

Human Exploration Development & Operations Office

Advancing Human Exploration & Discovery

11/9/23

Space Operations at NASA's Marshall Space Flight Center

HP27/Mason Hall

Powering the Future of Space Exploration

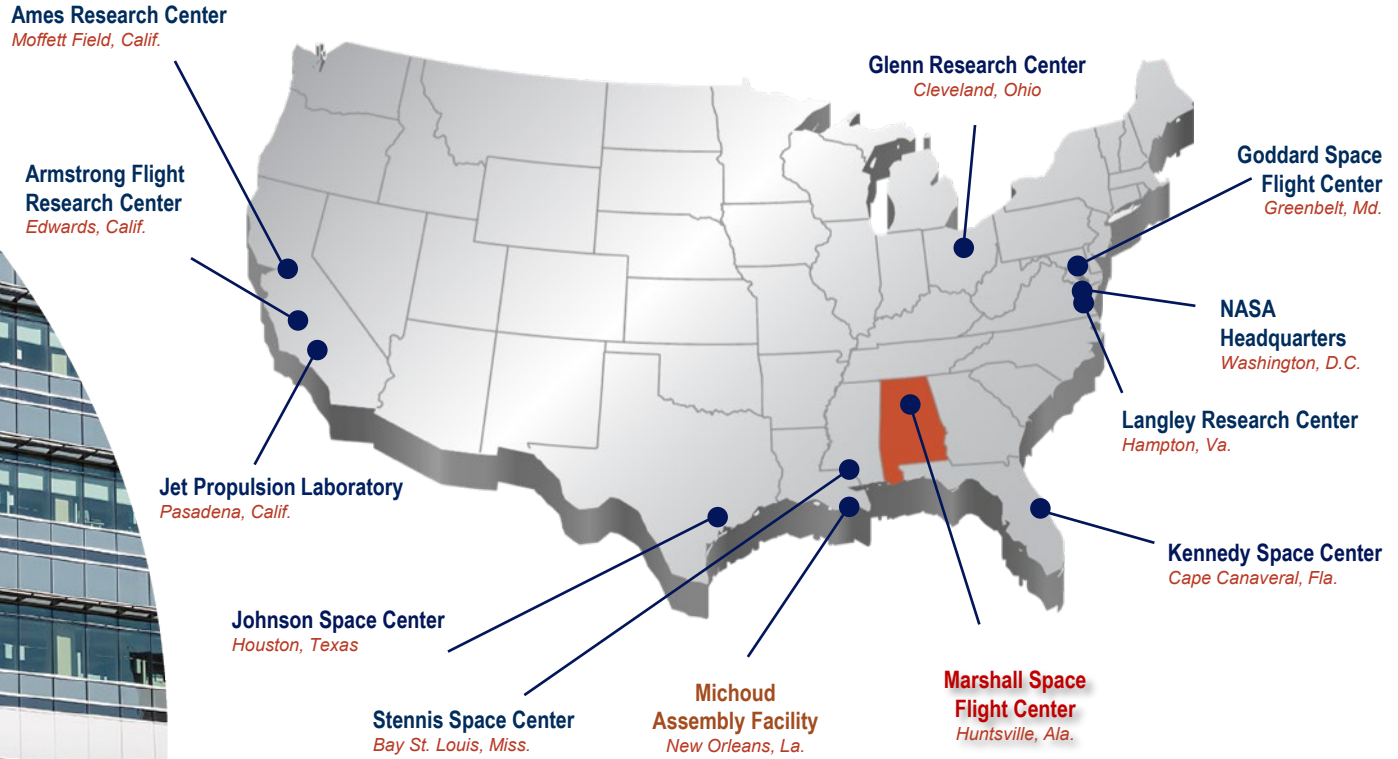
Name
Title
NASA's Marshall Space Flight Center
Date

National Aeronautics and Space Administration



EXPLORE MARSHALL





Marshall Space Flight Center



Huntsville is the Rocket City

2nd Largest Research Park in U.S.

1st Best Affordable Places to Live (2021)

3rd Best Places to Live (2021)

3rd Largest Concentration of High-Tech Workers (2020)

3rd Most Technical Workforce (2019)

