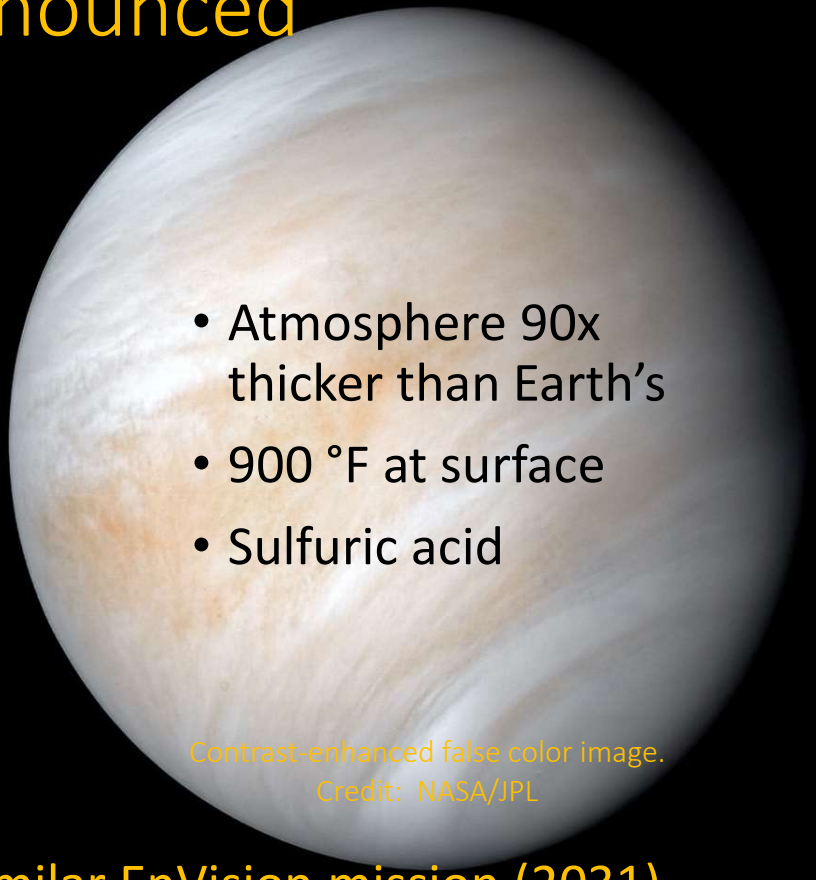
Space News

Greg Stanley July 10, 2021

NSS North Houston Space Society

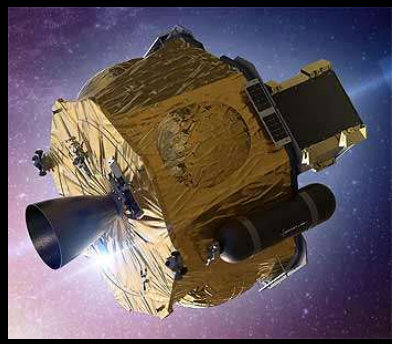
Robotic missions to Venus announced

- 2 NASA missions to launch around 2029
  - First US missions there in 30 years except flybys
  - DAVINCI+ (atmospheric analysis, images)
    - Parachute a probe (3 foot titanium sphere) in 1 hour descent to surface, 1.5 hour life
    - Determine how atmosphere evolved, if it had an ocean, look for controversial phosphine life indicator
  - VERITAS
    - Radar will update topographic maps
    - Looking for geologic activity like volcanos, land movement



Contrast-enhanced false color image.
Credit: NASA/JPL

- ESA (European Space Agency) announced similar EnVision mission (2031)



- Rocket Lab still plans private mission using Photon craft (2023)
  - Will orbit, drop a probe, look for that phosphine biomarker
  - Rocket Lab has NASA contracts to orbit the Moon (2021), Mars (2024)
- Why now: climate change emphasis, mostly-discredited recent evidence of life

Suborbital space tourism/private astronaut race

- Virgin Galactic launch expected July 11
  - First launch with passengers (+ 2 pilots)
  - Richard Branson + 3 other employee passengers
  - 2 hour ride, mostly in the carrier aircraft, 4-5 minutes of weightlessness
- Blue Origin launch expected on July 20
  - First New Shepard launch with people
  - Jeff Bezos going, taking his brother, 82-year old woman Wally Funk (trained as an astronaut), and someone who paid $28M in a charity auction
  - 10 minute automated ride (no pilots), 3 minutes of weightlessness
- Spaceship Neptune (balloon from Space Perspective) tested June 18
  - Only 19 miles up, but gentle 6 hour flight
  - Started ticket sales for 2024, $1K deposit
- Markets include tourism, astronaut training, short research experiments
  - Prices probably > $250K, except balloon ($125K)

