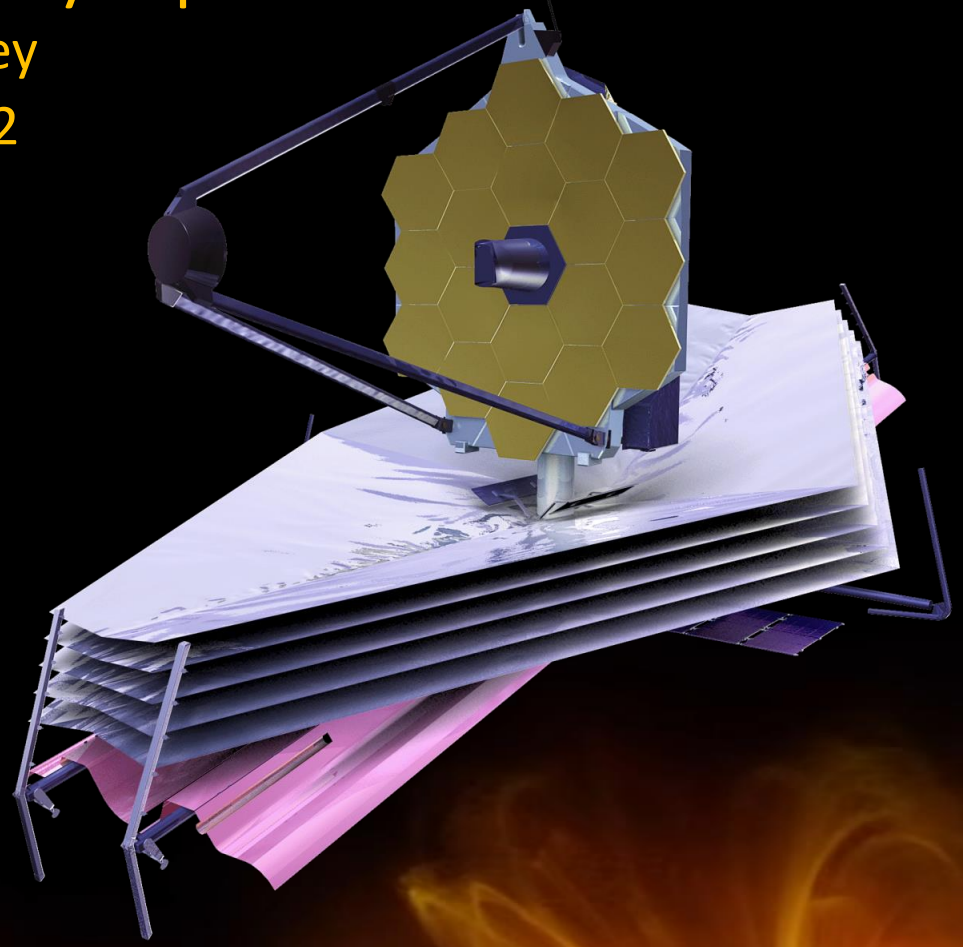
Monthly Space News -- and year end summary

Greg Stanley

Jan. 8, 2022



James Webb Space Telescope (JWST) launched

- Launched Dec 25 from French Guiana on an Ariane 5 rocket as successor to Hubble Space Telescope
- Details covered extensively last month in Doug Hall's presentation
  - 100x more powerful than the Hubble space telescope
  - Most risk: complex unfolding and calibration of all its parts, not launch
- So far, so good…

