launches with passengers on board, though, the spacecraft will have to undergo a series of test flights. The space plane, called the VSS Unity, completed its fifth ‘glide flight’ (distinct from the vertical trajectory of traditional space rockets) earlier in 2017. In the first months of 2018, it will be taking flights closer to the Karaman line, the official border between the Earth’s atmosphere and outer sp ace located 100 km (62 miles) above the Earth’s surface. Image Credit: Planetary Society Around that same time in early 2018, scientists will test the LightSail 2, a device that moves through space by harnessing the power of solar photons — no fuel tanks or thrusters required. The LightSail 2, a citizen-funded spacecraft and created by the Planetary Society (the largest nonprofit organization that promotes the exploration of outer space), would be a proof of concept that solar sailing could propel spacecraft deeper into space. The unmanned, light-propelled spacecraft will hitch a ride on SpaceX’s Falcon Heavy rocket before taking its test flight at an altitude of 720 km (447.4 miles). 2019: Space Tourism And Observation Image Credit: Blue Origin Blue Origin, the spaceflight services company started by Amazon founder Jeff Bezos, recently announced that it intends to take tourists to space before April 2019. In groups of six, passengers will board an 18-meter (60-foot) rocket to the edge of space, around 100 km (62 miles) from the Earth’s surface. Once there, they will experience zero-gravity flight. Three independent parachutes and a retro-thrust system ensure that passengers will gently sail back to Earth. This experience does not come cheap — a ticket to board the New Glenn to reach Earth orbit is rumored to cost anywhere between $150,000 and $250,000. And, yet, there’s little question that people will want to sign up — Virgin Galactic, a competing space tourism project, reportedly already has 700 people signed up. In 2019, Blue Origin plans to add two- and three-stage rockets to its arsenal. They are fully reusable, up to 99 meters (326 feet) tall, and can deliver payloads at a relatively low cost, competing with SpaceX’s Falcon Heavy rockets. Image Credit: NASA NASA also intends to launch its James Webb Telescope in the first quarter of 2019. The telescope will observe the solar system in the infrared to see every phase of the solar system’s maturation; it will ultimately be 100 times more powerful than the Hubble Space Telescope, thanks to its array of 18 hexagonal mirror segments. With a combined mirror diameter of 6.5 meters (the Hubble measures in at only 2.4), the James Webb Telescope will be able to detect events such as the formation of galaxies dating back to the time of the Big Bang. It will also have a special focus on discovering new planets that could be capable of supporting life. 2020-2025: “Earth Reliant” And Beyond From finding evidence of liquid water to detecting organic matter in the soil of the Red Planet’s surface, the Curiosity rover has answered some fundamental questions about what it’s like on Mars. However, that information has also sparked more questions about what other elements may be present. To this end, in an effort to establish whether oxygen is present in the Martian atmosphere, and at what concentration, Curiosity’s successor, the Mars 2020 rover, will be saddled with a host of sensors and instruments that will allow it to answer this question. Information about oxygen concentration will be important if humans are ever able to visit the Red Planet themselves, which could be possible as early as 2030. There are other things that need to happen if we’re going to colonize other planets. NASA has established three phases that we need to complete before this is possible. In the first, which NASA calls “Earth Reliant,” we continue to test the feasibility of living in space and conduct more research aboard the ISS. In the second (“Proving Ground”), operations around the Moon will be used to establish ways to return humans to the Earth safely. With those stages complete, we will finally reach the third stage (“Earth Independent”) in which humans establish a self-sufficient colony on Mars. Image Credit: NASA Just over 50 years after humans first touched the lunar surface, NASA is gearing up to launch another manned spacecraft to go beyond the Moon. The astronauts will be on board a ship called the Orion, which will lift off using NASA’s Space Launch System (SLS), a modular heavy launch vehicle. SLS is similar to SpaceX’s Heavy Falcon and has a maximum payload of 70 to 130 metric tons (150,000 to 290,000 lbs). First, though, the spacecraft will do a few test runs without any humans on board. The first mission, Exploration Mission-1, is slated for late 2018. The SLS will launch the unmanned craft, travel to the Moon, enter orbit about 100 km (62 miles) above the lunar surface, and use gravity to propel itself into deep, unexplored space. The goal of this mission is to see if the craft can help humans survive a trip to distant planets. The second mission (Exploration Mission-2), planned for August 2021, will be NASA’s first manned test flight beyond the Moon. “During this mission, we have a number of tests designed to demonstrate critical functions, including mission planning, system performance, crew interfaces, and navigation and guidance in deep space,” Bill Hill, the deputy associated administrator of Exploration Systems Development at NASA Headquarters said in a 2016 NASA blog. To gain enough momentum to make the trip around the Moon, the spacecraft will have to make multiple orbits around Earth, occasionally igniting its thrusters. During its stable orbit of the Moon, the Orion will gather data and test the spacecraft’s capabilities for interplanetary flight. 2022: Making Mars Habitable While NASA spends the 2020s exploring how to best keep humans healthy in space, SpaceX plans to start putting down the infrastructure for humans to colonize it. SpaceX anticipates completing its first 54.6-million-km (33.9-million-mile) trip to Mars in 2022. Image Credit: SpaceX In his update earlier this year, Elon Musk revealed plans for a rocket that is far bigger and more powerful than NASA’s Space Launch System and even his agency’s own Falcon Heavy — the BFR. A rocket that big would have enough space for fuel to take humans to Mars, or even allow for Earth-based city-to-city travel. With a maximum payload of 150 tons, the enormous 106-meter (347.7-feet) rocket would break the current record for biggest payload (including cargo, fuel, and passengers) launched into orbit, while providing the lowest cost for each additional launch. To reach the Moon, the BFR would launch from the Earth’s surface, transfer propellant from fuel depots previously stationed in Earth’s orbit, accelerate in orbit, pick up an injection of fuel for the remaining distance to the lunar surface on the way, and land. SpaceX plans to refuel the rocket once it is in orbit in order to extend its range and payload capacity so that it can return safely to Earth. Tests have already shown that it’s possible to refuel rockets in space. NASA conducted the Robotic Refueling Mission in 2011, and it successfully completed a robot-actuated propellant transfer on an exposed platform of the International Space Station. Image Credit: SpaceX By 2022, SpaceX expects to land at least two cargo ships on Mars in order to establish a habitat for humans. The primary goal of those initial missions is to find a reliable source of water on the Martian surface. 2024: Manned Missions On The BFR Image Credit: SpaceX Two years after those cargo ships establish an infrastructure, SpaceX plans to send humans to inhabit a colony on Mars. The passengers aboard the BFR’s 40-cabin Mars transit module will be the first to make the unprecedented trip. This is, Musk would probably admit, an aggressive timeline. And it may not work in SpaceX’s favor: Due to planetary alignments and other factors such as solar power requirements and fuel limitations, the launch window of Earth-Mars travel is only a few weeks, according to Wired. And that’s assuming that all the other pieces fall perfectly into place — neither the BFR nor its predecessor, the Falcon Heavy, has yet had a successful launch. Should the BFR mission make it to Mars, it will contain the materials to construct a propellant production plant as part of its Martian colony. The plan would suck carbon dioxide from the atmosphere and turn it into deep-cryo CO4 fuel using solar power. 2025-2030: A Year In Space Image Credit: NASA SpaceX might be ready to send humans to live in space by the early 2020s, but NASA is a little more cautious. The government space agency is planning to put astronauts into orbit for a year to find out if humans are indeed ready to live on a different planet. In March 2016, NASA astronaut Scott Kelly completed a similar year-long mission aboard the ISS to test the effects of zero gravity on the human body and what that will mean for future space travel to Mars. Unlike Kelly’s mission, however, NASA’s 2021 mission will put astronauts in orbit around the Moon. They’ll be in a “deep-space gateway” — a small ISS-like station that will serve as a testing ground for future deep space missions, including later missions to Mars. It will be built over five earlier missions, four of them with humans aboard. The effects of spending a year in lunar orbit on the human body, caused by factors such as different day-night cycles and solar radiation, are still unknown. 2030s: NASA Sends Humans To Mars Five years after SpaceX’s manned missions to Mars, NASA plans to send its own spacecraft to the Red Planet. Using data and samples from the Curiosity and Mars 2020 rovers, NASA will first establish how humans could sustain themselves on the Martian surface before sending manned spacecraft from its deep-space gateway to do so.

#### 5] Not colonizing space directly links to human and extraterrestrial extinction scenarios, which outweigh

Munevar, PhD, 19 [Gonzalo Munevar, Professor Emeritus at Lawrence Technological University, PhD Philosophy @ UC Berkeley. "An obligation to colonize outer space", Futures, Vol. 110, Pg. 38-40, published June 2019, accessed 11-1-2021, https://www.sciencedirect.com/science/article/abs/pii/S0016328718302660#!] HWIC