Redstone Arsenal

42,000 employees | 38,000 acres

Marshall's Community

Team Redstone



G-585886

Living and Working in Space






Traveling To and Through Space





Enabling Commercial Space & National Security








Understanding Our World and Beyond



Marshall's Mission Areas



Space Launch System



Michoud: Building the Next Generation Rocket

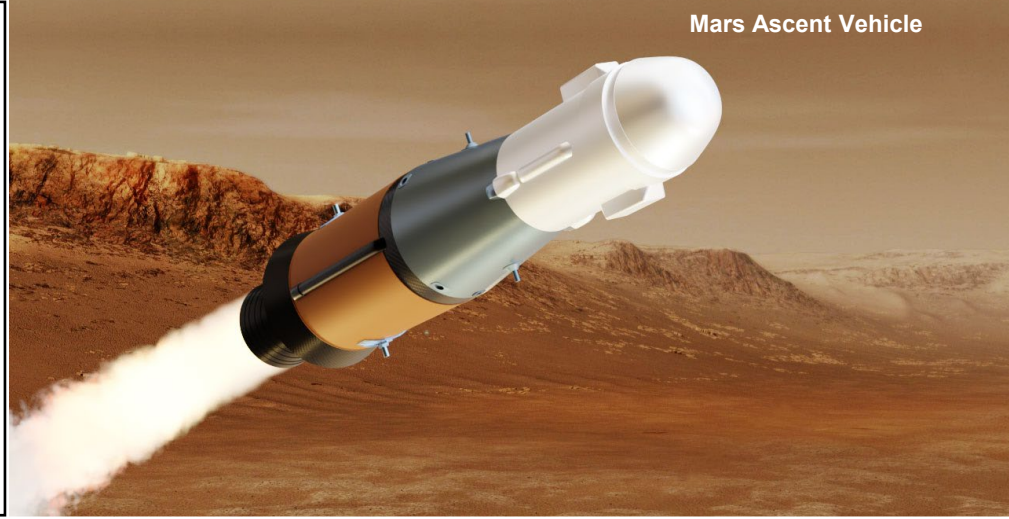
SpaceX HLS Starship
for Artemis III



Human Landing System



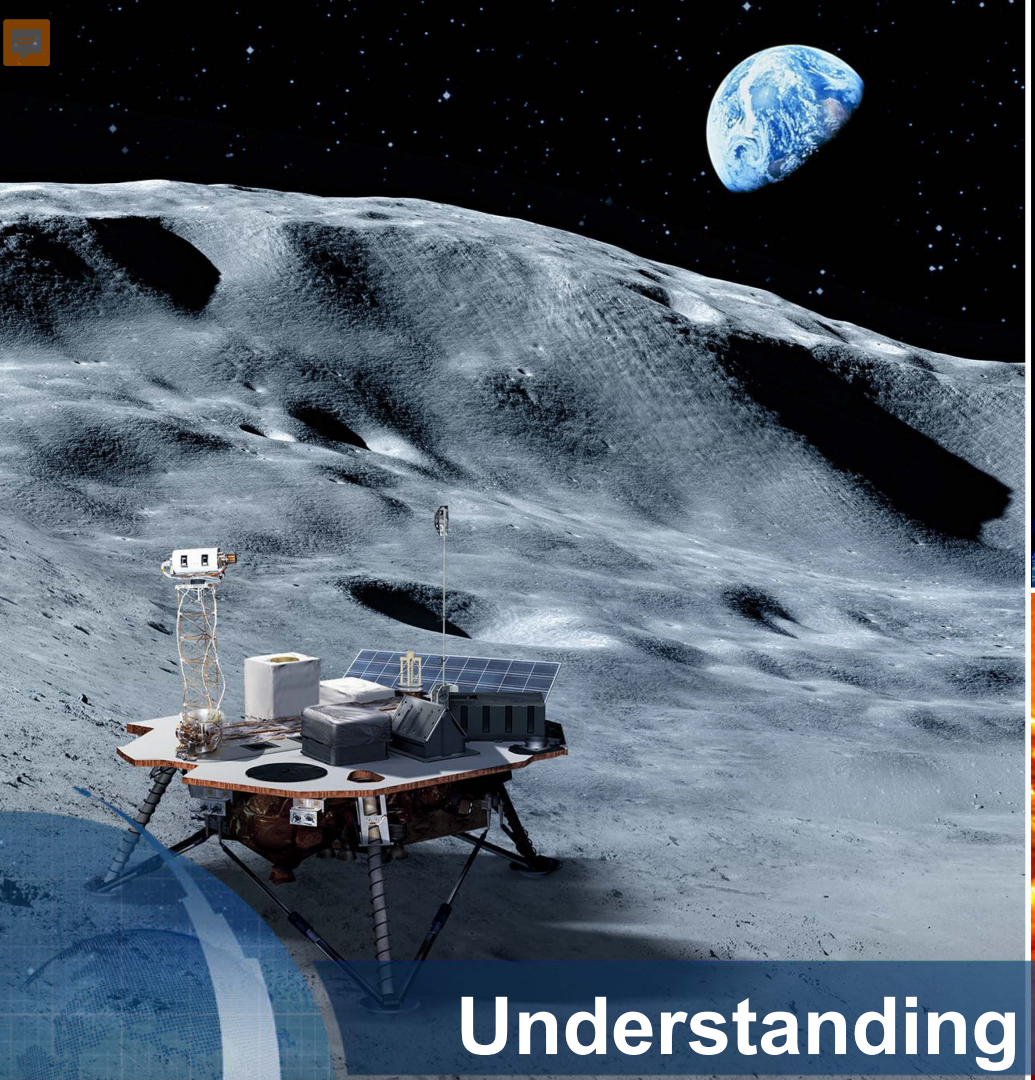
Living and Working in Space







Developing Technology for Exploration



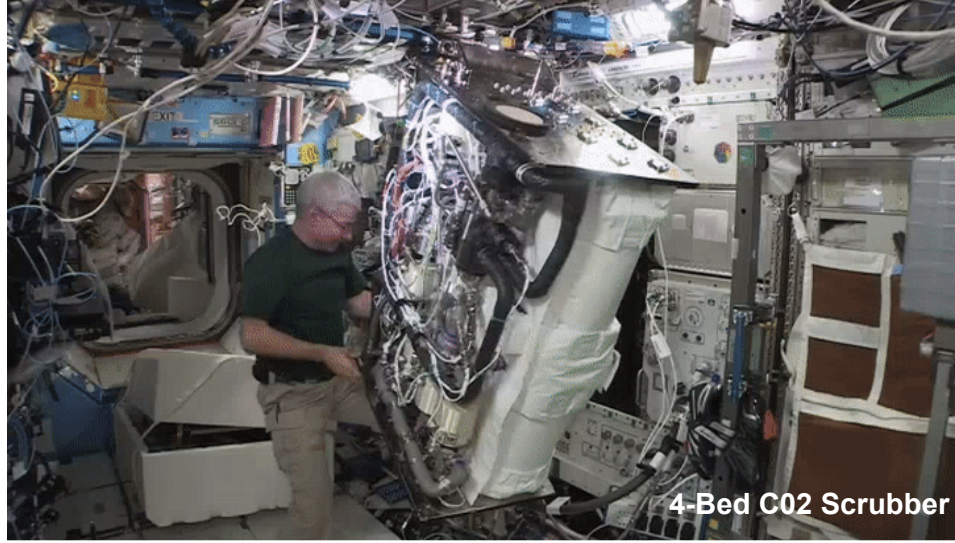




Understanding Our World and Beyond



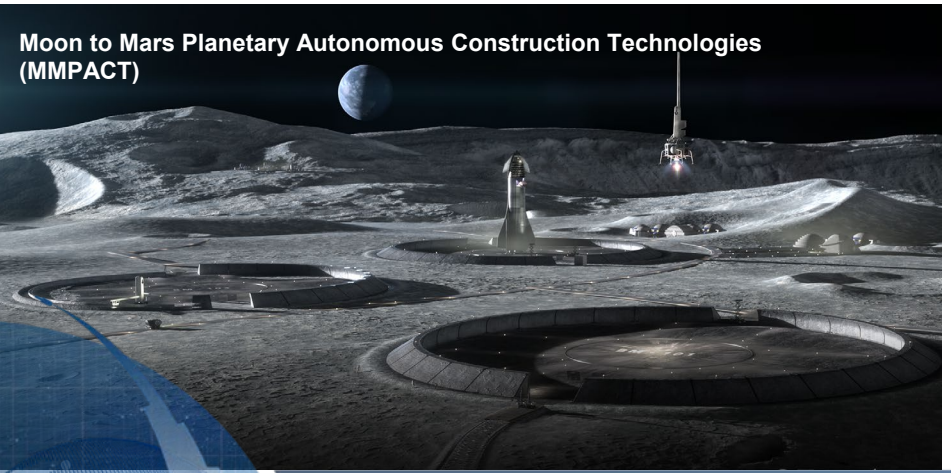
Understanding Our Home Planet





Life Support Systems and Habitats

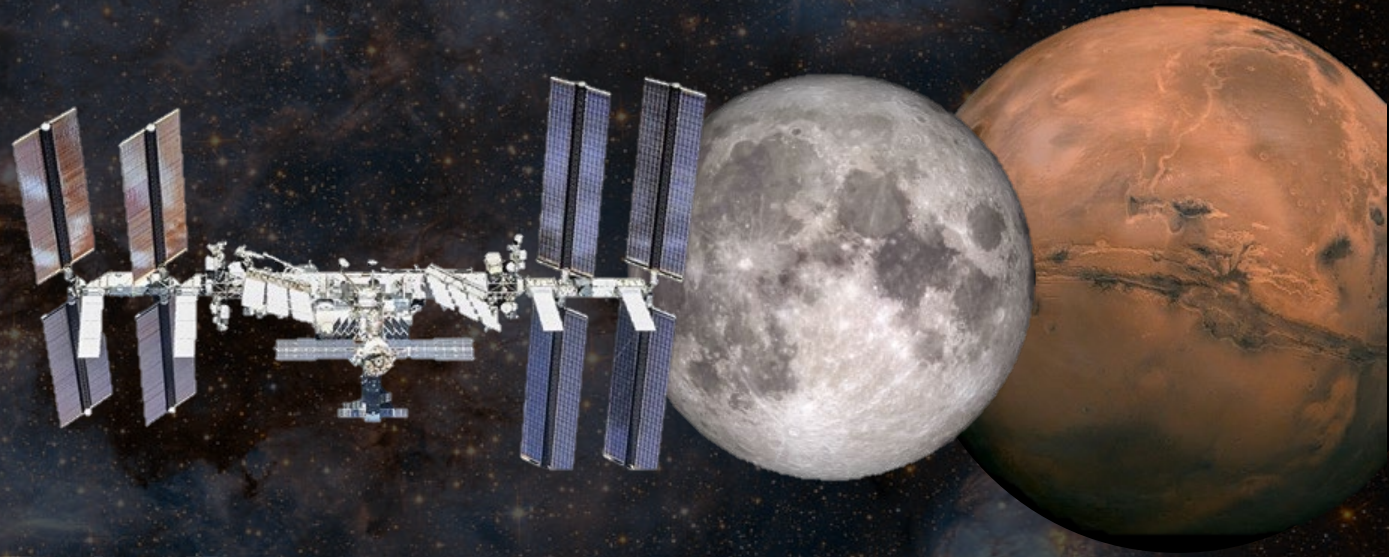






Advanced and Additive Manufacturing

Payload and Mission Operations Division



Plan, Train, Fly

WE PLAN

We take requirements and turn them into mission timelines. We use automated tools to help customers with turnkey, planning solutions.

WE TRAIN

Whether we meet in person or remotely, we can assess our customers' needs to develop a customized training plan. We provide instruction to prepare teams for operations.

WE FLY

Whether a mission is crewed or un-crewed, our ground systems operators and flight controllers are expert mission integrators. We can connect customers to a near-Earth or deep space platform, develop operations products and plans, and optimize execution utilizing a global team to ensure any mission's success.



Flight Operations

- **Planning**
  - Autonomous and crewed spacecraft science mission operations concept development
  - Integrate requirements for multiple experiments into a cohesive schedule of on-orbit activities
  - Development of safe and efficient on-orbit and ground command procedures
  - Logistics during all flight phases across various delivery schedules and vehicles
  - Use of automated tools in support of turnkey mission planning solutions
  - Create individual experiment plans based on specific customers' needs.
- **Training**
  - Science operations curriculum development and related instructional design
  - Flight and ground controller training and certification
  - Payload instructor assessment and training
  - Remote science user, ground systems interface and NASA tools training
  - Critical thinking, situational awareness, and anomaly response training
  - XR (virtual and augmented) training assessment
  - Simulation Model Development

- **Real-Time Execution**
  - Certified Flight Controllers/operators specializing in science mission operations
  - 24/7/365 monitoring from a secure and reliable facility
  - NASA's in-house imagery experts







HUNTSVILLE OPERATIONS SUPPORT CENTER

The Huntsville Operations Support Center, or HOSC, is a 24/7, multi-mission, ground systems operations facility which provides user-oriented, highly reconfigurable services. The HOSC provides secure and centralized gateway services and communications infrastructure to a globally dispersed user community. Our facilities offer custom solutions to fit mission requirements.