Image credit: ESA – D. Ducros

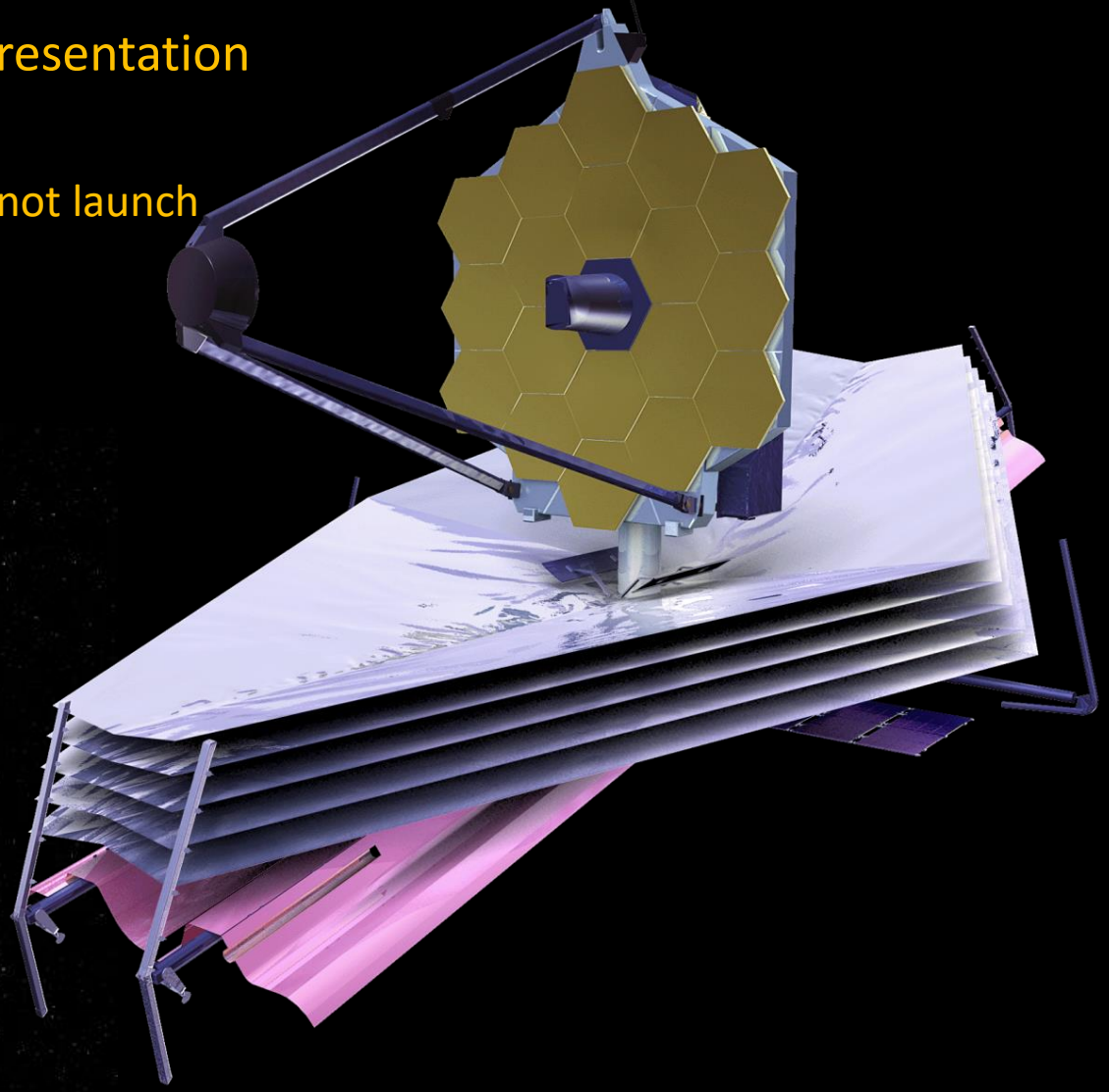
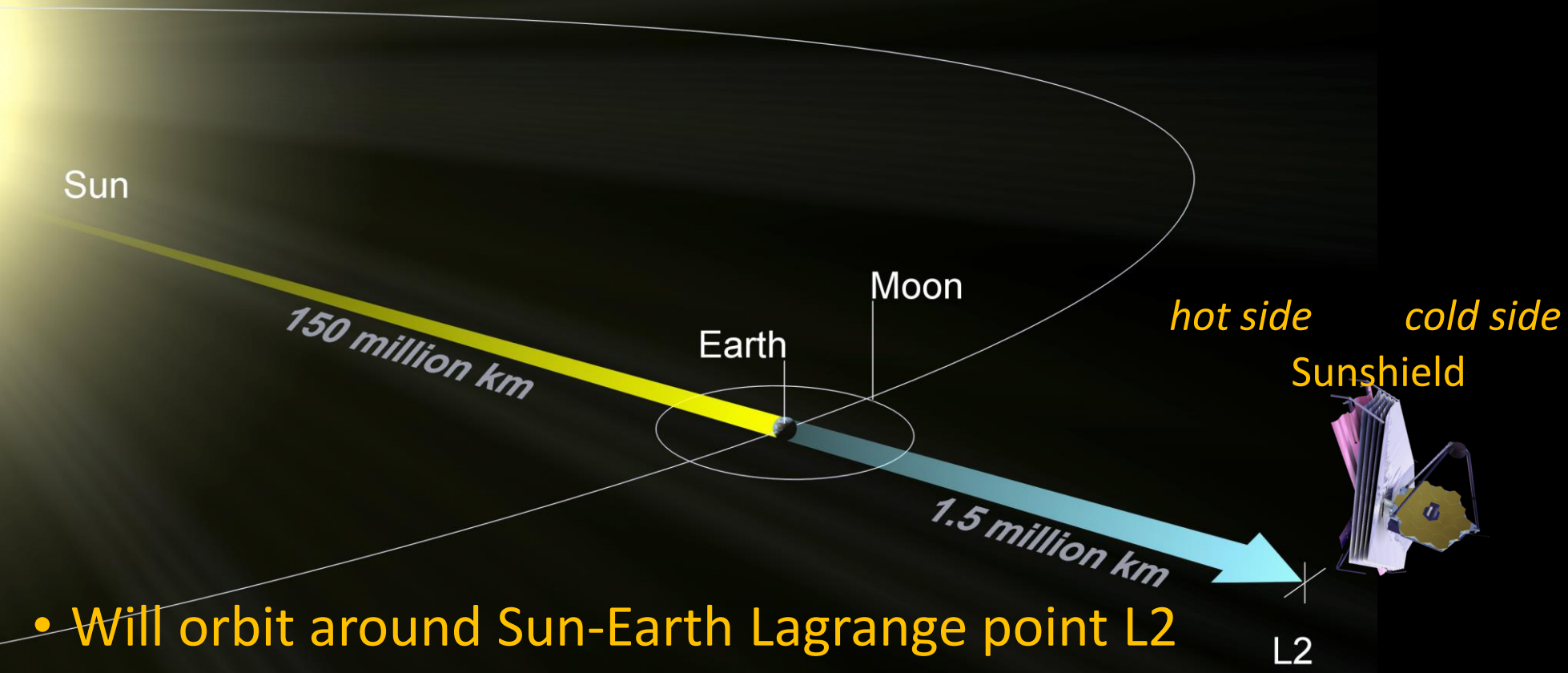


