NSS North Houston Space Society

Space News

November 7, 2020

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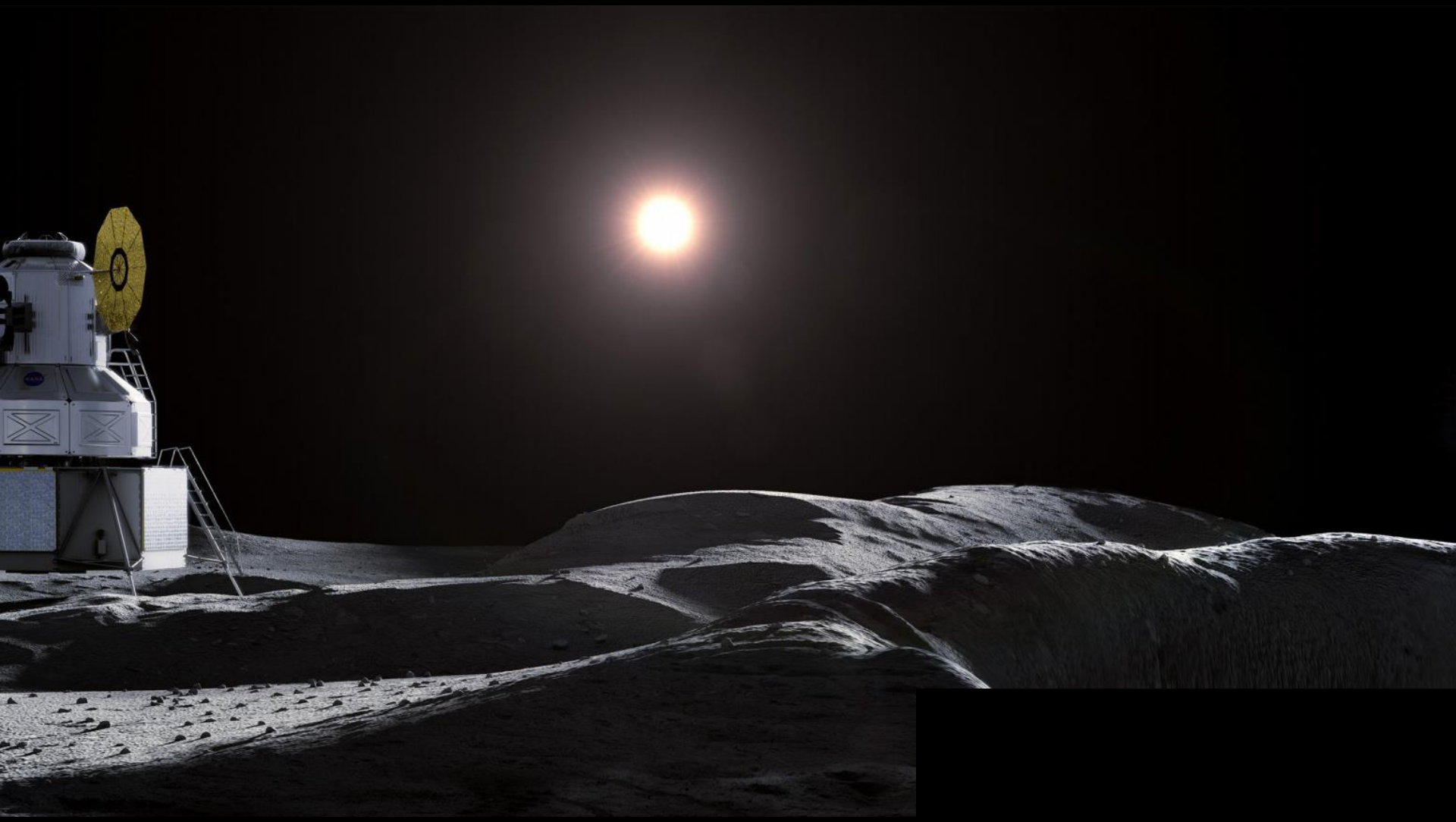
NSS North Houston Space Society

Lunar news



Credit: NASA Artemis document

NASA found water in sunlit areas of the Moon

- Found 100 – 412 ppm ice over large areas
  - Small 1cm “cold traps”, not just large shaded craters
  - Maybe in a glass formed after comet material impact
  - 15,000 sq. miles have this
  - 12 ounces water in a cubic meter of regolith
  - Sahara desert has 100x this amount of water
- May improve chances of living off the land
  - As water, if we determine how to free it
  - Broken down by electrolysis into O_2 and H_2 for breathing and rocket fuel
- Found by SOFIA flying infrared observatory
  - Stratospheric Observatory For Infrared Astronomy
  - Stratosphere above clouds, most water in atmosphere
  - Will this save SOFIA from termination?