Picture credit: Virgin Galactic

Photo credit: Blue Origin

Orbital space tourism/private astronaut update

- Axiom signs up 3 more private crew missions to ISS with SpaceX
  - Axiom now has total of 4 private missions, each taking up to 4 astronauts
  - Starting Jan, 2022 at earliest, 8 day visit
  - SpaceX has 10 Crew Dragon missions confirmed (including contracts with NASA and Space Adventures)
  - Cost about $55M/person ?
- Axiom goal is to create their own commercial space station by 2028
- First fully commercial human flight to LEO will carry 4 to space for 3 days
  - SpaceX flight to orbit only, not to ISS
  - Yet another billionaire, Jared Isaacman – as a charity drive for St. Jude Childrens Research Hospital
- dearMoon project – 6 day lunar orbit tourism on SpaceX Starship paid by a Japanese billionaire (2023-2024?)

SpaceX Crew Dragon Endeavour docked at International Space Station (ISS)

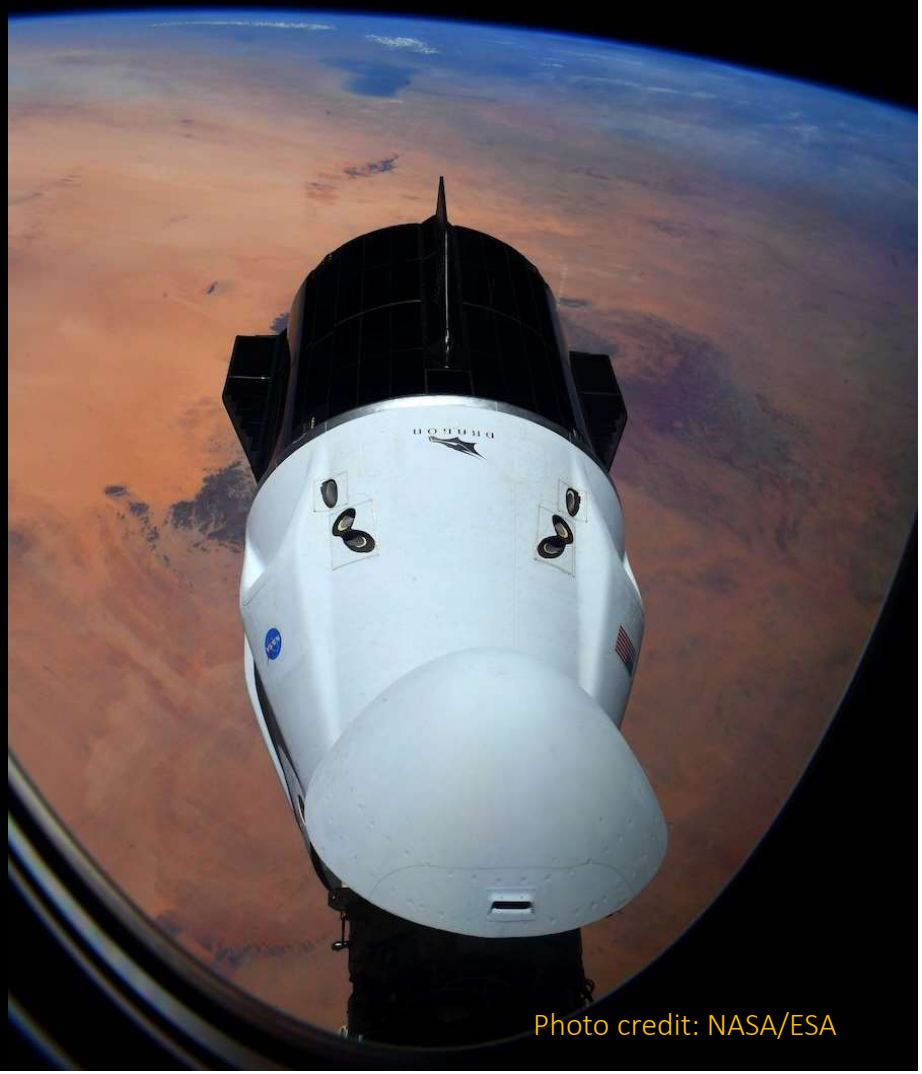


Photo credit: NASA/ESA