Configurable Control Rooms
Allow flexibility and shared cost across PMOD projects and programs

Test and Readiness Room
In-house command and telemetry testing

Data Operations Control Room
Ground systems support of all PMOD programs and projects

Mission Training Complex
Basic trainer for ground support personnel and flight control team



HOSC

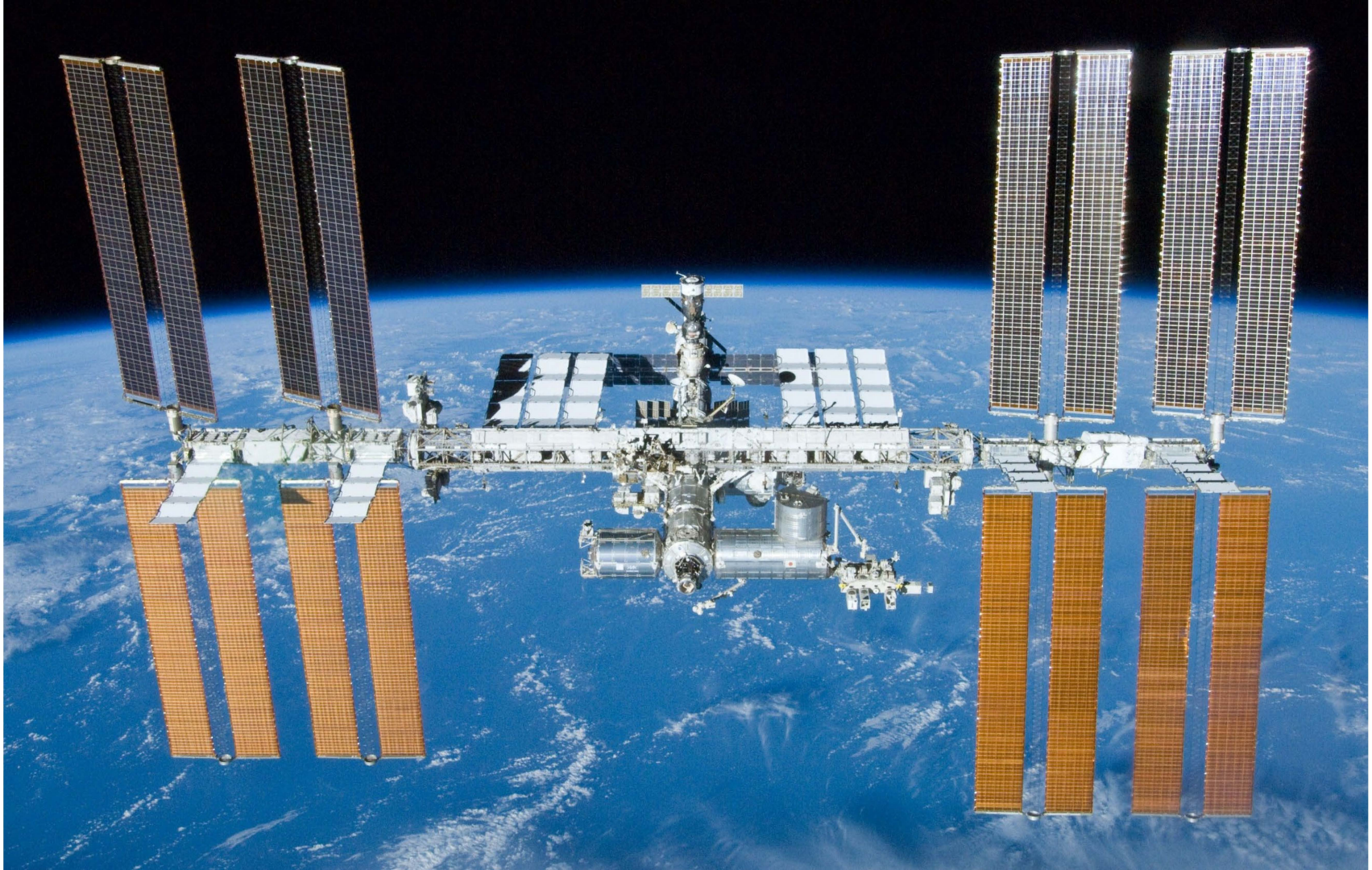
Ground Systems

- Turnkey operations areas, complete connectivity to offsite locations, and ability to host customers' systems onsite
- State-of-the-art Command and Control, Telemetry, Voice, Video services
- Communications solutions and connectivity via established NASA communication assets (e.g. NSN, DSN) and capability to expand to commercial vendors
- Cyber Security, including In-house IT/security specialists
- Lights-out automated services for routine command and control operational services.
- NASA's in-house imagery experts
- Data Storage Data Management Facility
- Telescience Resource Kit
- Exception monitoring
- Remote systems access
- Distributed ground systems routing data to multiple remote sites
- "Live From Space" video support









- Size: ~Football field w/ endzones
- Volume: ~33,000 cubic feet
- Altitude: ~250 miles
- Inclination: ~52 degrees
- Speed: ~17,000 MPH
- Orbits every ~92 minutes

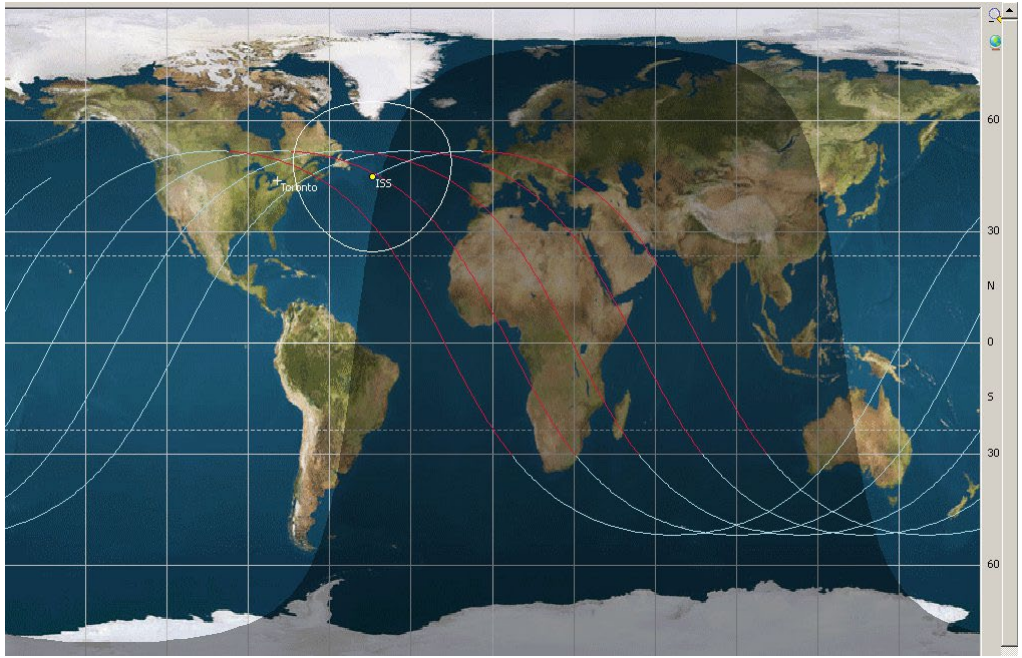


Image Credit: “By self-made by the uploader [GPLv3 (http://www.gnu.org/licenses/gpl-3.0.html)], via Wikim”



Image Credit: By TastyCakes - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=7646003



Payload Rack Officer – “PRO”
Timeline Change Officer – “TCO”
Stowage Officer – “Stowage”
Operations Controller - “OC”
Payload Communications Officer – “PAYCOM”
Data Management Coordinator – “DMC”
Marshall Ground Control – “Marshall GC”
Payload Operations Director – “POD”