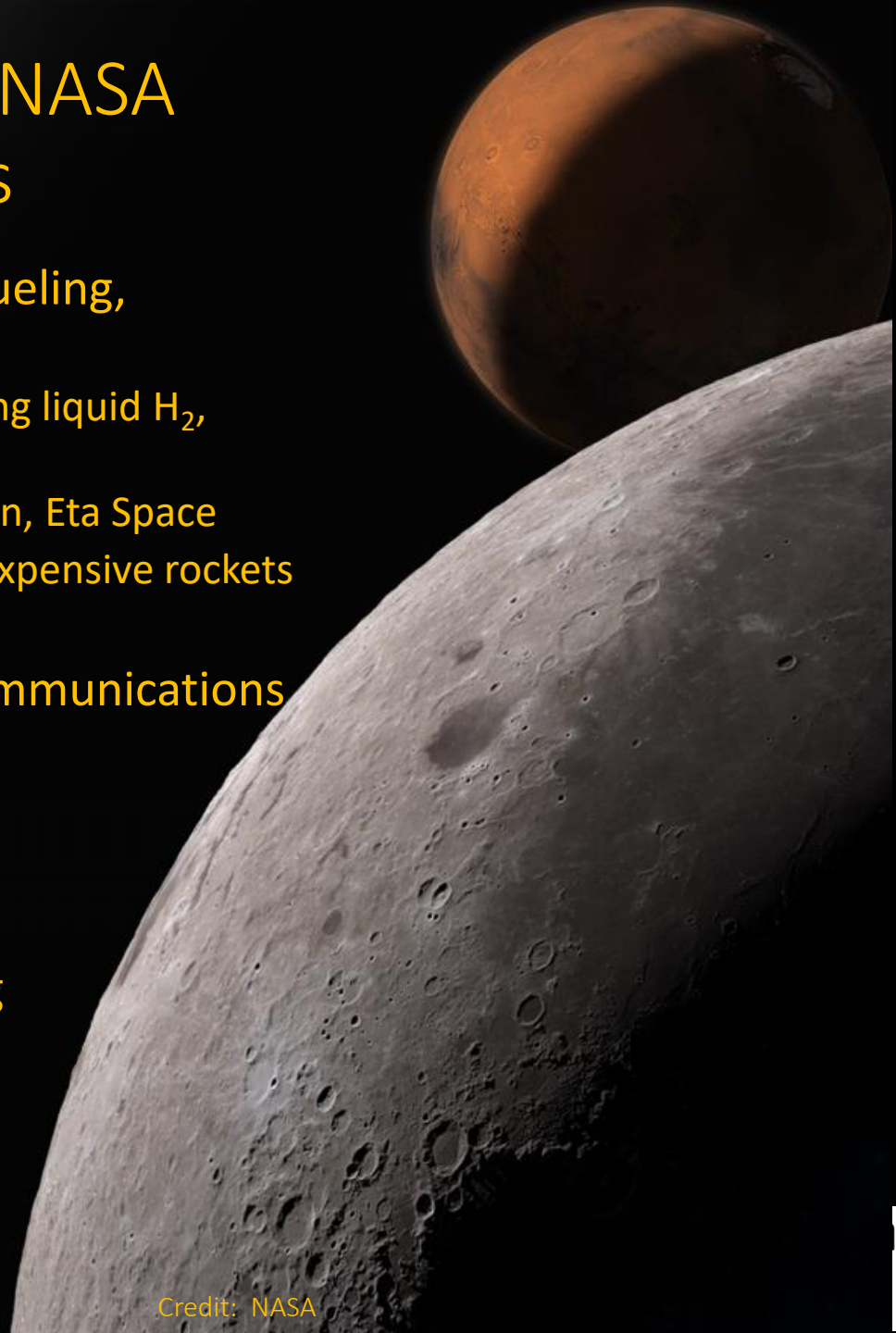
Credit: NASA

Credit: SpaceX

$370 million for 14 New NASA "Tipping Point" contracts

- $256 million focused on in-space refueling, propellant depots
  - Cryogenic fluid management transferring liquid H_2, methane, O_2
  - Mostly to ULA, SpaceX, Lockheed Martin, Eta Space
  - A shift, undermining need for largest, expensive rockets like Space Launch System (SLS)
- Rest for power, precision landing, communications

- "Tipping point" refers to accelerating technology and commercialization through public/private partnerships

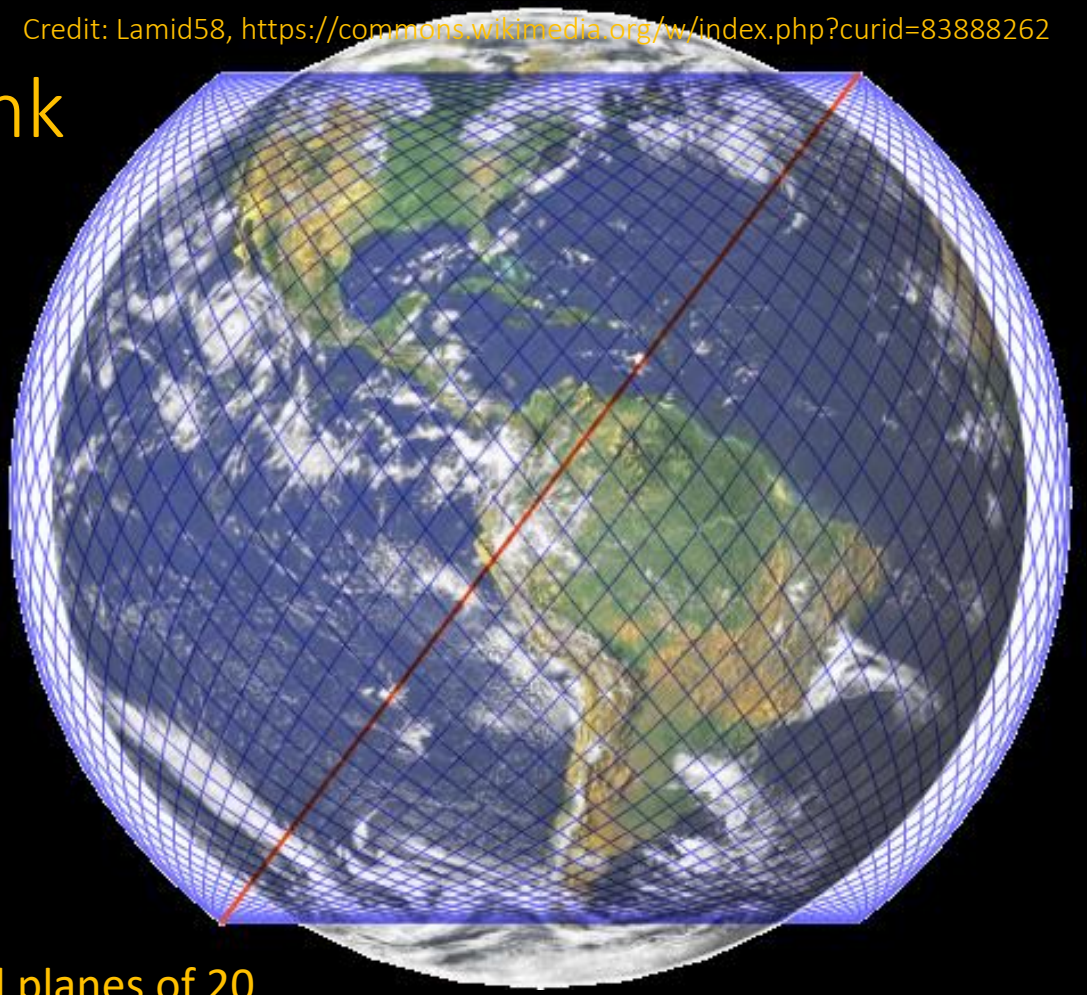


Credit: NASA


Credit: SpaceX

SpaceX Starlink update

Credit: Lamid58, https://commons.wikimedia.org/w/index.php?curid=83888262



- Near-global satellite based internet service
  - Pays for ambitious Mars plans – launch market is too small for that
  - Constellation of LEO satellites

