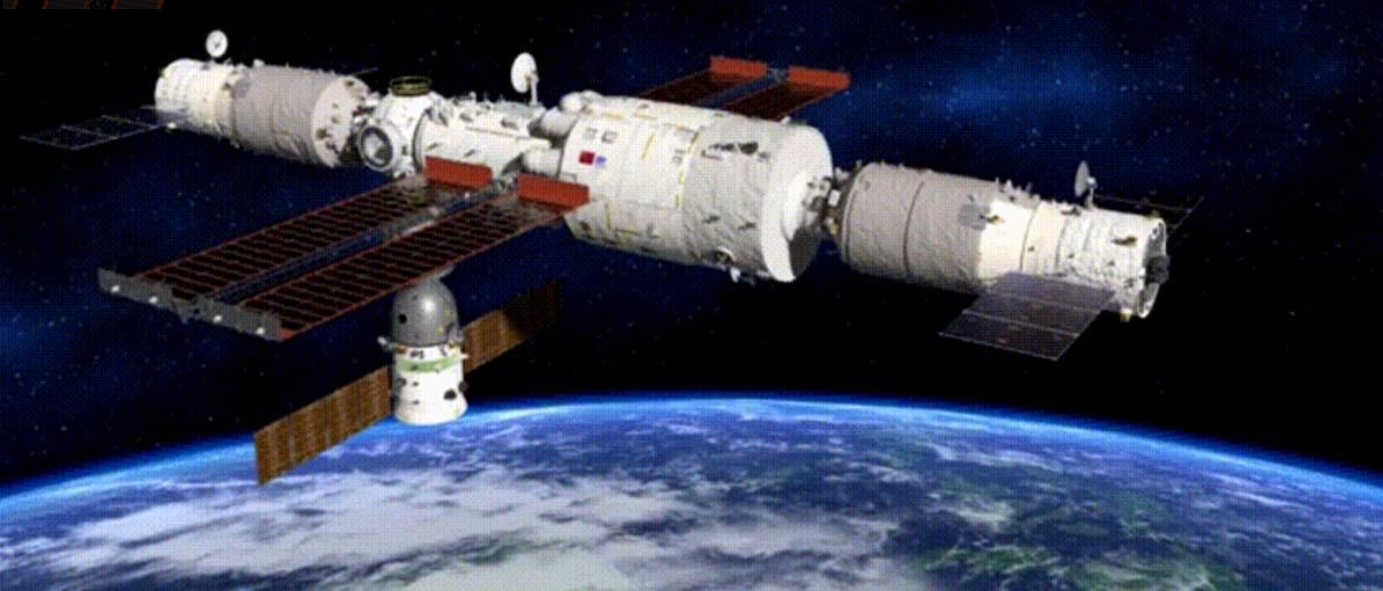
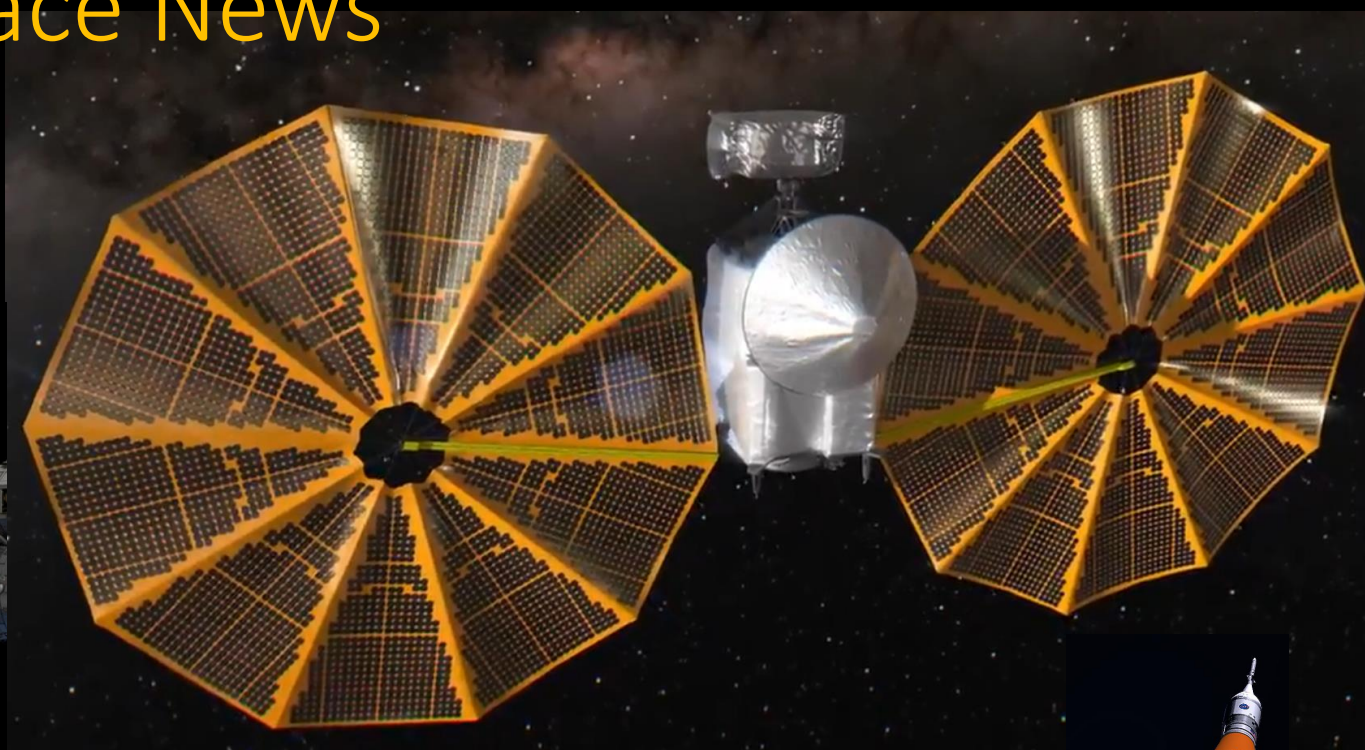
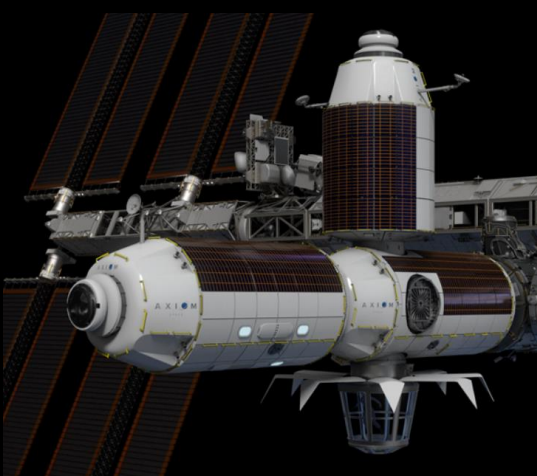