ISS Configuration

As of June 2017

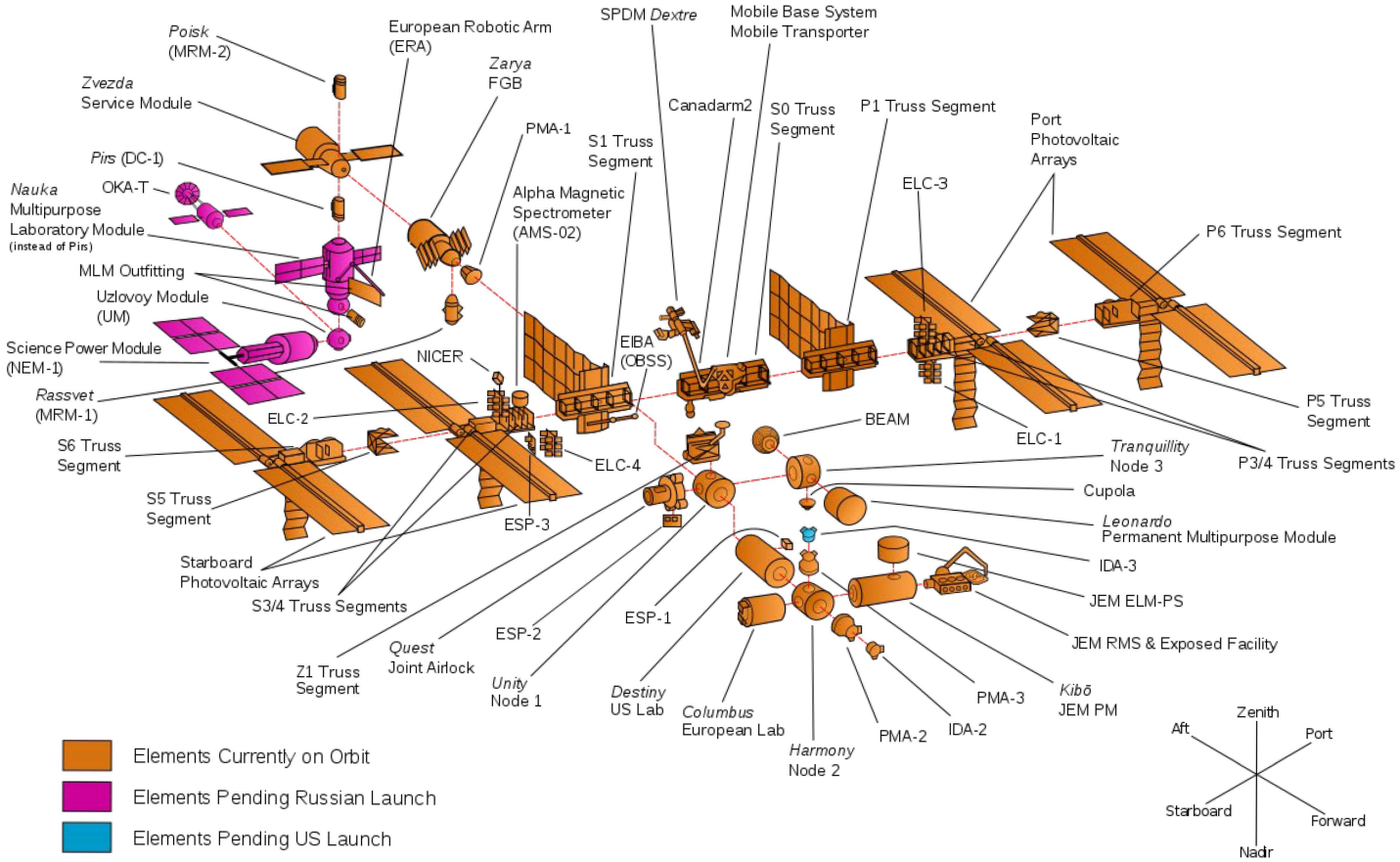
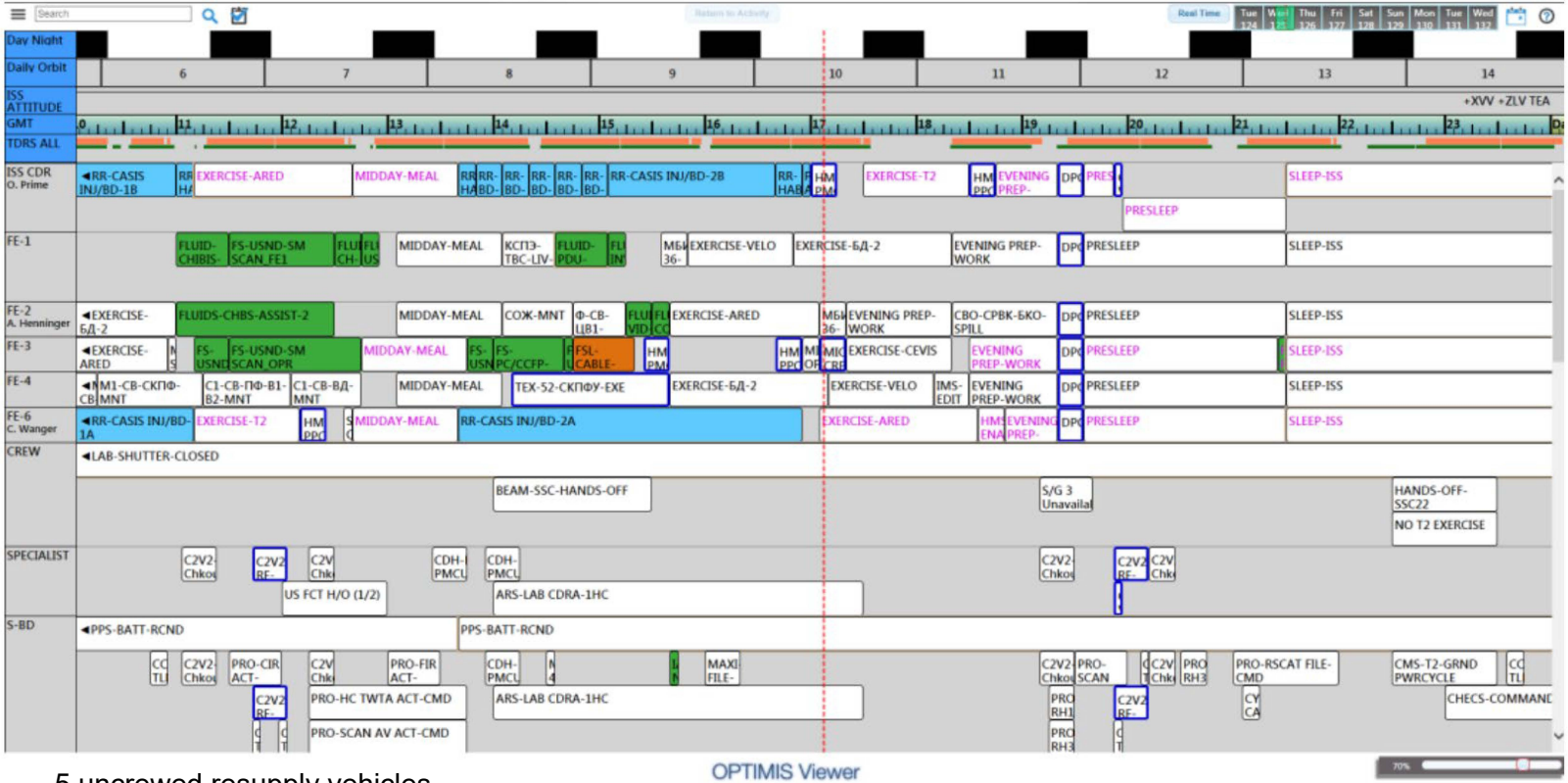


Image Credit: By ISS_configuration_2011-05_en.svg: NASA and various Wikimedia editors including Colds7ream, Fritzbox and Johndrinkwater.derivative work: Trex2001 (talk) - ISS Configuration as of August 2016.svg, Public Domain, https://commons.wikimedia.org/w/index.php?curid=61056806

- S-Band
  - Critical commanding and telemetry
- Ku-Band
  - Video
  - Payload Science data
  - Hardware telemetry
  - Backup commanding
  - Crew “internet”
  - Delay Tolerant Networking
- AOS/LOS and ground stations
  - AOS – Acquisition of Signal
  - LOS – Loss of Signal



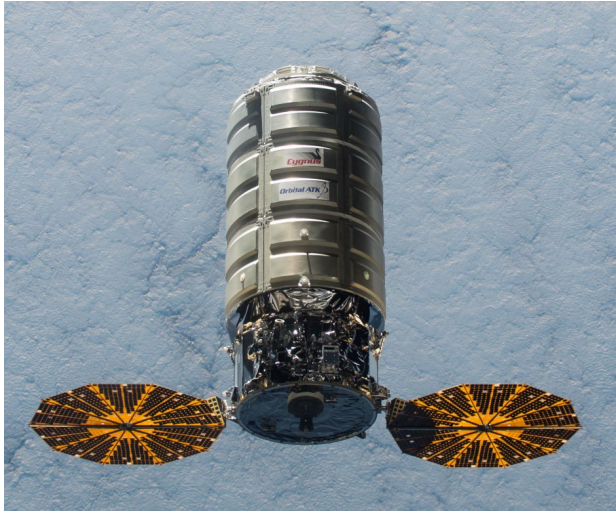
- 5 uncrewed resupply vehicles
  - Progress
  - HTV
  - Dragon
  - Cygnus
- Soyuz and Dragon are the only current crewed vehicle
- ISS Planning is a worldwide effort
- Standard crew rotation is ~6 months – divided into increments