- Plan
  - Phase 1: 1440 satellites in 72 orbital planes of 20 satellites each, in 340 mile orbits, 53° inclination
  - FCC approved: 12,000+ satellites
  - Applied for: another 30,000 satellites
- Satellite status (10/24/2020)
  - 895 launched, 51 deorbited, 844 orbiting

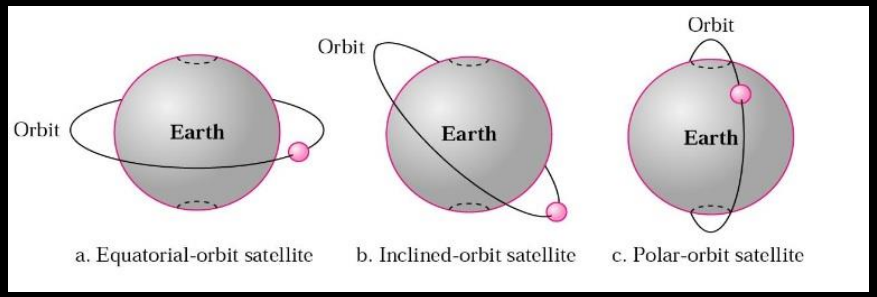
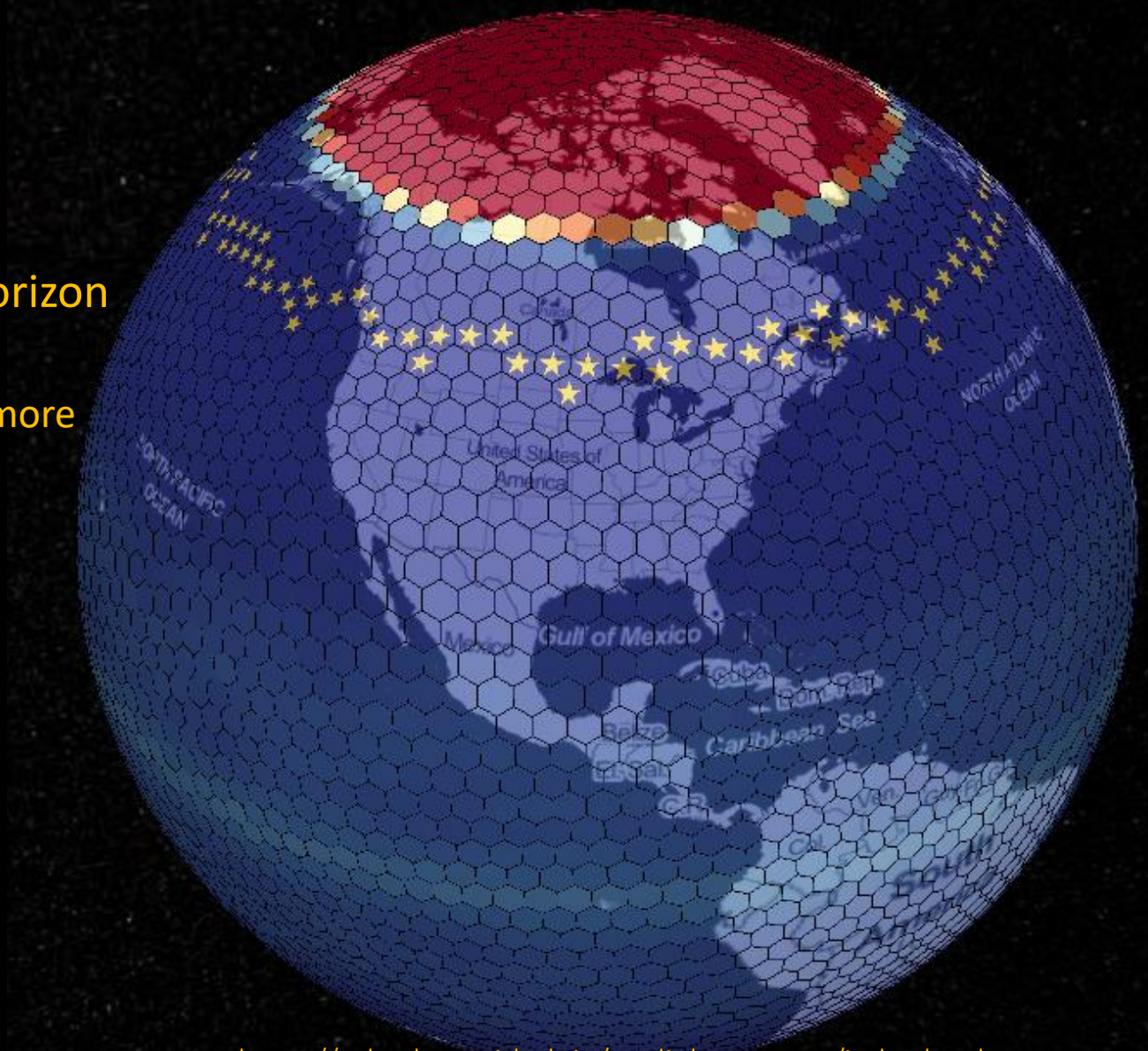


