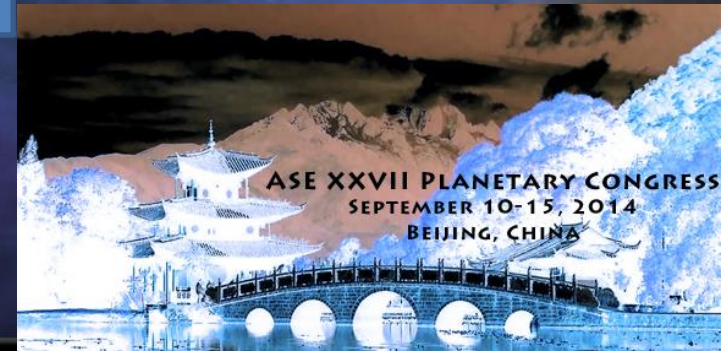


International Human Spaceflight Program Update- USA

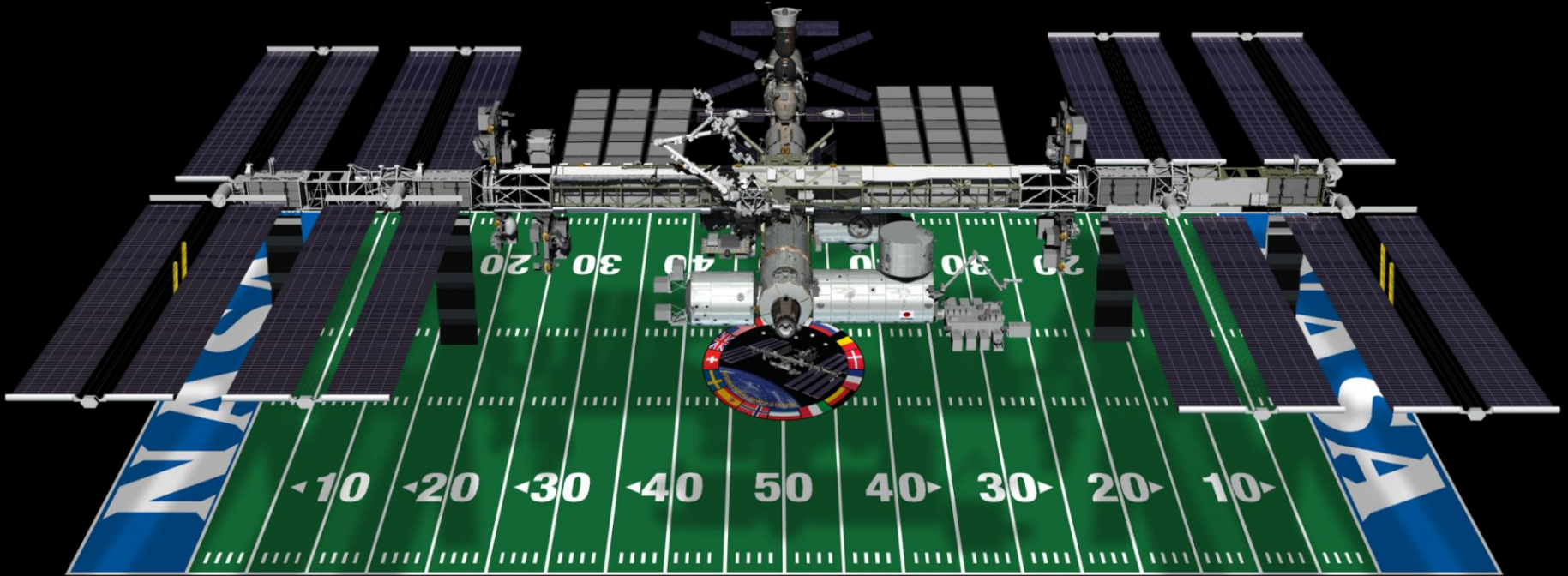
Mike Fincke
NASA Astronaut



Current and Future Human Spaceflight (US Perspective)

- 2013/2014:
 - International Space Station (6 crew)
 - Soyuz 4 launches/year
 - ISS Resupply with International Partners (Progress, ATV, HTV)
 - ISS Resupply with Commercial Resupply Contract (Space-X and Orbital)
- ~2017
 - International Space Station (6+ Crew)
 - Soyuz 2 launches /year
 - Commercial Crew ~2 launches/year
 - ISS Resupply with International Partners (Progress, HTV ?)
 - Orion Exploration Mission-1 (uncrewed, circumlunar)
- ~2021
 - International Space Station (6+ Crew)
 - Soyuz 2 launches /year
 - Commercial Crew ~2 launches/year
 - ISS Resupply with International Partners (Progress, ATV ?, HTV ?)
 - Orion Exploration Mission-2 (crewed, Lunar orbit)

YES, IT'S REALLY THIS BIG



Completion: ~1 million pounds
Velocity: 17,500 mph
Altitude: 220 miles above Earth
16 Sunrises and 16 Sunsets
24 hours a day/7 days a week/365 days a year operation

<http://spotthestation.nasa.gov>

THE ISS BRINGS

➤ GLOBAL PARTNERSHIP

- ✧ The ISS Partnership is the blueprint for global cooperation in future exploration beyond Earth – one that enables a U.S.-led multinational partnership and advances shared goals.