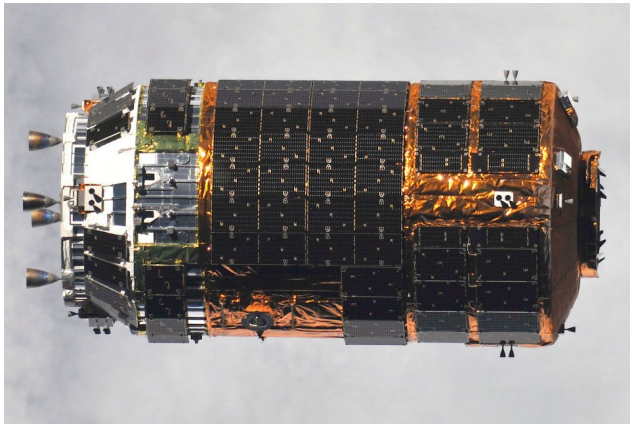
By Crew of Expedition 11.(Original uploader was Colds7ream at en.wikipedia) - http://spaceflight.nasa.gov/gallery/images/station/crew-11/html/iss011e08855.html(Transferred from en.wikipedia. Transfer was made by User:Colds7ream.), Public Domain, https://commons.wikimedia.org/w/index.php?curid=3223928



By NASA - http://www.youtube.com/watch?v=bGoJ66WNapE, Public Domain, https://commons.wikimedia.org/w/index.php?curid=19602764



By NASA - https://www.flickr.com/photos/nasa2explore/23660365065/, Public Domain, https://commons.wikimedia.org/w/index.php?curid=45801753



By NASA - http://spaceflight.nasa.gov/gallery/images/station/crew-20/html/iss020e041380.html, Public Domain, https://commons.wikimedia.org/w/index.php?curid=16124733



Credit: NASA https://www.nasa.gov/content/expedition-38-soyuz-


28000
km/h


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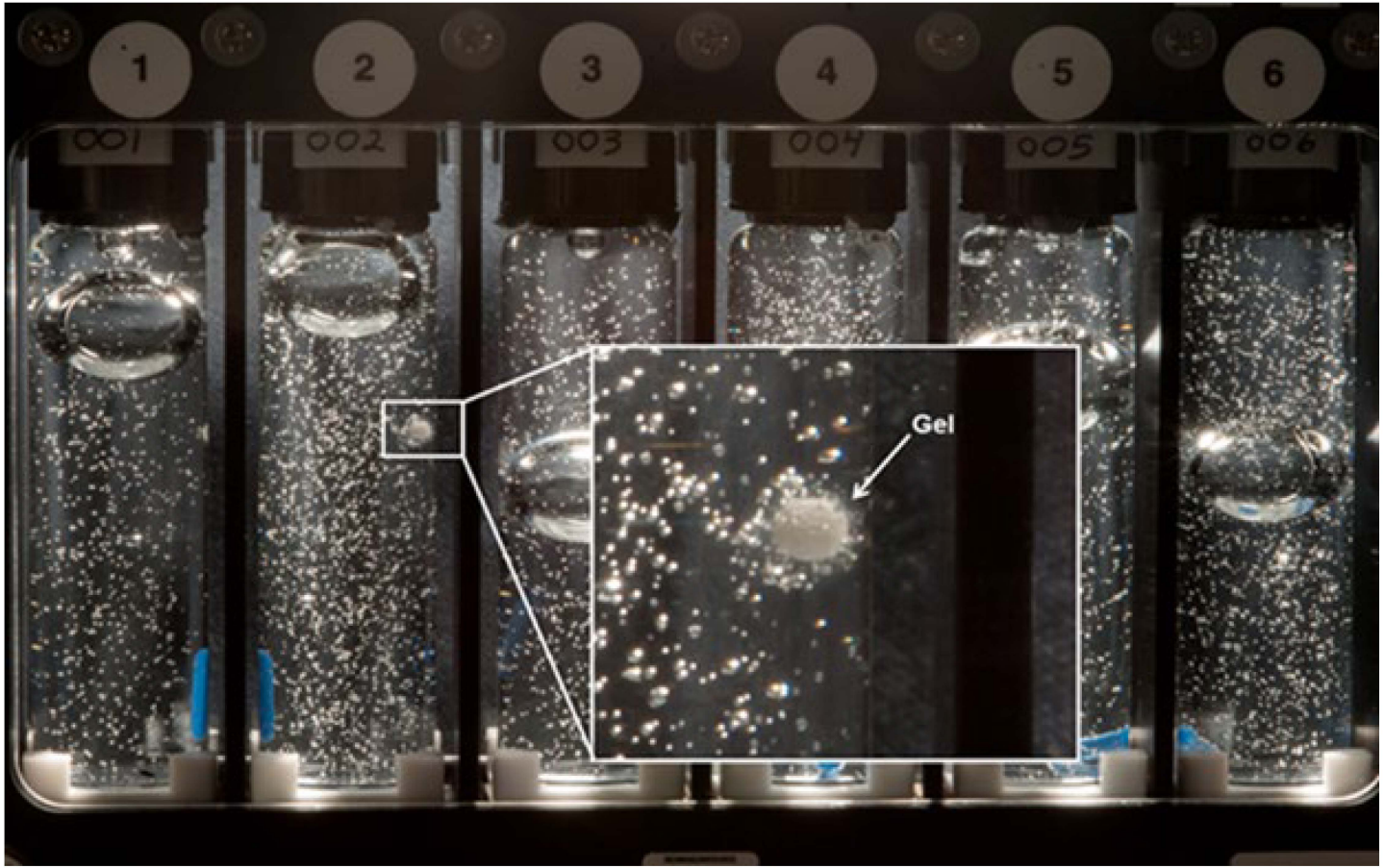




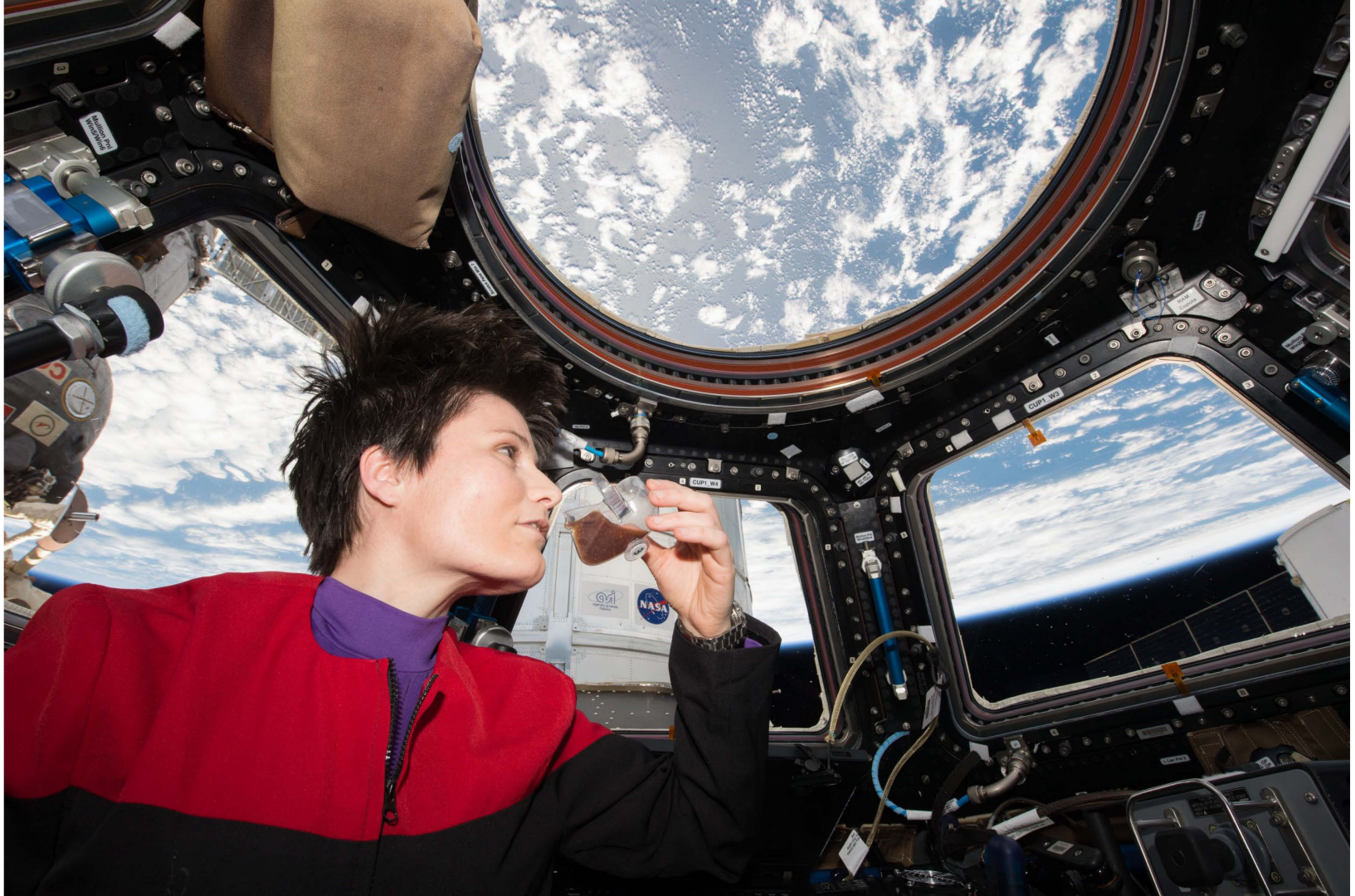


- NASA classifies research into 6 broad categories:
  - Biology and Biotechnology - ~20%
  - Earth and Space Science - ~10%
  - Educational and Cultural Activities ~15%
  - Human Research ~10%
  - Physical Science ~10%
  - Technology Development and Demonstration~35%