Monthly Space News

Greg Stanley

Nov. 6, 2021



Low Earth Orbit (LEO) news: Chinese space station

- Chinese sent a second crew of 3 to their space station for 6 month tour
- Under construction with initial target configuration of 3 modules in 2022



Chinese space station configuration Oct, 2021 (artist illustration). Credit: CMSA

Space stations galore (potentially)

- ISS life may be extended to 2028-2030, but the end is coming
 - Concern over stress cracks, air leaks in Russian Zarya module (the oldest - 1998)
 - Cost \$150 billion to build, \$4 billion/year to operate
- Chinese space station
- Axiom building detachable ISS modules, launching in 2024 (\$140m NASA funding)
 - Axiom says it has lost some business to the Chinese station
- NASA Commercial LEO Destinations Project (CLD) program analogous to Commercial Crew has proposals already, funding up to 4 at \$400 million initially
 - Orbital Reef: Blue Origin/Sierra Space/Boeing/others
 - Starlab: Nanoracks/Lockheed Martin (2027)
- Previous business failures: Bigelow Aerospace, Orion Span



Image credit:CMSA

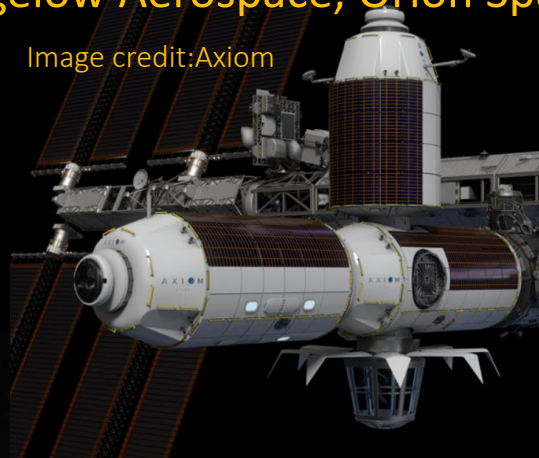


Image credit:Axiom



Image credit:NASA



Image credit:Blue Origin



Image credit:Nanoracks

Axiom space station still attached to ISS

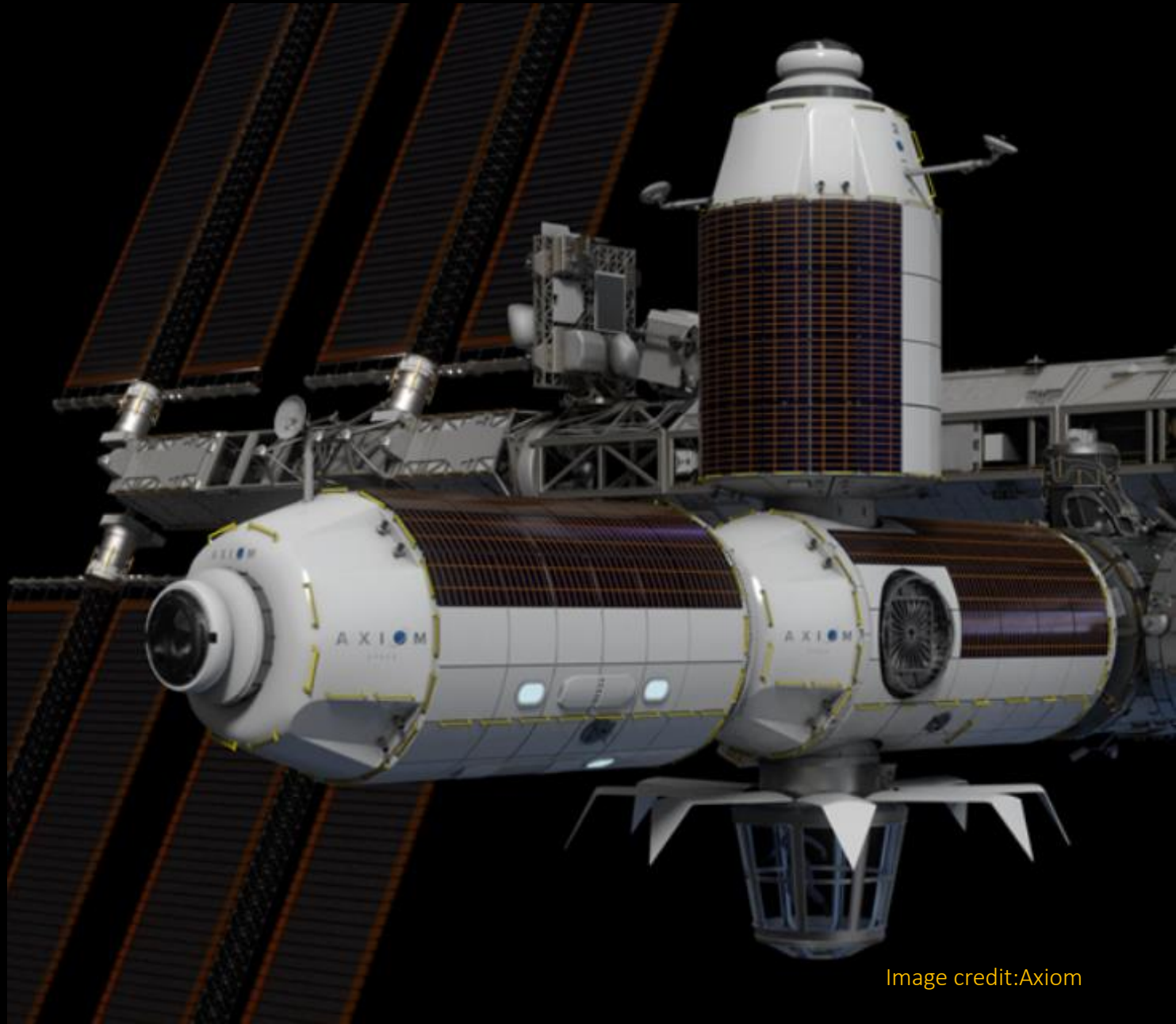


Image credit:Axiom

Nanoracks Starlab space station

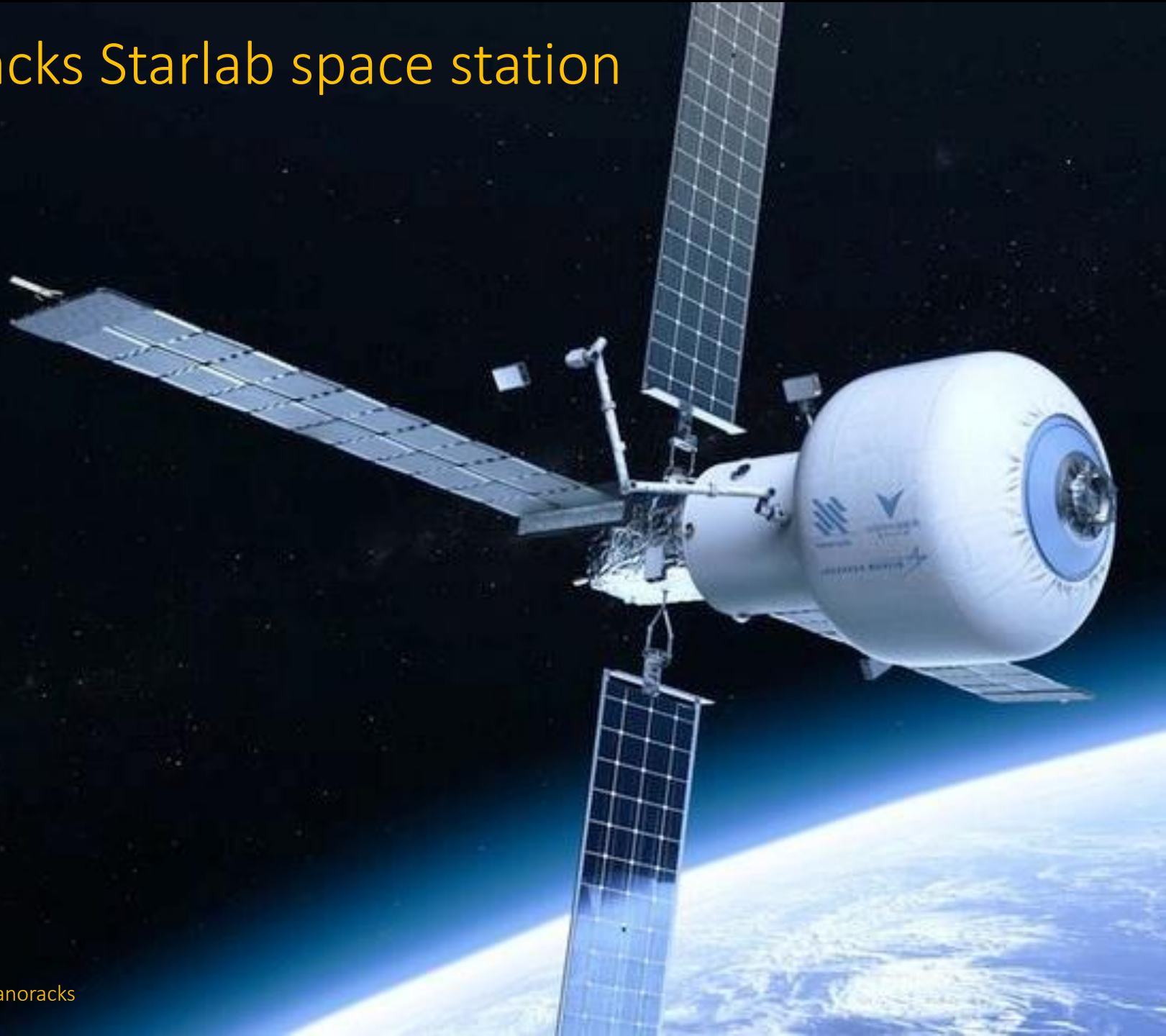


Image credit: Nanoracks

Blue Origin Orbital Reef space station

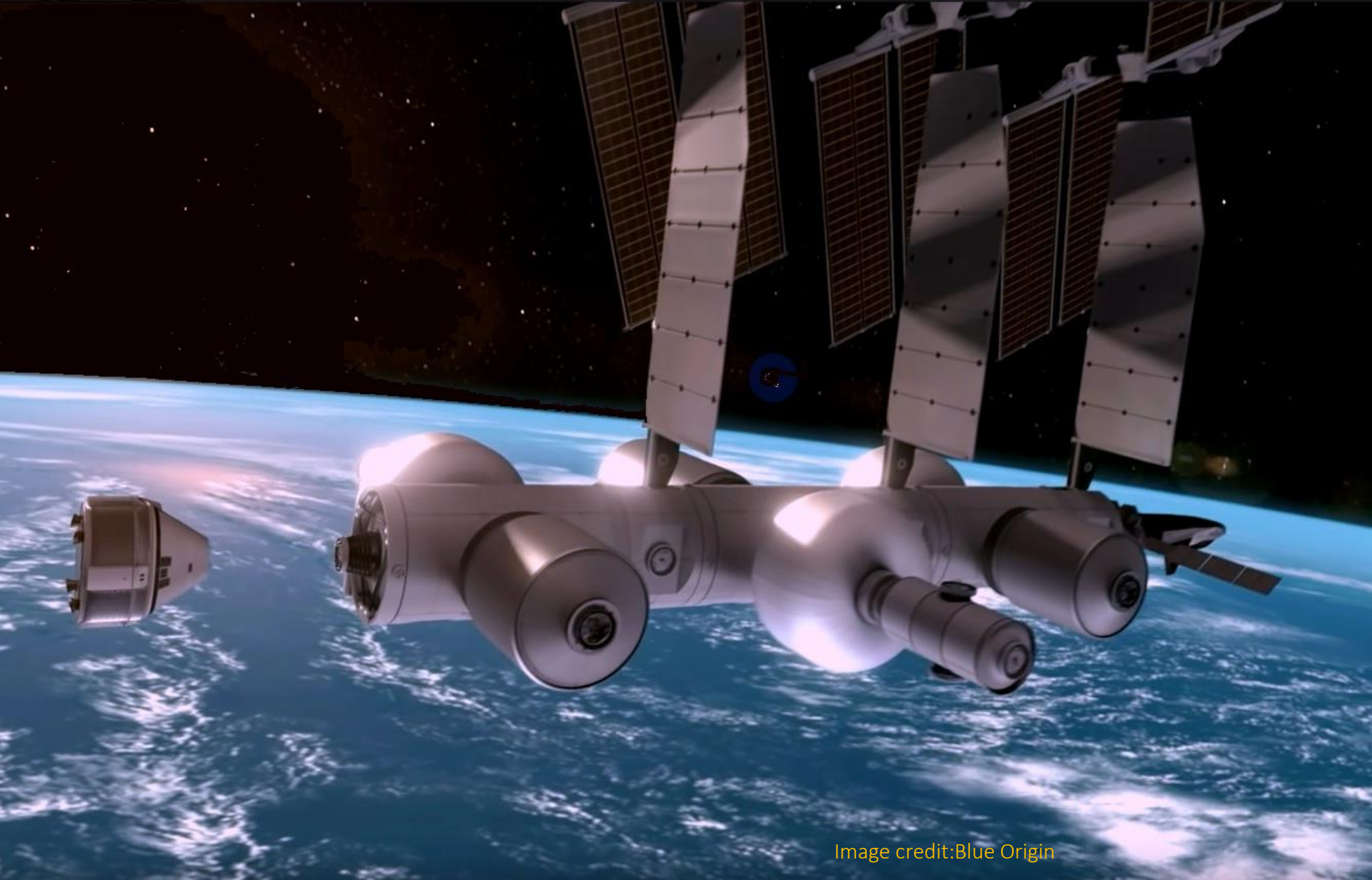


Image credit:Blue Origin

Orbital Reef: “Mixed use business park”, open spaces...



Image credit: Blue Origin

... compared to ISS (International Space Station)



Image credit: NASA

Movie making at the ISS (International Space Station)

- Russian Soyuz took director, actress to the ISS to film “The Challenge”
 - Actress Yulia Peresild plays a surgeon making an emergency house call to ISS
 - After 12 days of filming, the director and actress returned to Earth
- Real-life minor drama: Automated docking failed, Soyuz docked manually
- Russians accidentally fired a thruster again, tilting ISS 57 degrees, destabilizing ISS for 30 minutes



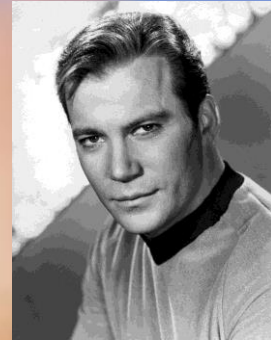
Image credit: NASA

Suborbital space tourism starts a controversy

- Captain Kirk (William Shatner) finally made it to the edge of space (66 miles/10 minutes)
 - Free ride on Blue Origin New Shepard suborbital flight
 - Now the oldest person to get to space (age 90)
- But Prince William (British royal family) wasn't happy about it...