We have an obligation to colonize outer space. This colonization may include establishing bases on the Moon, Mars, and other bodies in the solar system, perhaps leading to terraforming some of them, as well as building the sorts of space colonies championed by Gerard O’Neill.1 By doing so we may save humanity from collisions with asteroids and other cosmic catastrophes, while also bringing clean energy to Earth and giving us access to the resources of the solar system. Carrying out such tasks will, moreover, increase our scientific knowledge of heaven and Earth. A collision with a large asteroid may bring human life on Earth to an end. Space colonization would allow human life to continue. Smaller, and far more likely, collisions will cause great destruction and kill millions of people. Furthermore, a heavy human presence throughout the solar system would make it possible, even highly probable, that many such collisions may be prevented, thus saving billions of humans, and many other living beings, from a horrible death. And whether we are able to avert such a catastrophes, the sun will become a red giant in four or five billion years; but even long before then, it will make the Earth an unbearable planet. In the long run, thus, space colonization will give terrestrial life another chance. Space colonization will give us many opportunities to improve the Earth itself, for example by moving polluting industries into space, providing clean solar power from space at reasonable prices, and making available to our home planet many of the resources of the asteroids and other bodies in the solar system. Doing so will enable us to increase our knowledge of the universe, and particularly of planetary science, which would then permit a wiser approach to our own planet. The word limit narrows my scope, and thus I will concentrate on the likelihood of collisions with comets and asteroids. Gravitational disturbances of the asteroid belt, the Kuiper Belt (a little beyond Pluto) or of the Oort cloud, in the outskirts of the solar system, send many large bodies towards the sun.2 Some of them collide with the planets and moons of the solar system. Consider that there are trillions of objects larger than 1 km and billions larger than 20 km in the Oort cloud alone. Given its position, and its gravitation, the Earth becomes a target for collisions. Even in recent geologic times (within the last 100 million years) large meteors indeed have collided with the Earth, altered the weather catastrophically and brought extinction to the majority of species then living. One asteroid about 10 km in diameter, now called the Alvarez asteroid, is held responsible for the disappearance of the dinosaurs about 65 million years ago,3 although some think a comet may have been the culprit.4 And in 1994, large fragments of Comet Shoemaker-Levy 9 hit the atmosphere of Jupiter at velocities over 200,000 km per hour, exploding with a brightness as much as fifty times that of the entire planet, and ejecting searing materials thousands of kilometers above the clouds. Had Shoemaker-Levy 9 hit the Earth instead, we would have gone the way of the dinosaurs.5 Apart from the realization that our natural history has to make conceptual room for such catastrophes,6 there is a most obvious practical issue of survival involved. With a reliable tracking system in place, space technology might allow us to change the orbits of those comets or asteroids most in danger of colliding with the Earth. But how worried should we be? According to present models, meteors large enough to create Meteor Crater in Arizona would hit an urban area every 100,000 years on average. That meteor was presumably 60 m across; the crater is 1.2 km across. A body with a diameter of 250 m would cause a crater 5 km across and destroy some 10,000 square Kilometers (about the area of greater Los Angeles). And global catastrophes would take place every 300,000 years. These would be caused by meteors with a diameter of approximately 1.7 km.7 What is the evidence for these calculations? Soon after impact on Earth, craters are attacked by wind, water, life, lava and a myriad of tectonic motions. In the blink of an eye, geologically speaking, all obvious traces of them disappear from the surface of our active planet. But we find a good record on the Moon. And in Venus, where most of the surface is 600 million years old, the spacecraft Magellan counted nearly one thousand impact craters at least twice the diameter of Meteor Crater. Venus is almost the same size as Earth, and in the Earth’s vicinity, and since the impacts are geologically recent, the Venusian impact record makes it reasonable to fear catastrophic impact on Earth every half a million years or so.8 Still greater collisions, with bodies of 5 km across, would happen, on the average every 20 million years.9 Apart from the asteroid that led to the extinction of the dinosaurs and the majority of species on Earth 65 million years ago, there have been at least two more impacts by asteroids 10 km or larger in the last 300 million years.10 New worries have been caused by the discovery of “rogue planets,” i.e. planets that were expelled from their solar systems and boulder their way through interstellar space. Some will be rocky like the Earth and some will resemble Jupiter, even much larger, carrying their large moons with them. Were one of them to come into our solar system, it would disrupt the orbits of our planets, perhaps sending the Earth itself into interstellar space. A collision would pulverize both bodies. Some scientists think that there are far more rogue planets than stars in the Milky Way, whereas the lowest estimate of Jupiter-size rogue planets is that of one per every four stars.11 Whether those of us living today will experience such catastrophes, eventually our descendants will be thankful to us for creating a warning system and the technology to prevent disaster.12 There can hardly be a better reason than the preservation of life, and perhaps the survival of the species, to establish the importance of colonizing space. An expansion of human colonies throughout the solar system would make it far easier to reach, say, an asteroid in a collision path with the Earth, when it is still very far away, and thus when the angle is small and the necessary alteration of its path will be relatively minor. Such deflection can be accomplished by several means: astronauts could make a smaller asteroid collide with the larger one, or use one of the mass drivers designed by O’Neill. Nuclear explosions might work also. If we are established in outer space. To do a proper mission starting from Earth may take many years, thus making it far less likely to succeed. Robotic deep-space missile platforms, which can never achieve human flexibility, let alone human ingenuity, are unlikely solutions, as can be gathered from previous discussion on robotic missions.13

## 2

#### Text: The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)’s Legal Subcommittee ought to do (the aff)

#### Normal means for treaties involves solely the signatory countries

Berkeley Law Library 16

Berkeley Law (It’s the handbook from the Berkeley law library, just a basic definition), 2016-2-23 (date from source code), "Treaties and International Agreements," Berkeley Law Library, https://www.law.berkeley.edu/library/guide.php?id=65, // HW AW

Treaties can be referred to by a number of different names: international conventions, international agreements, covenants, final acts, charters, protocols, pacts, accords, and constitutions for international organizations. Usually these different names have no legal significance in international law. **Treaties may be bilateral (two parties) or multilateral (between several parties) and a treaty is usually only binding on the parties to the agreement.** An agreement "enters into force" when the terms for entry into force as specified in the agreement are met. Bilateral treaties usually enter into force when both parties agree to be bound as of a certain date.

#### The CP competes off of actor spec – they had complete control over how and who implements the aff, especially in this topic since the actor was not specified in the resolution. The actor is a key, debatable element and a change poses an opportunity cost, which is sufficient for competition.

#### COPUOS has jurisdiction and has passed treaties on similar topics in the past

UNOOSA

UNOOSA (united nations outer space committee), 2021 (no date but written about the 2021 conference), "COPUOS 2021 Session," UNOOSA, <https://www.unoosa.org/oosa/en/ourwork/copuos/index.html> // HW AW

The Committee on the Peaceful Uses of Outer Space (COPUOS) was set up by the General Assembly in 1959 to govern the exploration and use of space for the benefit of all humanity: for peace, security and development. The Committee was tasked with reviewing international cooperation in peaceful uses of outer space, studying space-related activities that could be undertaken by the United Nations, encouraging space research programmes, and **studying legal problems arising from the exploration of outer space**. The Committee was **instrumental in the creation of the five treaties and five principles of outer space**. International cooperation in space exploration and the use of space technology applications to meet global development goals are discussed in the Committee every year. Owing to rapid advances in space technology, the space agenda is constantly evolving. The Committee therefore provides a unique platform at the global level to monitor and discuss these developments. The Committee has two subsidiary bodies: the [Scientific and Technical Subcommittee](https://www.unoosa.org/oosa/en/ourwork/copuos/stsc/2020/index.html), and the [Legal Subcommittee](https://www.unoosa.org/oosa/en/ourwork/copuos/lsc/2019/index.html), both established in 1961. The Committee reports to the [Fourth Committee of the General Assembly](http://www.un.org/en/ga/fourth/), which adopts an annual resolution on international cooperation in the peaceful uses of outer space.

#### **COPUOS is losing legitimacy due to an inability to reach consensus and thereby pass policies – the plan restores faith, discourages weak agreements, solves space debris, sustainability, and security issues**

Masson-Zwaan 19

Tanja Masson-Zwaan (deputy director of institute of air and space at Leiden University), 2019, "SYNOPSIS ON THE NEW SPACE RACE: NEW STATES IN SPACE " Cambridge, https://www.cambridge.org/core/services/aop-cambridge-core/content/view/E68383DE71B60A711EE1E4578CA303A8/S2398772319000138a.pdf/new\_states\_in\_space.pdf, // HW AW

The “old” space race started in 1957 and involved mainly the United States and the Soviet Union. These states led the development of the initial international agreements adopted in the framework of the UN Committee on the Peaceful Uses of Outer Space (COPUOS).1 Within less than two decades, between 1967 and 1984, five international treaties were adopted and entered into force.2 At the time, COPUOS had less than twenty-five member states and agreement was reached relatively easily. Gradually, the group of space actors grew, but space activity remained state-centered and involved a relatively small number of states, while private-entity involvement was mostly limited to the telecommunication sector in the United States. Today, the landscape is entirely different. Not only are more and more states interested and involved in exploring and using outer space, but private entities also have entered the scene, and the trend of privatization and commercialization of space activities is expected to gain more speed in years to come. As the number of states active—or wishing to become active—in outer space has grown, so has the membership of COPUOS, which today counts nearly ninety states.3 It has thus **become more difficult to reach consensus, which has been the working method of COPUOS from the start**. As a consequence of the growing number and diversity of stakeholders, in recent decades the **agreements among states about the use and exploration of outer space have taken the form of principles and other UN resolutions, rather than legally binding treaties**. At the same time, a growing number of new topics require states’ attention. With constant advances in technology, new capacities and activities emerge at high speed, such as ever-smaller satellites, large constellations of hundreds or even thousands of satellites, the prospect of suborbital flights, reusable launch vehicles, on-orbit servicing, and the use of resources from asteroids or the Moon. These developments were not foreseen in the early days of space exploration. Although the UN space treaties and resolutions provide the basic legal framework, some form of further elaboration is now needed to provide clear and predictable standards to govern these new activities. Issues such as the continuing congestion of outer space, the problems related to the mitigation and remediation of space debris, the long-term sustainability of space activities, space traffic management, space situational awareness, and the security of critical space infrastructure will also increasingly require the attention of the international community of states. In this changed landscape with new states, private entities, new activities, and new concerns, it is useful to look at how emerging space nations view the rules that were laid down in the past, the issues that will require regulation in the future, and whether there are any special concerns that influence their positions.4 The main principles of international space law are embodied in the Outer Space Treaty of 1967 (OST). The treaty has been widely adopted and states have consistently acted in accordance with its principles.5 In addition, states have not publicly contested those principles, proposed amendments, or withdrawn from the treaty. Thus, at least parts of the treaty could be considered to have reached the status of customary international law, meaning that they are binding on all states, including nonparties. The following sections highlight principles that are not likely to be contentious for new space states and then identify current principles and future issues that may raise more concerns.