Image: https://www.bcsatellite.net/blog/leo-update-the-big-three-which-is-best/

Starlink satellite coverage Nov 5, 2020

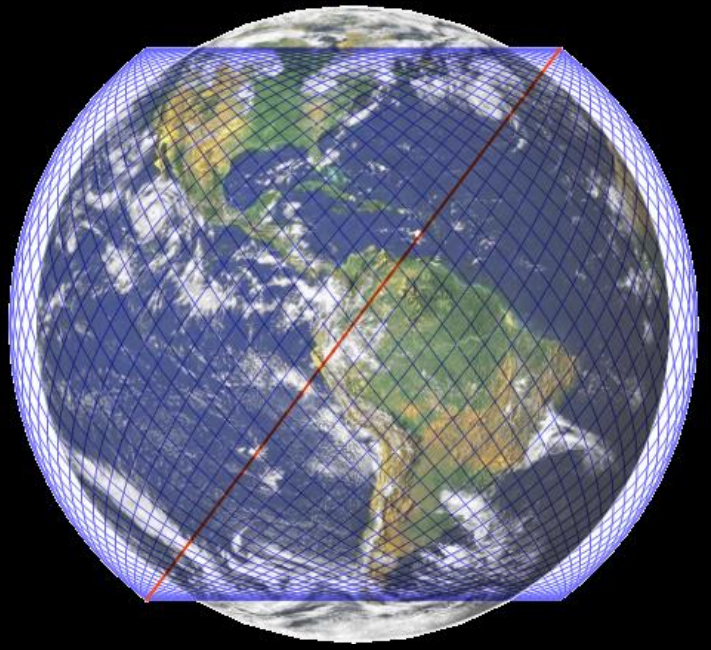
- Antenna angle from horizon matters
  - 25 degrees: blockage more likely
  - 35 deg: target as more satellites come online

- Red: no coverage
- Blue: daily coverage
- Star: 100% coverage




Credit: SpaceX

Starlink beta test

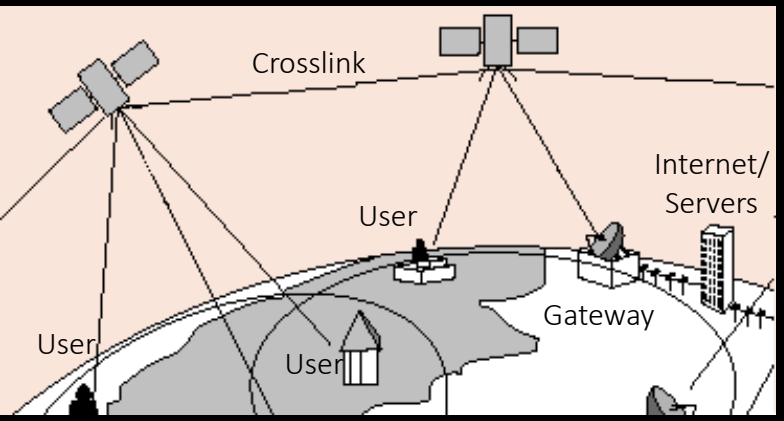


- "Better Than Nothing Beta" test
  - Estimated speeds 50Mbps – 150 Mbps
  - Estimated latency 20 ms to 40 ms
  - Expecting 16 ms to 19 ms by summer 2021
  - Some interruptions in connectivity to be expected
  - $499 for phased array antenna and Wi-Fi router
  - $99/month subscription
  - Offered at higher latitudes (44° – 52° N), e.g., Montana, Washington state, Canada
- Washington state emergency services has been happily using it (for free)

Credit: Lamid58, https://commons.wikimedia.org/w/index.php?curid=83888262

Starlink Ground station problem

- User terminals connect user to satellite
- "Gateway" ground stations are also needed
  - Tie to existing fiber optic infrastructure
  - Original FCC registration had 26 locations



- Gateway – satellite – user link could reach 500 miles ("bent pipe" architecture)
- Beyond 500 miles, need satellite crosslinks

- But planned laser based crosslinks are not in place yet
- Limits coverage to presence of gateways
  - Higher costs to cover land areas with many more gateways
  - Rules out coverage of vast areas of seas, some deserts, unfriendly countries that don't want citizens or foreigners with uncensored access, much military use

Asteroids!

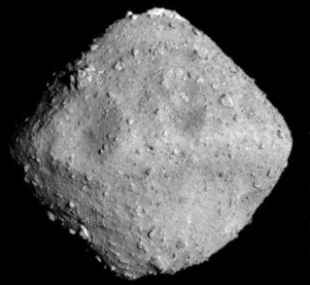
- Can we mine them, and live amongst them?
- How do we prevent some of them from hitting Earth?
- Do they give hints to origins of solar system and life?
- We need visits and samples to answer those questions

Credit: NSS - Space Settlement Summit 2020

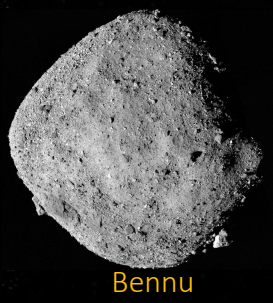
Missions to land on asteroids and get samples

- Japanese probe Hayabusa returned 1 mg sample from 25143 Itokawa in 2010 (launched in 2003)
- Japanese probe Hayabusa 2 will return 100 mg sample from half-mile wide 162173 Ryugu in Dec., 2020 (launched Dec., 2014)
  - Had dropped robotic explorers, used explosives to blast a 60 foot crater
- Now, NASA missions …