NEW SHEPARD
MISSION NS-18



Prince William is unhappy



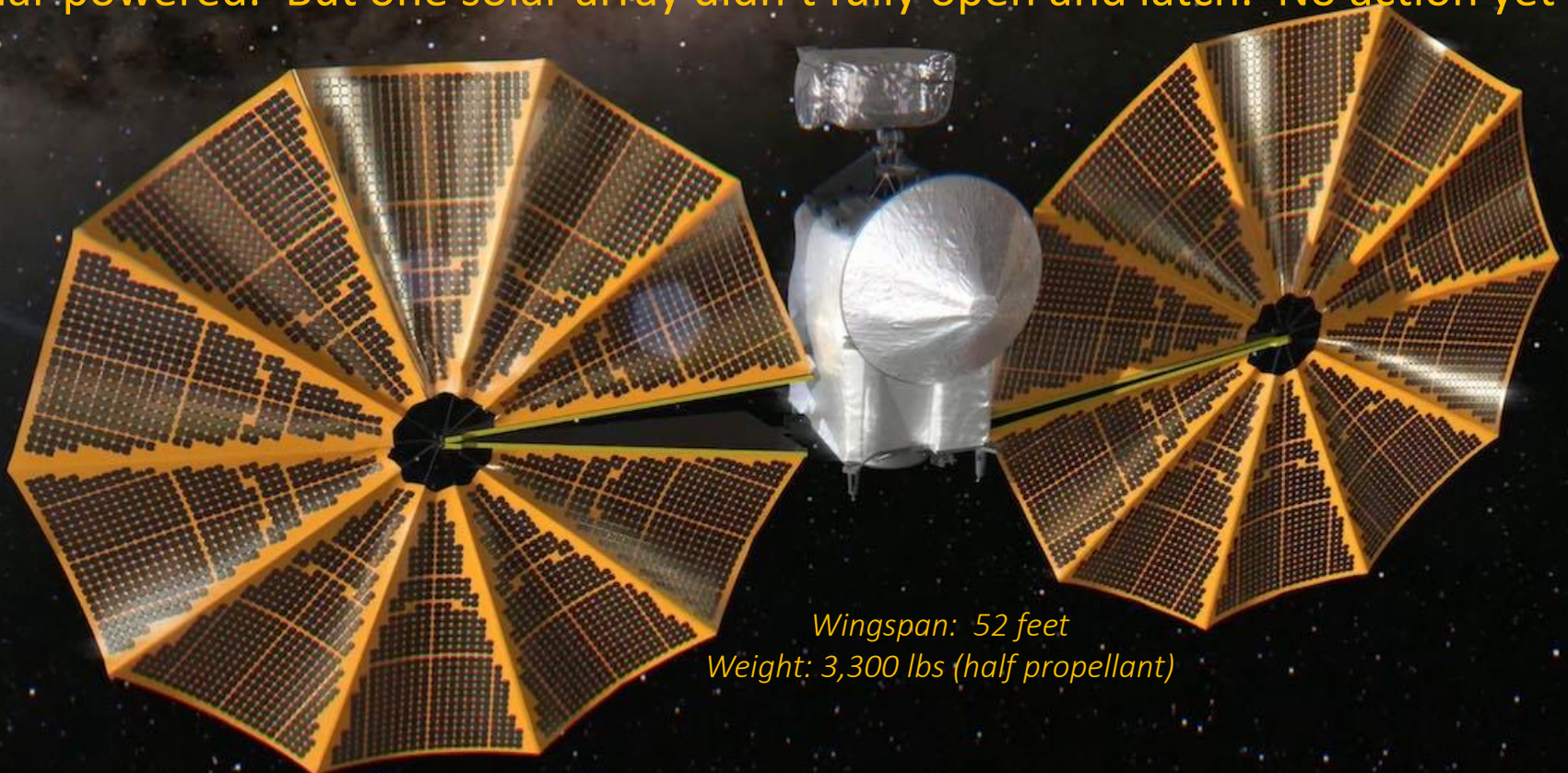
“We need some of the world’s greatest brains and minds fixed on trying to repair this planet, not trying to find the next place to go and live”



- Space vs. environment is a false dichotomy!
 - Space development and environmental stewardship are not mutually exclusive – each helps the other
- Space programs are a major factor in providing data to enable climate modeling and understanding, and improving earth life
 - GPS, temperatures, cloud cover, ice extent, atmospheric composition, deforestation, land use, solar input, ...
- Modeling the environment is essential for settling space, and includes studies with much shorter time scales to see the effects faster than on earth
- Even joyrides by a privileged few lead to an appreciation of earth
 - Environmentalism got a big jolt with the “Blue Marble” view of Earth from space
- The vast resources of space will enrich humankind (material, energy, places to go, ...)
 - Environmentally-friendly space solar power, specialized industry, new technology, diverse governments, new hopes and challenges for the human spirit, surviving cataclysms, ...