Relativity Space announced a larger 3D printed rocket

- Announced Terran R, ready in 2024
  - Fully re-usable 3D printed 2-stage rocket
  - Will take 22 tons of cargo to LEO (Falcon 9 competitor)
- Earlier Terran 1 rocket should launch by year end
  - Expendable, 3D printed
  - Will take 2,750 pounds to LEO (>4x Rocket Lab Electron)
  - Has 9 launch contracts
- 3D printing goal: Print entire rocket in 60 days, including engine
  - Faster iteration for testing & improving
  - Others like Rocket Lab 3D print engines, Blue origin prints parts
  - Longer range goal for settlement: 3D printed habitats, etc.
  - Example of a disruptive technology
- Continues to raise private money: VC, Fidelity, Mark Cuban, …

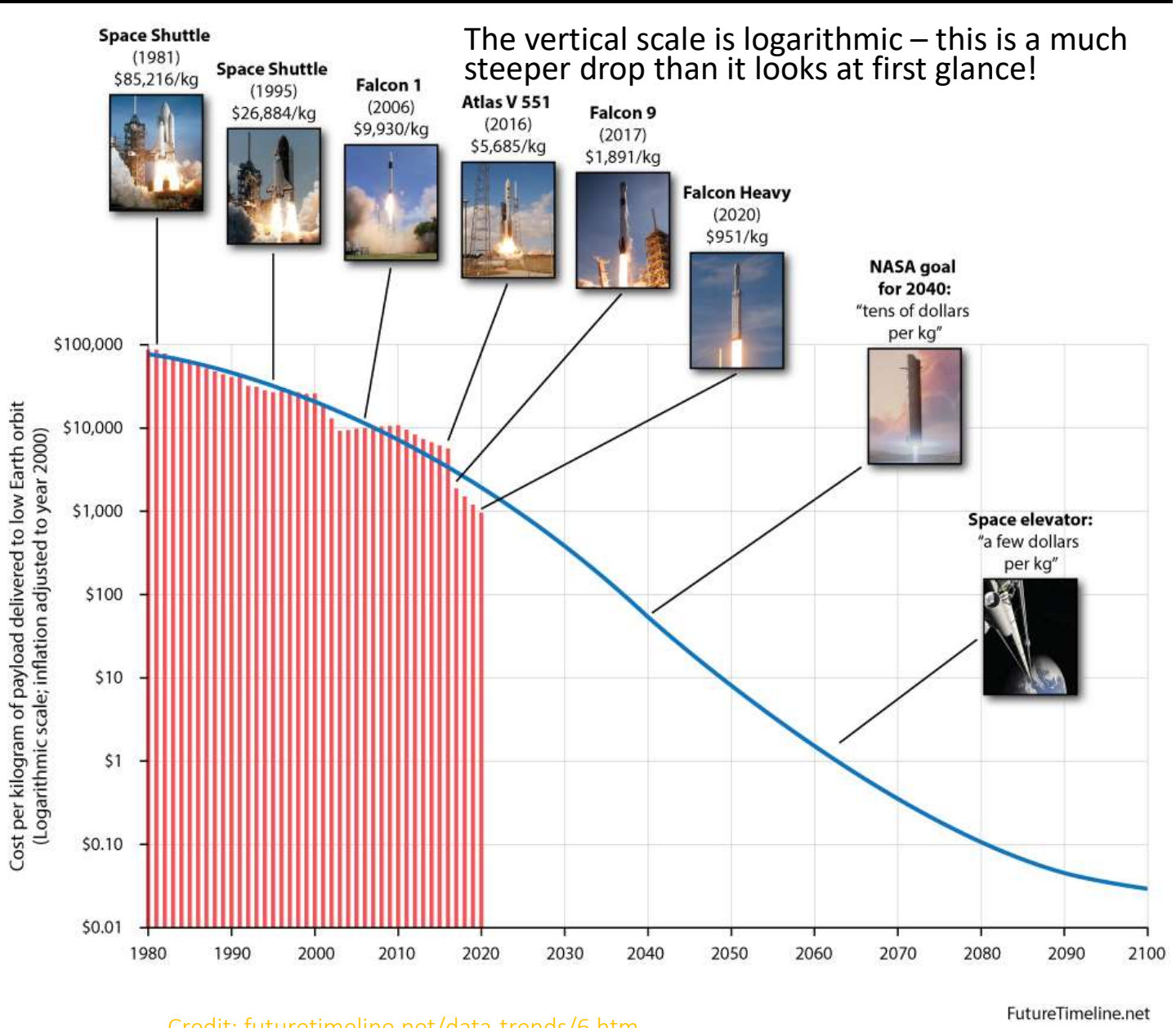
Illustration credits: Relativity Space

Terran 1

Terran R

Disruptive technologies are opening up space

- Example: SpaceX drove down the launch cost 90% by developing and refining technologies for reusable craft