Itokawa


Ryugu


Psyche

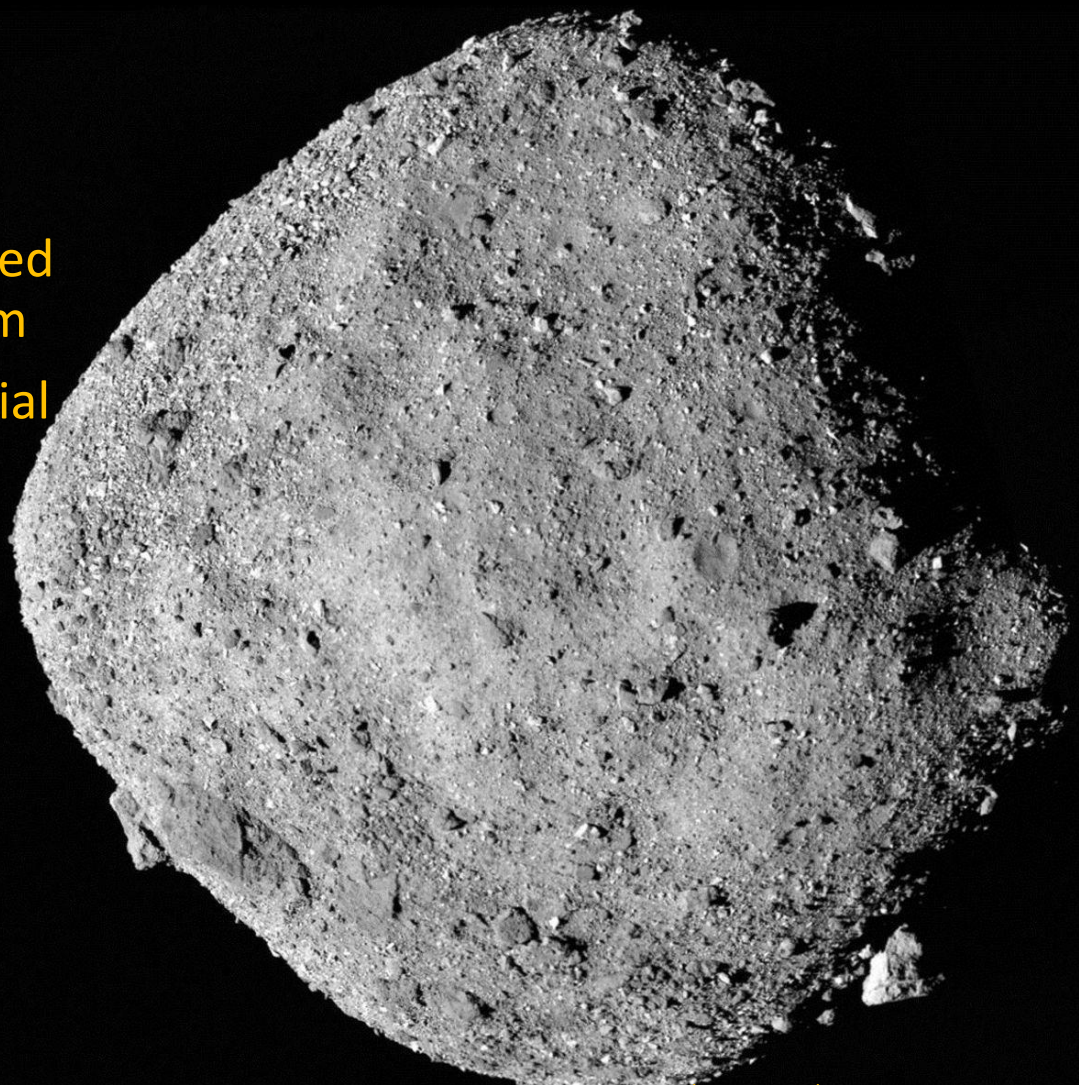

Bennu

Credit: NASA JPL/Caltech/ASU

Credits: Shutterstock via Space.com, JAXA

Asteroid Bennu

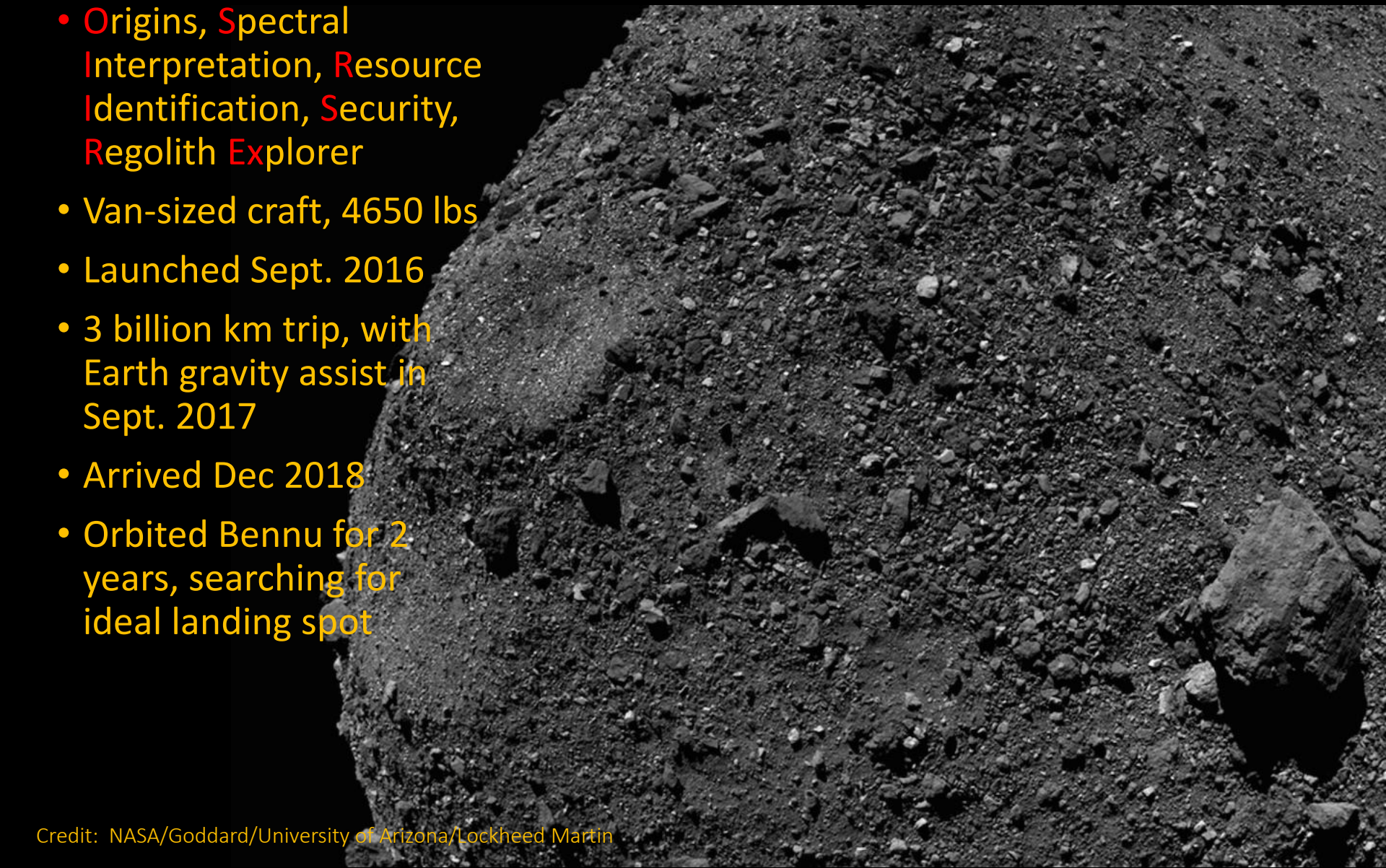
- 1/3 mile diameter
- 200 million miles away
- 1 in 2700 chance of hitting earth in late 2100's
- A "time capsule" little changed from birth of the solar system
- A lot of carbonaceous material (organic molecules)