#### Revitalizing COPUOS solves great power space conflict – it is the single organization that has enough member states, legitimacy, and empirical success to ensure peace – it stopped the first space race, it can do it again

McMillan 7-14-21

Anne Mcmillan (journalist trained in law, chai tea enthusiast), 7-14-2021, "The final frontier – 21st century space race," International Bar Association, <https://www.ibanet.org/the-final-frontier> , // HW AW

As far as international oversight is concerned, the UN Committee on the Peaceful Uses of Outer Space (COPUOS) is the main forum governing the exploration and use of space. But it has failed to achieve an agreement on the interpretation of the broad concepts outlined in the OST, and legal developments since 1979 have been in the form of soft law guidelines and principles. Perhaps multinational initiatives led by individual states, such as the recent US-sponsored Artemis Accords, signal an alternative route. These envisage a series of bilateral agreements between the US and individual countries in the context of planned future exploration of the Moon, Mars, comets and asteroids. Nacimiento thinks such initiatives could help to develop space law. ‘There is some indication that international space law may develop in a different form, meaning not necessarily within the United Nations Committee on the Peaceful Uses of Outer Space and via multilateral international treaties. The Artemis Accords signed in October 2020 are one very recent example of how space law could develop in the future.’ However, not all states support the US-led initiative and so far the Artemis accords have only been signed by eight countries. Predictably China and Russia are prominent critics, objecting in particular to a suggestion in Artemis to create ‘safety zones’ around national lunar exploration sites, arguing that this amounts to a creeping claim of sovereignty. Nacimiento concedes that the provision for such zones under Artemis ‘could be in conflict with existing international law prohibiting any form of national appropriation of celestial bodies. It remains to be seen how these Accords work in practice and if they develop into generally recognized principles of cooperation.’ Although much of Artemis reflects existing international law, its future is likely to depend on as much as law itself. The mere fact that the process is led by the US seems to have stoked the fires of competing states, with the head of Russia’s space agency dubbing it ‘too US-centric’. Consequently, China and Russia signed an agreement this year to set up a rival system for exploration of the Moon, planning to establish a joint ‘International Lunar Research Station’. This, like the US-led effort, seeks to attract international partners. Monthly number of objects in Earth orbit by object type As China-Russia cooperation increases, Russia-US cooperation is waning. For many years the International Space Station has been a beacon for international cooperation in space, notably as a forum for detente between Russia and the US. However, it will eventually be de-orbited, possibly as soon as 2024, and with its demise will go a touchstone of cooperation between historical rivals. Clearly, events in space exploration have moved on since the 1967 OST which reduced tensions between Russia and the US. But now, with China as a significant new player, we seem to be witnessing a reignition of the space race. ‘The UN, notably its COPUOS, is still the best forum for all discussions on where the OST and the rest of the framework might need further elaboration, interpretation and implementation, comprising basically all the spacefaring nations,’ says von der Dunk. Based on experience, are international bodies helping to reduce friction in space?

#### The new space race is happening because of a decrease in multilateralism and fracturing of the international community – solvency is reverse causal

Harding 7-16-21

Luke Harding (guardian foreign correspondent for russia, wrote a book about Russian relations called “shadow state”, won James Cameron Memorial Trust award), 7-16-2021, "The space race is back on – but who will win?," Guardian, https://www.theguardian.com/science/2021/jul/16/the-space-race-is-back-on-but-who-will-win, // HW AW

Liu Boming took in the dizzy view. Around him lay the inky vastness of space. Below was the Earth. “Wow,” he said, laughing. “It’s too beautiful out here.” Over the next seven hours Liu and his colleague Tang Hongbo carried out China’s second spacewalk, helped along by a giant robotic arm. Mission accomplished, the two taikonauts – China’s astronauts – clambered back into their home for the next three months: Beijing’s new space station. The core module of the station, named Tiangong, meaning “heavenly palace”, was launched in April. “There will be more spacewalks. The station will keep growing,” Liu said. Meanwhile, on Mars, a Chinese rover was exploring. Video shows the [vehicle trundling over a rocky surface](https://www.theguardian.com/world/video/2021/jun/27/china-releases-footage-from-its-mars-rover-video). There is even sound: an eerie mechanical groaning. Since landing in May the Zhurong probe has been busy seeking clues as to whether Mars once supported life. There is no answer yet: so far it has travelled just over 410 metres. China is only the second country to land and operate a rover on the red planet, after the US. The **frantic tempo of the China National** [**Space**](https://www.theguardian.com/science/space) **Administration’s (CNSA) recent programme is reminiscent of the cold war, when Moscow and Washington were superpower rivals scrambling to put the first man in space and land on the moon**. Half a century on, space has opened up. It is less ideological and a lot more crowded. About 72 countries have space programmes, including India, Brazil, Japan, Canada, South Korea and the UAE. The European Space Agency is active too, while the UK boasts the most private space startups after the US. Space today is also highly commercial. On Sunday [Richard Branson](https://www.theguardian.com/business/richard-branson) flew to the edge of space and back again in his Virgin Galactic passenger rocket. On Tuesday, Branson’s fellow billionaire Jeff Bezos is due to travel in his own reusable craft, New Shepard, built by the Amazon founder’s company Blue Origin and launched from west Texas. Non-state actors play an increasingly important role in space exploration. Elon Musk’s SpaceX vehicles have made numerous flights to the International Space Station (ISS), and [since last year they have transported people as well as cargo](https://www.spacex.com/human-spaceflight/iss/index.html). Later this year Musk is due to send his own all-civilian crew into orbit – though he isn’t going himself. Even so, space still reflects tensions on Earth. “**Astropolitics follows terrapolitics**,” says [Mark Hilborne](https://twitter.com/space_security?lang=en), a lecturer in defence studies at King’s College London. Up there anything goes, he adds. “Space governance is a bit fuzzy. **Laws are few and very old**. They are not written for asteroid mining or for a time when companies dominate.” The biggest challenge to US space supremacy comes not from [Russia](https://www.theguardian.com/world/russia) – heir to the Soviet Union’s pioneering space programme, which launched the Sputnik satellite and got the first human into space in the form of Yuri Gagarin – but from China. In 2011 Congress prohibited US scientists from cooperating with Beijing. Its fear: scientific espionage. Taikonauts are banned from visiting the ISS, which has hosted astronauts from 19 countries over the past 20 years. The station’s future beyond 2028 is uncertain. Its operations may yet be extended in the face of increasing Chinese competition. In its annual threat assessment this April, the office of the US Director of National Intelligence (DNI) described China as a “near-peer competitor” pushing for global power. It warns: “Beijing is working to match or exceed US capabilities in space to gain the military, economic, and prestige benefits that Washington has accrued from space leadership.” The Biden administration suspects Chinese satellites are being used for non-civilian purposes. The People’s Liberation Army integrates reconnaissance and navigation data in military command and control systems, the DNI says. “**Satellites are inherently dual use**. It’s not like the difference between an F15 fighter jet and a 737 passenger plane,” Hilborne says. Once China completes the Tiangong space station next year, it is likely to invite foreign astronauts to take part in missions. One goal: to build new soft-power alliances. Beijing says interest from other countries is enormous. The low Earth orbit station is part of an ambitious development strategy in the heavens rather than on land – a sort of belt and rocket initiative. Liu Boming leaving China’s new Tiangong space station earlier this month to go on the second space walk in the country’s history. Photograph: Jin Liwang/AP According to Alanna Krolikowski, an assistant professor at the Missouri University of Science and Technology, a “bifurcation” of space exploration is under way. In one emerging camp are states led by China and Russia, many of them authoritarian; in the other are democracies and “like-minded” countries aligned with the US. Russia has traditionally worked closely with the Americans, even when terrestrial relations were bad. Now it is moving closer to Beijing. In March, China and Russia [announced plans to co-build an international lunar research station](https://www.theguardian.com/science/2021/mar/10/china-and-russia-unveil-joint-plan-for-lunar-space-station). The agreement comes at a time when Vladimir Putin’s government has been increasingly isolated and subject to western sanctions. In June, Putin and his Chinese counterpart Xi Jinping renewed a friendship treaty. Moscow is cosying up to Beijing out of necessity, at a time of rising US-China bipolarity. These rival geopolitical factions are fighting over a familiar mountainous surface: the moon. In 2019 a Chinese rover landed on its far side – a first. China is now planning a mission to the moon’s south pole, to establish a robotic research station and an eventual lunar base, which would be intermittently crewed. Nasa, meanwhile, has said it intends to put a woman and a person of colour on the moon by 2024. SpaceX has been hired [to develop a lander](https://www.theguardian.com/science/2021/apr/17/nasa-spacex-moon-spacecraft-elon-musk). The return to the moon – after the last astronaut, commander Eugene Cernan, said goodbye in December 1972 – would be a staging post for the ultimate “giant leap”, Nasa says: sending astronauts to Mars. Krolikowski is sceptical that China will quickly overtake the US to become the world’s leading spacefaring country. “A lot of what China is doing is a reprisal of what the cold war space programmes did in the 1960s and 1970s,” she said. Beijing’s recent feats of exploration have as much to do with national pride as scientific discovery, she says. But there is no doubting Beijing’s desire to catch up, she adds. “The Chinese government has established, or has plans for, programmes or missions in every major area, whether it’s [Mars](https://www.theguardian.com/science/mars) missions, building mega constellations of telecommunications satellites, or exploring asteroids. There is no single area of space activity they are not involved in.” “We see a tightening of the Russia-China relationship,” Krolikowski says. “In the 1950s the Soviet Union provided a wide range of technical assistance to Beijing. Since the 1990s, however, the Russian space establishment has experienced long stretches of underfunding and stagnation. China now presents it with new opportunities.” Russia is poised to benefit from cost sharing, while China gets deep-rooted Russian technical expertise. At least, that’s the theory. “I’m sceptical this joint space project will materialise anytime soon,” says Alexander​ Gabuev, a senior fellow at the Carnegie Moscow Centre. Gabuev says both countries are “techno-nationalist”. Previous agreements to develop helicopters and wide-bodied aircraft saw nothing actually made, he says. The Kremlin has been a key partner in managing and resupplying the ISS. US astronauts used Russian Soyuz rockets to reach the station, taking off from a cosmodrome in Kazakhstan, after the Space Shuttle programme was phased out. But this epoch seems to be coming to an end as private companies such as [SpaceX](https://www.theguardian.com/science/spacex) take over. “I expect US-Russian relations to get worse,” Gabuev says, adding that Americans “no longer need” Russia’s help. Moscow’s state corporation for space activities, Roscosmos, has faced accusations of being more interested in politics than space research. Last month the newspaper Novaya Gazeta reported that Roscosmos’s executive director of manned space programmes, former cosmonaut Sergei Krikalev, had been fired. His apparent crime: questioning an official decision to shoot a film on the Russian section of the ISS. The film, Challenge, is about a female surgeon operating on a cosmonaut in space, and has been backed and financed by Roscosmos . It stars Yulia Peresild, who is due to head to space in October with director Klim Shipenko. The launch seems timed to beat Tom Cruise, who is due to shoot his own movie on board the ISS with director Doug Liman[.](https://www.theguardian.com/science/2021/may/13/russia-send-actor-director-iss-shoot-first-movie-space) Krikalev, who spent more than 800 days in space and was in orbit when the USSR collapsed, apparently told Roscomos’s chief, Dmitry Rogozin, that the film was pointless. Rogozin – its co-producer – has called on the west to drop sanctions in return for Russia’s cooperation on space projects. Putin, Rogozin’s boss, appears to not be very interested in other planets, though, and is more concerned with [nature and the climate crisis](https://www.reuters.com/article/us-russia-putin-idUSKCN1LC1X0) these days. “Space is one of the areas that has traditionally transcended politics. The Mir space station worked at a time of east-west tensions. There was symbolic cooperation. Whether this will continue in the future is really up for debate,” Hilborne says. “The US is very sensitive about what happens in space.” Most observers think the US will remain the world’s pre-eminent space power, thanks to its innovative and flourishing private sector. China’s Soviet-style state programme appears less nimble. Despite ambitious timetables, and billions spent by Beijing, it is unclear when – or even if – an astronaut will return to the moon. The 2030s, perhaps? Will they be American or Chinese? Or from a third country? It may well be that the first person to boldly go again doesn’t merely represent a nation or carry a flag. More likely, they will emerge from a lunar lander wearing a spacesuit with a SpaceX logo on the back – a giant leap not only for mankind, but for galactic marketing.

