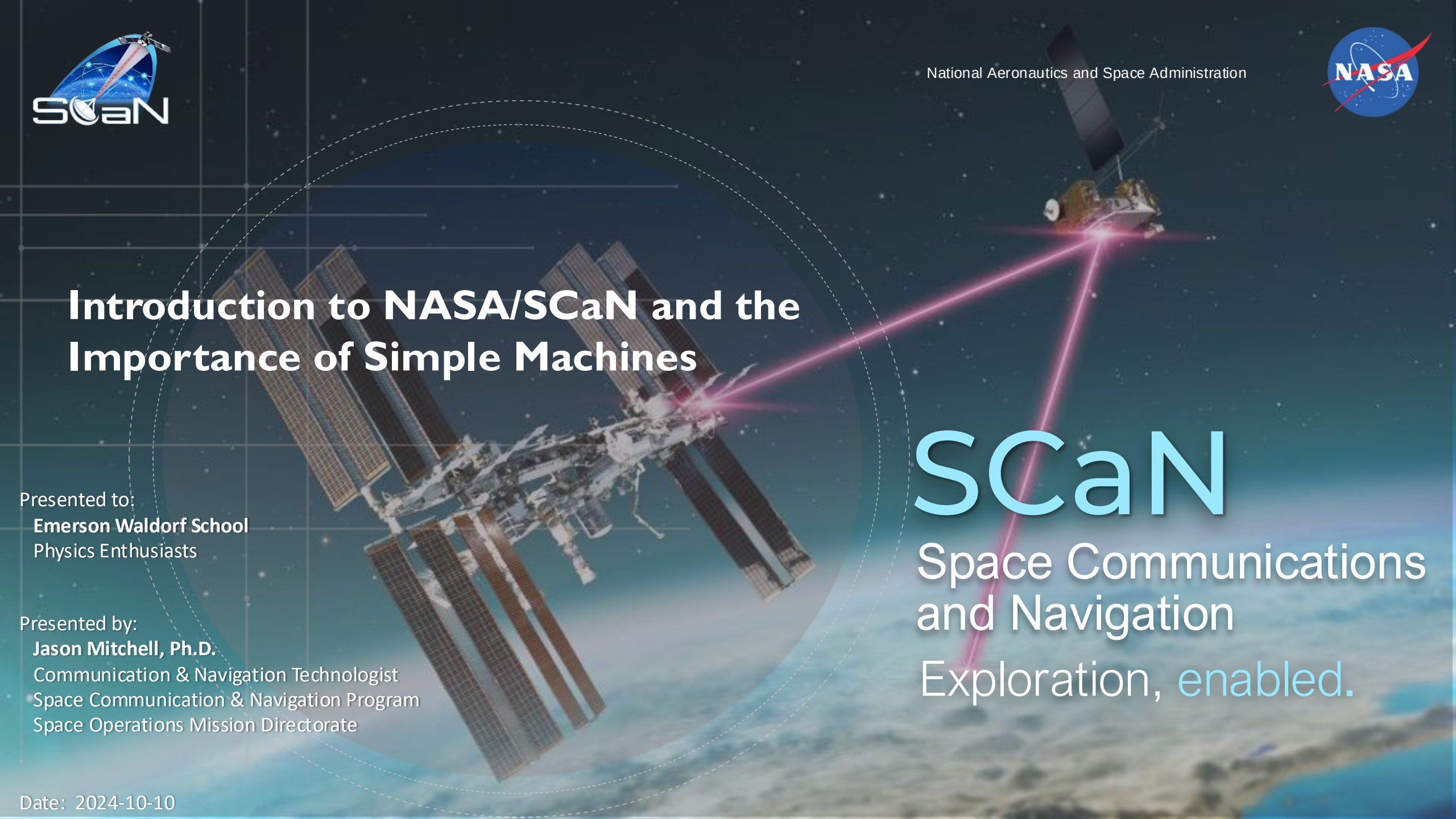
National Aeronautics and Space Administration

Introduction to NASA/SCaN and the Importance of Simple Machines



SCaN

Space Communications and Navigation

Exploration, enabled.