Lucy launched to explore 8 asteroids in 12 years

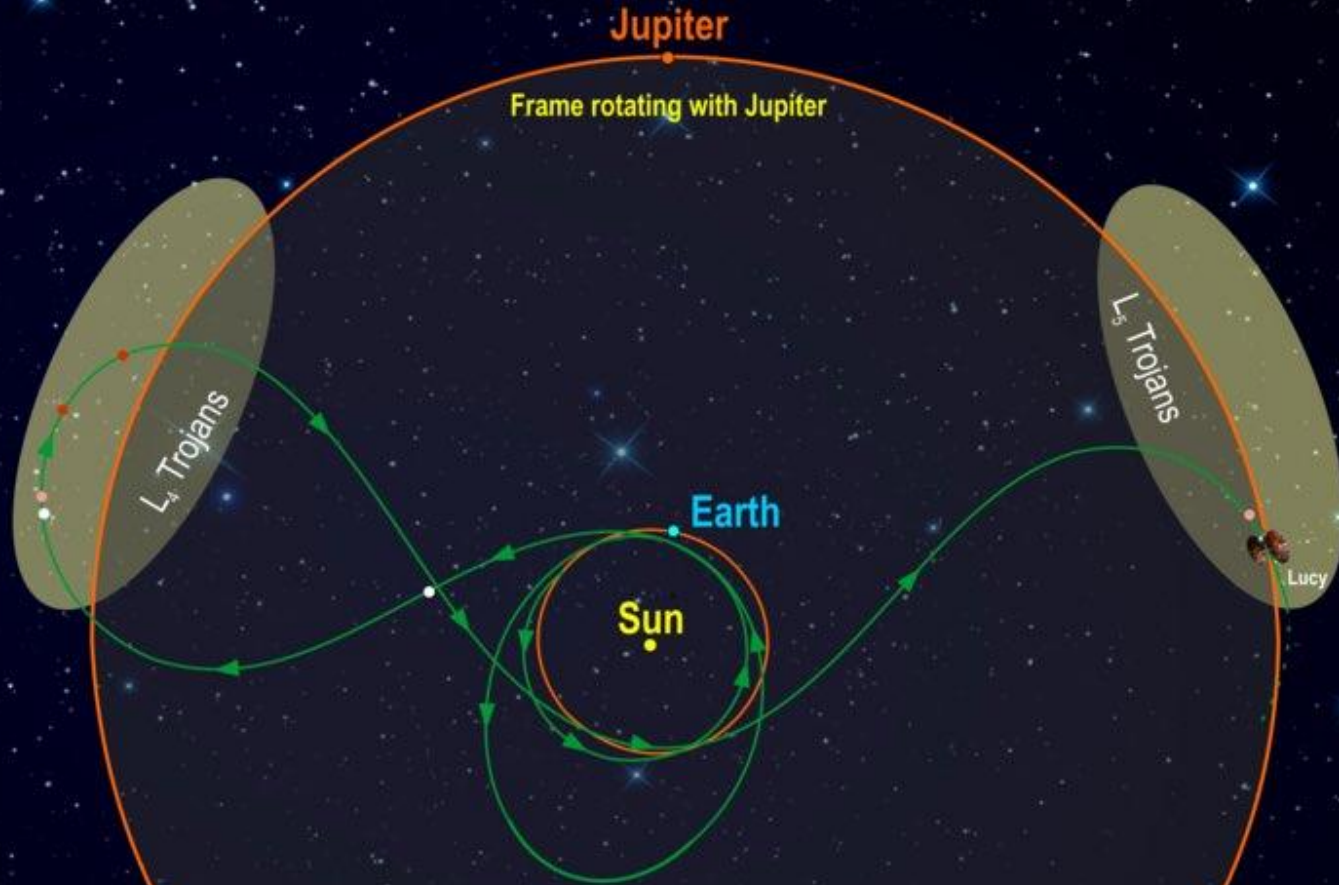
- NASA's Lucy will fly by Jupiter's "trojan" asteroids
 - Asteroids trapped by Jupiter's gravity near Lagrange points L4 and L5
 - Expected to be about the same as 4 billion years ago - window to the distant past
- Will obtain detailed images, analysis with imaging spectrometers, temperatures, mass estimates by velocity changes through doppler effect
- Solar powered. But one solar array didn't fully open and latch. No action yet



*Wingspan: 52 feet
Weight: 3,300 lbs (half propellant)*

Illustration of final phase of deploying solar arrays on NASA's Lucy spacecraft. Credit: NASA

Lucy has a complex trajectory to save 80% of fuel



- Lucy will fly by Earth 3 times for gravity assist!
- Most distant use of solar power (usually nuclear power for deep space)
 - 18,000 watts of solar power near earth, but only 500 watts near Jupiter!

New NASA SLS (Space Launch System) controversy

- Background on the SLS heavy launch rocket program
 - Started in 2011 by Boeing (prime contractor)
 - Original estimate: \$10 billion cost, for launch in 2016
 - Now expected to first launch in 2022, after \$21+ billion for the rocket & ground systems
 - Will use up 16 old Space Shuttle engines for first 4 flights (Congressional mandate), then use Aerojet updated copies
 - A key part of Artemis back-to-the-moon program
 - Dropped from NASA 2024 Europa Clipper due to delays, cost
 - Then-Florida Senator Bill Nelson was a political architect, steering billions to Florida for ground systems, etc.

“If we can’t do a rocket for \$11.5 billion, we ought to close up shop”
(Bill Nelson, 2011)

- New NASA RFI (Request For Information), under NASA administrator Bill Nelson
 - Wants proposal by January 27, 2022 to fly SLS rocket for 30 years, with one crewed flight per year for the next decade
 - A “sustainable and affordable system” by saving 50% off “baseline per flight cost” (not stated)
 - (Cost of one launch was estimated by OMB at over \$2 billion in 2019), vs. Starship where estimates are in units of millions



SLS controversy

- SLS detractors say competition offers much lower costs
 - Technology changes faster now: we shouldn't have 30-year time horizons
 - This is just old-school NASA/defense-style “pork”, appeasing Congress
 - Reusability, pioneered by SpaceX, is now proven to lower costs
 - Entire industry is planning to shift to reusability
 - SLS is disposable, although the old Shuttle engines could be reused
 - In orbit refueling with reusable craft (Falcon Heavy) would be cheaper
 - Entire Starship development expected to be \$5 billion, largely self-funded
 - One flight per year is too low to achieve cost savings, and no one but NASA would pay the high SLS price
- Some think this RFI is a maneuver by Nelson to force Boeing and Congress to give up after the initial few SLS launches , since they couldn't really make SLS “sustainable and affordable”



The first Artemis HLS contract dispute may be over

A federal judge dismissed the Blue Origin lawsuit over NASA's awarding the first Human Landing System contract to SpaceX for a manned lunar landing