#### Space race inevitably escalates into global conflict via anti-satellite attacks and ground deployment to defend above tech

Rogin 11-30-21

Josh Rogin (baller journalist with a bunch of awards, a wikipedia page, and a BA in international affairs), 11-30-2021, "A shadow war in space is heating up fast”, Washington Post, https://www.washingtonpost.com/opinions/2021/11/30/space-race-china-david-thompson/, // HW AW

**When Russia blows up a satellite in space with a missile (**[**as it did this month**](https://www.bbc.com/news/science-environment-59299101)**), or when China tests a new hypersonic missile (**[**as it did last month**](https://www.armscontrol.org/act/2021-11/news/china-tested-hypersonic-capability-us-says)**), the ongoing arms race in space leaps into the news.** But in between these “[Sputnik](https://www.nytimes.com/2021/10/27/us/politics/china-hypersonic-missile.html)”-like moments, outside the public’s view, the United States and its adversaries are battling in space every day. [Opinions to start the day, in your inbox. Sign up.](https://www.washingtonpost.com/newsletters/opinions-am/?method=SURL&location=ART&initiative=INLINECTA?itid=lk_cta_ssinline) While Washington officials and experts [warn of the risks](https://www.rand.org/blog/2020/10/how-to-avoid-a-space-arms-race.html) of an arms race in space, the United States’ adversaries are constantly conducting operations against U.S. satellites that skirt the line between intelligence operations and acts of war. The pace of conflict is intensifying, according to a top Space Force general, who told me that China could overtake the United States to become the number one power in space by the end of the decade. “The threats are really growing and expanding every single day. And it’s really an evolution of activity that’s been happening for a long time,” Gen. David Thompson, the Space Force’s first vice chief of space operations, told me in an interview on the sidelines of the recent [Halifax International Security Forum](https://halifaxtheforum.org/). “We’re really at a point now where there’s a whole host of ways that our space systems can be threatened.” [John W. “Jay” Raymond: How the U.S. Space Force is trying to bring order to increasingly messy outer space](https://www.washingtonpost.com/opinions/2021/11/29/space-activity-its-debris-increases-us-works-establish-international-norms-rules/?itid=lk_interstitial_manual_6) Right now, Space Force is dealing with what Thompson calls “reversible attacks” on U.S. government satellites (meaning attacks that don’t permanently damage the satellites) “every single day.” Both China and Russia are regularly attacking U.S. satellites with non-kinetic means, including lasers, radio frequency jammers and cyber attacks, he said. Thompson repeatedly declined to comment on whether China or Russia has attacked a U.S. military satellite in a way that did permanent or significant damage, telling me that would be classified if it had happened. The Chinese military is quickly deploying ground-based systems for doing battle in space, [such as lasers](https://spacenews.com/op-ed-u-s-satellites-increasingly-vulnerable-to-chinas-ground-based-lasers/) that can [damage nosy U.S. intelligence community satellites](https://www.smh.com.au/world/asia/space-lasers-and-the-new-battlefield-emerging-under-china-s-anti-satellite-tactics-20210804-p58ft2.html), which could be considered an act of war. “The Chinese are actually well ahead [of Russia],” Thompson said. “They're fielding operational systems at an incredible rate.” Both the Russians and the Chinese are working on satellites that can attack other satellites, he said. For some time now there have been reports that China was developing a [satellite that could claw](https://medium.com/war-is-boring/chinas-mystery-satellite-could-be-a-dangerous-new-weapon-630a858923ec) another satellite or [grab one with a robotic arm](https://www.foxnews.com/world/china-satellite-launch-space-weapons) or a grappling hook. The Chinese government has several reasons to want to disable U.S. satellites, which have been useful in revealing concentration camps built to intern Uyghur Muslims and [new Chinese nuclear missile silo fields](https://fas.org/blogs/security/2021/07/china-is-building-a-second-nuclear-missile-silo-field/). In 2019, Russia deployed a small satellite into an orbit so close to a U.S. “national security satellite” that the U.S. government didn’t know whether it was attacking or not, Thompson said. Then, the Russian satellite backed away and conducted a weapons test. It released a small target and then shot it with a projectile. “It maneuvered close, it maneuvered dangerously, it maneuvered threateningly so that they were coming close enough that there was a concern of collision,” he said. “So clearly, the Russians were sending us a message.” China is building its own version of satellite-based global positioning systems, said Thompson. That’s in addition to the “couple of hundred” intelligence, surveillance and reconnaissance satellites China has now deployed to watch over any part of the globe. China is also putting satellites into space at twice the rate of the United States, meaning that if nothing changes on our end, China will surpass the United States in capability in space in a few years, he estimated. “We are still the best in the world, clearly in terms of capability. They're catching up quickly,” he said. “We should be concerned by the end of this decade if we don't adapt.” While China is quickly [weaponizing space](https://thediplomat.com/2017/01/how-china-is-weaponizing-outer-space/), [its government points fingers](https://www.globaltimes.cn/page/202109/1235454.shtml) at United States, claiming that Washington is the diplomatic stumbling black. [There are reports](https://www.nytimes.com/2021/11/28/us/politics/china-nuclear-arms-race.html) that the Biden administration is reaching out to Beijing to establish new negotiations for a nuclear arms control, as well as international norms for cyberspace and space, but U.S. officials say that China won’t meaningfully engage. The U.S. military is trying to speed up the procurement and deployment of space assets by creating structures like the [Space Rapid Capabilities Office](https://www.kirtland.af.mil/Units/Space-Rapid-Capabilities-Office/) and the [Space Development Agency](https://www.sda.mil/), he said. Thompson’s idea is to deploy a large number of relatively low-cost satellites in constellations that increase the resiliency of U.S. space assets if they come under attack. Conventional thinking about how to deter an enemy from attacking on the ground, by sea or in the air doesn’t really apply to space. New doctrines and norms for space need to be established, mostly by diplomats. That work will take years. Meanwhile, the arms race in space is heating up, and the United States risks losing it if it doesn’t recognize this reality.

#### Goes nuclear

Nancy Gallagher 15 “Antisatellite warfare without nuclear risk: A mirage” <http://thebulletin.org/space-weapons-and-risk-nuclear-exchanges8346> (interim director of the Center for International and Security Studies in Maryland, previous Executive Director of the Clinton Administration’s CTBT Treaty Committee, an arms control specialist at the State Dept., and a faculty member at Wesleyan)//Elmer recut HW AW

In recent decades, however, as space-based reconnaissance, communication, and targeting capabilities have become integral elements of modern military operations, strategists and policy makers have explored whether carrying out antisatellite attacks could confer major military advantages without increasing the risk of nuclear war. In theory, the answer might be yes. In practice, it is almost certainly no. Hyping threats. No country has ever deliberately and destructively attacked a satellite belonging to another country (though nations have sometimes interfered with satellites' radio transmissions). But the United States, Russia, and China have all tested advanced kinetic antisatellite weapons, and the United States has demonstrated that it can modify a missile-defense interceptor for use in antisatellite mode. Any nation that can launch nuclear weapons on medium-range ballistic missiles has the latent capability to attack satellites in low Earth orbit. Because the United States depends heavily on space for its terrestrial military superiority, some US strategists have predicted that potential adversaries will try to neutralize US advantages by attacking satellites. They have also recommended that the US military do everything it can to protect its own space assets while maintaining a capability to disable or destroy satellites that adversaries use for intelligence, communication, navigation, or targeting. Analysis of this sort often exaggerates both potential adversaries’ ability to destroy US space assets and the military advantages that either side would gain from antisatellite attacks. Nonetheless, some observers are once again advancing worst-case scenarios to support arguments for offensive counterspace capabilities. In some other countries, interest in space warfare may be increasing because of these arguments. **If any nation, for whatever reason, launched an attack on a second nation's satellites, nuclear retaliation against terrestrial targets would be an irrational response. But powerful countries do sometimes respond irrationally when attacked**. Moreover, disproportionate retaliation following a deliberate antisatellite attack is not the only way in which antisatellite weapons could contribute to nuclear war**. It is not even the likeliest way**. As was clearly understood by the countries that negotiated the Outer Space Treaty, crisis management would become more difficult, and the risk of inadvertent deterrence failure would increase, if satellites used for reconnaissance and communication were disabled or destroyed. But even if the norm against attacking another country’s satellites is never broken, developing and testing antisatellite weapons still increase the risk of nuclear war. If, for instance, **US military leaders became seriously concerned that China or Russia were preparing an antisatellite attack, pressure could build for a pre-emptive attack against Chinese or Russian strategic forces**. Should a satellite be struck by a piece of space debris during a crisis or a low-level terrestrial conflict, leaders might mistakenly assume that a space war had begun and retaliate before they knew what had actually happened. Such scenarios may seem improbable, but they are no more implausible than the scenarios that are used to justify the development and use of antisatellite weapons.