Image credit: NASA

James Webb Space Telescope (JWST)



- Will orbit around Sun-Earth Lagrange point L2
  - L2 is position always in the shadow of Earth as Earth orbits the Sun
  - Halo orbit around L2 (out of Sun-Earth-Moon plane) so the Moon never blocks signals
  - 1 million miles further out than Hubble Space Telescope in Low Earth Orbit

Images credit:NASA

James Webb Space Telescope (JWST) schedule

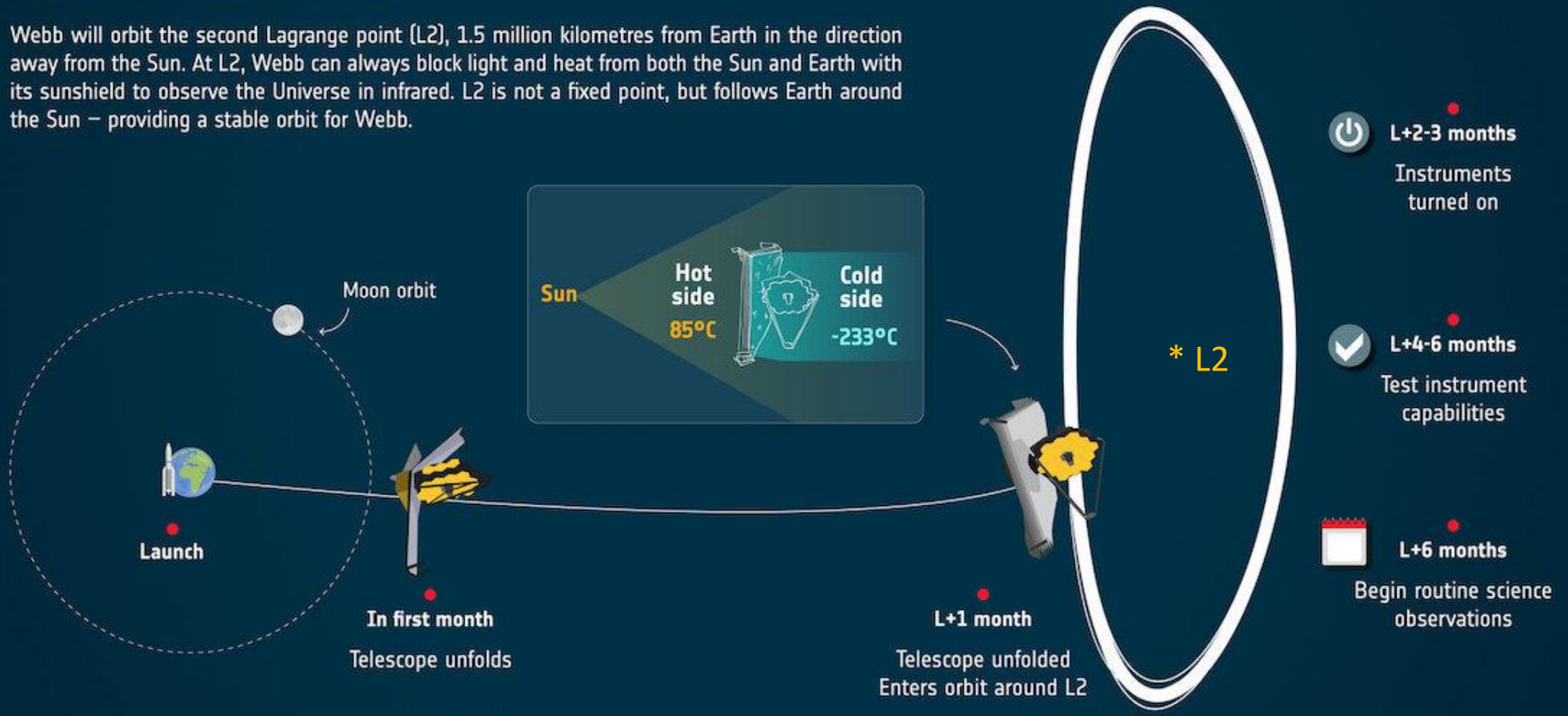
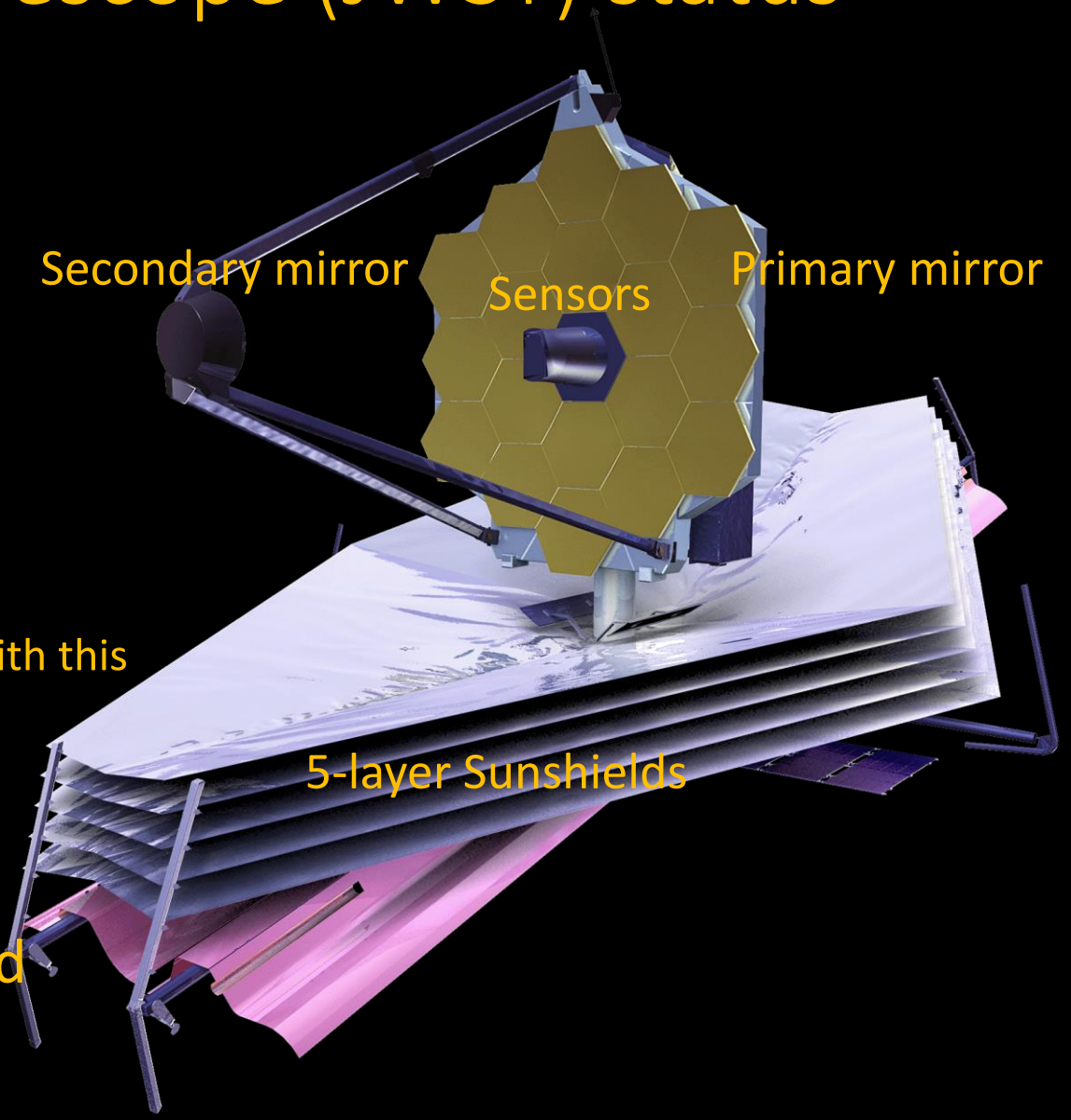