Presented to:
Emerson Waldorf School
Physics Enthusiasts

Presented by:
Jason Mitchell, Ph.D.
Communication & Navigation Technologist
Space Communication & Navigation Program
Space Operations Mission Directorate

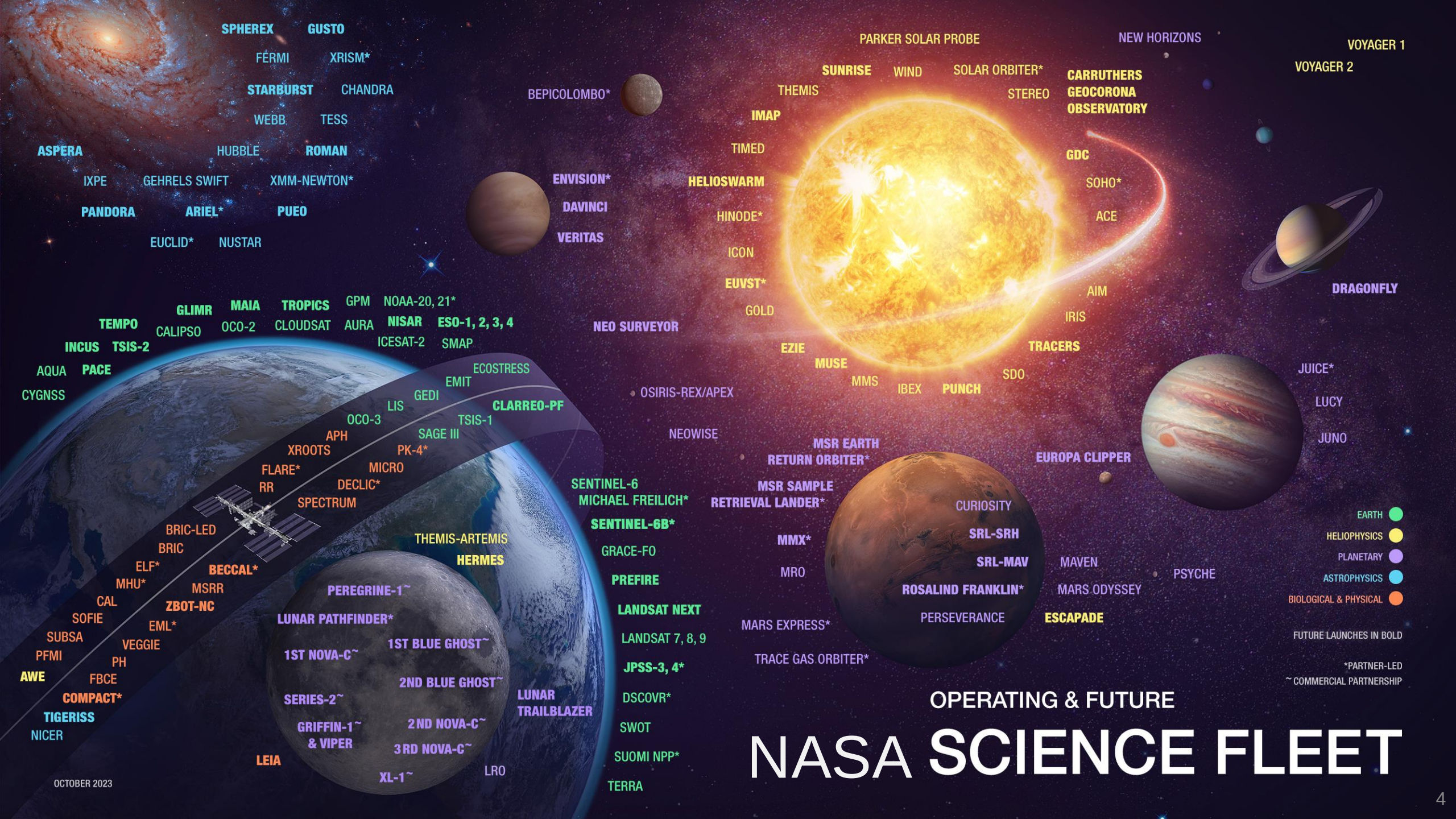
Date: 2024-10-10

NASA Centers



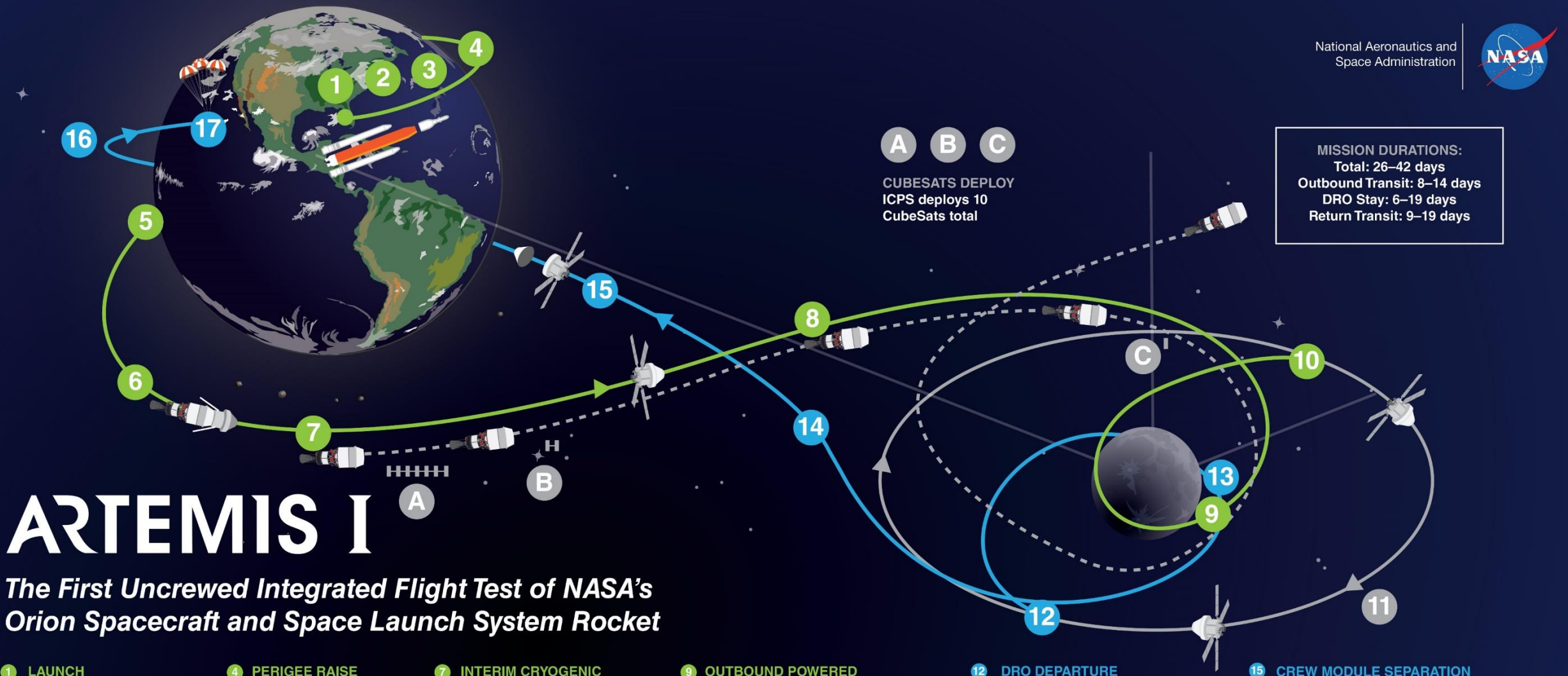
International Space Station (ISS)