## 3

#### CP – the US and Japan ought to divert funds to build a laser cannon for the International Space Station and require gossamer sails on all future satellites

#### it’s possible with the proper funding and the profit motive from private entities like RIKEN – solves extinction and future space junk permanently

Powell 15

Corey S Powell (science journalist and editor in chief at discover magazine, wrote 3 books with Bill Nye!!), May 20 2015, "Space Junk is a Problem. Is a Laser Cannon the Solution?," https://www.discovermagazine.com/the-sciences/space-junk-is-a-problem-is-a-laser-cannon-the-solution#.VV4ENGRViko, // HW AW, bracketed cause I don’t like reading big numbers

There’s a general rule in media reporting called Betteridge’s Law: Whenever a headline poses a question--especially a sensational one--the answer is “no.” I’m going to break the law this time. **An orbiting laser cannon is not only an intriguing technology but, yes, it’s one of the most promising ways to clean up the ever-thickening cloud of dangerous debris surrounding the Earth**. And just to be clear, space junk is a danger. There are about 25,000 human-made objects larger than your fist flying around in orbit, and about half a million pieces bigger than a dime. If you include millimeter-scale shrapnel, the number of rogue bits reaches deep into the millions. Typical speeds in low-Earth orbit are about 30,000 kilometers per hour (18,000 miles per hour), ten times the velocity of a rifle bullet. You see the problem: A little impact can pack a big wallop. So far, there have not been any space-junk catastrophes remotely resembling the sensationalized events in the movie Gravity, but the reality is still disconcerting. In 2009, a $50 million Iridium communications satellite was destroyed by a collision with a defunct Russian satellite. Three years later, the [Fermi space observatory](https://www.nasa.gov/mission_pages/GLAST/news/bullet-dodge.html) had a near miss with another Soviet-era satellite. NASA had to clad the International Space Station in shielding to protect it from repeated small impacts, and the agency sometimes moves the whole station to dodge larger pieces of junk. Orbiting debris adds cost and risk to the space business.The proposed space-station laser cannon (upper left) would work in conjunction with a telescope called EUSO to track and destroy space debris. (Credit: RIKEN) The amount of junk in orbit is increasing rapidly, meaning that those costs and risks are increasing, too. Once junk gets up there, it takes a long time to come back down: years to centuries in low orbits, and essentially forever in geosynchronous orbit (40,000 kilometers up, where many communications satellites are located). Most disconcerting, collisions in orbit create more junk, which leads to more collisions. Potentially this could lead to a runaway process called [Kessler Syndrome](http://en.wikipedia.org/wiki/Kessler_syndrome). **This is where the laser cannon comes in**. Toshikazu Ebisuzaki and a team of researchers at the RIKEN lab in Japan have [formulated a plan](http://www.riken.jp/en/pr/press/2015/20150421_2/) to clear out near-Earth space by zapping pieces of space junk with a high-power blast of focused radiation. The laser doesn’t need to be able to destroy the whole piece of debris. All it has to do is vaporize enough of the object to slow its orbit and send it spiraling into Earth’s atmosphere, **where it will burn up harmlessly before reaching the ground. It’s an ingenious solution**. Ebisuzaki’s concept was inspired by a science project called the Extreme Universe Space Observatory, currently under development for the International Space Station. [EUSO](http://jemeuso.riken.jp/en/), which will be installed on the station in 2017, is a fascinating instrument in its own right; it will study extremely high-cosmic rays by watching the light they create when they collide with air molecules. But EUSO’s sensitive, wide-field optics also make it well suited to spotting and tracking small bits of space debris, which are hard to locate from the ground. Finding targets is the crucial first step toward getting rid of them. The next step, of course, is the laser. RIKEN’s concept (which is not yet funded) would start with a 10-watt laser prototype, mounted on the International Space Station, capable of firing 100 laser pulses a second. That would pave the way for a larger system powerful enough to blast away any pieces of space junk within a 100-kilometer range, and eventually lead to a dedicated garbage-cleanup satellite equipped with a [five-hundred-thousand]500,000-watt laser that can fire [fifty-thousand]50,000 times per second. Such a satellite could remove 100,000 pieces of junk a year, the Japanese researchers claim, **fast enough to bring the whole orbital debris problem under control.** The fast-growing population of space debris. "LEO" refers to low-Earth orbit. (Credit: Surrey Space Centre) There are significant technical hurdles to overcome, including the data-processing capacity needed to spot the bits of debris and the considerable energy supply needed to keep such a powerful laser operating for years. Building a giant laser-cannon satellite would not be cheap, either. But this is exactly the kind of ambitious thinking needed to tackle the space-junk mess. Several additional cleanup technologies are also under development. A separate Japanese-led team has proposed trapping and eliminating space debris with a huge [electromagnetic tether](http://www.academia.edu/1265073/Space_Demonstration_of_Bare_Electrodynamic_Tape-Tether_Technology_on_the_Sounding_Rocket_S520-25http:/). A European project called [e.DeOrbit](http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/How_to_catch_a_satellite) would snare big pieces of space junk using a net or harpoon and dispatch them Earthward. Other concepts under study would use puffs of [pressurized gas](http://www.nasa.gov/directorates/spacetech/niac/gregory_space_debris_elimination.html), large [magnetized nets](http://www.spacesafetymagazine.com/space-debris/debris-removal/electrodynamic-debris-eliminator-receives-funding/), or a [slingshot-style satellite](http://aero.tamu.edu/news/removing-space-debris-tamu-sweeper-sling-sat). The laser cannon has some obvious advantages over all of these options, however. It could tackle the small fry, not just the big pieces, and it could deal with far more targets than would be possible for any spacecraft that is going after them one by one. If all of these ideas sound a little wacky, there's a good reason: Getting rid of space junk is a really, really hard problem. There is a lot of space to scour for debris. The individual pieces are mostly small and nearly invisible, and they each follow a unique orbit. Hard problems call for creative (and sometimes wacky) solutions. Further complicating things, nobody has devoted much money to cleanup, and any mission that can remove space junk could potentially remove active satellites as well--a delicate political issue. **If the RIKEN laser cannon never happens, it will more likely be due to budget** and political **obstacles than to technical ones**. In the long run, the best way to deal with space junk is never to create it in the first place. One of the most important principles here is what is called [design for demise](http://www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space/Space_debris_mitigation)--that is, engineering satellites so that they will automatically de-orbit and remove themselves from the trash pile within, say, 25 years of the end of their mission. A simple way to do this is to equip a satellite with a small sail that would pop open when it is no longer needed. The so-called [gossamer sail](https://theconversation.com/cleaning-up-space-debris-with-sailing-satellites-20384) would act like a space parachute, using the pressure of sunlight and the extremely thin traces of atmosphere in orbit to create drag. The drag would then pull the satellite down to a fiery demise. Simulated view of Earth from the Planetary Society's new LightSail, launched on May 20. Space sails could be used to clear away satellite debris--or to take humanity on great ventures of exploration. (Credit: Josh Spradling/Planetary Society) A gossamer sail is very similar in function to a solar sail--like the prototype [LightSail](http://sail.planetary.org/) launched today by the Planetary Society. That creates a neat kind of symmetry to the story. Powerful space lasers may be useful for clearing debris, but they could also be used to launch high-speed spacecraft. Solar sails could be used to de-orbit satellites, but they could also provide new ways to navigate to new worlds. In short, the kinds of technological solutions needed to clear a path through our local garbage dump could be the exact same ones needed to blaze a path to the stars.

#### Asteroid mining is critical to future survival – it can fund more space exploration, eliminate resource scarcity, build space cities to house millions, and manufacture organs to save lives

Elvis 21 [Martin Elvis is a senior astrophysicist at the Center for Astrophysics | Harvard & Smithsonian. He is the author of Asteroids: How Love, Fear, and Greed Will Determine Our Future in Space (2021). “Riches in space.” Aeon. July 2, 2021. <https://aeon.co/essays/asteroid-mining-could-pay-for-space-exploration-and-adventure>] HW AL