➤ COMMERCIAL SPACE MARKET

- ✧ The ISS facilitates the growth of a robust commercial market in low-Earth orbit for scientific research, technology development, and human and cargo transportation

➤ SPACE LABORATORY

- ✧ The ISS' variety of space laboratories advances scientific knowledge in Earth, space, physical, and biological sciences benefiting all on our home planet

➤ DEEP SPACE EXPLORATION

- ✧ The ISS serves as the world's leading laboratory as a test bed for researchers conducting cutting edge research and technology development that will enable human and robotic exploration of destinations beyond low-Earth orbit, including asteroids and Mars

GLOBAL PARTNERSHIP

Created by 5 space agencies representing 15 nations

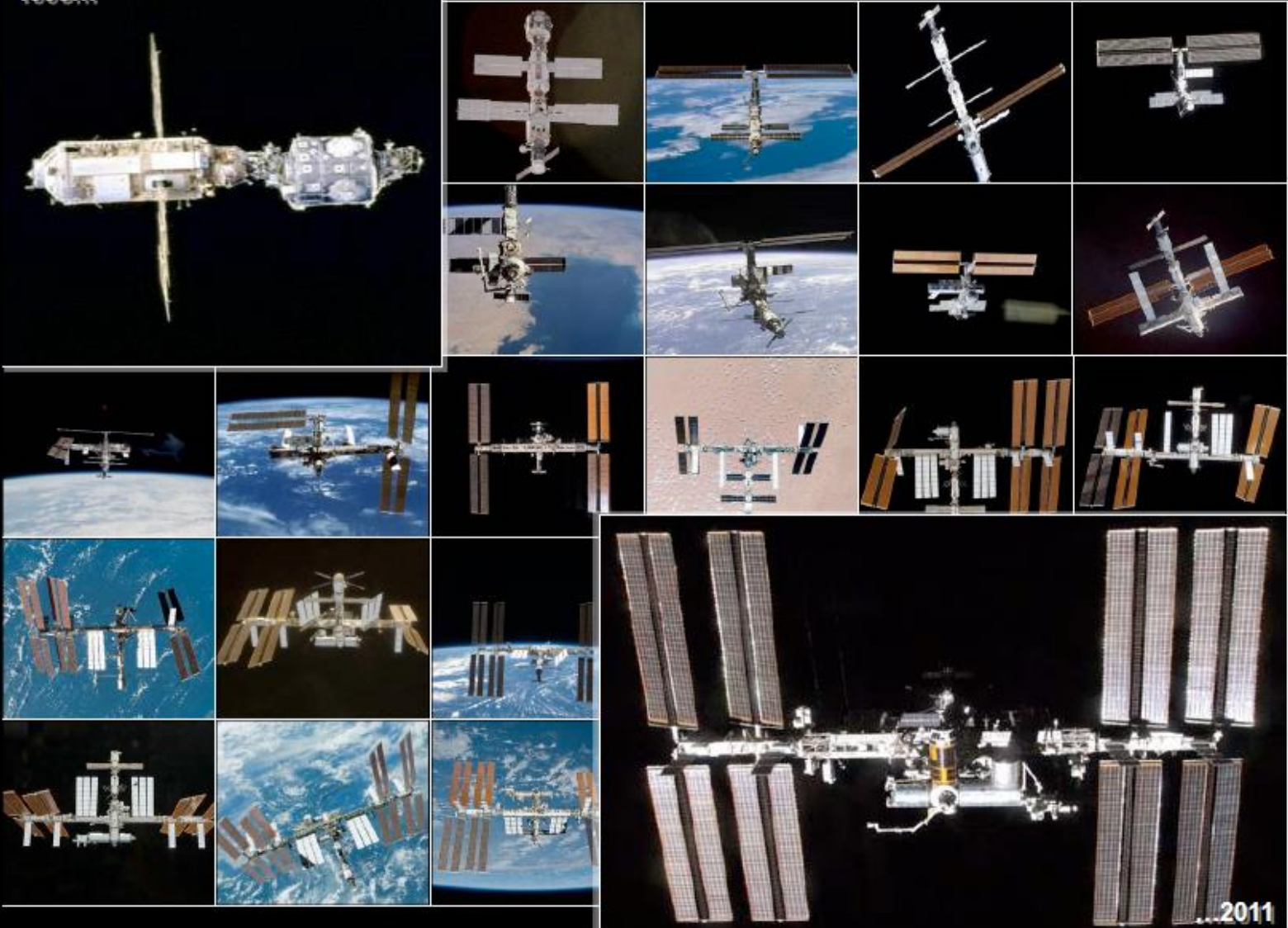


The largest peace time effort
among the most countries in recorded human history.
(Nations that not long ago were mortal enemies)
Over 10 years and 32 missions to assemble