Image credit: European Space Agency (ESA)

James Webb Space Telescope (JWST) status

- Solar power arrays deployed
- Main antenna deployed
- Tower for primary mirror extended
- Sunshields deployed, opened, tensioned
  - 0.002 inches thick
  - Size of a tennis court
  - Biggest risk in the project
    - 70-75% of 344 single-point failures completed with this
    - 139 release mechanisms, 70 hinges, 8 motors
    - 400 pulleys, 90 cables with total length ¼ mile
- Secondary mirror deployed
- Left 3 segments of primary mirror unfolded



- Accurate launch left more fuel for maintaining orbit: should last 10 years, not just 5

Image credit:NASA

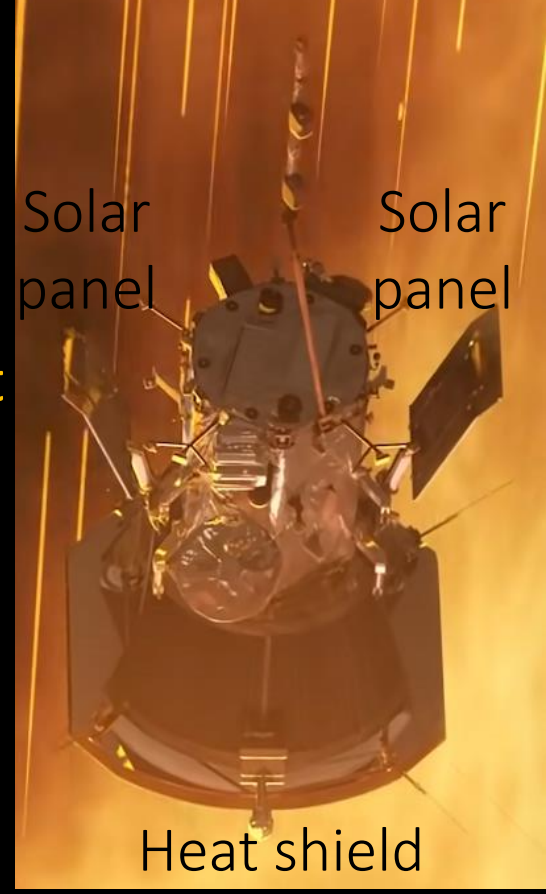
Parker Solar Probe “touched the Sun”

- Launched in August, 2018
  - Will travel at 430,000 mph at closest to Sun (fastest human object)
- Entered Sun’s corona (where magnetic fields dominate particle movement) several times, closest 4.9m miles from Sun’s surface
  - Boundary is irregular and always in flux
  - Spiraling ever closer in elliptical orbit, goal of 3.8m miles in 2025
    - 24 orbits over 7 years, with 7 Venus gravity assist flybys to slow it down
- Measuring temperature, particle flow & angle, density, magnetic fields
- Will lead to better forecasting extreme space weather (solar wind) events that endanger communications, satellites, and astronauts

Image credit:NASA

Why doesn't the Parker Solar Probe melt?