Asteroids are the remnants of our solar system’s youthful exuberance, the leftover crumbs from when the planets formed. For much of the space age, asteroids were ignored in favour of the far more glamorous planets, and the Moon. The asteroids – dark, misshapen rocks, hard to see and hard to find – have long flown beneath our notice. But that was a mistake. They have a crucial role to play in the future of our species – in fact, the survival and flourishing of humanity are tied up with asteroids. There are three reasons. They bear messages from the beginnings of the solar system, before our Earth came into being, and how we got here matters to where we’re going. They are also hoards of resources that might lead us to a future without scarcity. And last – a minor detail – a single asteroid could wipe us off the face of our planet. Let’s look at each in turn. Asteroids are the remnants of collisions between some of the first mini-planets (called ‘planetesimals’) that formed in abundance when the solar system was no older than a few million years. As a result, many asteroids are just piles of broken rubble held together by their own weak gravity, about a million times more feeble than the gravity we feel here on Earth. Untangling the eventful history of the solar system is easier with asteroids because they’re unsullied envoys from those turbulent early times. Unlike the planets, nothing much has happened to the asteroids in the past few billion years. And there are millions of them, the vast majority orbiting the Sun between Mars and Jupiter in a band called the ‘Main Belt’. An animation depicts a mapping of the positions of known near-Earth objects at points in time over the past 20 years, and finishes with a map of all known asteroids as of January 2018. Courtesy of JPL/NASA Perhaps 10,000 asteroids the size of sports stadiums are on orbits that swing close to Earth. As the dinosaurs would attest, our planet occasionally gets hit. But the results aren’t always a bad thing: it’s looking likely that Earth’s oceans were filled by water brought by asteroids. Along with water, asteroids might even have brought the ingredients of life to Earth in the form of so-called ‘prebiotic’ molecules, including amino acids and, as recently found, components of proteins and sugars. Learning more about asteroids means learning more about our origins. What can we actually do with asteroids? That brings us to my favourite thing about them: their resources. Being an idealistic astrophysicist, my interest is in the money to be made from them. That really is idealistic because, if we can make a profit mining the asteroids, then doing bigger things in space will become a lot cheaper. Capitalism has its faults, but one thing it does well is to make things cheaper. I want to use it as a tool so that we can build far bigger telescopes than we could practically realise today. What do astronomers want? More light! Bigger telescopes! Asteroid mining could make that dream a reality. The siren call of asteroids for miners is that the Main Belt asteroids contain vast amounts of resources. The iron found in asteroids adds up to some 10 million times the iron that we have in proven reserves on Earth. That’s a lot. It’s enough to build many rings of iron girders all the way around Earth’s orbit, along the lines of the science fiction novel Ringworld (1970) by Larry Niven. Not that a ringworld is a sensible thing to make, but it is a really big ring. More plausibly, with that much iron we could build cities in space, as envisaged by the physicist Gerard K O’Neill in the 1970s. Each of these cities would be big enough for a million people to live in. They would be rotating cylinders, and as a citizen of one you would be walking around inside the cylinder’s surface, feeling a fake gravity from the centrifugal force. That’s the scale of resources we’re talking about. These vast material supplies could make for an era that people call ‘post-scarcity’, where there’s plenty for everyone, just as there is in the 23rd century of the Star Trek science fiction franchise. The starship crew on Star Trek don’t work to keep themselves fed and housed, that’s taken for granted. They work for adventure and exploration. Asteroid wealth could help all of us take a step towards that happy state. The problem is how to get started. Iron in space is not going to make for giant profits in the short run. On the ground, it sells for less than $200 a ton. It would be worth more in space, but unfortunately there’s no one to buy huge tonnages of iron in space. To adapt the tagline from the Alien movies – ‘In space, no one can hear you sell.’ It certainly isn’t worth bringing space iron back to Earth since the cost of doing so would far exceed the price it could command. Starting to mine space for resources will have to begin with something so valuable that the cost of obtaining it in space is small by comparison. For now, the best bets are precious metals and – surprise – water. Precious metals are obvious. Platinum sells for about $33.5 million a ton, and we know from meteorites that some asteroids are richer in platinum than any mine on Earth. That sounds promising. Platinum sales run at about 200 tons, or billions of dollars, per year. The bad news is that ‘richer than any mine on Earth’ is still concentrations of just tens of grams per ton, and extracting those precious grams isn’t easy. We can’t just bring an asteroid near to Earth to start extracting the platinum where we can have heavy machinery to work on it. That would take way too much fuel because, to carry more mass, rockets have to carry exponentially more fuel; unlike airplanes, they don’t get the oxygen for free from their surroundings, they have to pull it along with them. Any refining of platinum will have to be done robotically out in the native orbit of the asteroid. That’s quite a challenge. Water is a less obvious money-maker. The surprise is that water is also worth millions per ton – if it’s sold in space. Water in space is really useful. It’s good for drinking, and the oxygen in it is good for breathing. You can split the hydrogen from the oxygen in H2O and you’ve got rocket fuel, and water is good at absorbing radiation to protect people from cancer-causing cosmic rays. So, in principle, water in orbit is pretty valuable. The good news is that up to 10 per cent of a water-rich asteroid can be water. It won’t be simple ice, most likely, but will be bound into clays and other rocks. Even better, water is much easier to extract than precious metals. Simply heating up the rock will release water that can then be captured. How much is space water worth? Until recently, it cost $20 million to get a ton of water into even a low orbit – say, to the International Space Station (ISS). To get a ton of water to a high orbit, like the 24-hour orbit of TV transmitting satellites, would cost about three times as much. SpaceX has started to cut that cost; for now, it’s charging about $3 million a ton to a low orbit on a Falcon 9 rocket. Water from asteroids might be able to compete with those prices and still return a nice profit. But the bad news is that, right now, there’s no one in space who wants to buy water. At least not yet. That might be about to change. We won’t get to build cities in space unless we can build simpler space stations first, and do so at an affordable cost that can scale. If we have space stations, they will need supplies, especially of water and perhaps construction materials. That demand could create a business delivering these supplies from space instead of from Earth. In this case, the asteroids would have the most to offer. So space stations – particularly commercial space stations – are the key to acquiring asteroid resources. Why build space stations? There are three primary uses: research, manufacturing and tourism. Research has always been done on the ISS, but facilities and time have been in short supply. In recent years, the equipment has improved a lot, but astronaut time is still scarce. Each astronaut has to look after multiple experiments. Multitalented and smart as the astronauts all are, they simply can’t have all the experience of the scientists whose experiments they’re operating. A lot of effort goes into automating those experiments so that the astronauts aren’t overwhelmed. It would be far more efficient if the scientists who invent the experiments also get to be the ones who carry them out in space. Then their years of experience could be put to good use operating and watching over their studies. Spotting subtle anomalies that could be a sign of a failure, or of a discovery, is much better done in person by experts. But, until now, scientists didn’t have that opportunity, and they would have likely declined it if offered the chance. That’s because training for a mission to the ISS takes more than two years full-time and requires learning Russian. If you take two years off from doing your research, then you’re no longer at the forefront and you’ll have lost your edge. Few top scientists would risk that, however much fun it might be to float in space. We scientists live for our research. Fortunately, the new commercial stations will be much easier to train for, taking a couple of months or so, because they’ll have a single manufacturer with consistent, uniform interfaces, and a separate professional crew to deal with maintenance and emergencies. The companies with advanced plans so far are all US-based, so English will be the language used. As English is the lingua franca of science, it poses little challenge to scientists worldwide. Manufacturing in space has always seemed like a fool’s errand. Whatever you make out there would have to be worth outrageous amounts to cover the shipping costs back to Earth. Now, though, those costs have come down almost 10-fold, with more reductions promised. As a result, a few items do pass that test. Already, there are first tests taking place on the ISS to see if the advantages of manufacturing in almost zero gravity (‘micro-gravity’) are really as great as some have suggested. The most popular idea is to make super-powerful optical fibres that could carry far more data traffic than current transoceanic fibres can. They could potentially do so more cheaply because they would be simpler: they wouldn’t need repeater stations. Certainly, the demand is there, since there’s no limit to the number of cat videos we must share. These ‘ZBLAN’ optical fibres showed dramatic improvements when small amounts were made during brief, half-minute long intervals of weightlessness on a parabolic flight. There are a few companies already trying to make ZBLAN fibres on the ISS. The results must be promising because they went back after their first attempt. A kilogram of fancy optical fibres already sells for about $1 million to $20 million. That will pay for the postage and still give you change! Another idea is to 3D-print human organs in space. Why? Printing ears on Earth has been done, using a scaffolding that later dissolves away. But some organs are trickier, and scaffolds don’t always work. Without that support, the layers of cells tend to slip and slide out of position, which is not the desired effect for something meant to keep you alive. In micro-gravity, the slipping and sliding should be much smaller. The goal is eventually to be able to print a human heart. A heart weighs less than a kilogram. Even with packaging to keep it healthy, **the transport cost of bringing a new heart down to Earth is going to be far less than it’s worth to the recipient.** Again, first experiments toward this goal are underway on the ISS.

## 4

#### The US government is perfectly positioned to focus on space governance and let private entities develop tech – this avoids bilateral or unilateral missions that increase the chance for conflict and space weaponization while creating effective multilateral agreements that spill over

Rosenberg and Marber 21 (Mark Y. - CEO of Geoquant and an adjunct professor at Columbia University’s School of International and Public Affairs, Peter - teaches at Harvard University and is a senior portfolio manager at Aperture Investors, 2/22, “America Needs a Supercharged Space Program,” [accessed 9/25/21], <https://foreignpolicy.com/2021/02/22/biden-space-force-race-policy-rockets-china/>)

In 2015, the U.S. government granted U.S. citizens the right to own any materials they extract in space, blowing open the door for civilian space business. In 2018, China launched a reconnaissance rover on the moon’s far side that’s been gathering data for more than 18 months now. In late 2019, then-President Donald Trump launched the formation of the U.S. Space Force as part of the military, while early 2020 saw the National Aeronautics and Space Administration (NASA) sign a contract with Axiom Space to build the first commercial space station. And in October 2020, the United States led the signing of the Artemis Accords, a set of bilateral agreements on space with Australia, Canada, Italy, Japan, Luxembourg, Italy, the United Kingdom, and the United Arab Emirates, which deliberately skirted the United Nations and did not include space rivals such as China and Russia. (Ukraine and Brazil were later added to the accords.) Although this pact claims to affirm the Outer Space Treaty, it actually increases the potential for conflict by expanding the interpretation of commercial space law while drawing hard geopolitical borders. Without Russia and especially China on board, much of the world will see the Artemis Accords as the informal rulebook of a cliquish club rather than a true multilateral agreement. Meanwhile, a new space race is gathering stream: In addition to this year’s unmanned missions to Mars, both the United States and China are planning moon landings later this decade. The Biden administration must prioritize a more multilateral approach to space governance than what was taken under Trump. Just like on Earth, a lack of international standards in space will likely lead to chaotic, wasteful competition. A 2011 U.S. law blocking NASA from cooperating with Chinese agencies has already shut China out of the U.S.-Russian International Space Station, prompting the Chinese to start building their own while partnering with Russia on a lunar research station. Revising this law would be a good place for the Biden administration to start. Cooperating with China in space might be a sensible hedge against growing conflict on Earth. Unregulated space activity could create a myriad of problems from accidentally or intentionally blocked data transmission to orbital pollution from too many space objects. Indeed, U.S. companies are currently the worst offenders, highlighting the need for more targeted regulation. Just a few uncontrolled collisions could generate enough debris to render near-Earth space unusable. And of course, no one wants to see space weaponized with extremely expensive, escalating arms races. Given private U.S. companies’ increasingly aggressive push to expand space exploration, the U.S. government is in a position to structure a more effective extraterrestrial regulatory regime. Renewed U.S. leadership founded on rebuilt space capabilities will be key to any hope for multilateral space cooperation. A more dedicated focus on space governance and a more aggressive approach to exploration can be the underpinnings of a future “New Space Deal.” A supercharged space program can help build entire new industries, create new jobs, green the economy, turbocharge next-generation communications, and expand the frontiers of science and technology. By uniting Americans behind a common purpose, it could even help mend the country’s frayed democracy. It would also reestablish Washington’s leadership in the fight against climate change and for a stronger multilateral system. Who else but the United States could even contemplate such a bold plan?