UOP
#7

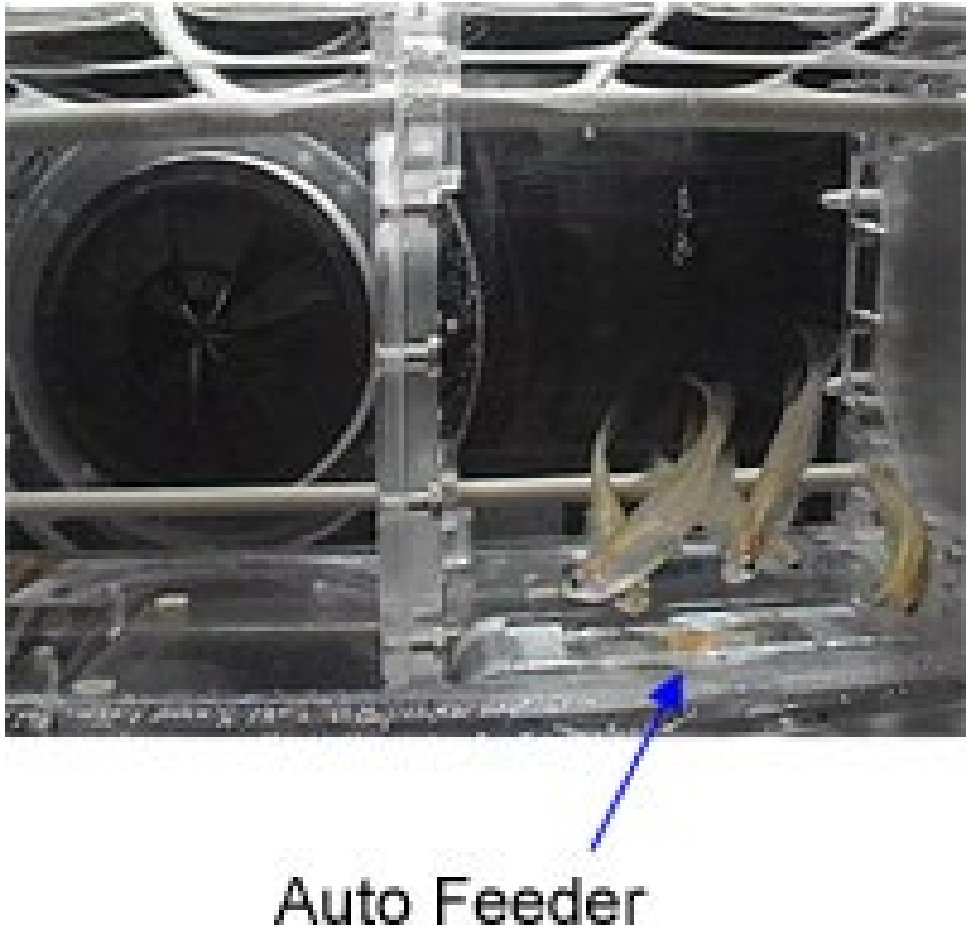

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001
002
003
004
005
006
Gel




CUP1 W4
NASA


HATCH

[JAXA Digital Archives | Search Results]

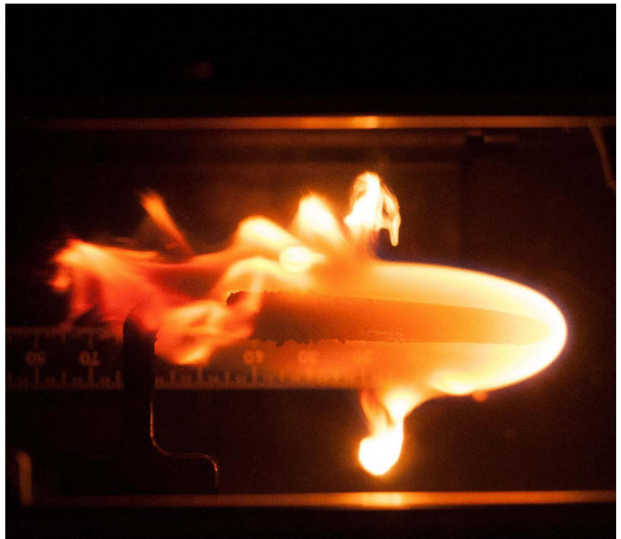


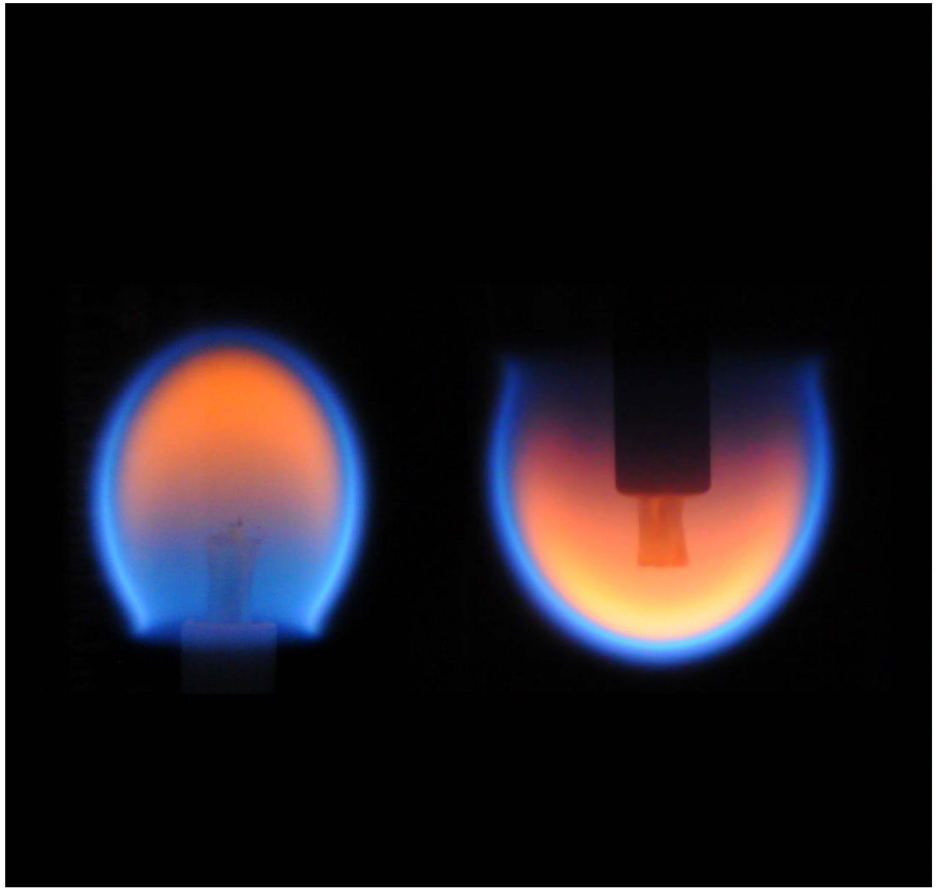
Images Provided by Japan Aerospace Exploration Agency (JAXA)

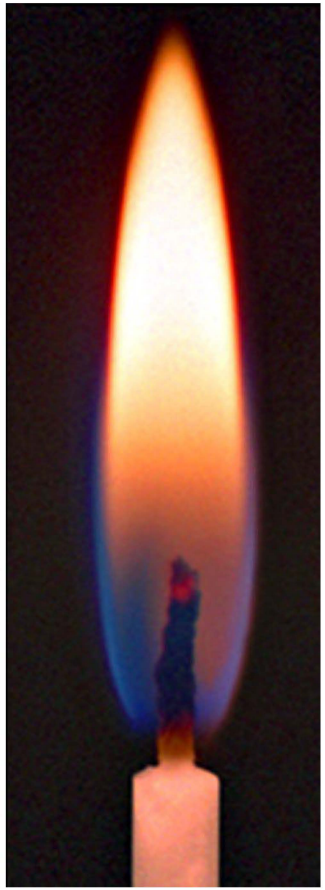














Combustion Integrated Rack - Wikipedia


Veg-01 Plant Pillow
(Zinnia)
Veg-01 Plant Pillow
(Zinnia)
Veg-01 Plant Pillow
(Zinnia)
Bungee
Bungee
P/N 54366
S/N 0015