Credit: NASA/Goddard/University of Arizona

OSIRIS-REx mission to Bennu

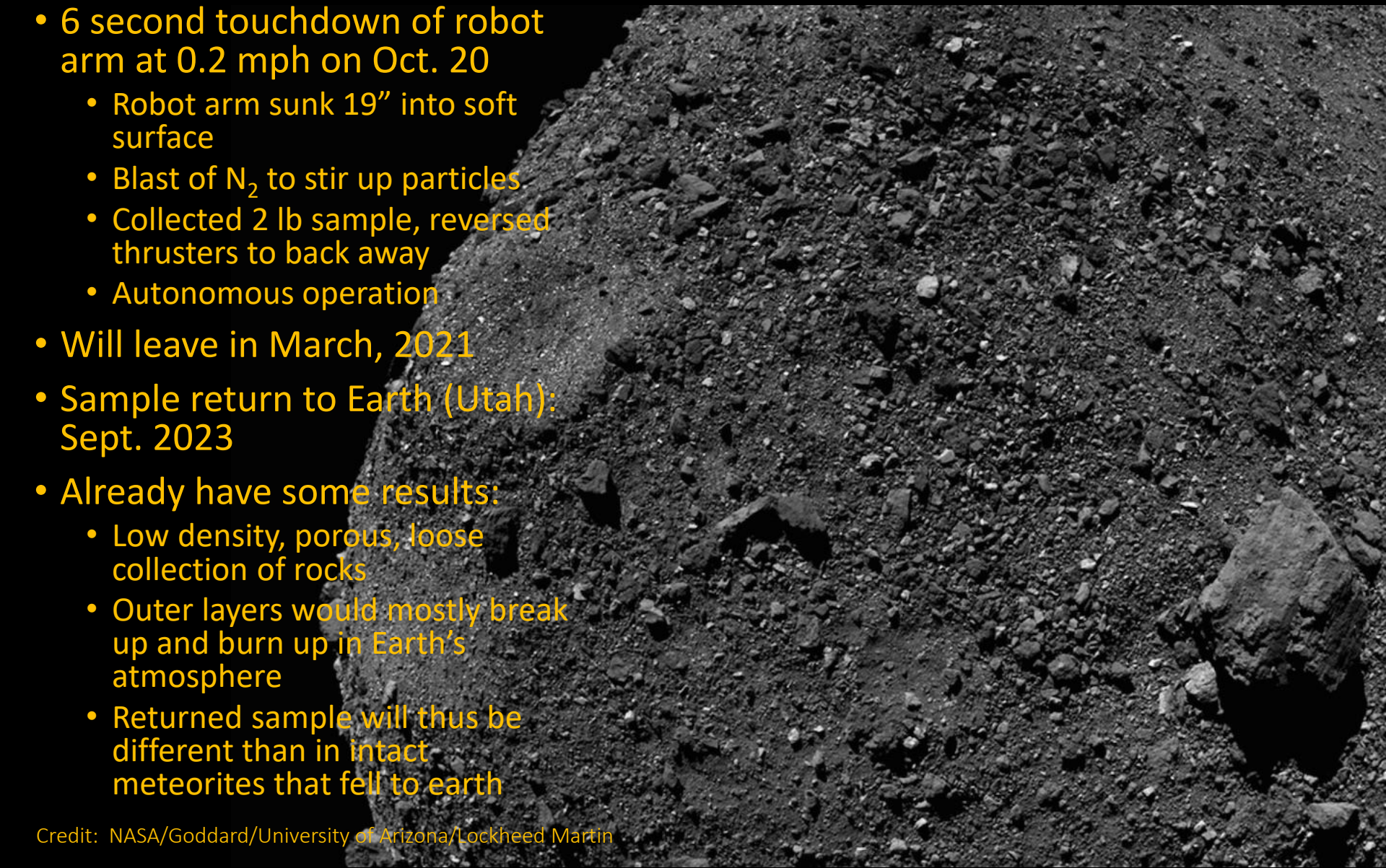
- Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer
- Van-sized craft, 4650 lbs
- Launched Sept. 2016
- 3 billion km trip, with Earth gravity assist in Sept. 2017
- Arrived Dec 2018
- Orbited Bennu for 2 years, searching for ideal landing spot



Credit: NASA/Goddard/University of Arizona/Lockheed Martin

OSIRIS-REx “smash and grab” at Bennu

- 6 second touchdown of robot arm at 0.2 mph on Oct. 20
  - Robot arm sunk 19” into soft surface
  - Blast of N_2 to stir up particles
  - Collected 2 lb sample, reversed thrusters to back away
  - Autonomous operation
- Will leave in March, 2021
- Sample return to Earth (Utah): Sept. 2023
- Already have some results:
  - Low density, porous, loose collection of rocks
  - Outer layers would mostly break up and burn up in Earth’s atmosphere
  - Returned sample will thus be different than in intact meteorites that fell to earth



Credit: NASA/Goddard/University of Arizona/Lockheed Martin

OSIREX-REx

OSIREX-REx craft

Artist's Illustration: NASA

Impact!

Credit: NASA Goddard-University of Arizona

Future NASA asteroid missions - DART

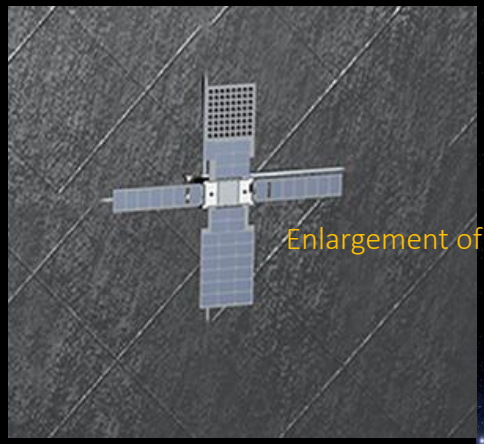
- DART (Double Asteroid Redirection Test) launching in July, 2021
  - Planetary defense test of diverting an asteroid if on collision course with Earth
  - 1100 lb craft will slam into a moonlet orbiting a larger asteroid (Didymos)