- Temperatures of corona particles are 1-2 million °F
  - BUT, low density: very few particles to carry & transfer heat
  - Radiation much more significant: 475 times higher than at Earth orbit
- Heat shield
  - 4.5" thick carbon & carbon composite foam, white ceramic paint
  - Surface gets heated to 2,500 °F, but spacecraft is at 85 °F
  - Solar panels retract during close approach in the elliptical orbit
  - Autonomous orientation correction (4 light sensors kept in shadow)
- Radiator cooling with pressurized water coolant
- 2 instruments not protected by heat shield
  - "Solar cup" measures ion & electron fluxes & angles, made from Titanium-Zirconium-Molybdenum alloy (melting point 4,260 °F), grids of tungsten (melting point 6,192 °F)
  - Wires made of niobium, suspended in sapphire crystal tubes



Images credit:NASA

China advances lunar base mission by 8 years

- Joint Chinese/Russian lunar base goal now 2027, not 2035
- Competing with US-led Artemis program
  - Direct: no diversion for lunar orbit space station (Gateway)
- Nuclear powered station, initially unmanned
- Automated mobile station to travel 1000 km to challenge expected US “safety zones” under Artemis accords
- Emphasis on cave exploration for permanent habitation
- Before that, 3 missions target the South Pole

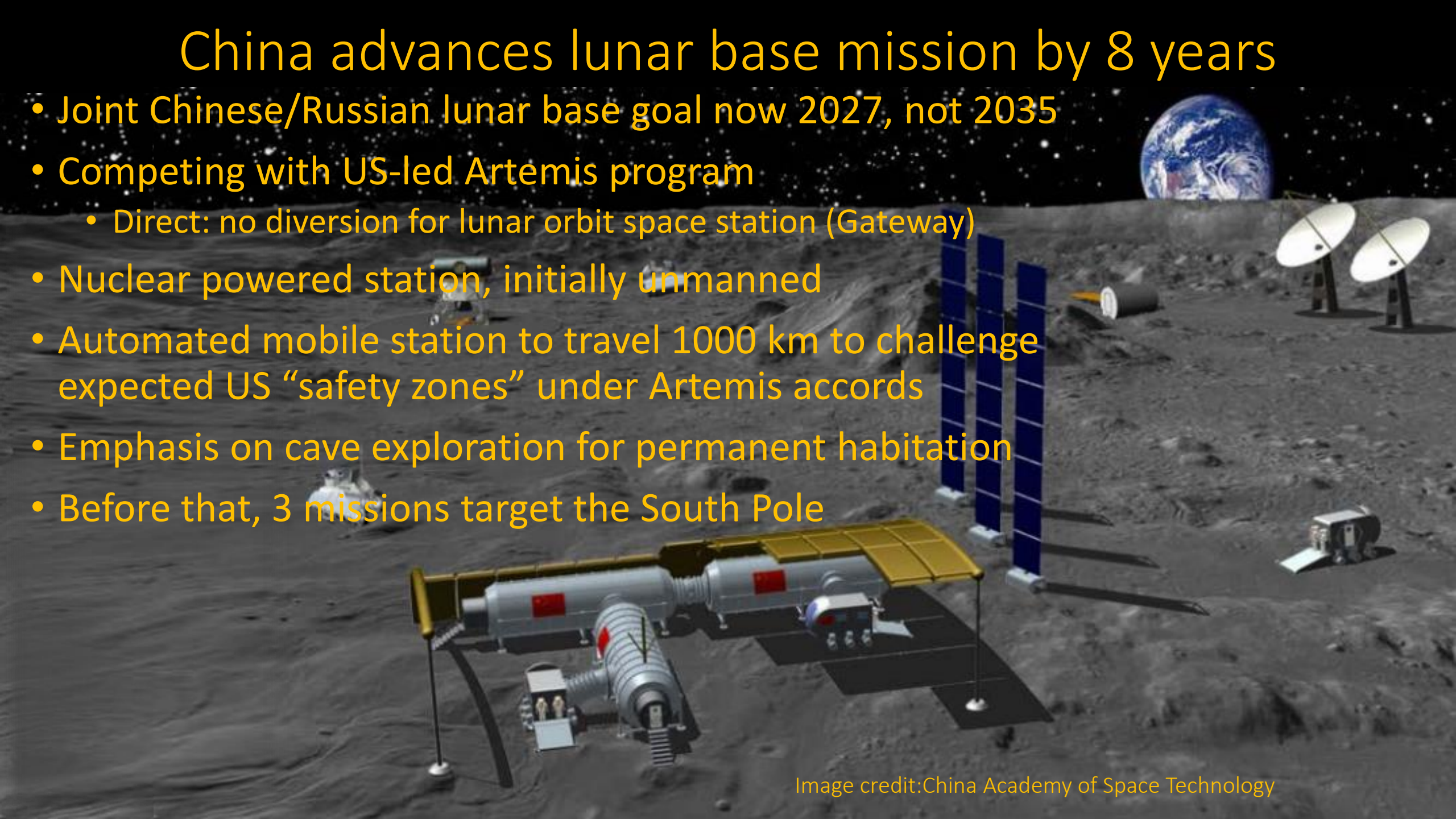


Image credit:China Academy of Space Technology

Some 2021 Highlights

- Record numbers of space missions and new satellites
- 3 Mars missions arrived, including 2 rovers and 1 helicopter
- Other major NASA achievements (besides Mars rover & helicopter)
  - OSIRIS-REX took samples from asteroid Bennu and started return flight
  - Parker Solar Probe “touched the Sun” (entered the corona)
  - Launched Lucy (asteroid explorer), DART (planetary defense test), IXPE (X-ray explorer), James Webb Space Telescope
  - Contracted for Human Landing System (for Moon), commercial space stations
- Chinese space station launched, module was added
- Russia added Nauka science module to ISS
- Suborbital tourism started with both Blue Origin and Virgin Galactic
- New companies reached orbit (Astra, Virgin Orbit)
- SpaceX Starship (upper stage) test landed successfully after many explosions

Some 2021 Lowlights

- More delays in SLS, Boeing Starliner, Blue Origin rocket engines, Artemis Moon missions (partly due to Blue Origin legal maneuvers)