#### Non-state actors in space are conflict dampeners – they avoid geopolitical tension and have financial incentives to keep conflict low

Frankowski 17 (Pawel, Assistant Professor at the Faculty of National Security. His current research interests include space policy, labour standards in free trade agreements, and theories of international relations, Jagiellonian University in Kakow, “OUTER SPACE AND PRIVATE COMPANIES CONSEQUENCES FOR GLOBAL SECURITY”, <https://doi.org/10.12797/Politeja.14.2017.50.06>)

In the terms of privatization and space security, space remains relatively untapped, but commercial and military benefits from space exploration/exploitation could even lead to ‘privatization of space’. Such privatization will result from growing pressure on spacefaring countries to defect from cooperation, since is less viable with good number of multiple actors who entered the space.36 However, space policy and space research are characterized by very high costs, which are rather impossible to bear by private companies, limited by economic calculation. As pointed out earlier, under-investment in technological development by private companies it is related to the fact that these actors are not focused on profits of a social nature, such as improving the quality of life of the recipient of the product.37 This makes some technology, potentially beneficial to society, not developed or introduced into use, because the profit margin is too small to make this viable for commercial players. To conclude, privatization of space security can develop in unexpected ways, but in today’s space environment private actors would rather play the role of security regulators than security providers. When investment in space technologies is less profitable than other areas of economy, private actors would focus on soft law and conflict prevention in space, and new private initiatives will appear. For example, apart from important space companies, as SpaceX or Blue Origin active in outer space, other private actors as Secure World Foundation (SWF), who focus on space sustainability, will play more important role in crafting international guidelines for space activities.38 This path the way for future solutions and projects, as cleaning the space debris, extracting resources from asteroids and planetoids, refuelling satellites, providing payload capabilities for governmental entities on market-based logic, will be based on activity non-state actors, providing soft law and regulatory solutions, where space faring states are unable to find any compromise. Therefore private companies will be in fact global (or space) regulators, as part of UNCOPUS, being involved in space activities.39 The last argument for private involvement in space security comes from an approach based on common good and resilience of space assets, emphasized by the Project Ploughshares, as an important part of space security. As of 2017 there are more than 700,000 man-made objects on the Earth’s orbit bigger than 1 cm, while 17,000 of them are bigger than 10 cm.40 Some of them are traced by SSA systems, both American and European, but these systems are public-military owned, and private operators are not granted any access to this data. Any collision of space object with space debris, even with small particles, might result in a chain reaction, called Kessler’s syndrome, and not only private but public, and military assets will be destroyed or impaired. In such conditions, a reluctant cooperation between the public and private sector, and unwillingness to share vulnerable data by public actors seem to confirm that private space activity is more than necessary. This is an apparent case when logic of mistrust between state powers must be overcome by private actors, perhaps by suggesting common preferences for debris mitigation, and space situational awareness. In the case of space debris, Space Data Association, an initiative supported by private sector, with its main aim to enhance data sharing between commercial satellite operators, could be an example of nascent public good provided by private actors for the sake of global security.

## Case

#### International mining regimes are inefficient, corrupt, and enable exploitation/private development as much as they claim to prevent it

Roach 11-8-21

Anna Bianca Roach (she/they, degree in conflict studies from munk school of global affairs), 11-8-2021, "The Obscure Organization Powering a Race to Mine the Bottom of the Seas," PassBlue, https://www.passblue.com/2021/11/08/the-obscure-organization-powering-a-race-to-mine-the-bottom-of-the-seas/, // HW AW