Credit: Blue Origin

Jeff Bezos conceded gracefully in a tweet. But...
Elon Musk tweet (quoting 1995 movie Judge Dredd:



X-37B Space plane lands after record 780 days in orbit

- What are they? (At least 2, also known as OTV = Orbital Test Vehicle)
 - Reusable, autonomous mini-shuttle (robotic space plane) built by Boeing
 - ¼ size of the Space Shuttle (29 feet long, 15 feet wingspan, 11,000 lbs)
 - Miniature payload bay for satellites or experiments
 - Launched on Atlas V or Falcon 9 rocket, Mach 25 deorbit, glide to land on a runway
- History
 - Started by NASA (1999), transferred to military classified project since 2004
 - First orbited by USAF (2010), now U.S. Space Force
- What do they do? It's classified, but officially...
 - “Demonstrate technologies for a reliable, reusable, uncrewed space test platform” for the U.S. Space Force
 - Focus on reusable spacecraft, operating experiments which can be returned to Earth



Photo credit: US Air Force

August Chinese hypersonic missile tests? Space plane?

- China denies testing a nuclear-capable hypersonic missile twice
 - China didn't announce launches, but now says they tested a reusable space vehicle
 - If true, indicates Chinese program is more advanced than we thought
- China, U.S., Russia, maybe N. Korea, lead work on hypersonic weapons
 - General John Hyten says U.S. is falling behind due to risk-averse culture
 - Claim: in last 5 years the U.S. did 9 hypersonic missile tests, China did hundreds
- Rocket launched and flies partly through a Very Low Earth Orbit (e.g., 150 km)
 - Circling earth in this test -- could stay in orbit for a while, attack from space
- De-orbit burn & release glider
- Hypersonic glide down to target
 - 5x the speed of sound: slower than a ballistic missile
 - Maneuverable, lower trajectories, does not follow a fixed parabolic trajectory
 - Hard to track, impossible to intercept with current defense
 - Could fly over South pole: challenge since U.S. defenses are focused on Northern polar route

China trials 'fractional orbital bombardment system'

Trajectory of an intercontinental ballistic missile . . .

Defence system designed to detect ICBMs

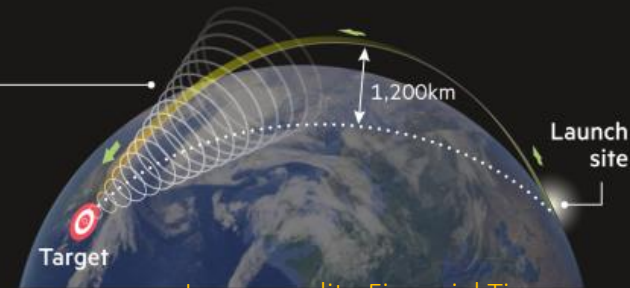
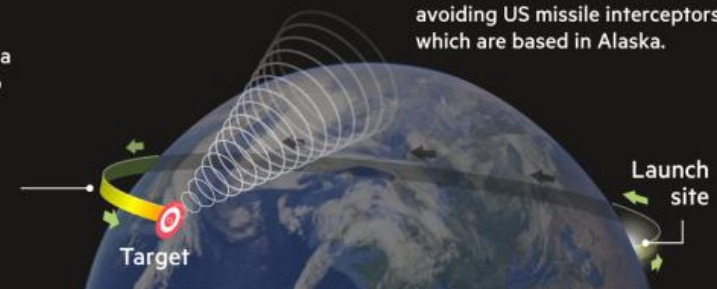


Image credit: Financial Times

. . . compared to the hypersonic glide vehicle

Travels at around Mach 5 along a low trajectory with the ability to maneuver in flight, making it harder to detect than a ballistic missile. Has potential to carry a nuclear warhead.



Source: FT research
© FT

Hypersonic gliders aren't a new concept

- Explored since the 1960s by Russia, US, ...
- Any craft returning from Low Earth Orbit is hypersonic: 17,000 mph/Mach 25
- Space Shuttle was a controllable hypersonic glider, like other space planes
 - Difference? Space planes are less aerodynamic, landing gear, no explosive payload
- China fielded the mobile Dongfeng DF-17 medium range ballistic missile in 2019, equipped with a DF-ZF hypersonic glide vehicle
 - Conventional (or nuclear?) warhead
 - Range 1,100 – 1600 miles
 - No defense against these



Dongfeng-17 hypersonic glider in military parade, 2019.

Image credit: Zoya Rusinova/ Getty Images

Clearing space junk/preparing for space war

- Chinese launched a classified military satellite to “test space debris mitigation technology”
 - Dual use (civilian/military): Approach a satellite and capture, disable, or move it
 - Details have not been provided on this satellite which went into geosynchronous orbit
 - Geosynchronous orbits (22,000 miles) are where the large, highest-value targets are
- The military (especially the US) depends heavily on space
 - Communications
 - GPS for guiding weapons: smart bombs, missiles, drones, ...
 - Identifying targets, and tracking moving targets (ship/submarine/troops/planes)
 - Detecting missile launches and calculating trajectories for anti-missile defense
 - General intelligence on economic and military capability, agriculture
- Brute force weapons kill satellites by crashing into them or exploding
 - Kinetic weapons tested by U.S., China, Russia, others
 - Launched from ground, sea, planes, or satellites
 - Problem: dangerous debris for all, some left over from previous tests, even without Kessler cascade
 - Large EMP (Electromagnetic pulse). Problem: kills enemy & friendly assets.
 - Developed and retained “just in case” as a strategic deterrent
 - Might be used by minor space powers with little to lose (N. Korea)