Credit: futuretimeline.net/data-trends/6.htm

Disruptive technologies

- Focus now at SpaceX is not just reusability, but rapid re-use
  - Cost savings – fewer rockets are needed
  - With more launches, technology iterations can come faster
  - Starship takes reusability further, with faster iterations, plus advantage of economies of scale (analogous to large cargo ships).
  - Affects launch technology, but also all technologies tested in space, e.g., on ISS
- Other disruptive technology examples
  - Ion engines for satellites and interplanetary missions (efficient operations)
  - Cubesats and technologies like space tugs for moving and dispersing them
  - 3D printing
  - Future technologies like space solar power, space elevator
- Any drastic cost reduction opens up new possibilities
  - Analogy: Semiconductor industry relentlessly improved, enabling entire new industries and applications based on resulting cheaper computer power
- Low launch cost is a necessary enabler, but many other new technologies will be needed to succeed in space
  - Sustainable life support, dust management, in-situ resource use, artificial gravity, radiation protection, etc.

Disruptive business models also matter

- NASA shift to buying services rather than hardware brings in private investment
- Artemis accords as a enabler for using resources in space
- In-orbit services (debris cleanup, re-fueling or moving satellites, etc.)

A disruptive technology for deep space

- The US is funding company research into nuclear engines (for 2039+)
  - For travel beyond LEO, like Mars or cislunar space, not in Earth's atmosphere
  - Chemical rockets used first to get into Earth orbit
  - Long history, even with NASA prototypes , canceled in early 1970s
- Advantages of Nuclear Thermal Propulsion (NTP)
  - Higher power and efficiency, for faster travel (Earth to Mars in 3-4 months)
  - Switch to power generation at destination
- How?
  - Energy from nuclear reactions heats liquid H2 to 2430 °C
  - Rapid expansion produces 2x thrust of chemical rockets (and cools reactor)
  - New approaches reduce proliferation risks, high temperature, and chemical risks