- May produce first human-caused meteor shower, ejecting between 22,000 and 220,000 lbs of centimeter-sized debris
- Small amount of debris may reach Earth
- Will measure orbit change orbit of the moonlet
- Intercepting Didymos in Sept. 2022

Artist impression. Credit: NASA/Johns Hopkins APL

Future NASA asteroid missions: NEA Scout

- NEA (Near Earth Asteroid) Scout, mapping a small asteroid (< 300 ft diameter)
- Launching in 2021 as secondary payload of Artemis 1 moon launch
- First CubeSat to reach an asteroid (large shoebox size)
- Propelled by 282 sq. ft. solar sail (aluminized polymer)



Enlargement of Cubesat in picture to the right →

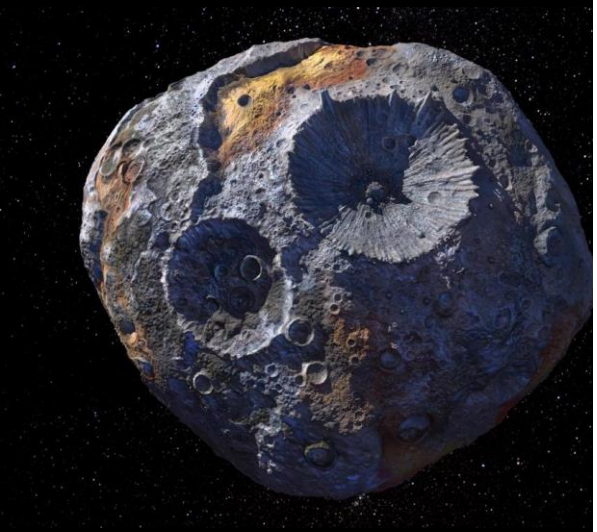
Credit: NASA/JPL/California Institute Of Technology

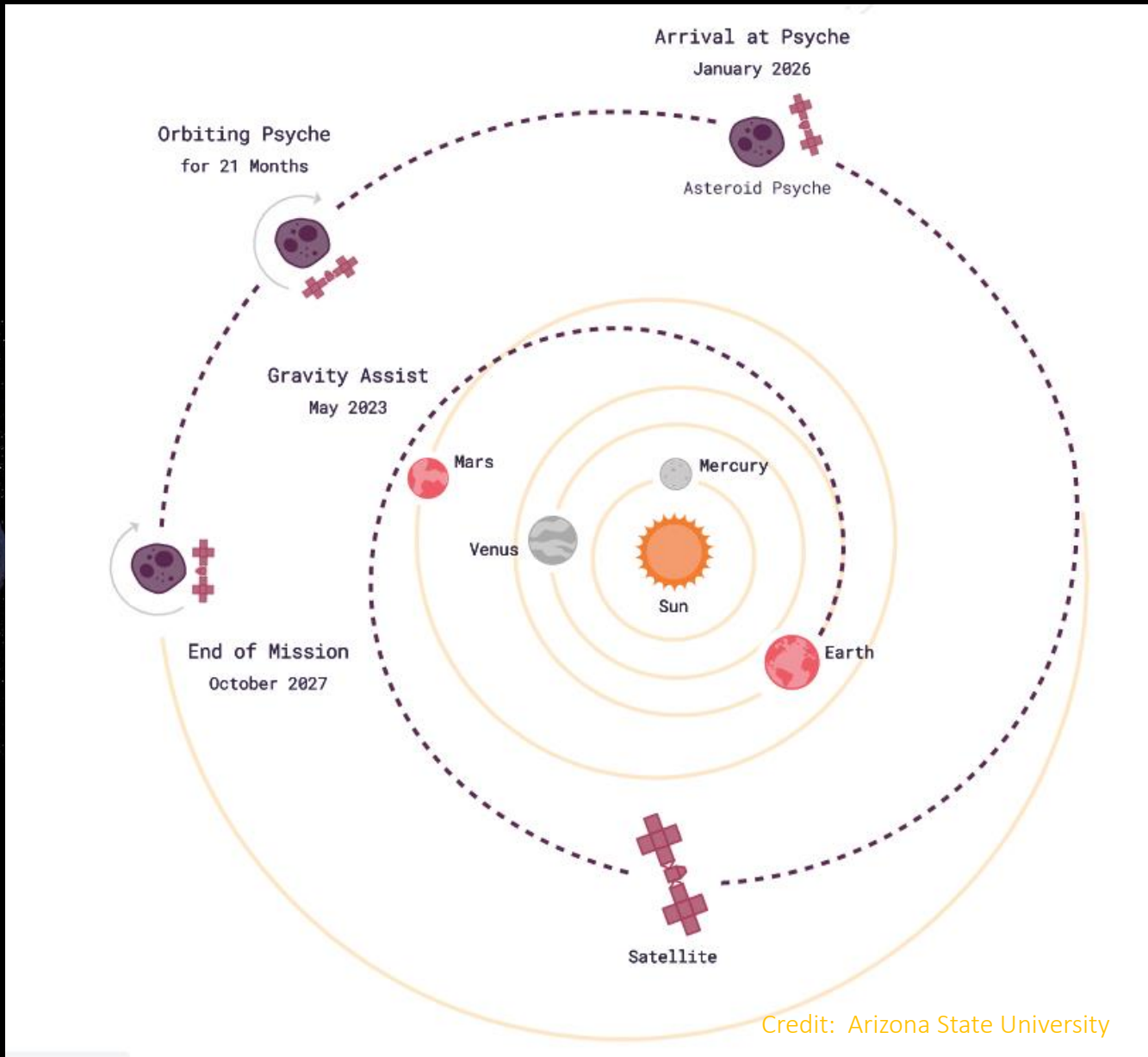
Future NASA asteroid missions, continued

- Lucy launching in 2021
  - Will pass “Trojan asteroids” trapped in Jupiter’s orbit (near Jupiter L4 & L5 points)
- Psyche mission launching in 2022
  - Unique metal asteroid, maybe the nickel-iron core of an early Earth-like planet
    - 1 percent of the mass of the entire asteroid belt
    - 140 mile wide, surface area of Texas
    - Worth $10 quintillion at current prices
    - Reminder of vast resources of space!
  - Mars flyby/gravity assist in 2023
  - Arrives at Psyche in 2026