OPERATING & FUTURE

NASA SCIENCE FLEET

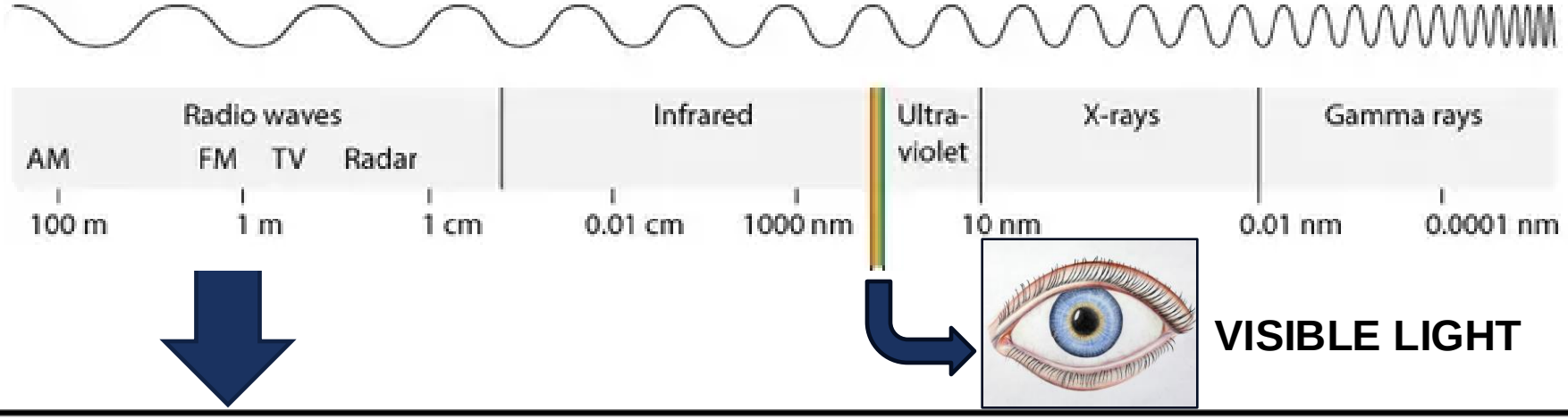


ARTEMIS I

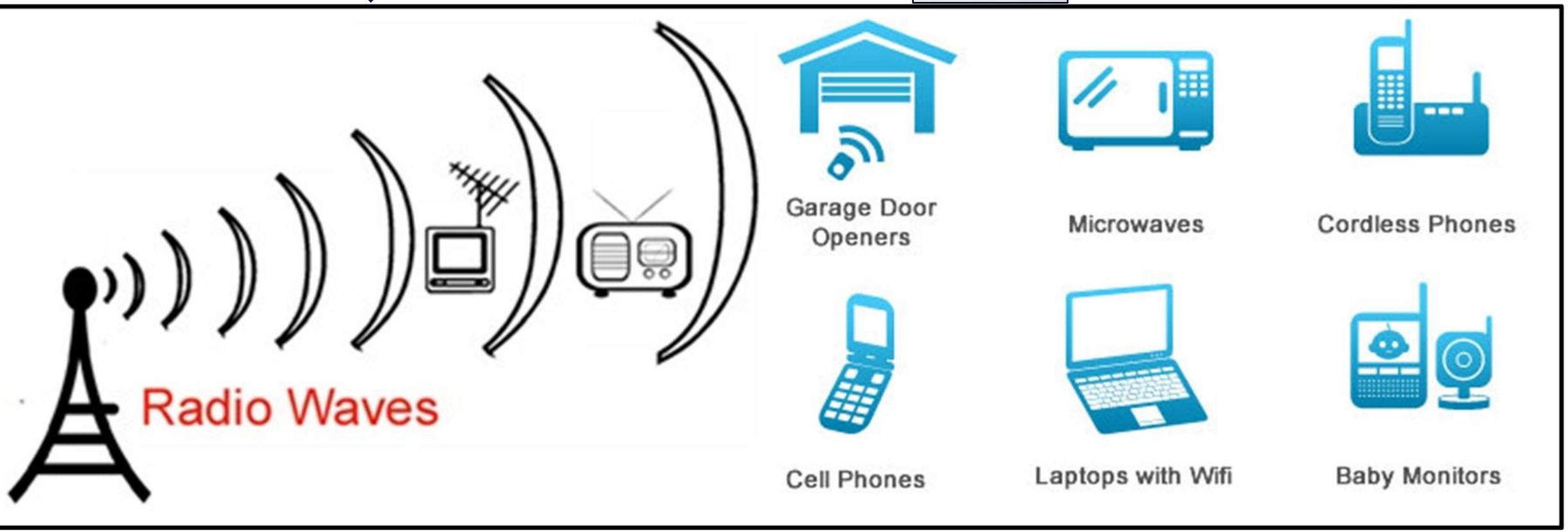
The First Uncrewed Integrated Flight Test of NASA's Orion Spacecraft and Space Launch System Rocket