Ongoing preparation for space war/deterrence

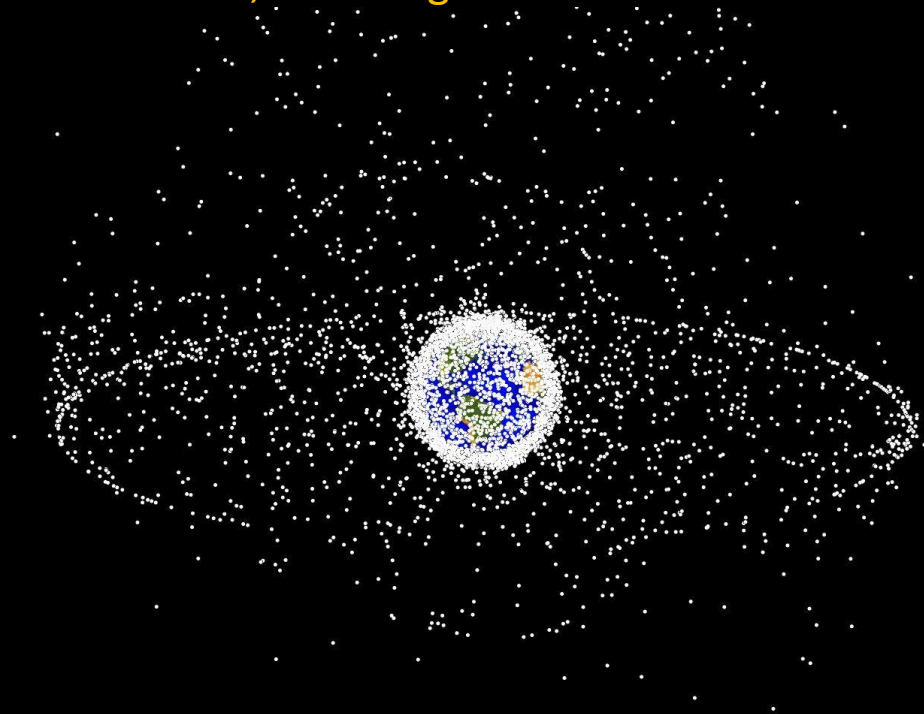
- Pentagon officially declared space is a warfighting domain
- Emphasis now is in disabling satellites in place, ideally with deniability
 - Chinese Shijian 17 satellite (2016) can approach & capture satellites in geo orbit, and has a robot arm for grappling or damaging it (e.g., destroying solar panels)
 - Chinese working on grabbing a satellite, putting small explosive up into the thruster, which could look just like a simple failure, according to Chinese press (SCMP)
 - MEV satellites by Northrop Grumman grab a satellite and change its orbit, and newer versions will have a robotic arm for capability
- Other examples for offense
 - Lasers to blind or disable satellites from ground, sea, air, maybe other satellites
 - L3Harris: \$121 million upgrading U.S. ground-based communications jamming
 - Cyberattacks on satellites
- Problem: how to respond to
 - A laser blinding a satellite
 - Tailgating by a satellite



Credit: Adobe stock/spacenews.com

Defensive strategies for space war

- French military satellite just launched has cameras to identify & monitor attackers, extreme anti-jamming, EMP resistance, moves to avoid attack
- School of fish strategy
 - Shift to from current large geo satellites (“juicy targets”) to constellations of smaller LEO satellites: easier to launch and replace, too many to easily destroy.
- Backup redundancy
 - US wants backup communications, GPS, intelligence gathering, in constellations of smaller commercial satellites, including Starlink



Objects in Earth orbit (5% satellites and 95% debris), density correlating with live satellites. Credit: NASA

How many launches since the last meeting (Oct 2)?

This includes failed launches only if they lift off the launch pad and only includes launches that attempt going into orbit













Does NOT include the Chinese hypersonic missile test



Long March 2F rocket carrying 3 astronauts to Chinese space station

Credit: Xinhua

Launches since last meeting (Oct 2, 2021)

-  Oct 5 – Soyuz – International Space Station – crew, actress, movie director
-  Oct 14 – Soyuz – 36 more OneWeb satellites for internet service
-  Oct 14 – Long March 2D – Solar observatory, 10 small secondary payloads
-  Oct 15 – Long March 2F – 3 astronauts to Chinese space station
-  Oct 16 – Atlas 5 – NASA's Lucy spacecraft flying to 8 asteroids in 12 years
-  Oct 21 – Nuri (S. Korea) – first test flight to orbit (FAIL)
-  Oct 23 – Long March 3B – Classified satellite military/space debris mitigation
-  Oct 23 – Ariane 5 – 2 Telecom satellites: 1 commercial, 1 French military
-  Oct 25 – H-2A (Japan) – Navigation service satellite
-  Oct 27 – Kuaizhou 1A – Small earth observation sat. for Jilin 1 constellation
-  Oct 27 – Soyuz – 79th Progress cargo ship – 5,000 lbs to the ISS
-  Nov 3 – Long March 2C – 2 classified military satellites

Discussion & questions?





Featured speaker: Nathan Price

- Lifelong passion for space exploration/development
 - Countdown to the Moon program interviewing a person a day <https://CountdownToTheMoon.org>
 - Volunteer at Space Center Houston
 - Started NSS North Houston chapter meetings in Jan, 2018
 - President, and the person who does the most to make this chapter successful !
- Manager and Solutions Architect at Anaplan, previously Development Lead at HP
- BS in Mathematics, minor in Economics, University of Houston
- TOPIC: Going Interstellar: What I learned at the 7th Interstellar Symposium
- Interstellar Symposia every 2 years provide an exciting vision for our long range future in space