Credit: NASA/JPL/California Institute Of Technology

Psyche, continued





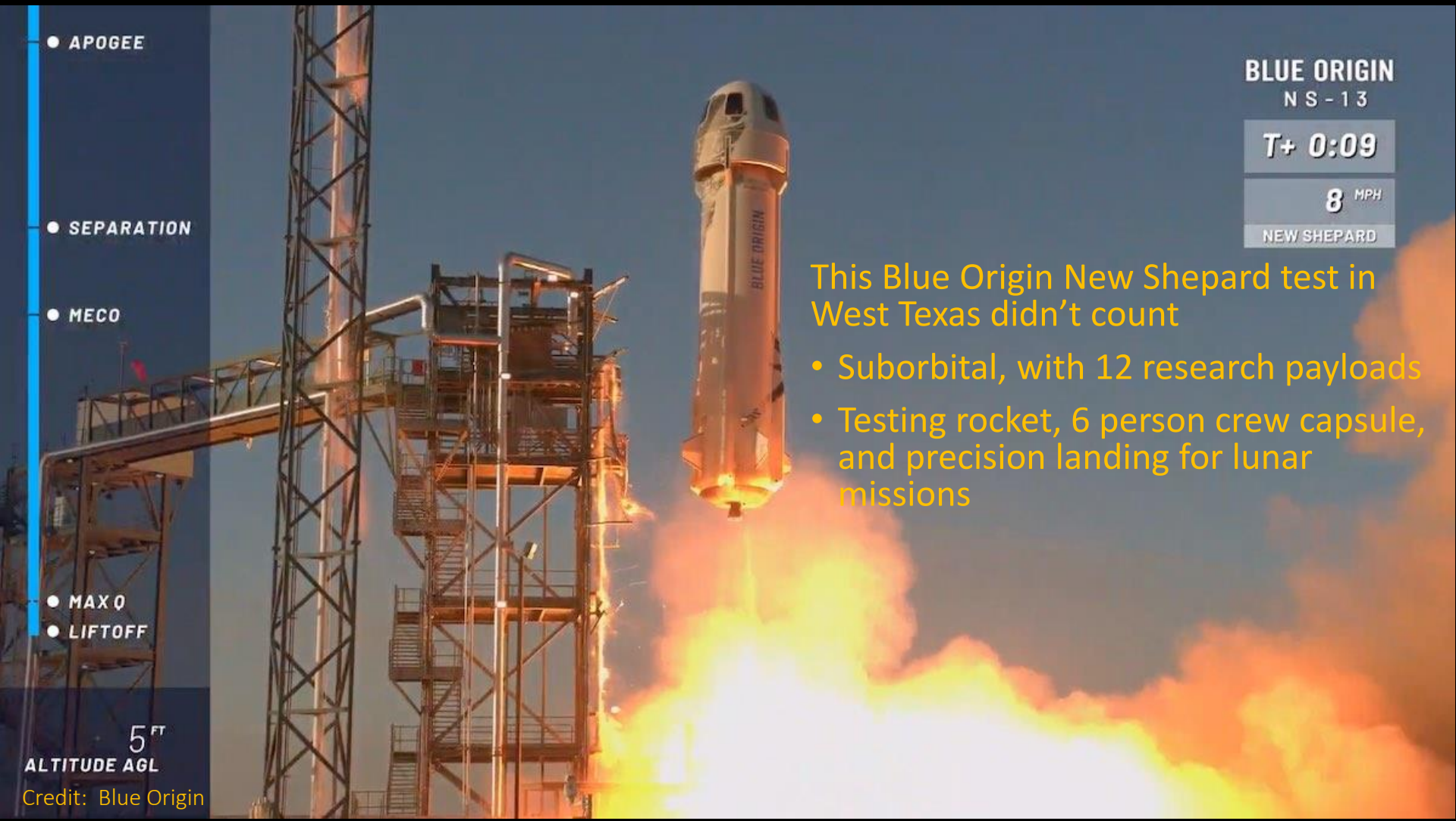
Credit: Arizona State University

Miscellaneous news

- International Space Station has now been inhabited continuously for two decades
  - Orbited 117,000 times with humans on board
  - Hosted 240+ astronauts from 19 countries
  - More active than ever doing research projects
- Phosphine gas detection on Venus (hinting at possible life) may just have been noise with flawed data analysis
- Voyager 2, after 43 years, responded to NASA call
  - 125 AU (Astronomical Units = Earth/Sun distance)
  - 17 hour time delay
- 7 Nations joined the US in the Artemis accords
  - (Australia, Canada, Italy, Japan, Luxembourg, UAE, UK)

How many launches since the last meeting (Oct 3)?

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



Credit: Blue Origin

This Blue Origin New Shepard test in West Texas didn't count

- Suborbital, with 12 research payloads
- Testing rocket, 6 person crew capsule, and precision landing for lunar missions

Launches since last meeting (Oct 3, 2020)


Oct 6 – Falcon 9 – 13th Starlink launch - 60 satellites - internet service


Oct 11 – Long March 3B – 13 geosynch. earth observation satellites


Oct 14 – Soyuz – Crew to ISS – END OF AN ERA

- Last seat NASA contracted to Russia
- Fastest trip to ISS (3 h)


Oct 18 – Falcon 9 – 14th Starlink launch - 60 satellites - internet service


Oct 24 – Falcon 9 – 15th Starlink launch - 60 satellites - internet service


Oct 25 – Soyuz – navigation satellite


Oct 26 – Long March 2C – 3 military spy satellites, small data relay


Oct 28 – Electron – 10 earth imaging satellites


Nov 5 – Falcon 9 – 5 ton GPS satellite


Nov 5 – Long March 6 – 13 satellites (10 for Argentina)


Nov 7 – Polar Satellite Launch Vehicle (PLSV – India) – 10 satellites

NSS North Houston Space Society

Featured Speaker: Elliot Roth

- Founder of Spira (company that creates better-tasting spirulina as an ingredient for food companies)
- “DIY astrobiologist and writer” with 10 years of synthetic biology experience
- Participant in NASA HI-SEAS program simulating living on the moon (in Hawaii)
- Founder of multiple companies and nonprofits
- 5 years as consultant in product design and business strategy
- Future Founders Fellow at Stanford d.school (1 year entrepreneurs program)
- Degree in Biomedical Engineering from Virginia Commonwealth University