1. **LAUNCH**
   SLS and Orion lift off from pad 39B at Kennedy Space Center.
2. **JETTISON ROCKET BOOSTERS, FAIRINGS, AND LAUNCH ABORT SYSTEM**
3. **CORE STAGE MAIN ENGINE CUT OFF**
   With separation.
4. **PERIGEE RAISE MANEUVER**
5. **EARTH ORBIT**
   Systems check with solar panel adjustments.
6. **TRANS LUNAR INJECTION (TLI) BURN**
   Maneuver lasts for approximately 20 minutes.
7. **INTERIM CRYOGENIC PROPULSION STAGE (ICPS) SEPARATION AND DISPOSAL**
   The ICPS has committed Orion to TLI.
8. **OUTBOUND TRAJECTORY CORRECTION (OTC) BURNS**
   As necessary adjust trajectory for lunar flyby to Distant Retrograde Orbit (DRO).
9. **OUTBOUND POWERED FLYBY (OPF)**
   60 nmi from the Moon; targets DRO insertion.
10. **LUNAR ORBIT INSERTION**
    Enter Distant Retrograde Orbit.
11. **DISTANT RETROGRADE ORBIT**
    Perform half or one and a half revolutions in the orbit period 38,000 nmi from the surface of the Moon.
12. **DRO DEPARTURE**
    Leave DRO and start return to Earth.
13. **RETURN POWERED FLYBY (RPF)**
    RPF burn prep and return coast to Earth initiated.
14. **RETURN TRANSIT**
    Return Trajectory Correction (RTC) burns as necessary to aim for Earth's atmosphere.
15. **CREW MODULE SEPARATION FROM SERVICE MODULE**
16. **ENTRY INTERFACE (EI)**
    Enter Earth's atmosphere.
17. **SPLASHDOWN**
    Pacific Ocean landing within view of the U.S. Navy recovery ship.

Electromagnetic Spectrum



VISIBLE LIGHT



How Do We Communicate with Radio Waves?



2 The satellite amplifies the incoming signal and changes the frequency

1 The ground equipment transmits signal to the satellite

3 Signal is transmitted back to Earth





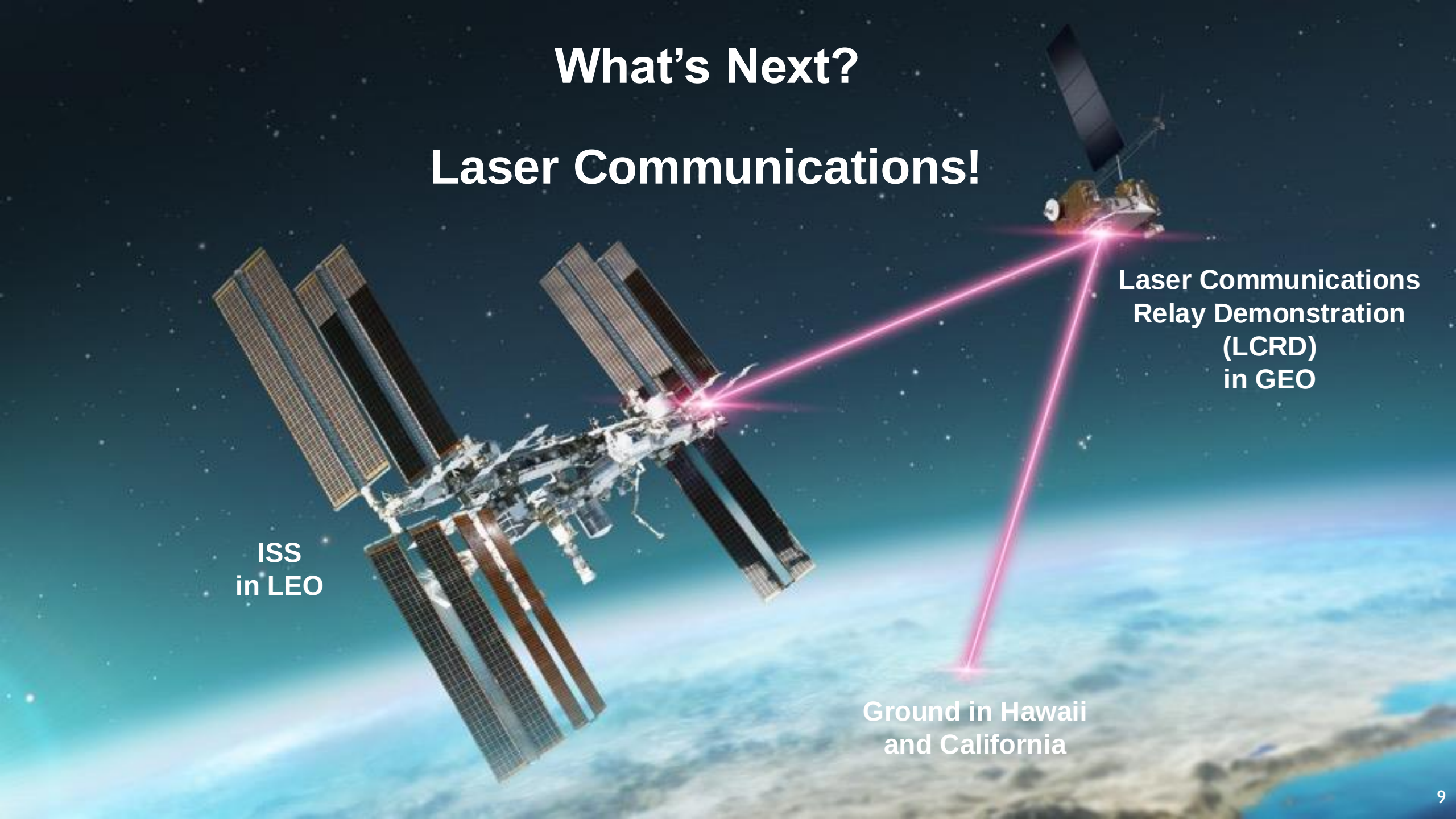
4 The ground equipment receives the signal