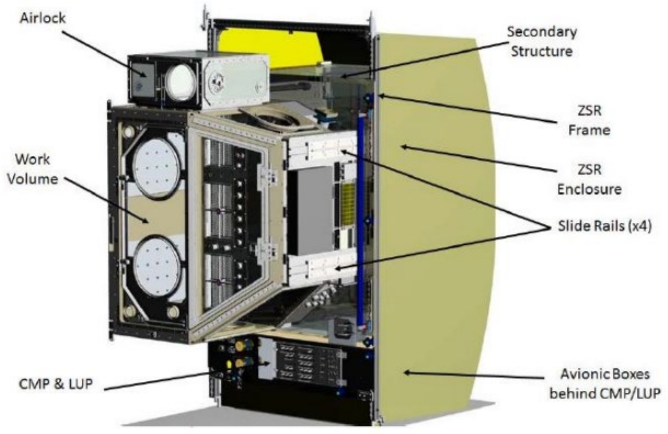

Veg-01 Plant Pillow
(Zinnia)





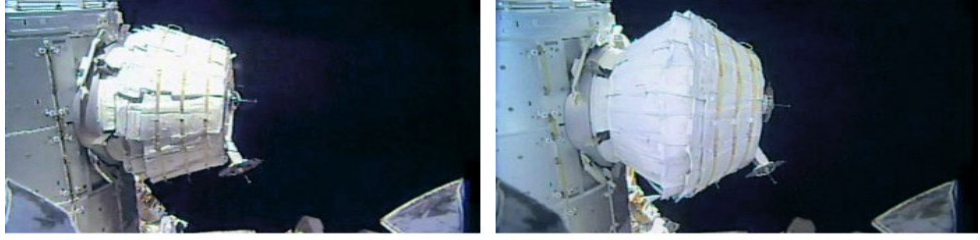
- 2011-2015 – average 25 hours/week
- Increment 49/50 (Fall ’16 – Spring ‘17) – averaged ~45 hours/week
- Increment 51/52 (Spring ‘17 – Sep. ‘17) – averaged ~63 hours/week
- Increment 53/54 (September ‘17 – now) – expecting ~68 hours/week
- Increment 54 had a week with ~110 hours of payload science research!
- Russian Joint Research – Bartering for Russian crew time

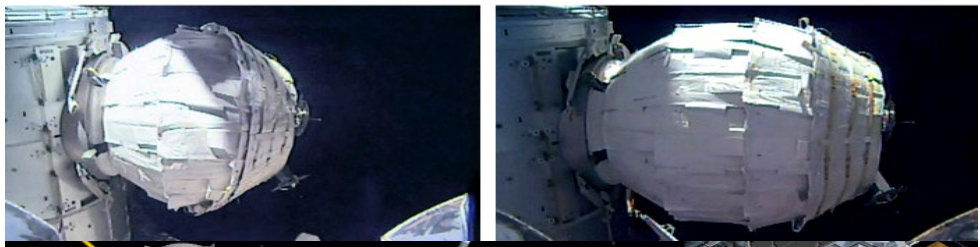
- More crew time = more research!

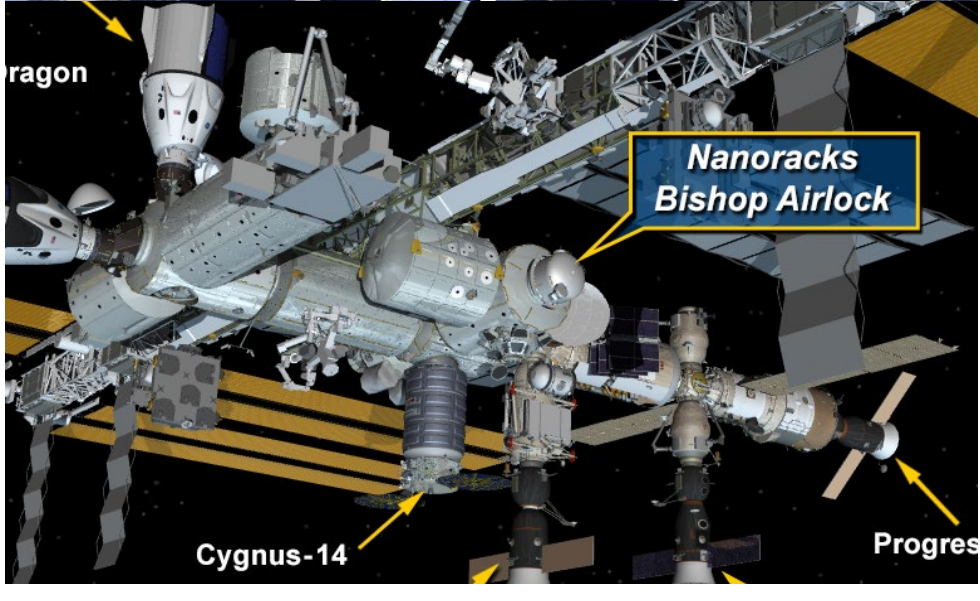


LSG with Airlock attached and Work Volume (WV) extended (extends approx. 31.6")

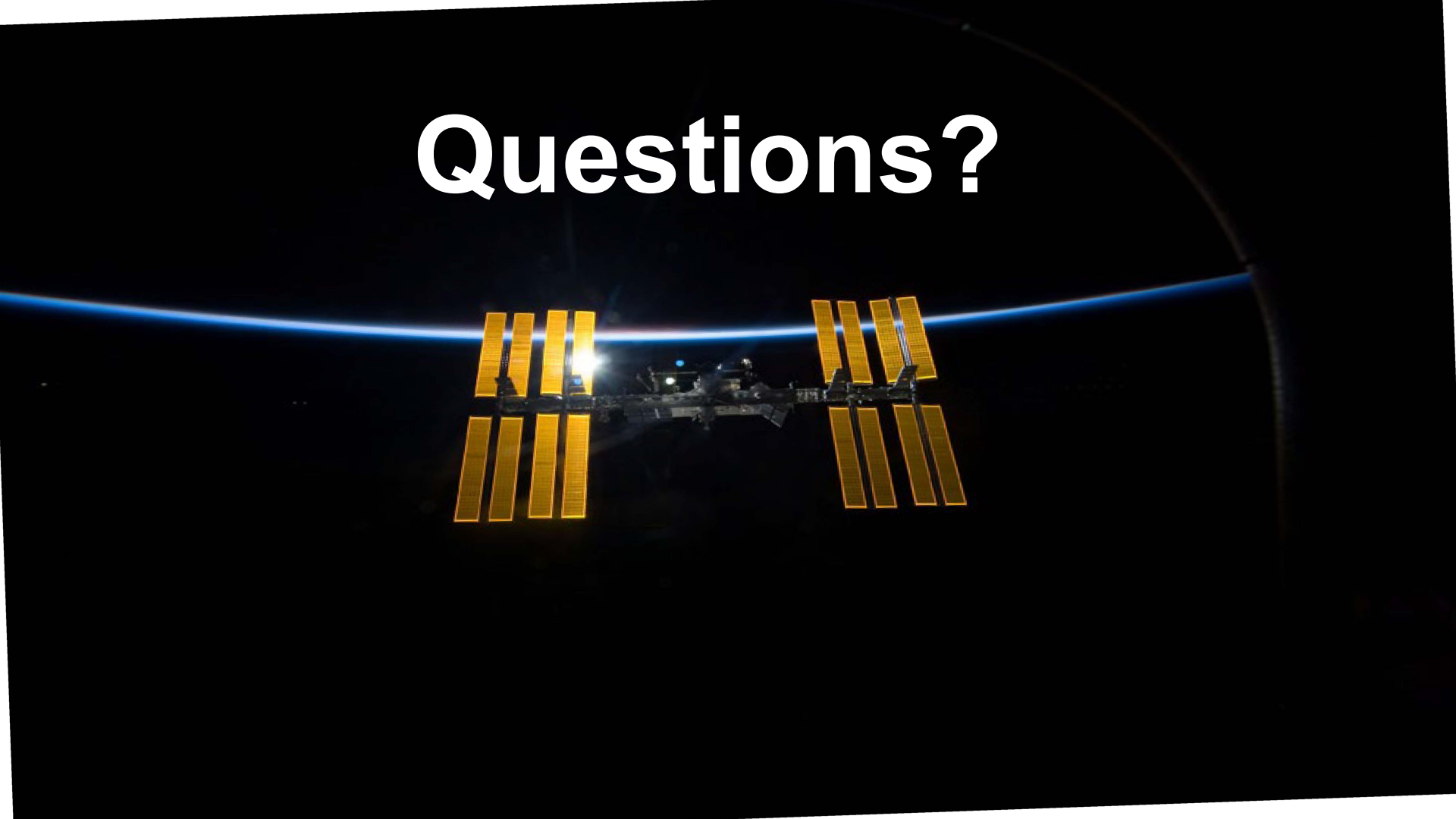
- Nanoracks Airlock "Bishop"
- Life Science Glovebox
- Basic Express Rack
- Bigelow Expandable Activity Module (BEAM)