- Russian ASAT test spread debris, requiring ISS to maneuver
- Chinese space station maneuvered to avoid de-orbiting Starlink satellites
- Aging Russian modules at ISS threaten reliability with cracks and leaks
- Accidental Russian thruster firing destabilized ISS – twice!

Trends in space missions

- Rapid ascent of Chinese space program
  - Including number of launches and variety of rockets and programs
- Market lead of SpaceX Falcon 9 due to reliability and low cost
  - 31 of 51 US missions were on Falcon 9, all successful
  - Proof of re-usability: only 2 new first stages were needed!
- Rise of new launch companies like Rocket Lab (with 6 launches)
- Rise of new companies providing services in space, just assuming launch costs will get cheaper (e.g., satellite constellations)
- Profusion of satellites
  - Especially in Low Earth Orbit (LEO)
  - Small satellites (down to the size of a sandwich – ¼ of a cubesat)

Expectations for 2022, part 1

- More launches: estimates are for 150
- More competition in rockets if they stay on schedule
  - SpaceX Starship should achieve orbit, promising reduced cost for space access
  - Chinese and European progress on reusable craft to challenge Falcon 9 and Starship
  - New rockets (Starship/Super Heavy, SLS, Vega-C, Ariane 6, H3, Terran 1, Vulcan, …)
- Up to 9 Moon missions, including robotic landers

Expectations for 2022, part 2

- Increasing growth in commercialization and space-based services
  - Especially in LEO (Low Earth Orbit)
  - Internet service (Starlink, OneWeb, …)
  - Monitoring: e.g., “how many cars park in Walmart parking lots each day”
    - Companies like Planet Labs, Black Sky, Maxar have satellites and analytics to answer that
  - “In-orbit services” growth
    - Moving existing satellites, e.g., GEO satellites out of propulsion fuel
    - Capturing and moving or de-orbiting space junk
    - Space tugs to deploy satellites to multiple orbits from one large (low cost) launch
- Increasing conflict over utilization of space
  - More obvious space race between China and the US, both in orbit and to the Moon
  - Increased concern over space junk, avoiding collisions, hardening satellite systems
  - Increased military reliance on commercial services

How many launches since the last meeting (Dec 11)?