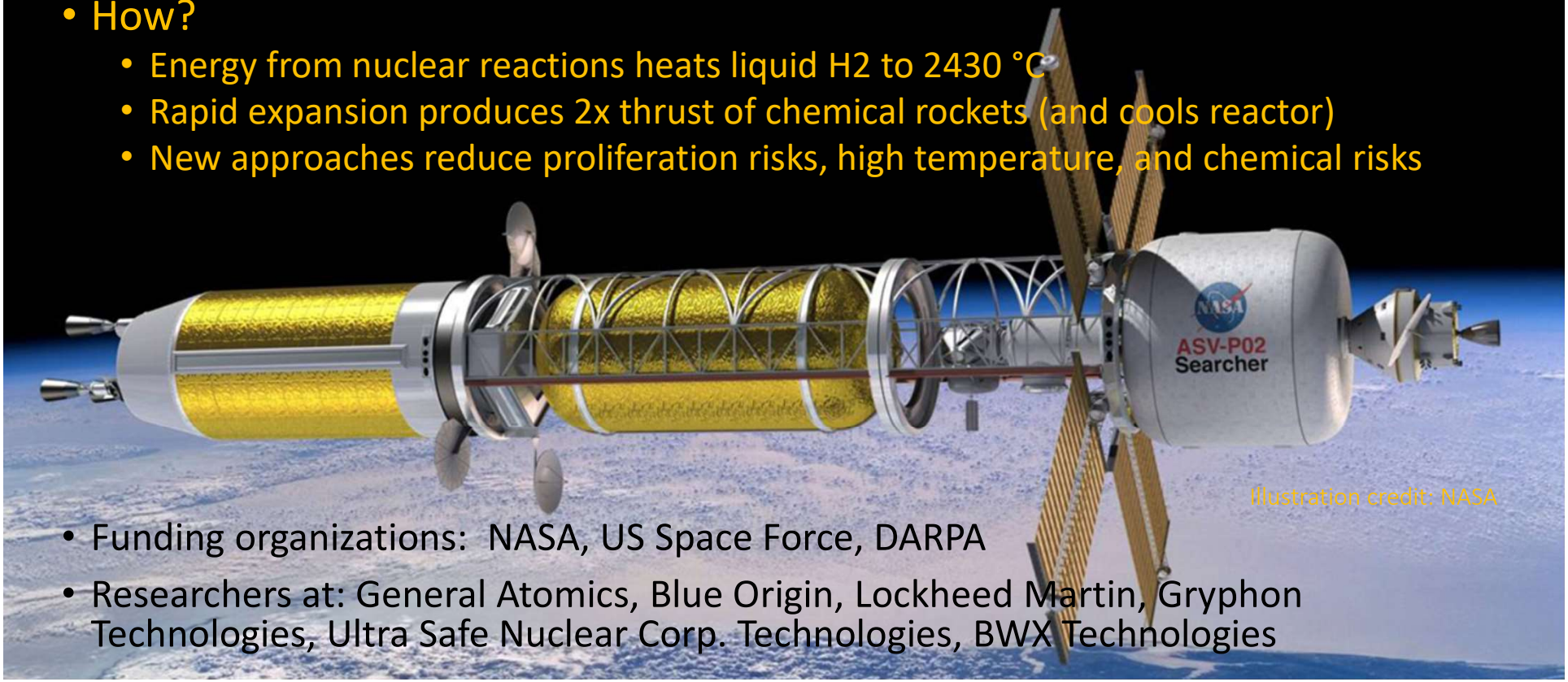
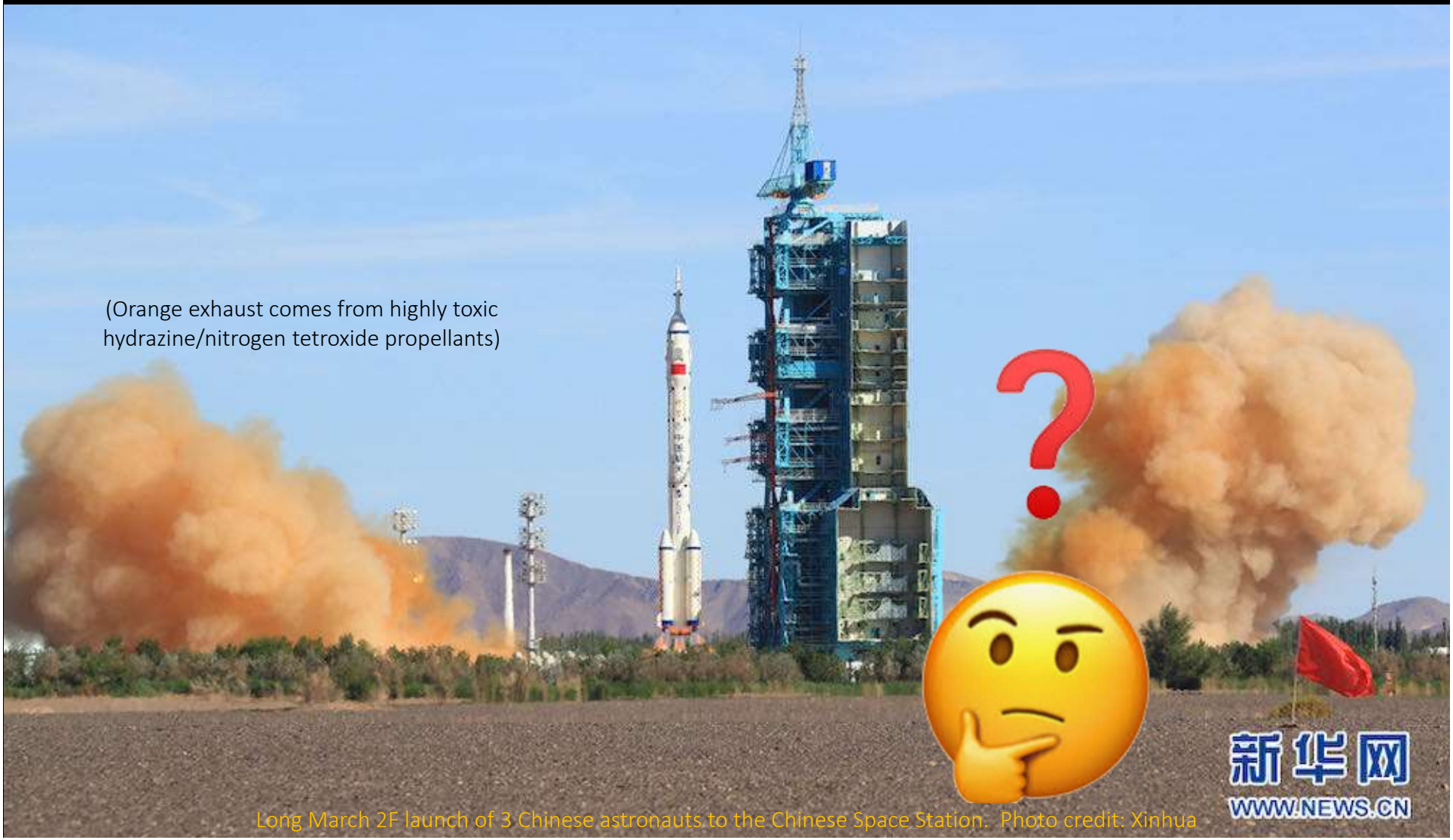