Tracking & Data Relay Satellite (TDRS)

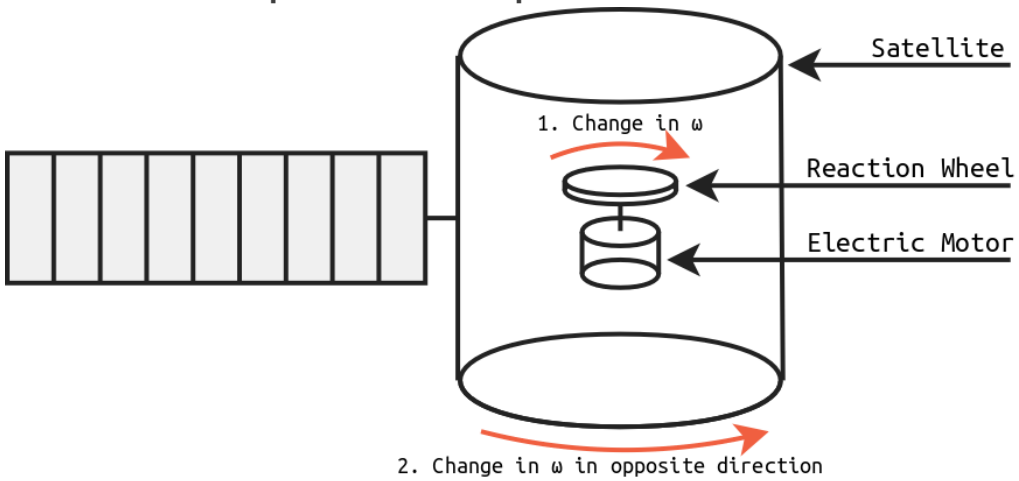
What's Next?

Laser Communications!

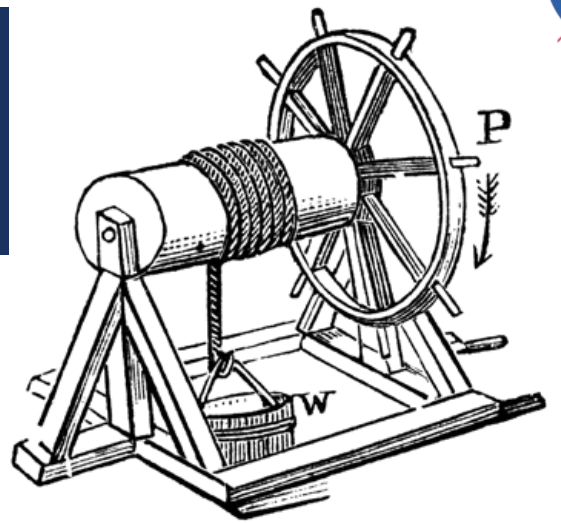


SIMPLE MACHINE: WHEEL & AXLE

- Combine disk (wheel) and rod (axle) to gain mechanical advantage
- Leverage *angular momentum* and *torque*
- When mass is *closer* to the axle, spins *faster*
- When mass is *farther* from the axle, spins *slower*
- Used in spacecraft to point, i.e., control *Attitude*



Spacecraft reaction wheel, see Charles' Labs



Example of a simple machine system using a wheel and axle. (Wikimedia Commons)



Nancy Kerrigan (USA) performs a scratch spin at the end of her freeskate at the 1994 Lillehammer games.

SCaN

Space Communications and Navigation

Exploration, enabled.

National Aeronautics and Space Administration

More Data = More Discoveries





Questions?

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