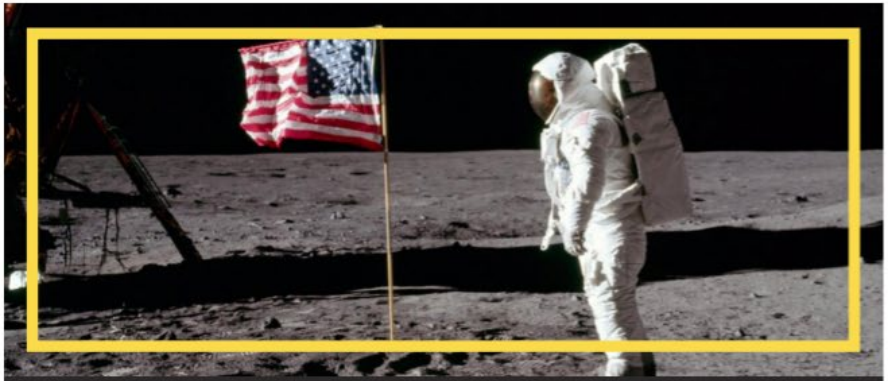




Questions?



Guiding Principles for the HP Leadership Team

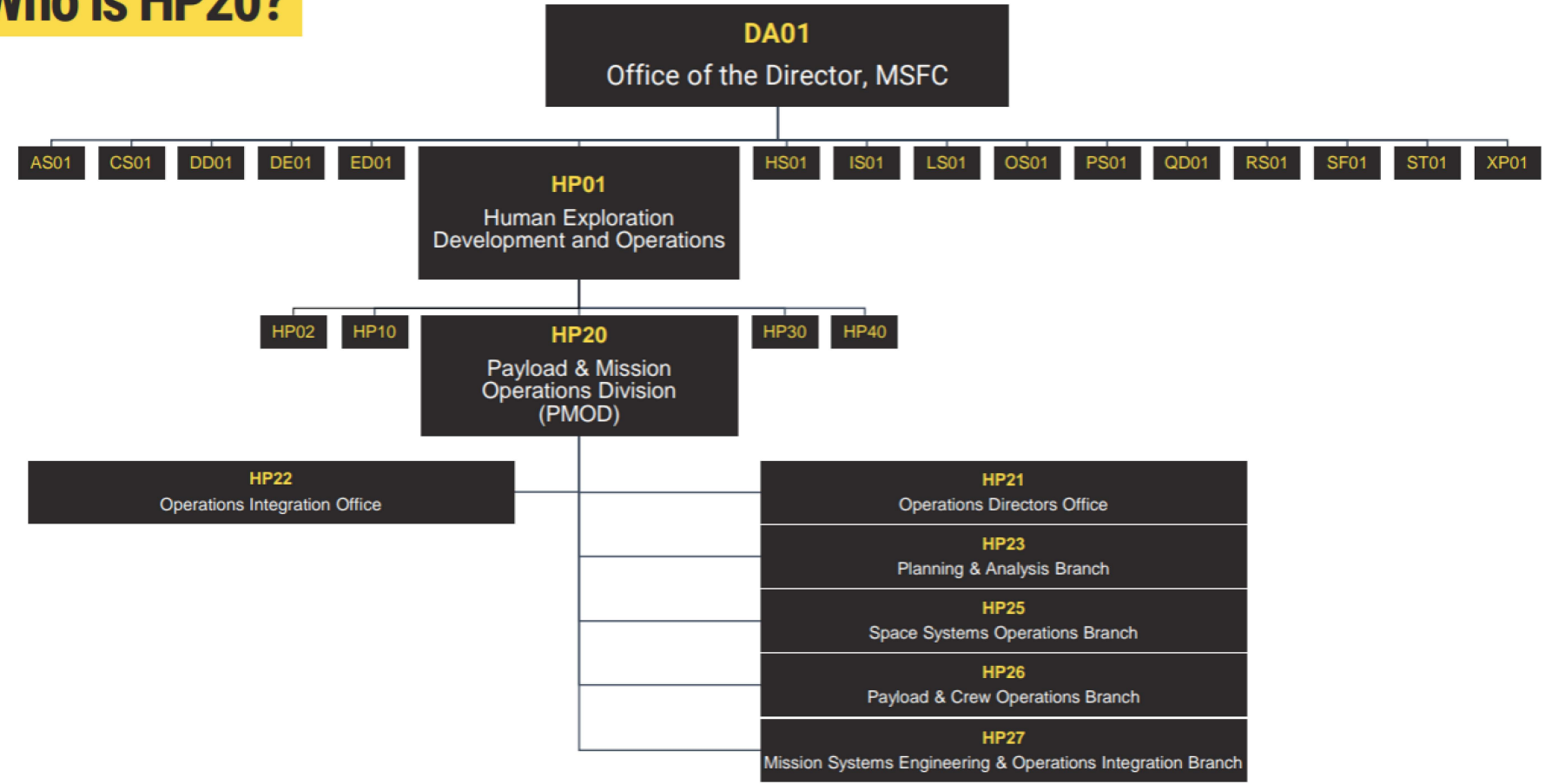


The following HP principles are derived from Marshall Senior Leadership Team values…

We, the Leadership team, agree to lead by example and commit to the following expectations, model accountability, plus encourage behaviors in others:

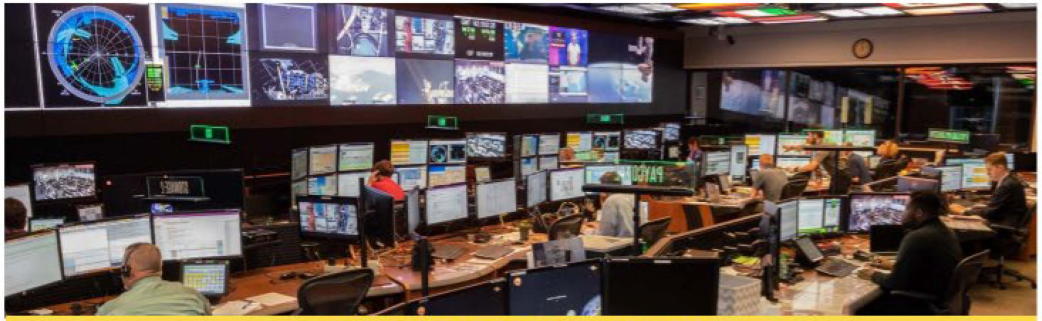
- Demonstrate servant leadership.
- Assume positive intent of others – extend trust and be trustworthy.
- Don't speak destructively about other people or organizations, even behind closed doors.
- Work to resolve differences quickly, directly, and respectfully. Keep short accounts.
- Seek first to understand, then to be understood.
- Avoid deliberate public surprises; communicate with key stakeholders ahead of time.
- Lead in a way that demonstrates support for a diverse and inclusive culture.
- As you play your position, respect the value of all positions.
- Seek ways to advance the goals of NASA and MSFC ahead of your organization or personal interests.
- Actively support continuous learning, new ideas, and innovation.

Who is HP20?


DA01
Office of the Director, MSFC
AS01
CS01
DD01
DE01
ED01
HP01
Human Exploration Development and Operations
HS01
IS01
LS01
OS01
PS01
QD01
RS01
SF01
ST01
XP01
HP02
HP10
HP20
Payload & Mission Operations Division (PMOD)
HP30
HP40
HP22
Operations Integration Office
HP21
Operations Directors Office
HP23
Planning & Analysis Branch
HP25
Space Systems Operations Branch
HP26
Payload & Crew Operations Branch
HP27
Mission Systems Engineering & Operations Integration Branch

What Does HP20 Support?

HP20 provides mission operation capabilities for primarily NASA Human Exploration and Operations Mission Directorate (HEOMD) programs via the Huntsville Operations Support Center (HOSC).



ISS Payload Operations Integration Center



Configurable Control Room



SLS Engineering Support Center

HP20 customers, facilities, and operations support include:

CUSTOMERS

- International Space Station
- Space Launch System
- Small Mission Satellites
- Deep Space Gateway

OPERATIONS SUPPORT

- Payload Operations Integration Function (POIF)

FACILITIES

- Payload Operations Integration Center (POIC)
- SLS Engineering Support Center (SESC)
- Configurable Control Room