Illustration credit: NASA

- Funding organizations: NASA, US Space Force, DARPA
- Researchers at: General Atomics, Blue Origin, Lockheed Martin, Gryphon Technologies, Ultra Safe Nuclear Corp. Technologies, BWX Technologies

How many launches since the last meeting (June 5)?

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



Long March 2F launch of 3 Chinese astronauts to the Chinese Space Station. Photo credit: Xinhua

Launches since last meeting (June 5, 2021), part 1


Jun 6 – Falcon 9 – SiriusXM satellite (digital radio programming)


Jun 10 – Long March 2D – 4 small satellites


Jun 13 – Pegasus XL (Northrop Grumman) – US Space Force surveillance satellite to monitor satellites & debris, launched from an aircraft

- Demo of rapid response, designed, built, launched in a year


Jun 15 – Minotaur 1 (Northrop Grumman) – 3 spy satellites for US NRO (National Reconnaissance Office)

- Converted from 54 year old solid fuel Minuteman missile - oldest engine ever used


Jun 16 – Long March 2F – 3 astronauts to Chinese space station


Jun 17 – Falcon 9 – GPS satellite for US Space Force


Jun 18 – Long March 2C – 3 surveillance satellites, small data relay satellite


Jun 25 – Soyuz-2.1b – Russian military satellite for naval surveillance


Jun 29 – Soyuz-2.1a – 2.7 tons of cargo to International Space Station

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Launches since last meeting (June 5, 2021), part 2


Jun 30 – Falcon 9 – 88 small satellites into polar, sun-synchronous orbits

- "Transporter" series rideshares are inexpensive: $1M for 200 kg


Jun 30 – LauncherOne (Virgin Orbit) – 7 mostly military CubeSats

- Expendable rocket launched from a 747 carrier jet


Jul 1 – Soyuz-2.1b – 36 more OneWeb internet satellites

- Total now 254 / planned 648 by next year for first-generation fleet
- Commercial internet service to start in a few months above 50 degrees latitude


Jul 2 – Long March 2D – 5 small Earth observation satellites


Jul 4 – Long March 4C – weather satellite


Jul 6 – Long March 3C – communications satellite

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Discussion & questions?

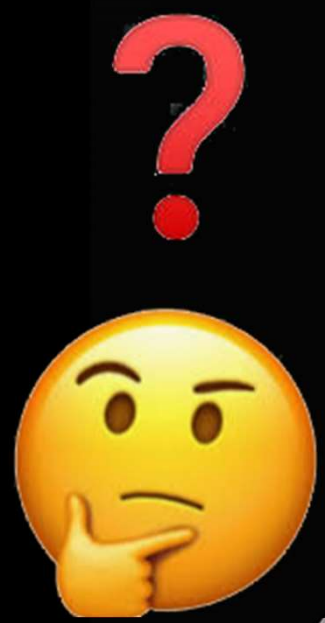

Image: NASA

Featured speaker: Dr. Kumar Krishen

TOPIC: Technology needs and innovations for space exploration

- Develops strategies for research and technology for NASA, universities, and industry
- Adjunct Professor, University of Houston
  - Taught, guided research at Kansas State University, Virginia Tech, Rice University
  - Also Honorary Distinguished Professor, Amity University, Delhi Technological University (India)
- NASA – numerous key positions, including Chief Technologist for JSC
- Lockheed – Staff Scientist
- Authored over 170 technical papers, received numerous awards
- Ph.D., MS (Electrical Engineering)– Kansas State University