On the seafloor, anemones with eight-foot-long tentacles live alongside [blind crabs](https://www.mbari.org/discovery-of-yeti-crab/) that cultivate food in their arm hair, sharks with glow-in-the-dark bellies and [glass sponges](https://www.mpg.de/5595233/climate_archive_deep-sea_sponge#:~:text=Researchers%20at%20the%20Max%20Planck,living%20animal%20species%20existing%20today.) that have been thriving since before the invention of the wheel. “Because of the lack of light and the fact that creatures do need to see each other to eat each other, you get these amazing photoluminescent animals down there,” said Helen Rosenbaum, the coordinator of the [Deep Sea Mining Campaign,](http://www.deepseaminingoutofourdepth.org/) an association of nongovernmental organizations located in Australia, Canada, the United States and the Pacific Islands. “We’re just starting to discover them!” The emerging industry of deep-sea mining is eyeing these otherworldly creatures’ home with keen financial interest: the potato-shaped rocks that provide a foothold for many of these animals in the otherwise silty, slippery environment of the ocean floor contain myriad metals that miners say are needed for a global eco-transition. At the heart of primary decision-making on deep-sea mining ventures is the [International Seabed Authority](https://www.isa.org.jm/), an autonomous organization based in Jamaica that critics say has little public oversight. “Our journey is to drive humankind through a wonderful adventure, which is to go very deep in the ocean to extract some minerals that are necessary for human activity on earth,” says Marie Bourrel-McKinnon, a special assistant to the secretary-general of the Authority, in one of its promotional [videos](https://www.youtube.com/watch?v=tzP-WqTJR_w&t=55s). The ISA, which was established through the 1982 [United Nations Convention on the Law of the Sea](https://www.un.org/depts/los/convention_agreements/convention_overview_convention.htm#:~:text=by%20%22*%22.-,The%20United%20Nations%20Convention%20on%20the%20Law%20of%20the%20Sea,the%20oceans%20and%20their%20resources.&text=The%20Convention%20also%20provided%20the,the%20law%20of%20the%20sea.), is led by the idea of a “common heritage of mankind,” a phrase that is used to explain that the wealth of the ocean floor should belong to all of humanity. Michael Lodge, the Authority’s secretary-general, says in the same video that the ISA’s focus on equity and common resources is what makes the organization special. “This is something that has never been done before,” he says. “It’s actually a unique experiment in human civilization.” **Critics balk at the organization’s lack of transparency and worry that the humanitarian intentions behind the Law of the Sea treaty aren’t enough to ensure that the monetary benefits of the minerals on the seafloor will reach everyone**. Some critics see an inherent contradiction in the Authority’s dual mandate to promote the development of deep-sea minerals while also protecting the environment. King among the coveted metals is cobalt, a mineral used for batteries in phones, electric cars and other electronics. Other minerals include nickel, manganese and copper. On land, these minerals — particularly cobalt — are shrouded in [controversy](https://www.youtube.com/watch?v=tzP-WqTJR_w&t=55s) related to child slavery and the environmental impacts of terrestrial mining, but they’re also in high demand. Large companies like the Canadian-based Metals Company and the American-based Lockheed Martin see these metals as the key to transitioning away from fossil fuels and contend that procuring these metals from the deep sea is a cleaner, more ethical alternative to digging them on land. “We’re on a quest for a more sustainable future, and we need metals to get there,” says [Gerard Barron](https://www.linkedin.com/in/gerardbarron), chief executive of the Metals Company, in an [advertisement](https://vimeo.com/286936275) for what was then called DeepGreen. “I don’t want to see more deforestation. I don’t want to see child labor. And I want to see us access the most sustainable supply of these important metals.” But scientists warn that disturbing these slow-moving ecosystems could hurt the biological pump — a process through which the ocean sequesters a substantial amount of carbon — in ways that can’t be remedied within generations. With the COP26 climate conference underway in Glasgow, Scotland, until Nov. 12, and the UN classifying the 2020s as the “Decade of Oceans,” leaders have been turning their eyes to the health of the seas and to the human activities that damage them. Peter Thomson, a Fijian diplomat and former president of the UN General Assembly who was president of the International Seabed Authority’s decision-making body twice, wrote an [open letter](https://ocean.economist.com/governance/articles/cop26-and-the-ocean-climate-nexus) calling for COP26 to devote attention to sustainability in the blue economy. “What the ocean gives, it can take away,” Thomson writes. “While our understanding of the ocean’s properties is still limited, we know it is the planet’s largest carbon sink, so that closely protecting the special places within it has become urgent work at hand.” Thomson is also the [UN’s envoy for the ocean.](https://sdgs.un.org/topics/oceans-and-seas/SpecialEnvoy) Other diplomats and advocates have spoken to similar concerns, including Monaco’s Prince Albert II. “We still need to avoid overexploitation of the ocean’s natural resources and the ocean floor,” he says in an [interview](https://people.com/royals/prince-albert-urges-bold-action-cop26-united-nations-climate-change-conference/) right before launching the most recent [Because the Ocean initiative](https://www.fpa2.org/en/initiatives/because-the-ocean-005) at COP26. “We cannot allow countries or large corporations to jump on every opportunity they see to exploit oil, gas or precious metal nodules protruding from the seabed without strict regulation.” Some experts and scientists who have worked with the ISA warn that harvesting metals from the mostly untouched ecosystems in the seafloor holds as much potential for global ecological devastation as it does for profit. The Authority has so far sold 31 licenses for companies and governments to explore the bottom of the high seas and is being [pressured](https://news.mongabay.com/2021/07/canadian-miner-looms-large-as-nauru-expedites-key-deep-sea-mining-rules/#:~:text=Nauru%2C%20which%20sponsors%20a%20company,whether%20regulations%20have%20been%20written.) by the small Pacific island nation of Nauru to authorize the beginning of mining operations within two years. Observers, civil society members and former employees of the ISA are raising alarms about **potential conflicts of interest in the organization and a lack of transparency surrounding funding for and profits from mining**. PassBlue’s investigation into the ISA’s operations has involved interviewing eight scientists, researchers and lawyers familiar with deep-sea mining as well as four former ISA employees and scouring documents from the Authority, embassy cables, civil society reports, academic papers and from the UN Appeals Tribunal, which is hearing [disputes](https://www.un.org/en/internaljustice/files/unat/orders/order-unat-2018-328.pdf) from employees who have left the organization. **The portrait that emerges is of an organization with a vested interest in promoting the work of the underwater mining industry, a consistent habit of alienating international marine scientists whose findings favor a more cautious approach to exploiting the ocean floor and a lack of good-faith engagement with civil society.** “If you guys are the first to mine, the first to extract nodules from international waters, it’s opening oceans earthwide,” Adrian Hellman, an Australian environmental scientist, says in an [ad](https://vimeo.com/user79094991) for the Metals Company. “What happens initially is going to affect everything down the track.” Although the push to speed up the start of undersea mining has been triggered by a two-year clause initiated by Nauru, it doesn’t mean that the Authority has to finalize the necessary legislation within two years, Duncan Currie of the [Deep Sea Conservation Coalition](http://www.savethehighseas.org/) says. The group consists of more than 80 international organizations that promote the conservation of biodiversity in the high seas. “**Once regulations are adopted, the voting requirements make it extremely difficult to disapprove a mining application, so it’s likely numerous 30 year contracts will be approved,**” Currie added in an email, noting that the contracts cannot be amended or canceled without the consent of the mining contractor. “Under the two-year rule, contracts can even be approved without regulations being in place. And it is likely they cannot be cancelled or amended without the contractor’s agreement.” PassBlue [published the first of its two-part investigation](https://www.passblue.com/2021/09/29/pressure-builds-to-mine-international-waters-amid-questions-about-ecosystems-and-profit-sharing/) on the ISA on Sept. 29, focusing on the efforts by Nauru to trigger deep-sea mining licenses. A spokesperson for the ISA declined an interview on the topic after repeated requests from PassBlue. A delegate of Nauru, Margo Deiye, attending the 26th session of the ISA, Feb. 18, 2020. The small Pacific island nation has triggered a clause at the ISA giving its member states the ability to demand that the process of granting mining permits to begin soon, possibly jeopardizing the delicate ecosystems of the oceans. ISA Navigating with good intentions? “A lot of idealists go into the International Seabed Authority thinking, ‘Oh wow, this is a place where there’s actually a statement about ensuring effective protection of the marine environment from harmful effects of seabed mining, and making sure that all states can participate in these activities,'” says Kristina Gjerde, who represents the [International Union for Conservation of Nature](https://www.iucn.org/) at ISA meetings. But she says that **the Authority is led more by corporate interests** than for “the benefit of all mankind,” the Authority’s stated goal. “It’s difficult for states to put on their hats as representing the global community interests, as opposed to one particular economic sector or another,” Gjerde told PassBlue. “Now that interest in seabed minerals is rising, this gives rise to very serious concerns about potential conflicts of interest.” The members of the ISA consist of 167 countries and the European Union. Formally, the organization is made up of five bodies: the Secretariat; the Assembly, where member countries are represented; the Council, elected by the Assembly; the Finance Committee; and the Legal and Technical Committee. The latter is tasked with making recommendations to the Council about approving legislation; together with the Secretariat, this committee is the most influential of the Authority’s organs. Longtime observers say that the Legal and Technical Committee has also never turned down an application for an exploration license. Critics of the ISA, including former employees who spoke to PassBlue confidentially, point to its leadership and revenue structure as the source of many of its problems. When deep-sea mining may actually begin, the ISA plans to receive a cut of the profits from the mining operations to cover its operating expenses. Until then, the organization receives money in two ways: through sales of exploration licenses and member states’ voluntary donations or assessed contributions. The ISA collects a $500,000 application fee for each exploration license that it grants as well as a yearly administrative fee of $47,000 per contractor doing the exploring, according to a 2019 [presentation](https://isa.org.jm/files/files/documents/dec-analysis_0.pdf) on the ISA’s payment regime. A [2020 report](https://isa.org.jm/files/files/documents/ISBA_26_FC_4-2006697E.pdf) by the Finance Committee to the Authority’s Secretary-General Lodge expressed concern that many member states haven’t been paying their assessed contributions. Outstanding contributions currently total just over $1.1 million, representing more than a month of the organization’s yearly budget. According to a former finance officer, who spoke to PassBlue but asked to remain anonymous because of the sensitivity of the information, the ISA depends heavily on the exploration license fees for its roughly $10 million annual operating budget. PassBlue has been unable to verify how much of the budget comes from contractor fees, as the Authority did not share audited financial statements after repeated requests to do so. The ISA also has a track record of dismissing scientists or employees who raise concerns about the speed at which decisions surrounding deep-sea mining are being taken, several former employees and longtime observers to the organization said. “I decided to speak out about the fact that, you know, we didn’t have enough science to be making informed decisions about how to manage this activity, unless the decision was not to proceed,” says Diva Amon, a marine biologist who [received](https://www.isa.org.jm/news/isa-secretary-general-presents-inaugural-edition-award-excellence-deep-sea-research-dr-diva) the ISA’s Award for Excellence in Deep Sea Research in 2018, referring to the writing of the Authority’s regulations around deep-sea mining. “That was when the relationship [with the Authority] switched.” Amon says she no longer gets invitations to the workshops that the ISA hosts on environmental management. The workshops are one way that the ISA consults scientists to inform members of the Legal and Technical Committee on policy decision-making. But some scientists who attend the workshops question whether their advice is being heeded. [Pradeep Singh](https://de.linkedin.com/in/pradeeparjansingh), a researcher at the University of Bremen, in Germany, who specializes in the Law of the Sea treaty, said that the reports on the workshops have gotten less substantive and sometimes fail to include the recommendations made by scientists at the gatherings. “If all this scientific input is not included in the workshop report,” he told PassBlue, “it won’t come to the attention of the Legal and Technical Committee.” Singh also said the organization’s selection of scientists attending the meetings isn’t transparent. Sabine Christiansen, a senior researcher at the German-based Potsdam Institute for Advanced Sustainability Studies, agreed. She has been studying the ISA since 2001 and attending the organization’s meetings since 2009, and says that it has a tendency to invite mostly “like-minded” scientists, a sentiment that other observers have also echoed. Who’s steering the ship? The relationship between Lodge, the secretary-general of the Authority, and the Metals Company, the Canadian company that holds three of the 31 current exploration licenses, especially concerns critics of the ISA. Lodge sparked controversy when he [tweeted](https://twitter.com/mwlodge/status/984626856384221185) a photo of himself in 2018, wearing a hard-hat branded DeepGreen, the previous name of the Metals Company, on one of its exploration cruises. Lodge also represented the ISA in an [ad](https://vimeo.com/286936275) for DeepGreen, where he said that mineral resources on Earth are dwindling and becoming more expensive and environmentally damaging to mine. [Baron Divavesi Waqa,](https://en.wikipedia.org/wiki/Baron_Waqa) the president of Nauru from 2013 until 2019, is also featured in the ad as well as in Lodge’s tweeted photos of the deep-sea cruise. [Lodge](https://www.isa.org.jm/secretary-general) is a British lawyer with a background in ocean law and fisheries management and has worked extensively in the South Pacific, where he was a lead negotiator for the 1995 [Fish Stocks Agreement](https://www.un.org/depts/los/convention_agreements/convention_overview_fish_stocks.htm), part of the Law of the Sea treaty. He has been with the ISA as a legal counsel since 1996 and was elected secretary-general in 2016. He did not respond to repeated requests for an interview from PassBlue. Christiansen of the Potsdam Institute says the climate at the ISA has become “less open” since Lodge’s election, citing less-thorough public reports. The Metals Company has been the most active corporation pushing for deep-sea mining to begin. It holds an exploration contract sponsored by Nauru through a local subsidiary. Gerard Barron, chief executive of DeepGreen (and now heading its renamed Metals Company), [represented](https://enb.iisd.org/events/1st-part-25th-annual-session-international-seabed-authority-isa/highlights-and-images-main-1) Nauru at the ISA’s Assembly meeting in 2019. In March 2021, the Metals Company [released](https://metals.co/deepgreen-combines-to-form-the-metals-company/) a $2.9 billion initial public offering stating that it would begin producing metals — and mining the ocean — as soon as 2024. Today, the company appears to be struggling, however, with one major investor [suddenly pulling out](https://www.ft.com/content/6675ac1e-a9a0-48d8-b4e9-aee2ef27c7be) his capital and a [class-action lawsuit](https://www.businesswire.com/news/home/20211028005874/en/EQUITY-ALERT-Rosen-Law-Firm-Files-Securities-Class-Action-Lawsuit-Against-TMC-the-metals-company-Inc.-fka-Sustainable-Opportunities-Acquisition-Corp.-%E2%80%93-TMC-TMCWW-SOAC-SOAC.U-SOACWS) accusing the company of misleading information in documents for investors. Lodge’s public statements on mining also raise questions about his commitment to protecting the environment when that work contradicts the interests of mining companies. Scientists, including the ISA awardee Diva Amon, have for years been calling for a moratorium on deep-sea mining to give scientists and miners more time to understand its potential consequences and devise mitigation strategies. During a [June 2020 hearing](http://www.dekamer.be/media/index.html?sid=55U0739) in Belgium’s parliament, Lodge said he had not heard a “powerful” call for a moratorium and called such an initiative “anti-science, anti-knowledge, anti-development and anti-international law.” In September 2021, 81 governments, more than 500 civil society organizations and several multinational companies, including Google, [jointly called](https://www.iucncongress2020.org/motion/069) for the moratorium. They also called on the ISA to improve its transparency and accountability. A deep-sea jellyfish collected by a remotely operated vehicle from a depth of at least 4,920 feet in the Celebes Sea of the western Pacific Ocean. The red color is common among deep-sea medusas, as it is invisible in the perpetual darkness and at the same time masks any bioluminescence of prey in the jelly’s gut. NOAA-OFFICE OF OCEAN EXPLORATION AND RESEARCH Sharing the profits The ISA was established “with this amazing principle as its fundamental legal basis to act on behalf of humankind,” Gjerde of the International Union for the Conservation of Nature says. The ISA contends that it is committed to prioritizing the interests of developing nations through the financial and economic frameworks that it writes for the exploitation of the riches that lie at the ocean floor. Though the US is not a party to the Law of the Sea treaty, American organizations still have influence over the ISA. Through subsidiaries, the weapons manufacturer Lockheed Martin holds two exploration contracts. The ISA also relies heavily on research by the Massachusetts Institute of Technology for its economic predictions. A [leaked US embassy cable](https://wikileaks.org/plusd/cables/05KINGSTON2220_a.html) from 2005 describes the involvement of the US in the Authority’s meetings, noting that the choice of an “acceptable” candidate to succeed then-secretary-general Satya Nandan would be an issue that the US would “want to address in the near future.” The 31 exploration licenses that the Authority has sold so far are held by a total of 23 governments, nationally owned entities and private companies. Seven of the contracts are set aside as “reserved areas,” which are donated by wealthy countries and meant to benefit developing countries. A closer look at the complex web of the parties involved with the exploration licenses, however, raises questions as to whether the mechanism is working as intended. “Sponsoring states need to think carefully, because if they fail to exercise due diligence and the company causes environmental damage because of that, they can be held liable,” Gjerde says, paraphrasing an [advisory opinion](https://www.asil.org/insights/volume/15/issue/7/advisory-opinion-seabed-disputes-chamber-international-tribunal-law-sea-) of the International Tribunal for the Law of the Sea. Of the contracts reserved for developing countries, three are owned by the Metals Company; one is a Chinese state company; one is a joint venture among Lockheed Martin, the Singaporean conglomerate Keppel and an investment company whose ownership is unknown; one is a joint venture between the Cooks Islands government and the Belgian dredging company DEME; and one is Blue Minerals Jamaica, of which little is known except its association with Peter Henrik Jantzen, a Dane. Indeed, as pressure increases for the Authority to speed up the process of allowing the mining of the deep sea, it remains an obscure body with little public oversight. The next meetings for the ISA Council and the Assembly, postponed last year due to the Covid crisis, are planned for December. “We have all these other activities in the high seas,” Christiansen of the Potsdam institute says. “The ISA is adding new pressures on the ocean, and nobody’s looking.”