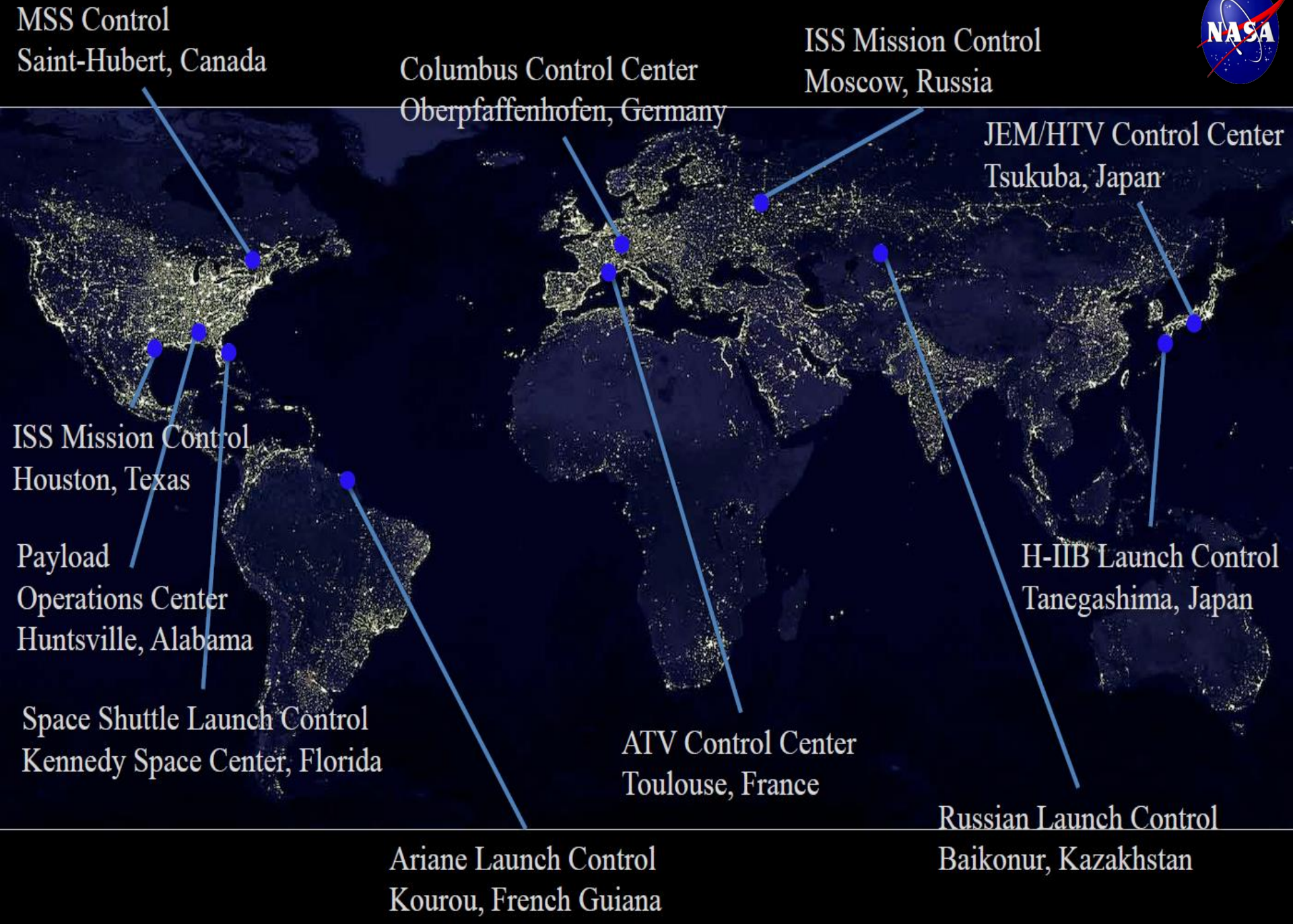
- Established A global partnership model for future exploration beyond Earth
 - ✧ The International Space Station is the blueprint for global cooperation – one that enables a U.S.-led multinational partnership and advances shared goals in space exploration

EVOLUTION IN SPACE

1998...