This includes failed launches if they lift off the launch pad

Only includes launches attempting going into orbit or beyond

December, 2021 SpaceX Falcon 9 launch from Vandenberg Space Force Base. Credit: SpaceX

Launches since last meeting

- Dec 13 – Proton – 2 communications satellites (TV, radio, internet relay)
- Dec 13 – Long March 3B – communications satellite
- Dec 14 – Kuaizhou-1A (China) – 2 Geely satellites supporting autonomous driving (FAIL)
- Dec 18 – Falcon 9 – 52 Starlink (internet) satellites
- Dec 18 – Falcon 9 – Turkish communications satellite
- Dec 21 – Falcon 9 – Cargo resupply to the International Space Station (ISS)
- Dec 22 – H-2A (Mitsubishi) – Inmarsat communications satellite
- Dec 23– Long March 7A– 2 classified satellites
- Dec 25 – Ariane 5 – James Webb Space Telescope
- Dec 27 – Soyuz– 36 OneWeb (internet) satellites
- Dec 27 – Angara-A5 (Russia) – test flight (FAIL in upper stage)
- Jan 06 – Falcon 9 – 49 Starlink (internet) satellites

Summary of launches (orbit or beyond) in 2021*


US: 51 launches, with 48 successes (includes Rocket Lab)


China: 48 launches, with 45 successes (another count: 56 launches/53 successes)


Russia: 24 launches, 23 successes

Europe (ESA): 6 launches, 6 successes


India: 2 launches, 1 success


Iran: 0 launches (not counting 2 unannounced failures)


Israel: 0 launches


Japan: 2 launches, 2 successes


South Korea: 1 launch, 0 successes


UAE: 0 launches

- Total: 134 launches: 125 successes, 9 fails
  - 2020: 114 launches: 104 successes, 10 fails
  - 2019: 102 launches: 97 successes, 5 fails
- <u>Close to or exceeded records set in 1967 (139 launches) and 1976 (125 successes)</u>

* Based on Monthly Space News reports. Other counts vary, mainly for Chinese launches

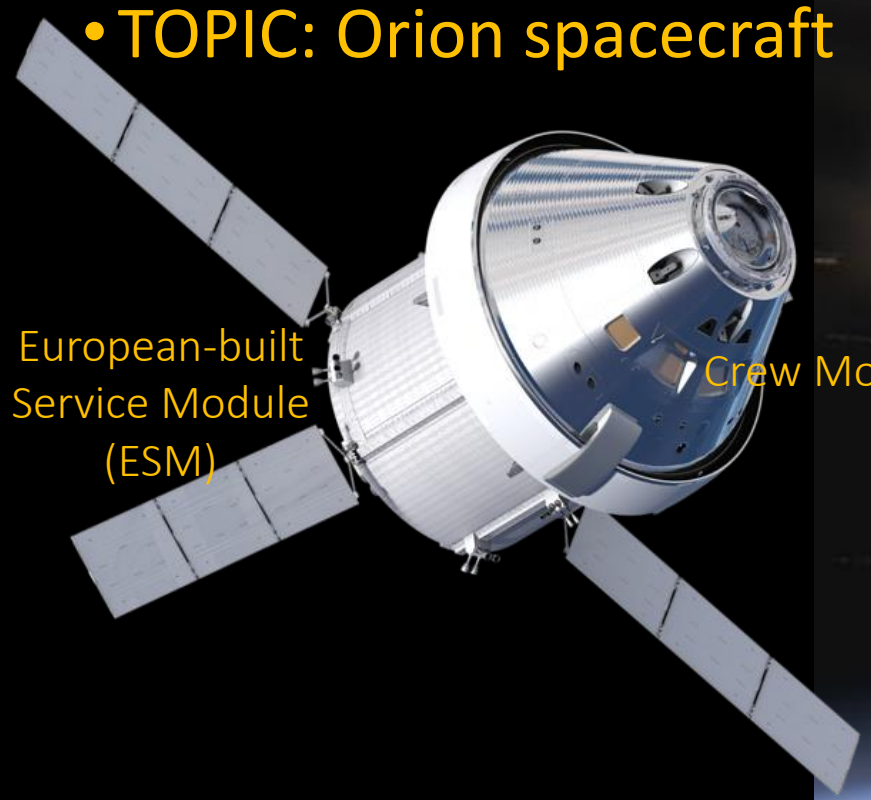
Discussion & questions?

Image: NASA

Featured speaker (Q&A) : Jeff Perkins

- Systems Engineer Principle at Lockheed Martin Space Systems, Houston
- Responsible for technical integrity of the Orion spacecraft
- Previously at Lockheed Martin Aeronautics, responsible for F-35 systems engineering
- BS in Electrical Engineering from Texas A&M
- MBA from University of Dallas
- TOPIC: Orion spacecraft

In Launch Abort System ready for SLS stacking



European-built Service Module (ESM)

Crew Module

Crew Module descent into atmosphere

Images credit: NASA

NSS North Houston Space Society