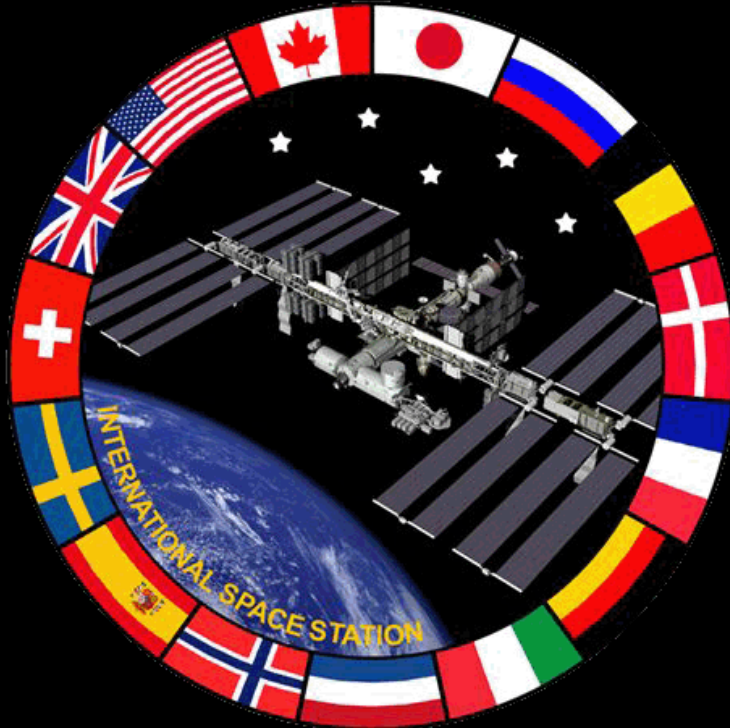


Global Ground-Based Infrastructure



83 Countries/Areas Have Participated in ISS Utilization through March 2014

Argentina
 Australia
 Austria
 Belarus
 Bermuda
 Bolivia
 Bosnia
 Brazil
 Bulgaria
 Chile
 China
 Columbia
 Croatia
 Czech Republic
 Democratic Republic of the Congo
 Dominican Republic
 Ecuador
 Egypt
 Estonia
 Fiji
 Finland
 Georgia
 Ghana
 Greece
 Guatemala
 Honduras
 Hungary
 India
 Indonesia
 Ireland
 Israel
 Kazakhstan
 Kenya



Kuwait
 Kyrgyzstan
 Lebanon
 Liberia
 Lithuania
 Luxembourg
 Macedonia
 Malaysia
 Mali
 Mexico
 Montenegro
 Nepal
 New Zealand
 Nicaragua
 Nigeria
 Peru
 Philippines
 Poland
 Portugal
 Republic of Korea
 Republic of South Africa
 Romania
 Senegal
 Slovakia
 Slovenia
 Taiwan
 Thailand
 Trinidad and Tobago
 Turkey
 Ukraine
 United Arab Emirates
 Uruguay
 Vatican City
 Venezuela
 Vietnam

Belgium	Italy	Spain
Canada	Japan	Sweden
Denmark	Netherlands	Switzerland
France	Norway	United Kingdom
Germany	Russia	United States

COMMERCIAL SPACE MARKET

**CARGO: CYGNUS
(ORBITAL)**



Growing a commercial marketplace in space

- ✧ The ISS facilitates the growth of a robust commercial market in low-Earth orbit for scientific research, technology development, by first creating the need for the road to get there: today's US based cargo transportation and tomorrow's US based crew transportation

**CARGO: DRAGON
(SPACE X)**



COMING SOON TO THE ISS WITH CREW

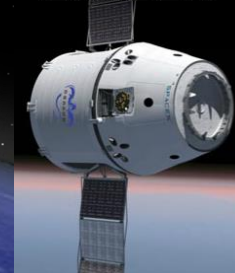
BOEING



SNC SIERRA NEVADA CORPORATION



SPACE X



US sponsorship by scientific discipline



**National Lab
(Earth Benefits)**

**NASA
(Exploration)**

Biology and Biotechnology

Human Research

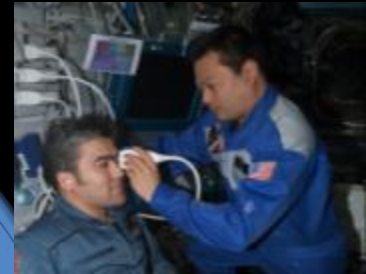
Physical Sciences

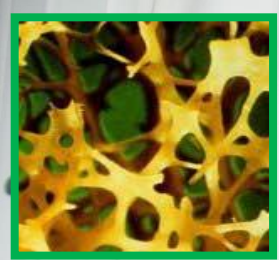
Tech Demos

Astrophysics

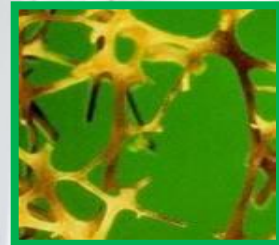
Earth Science

Education

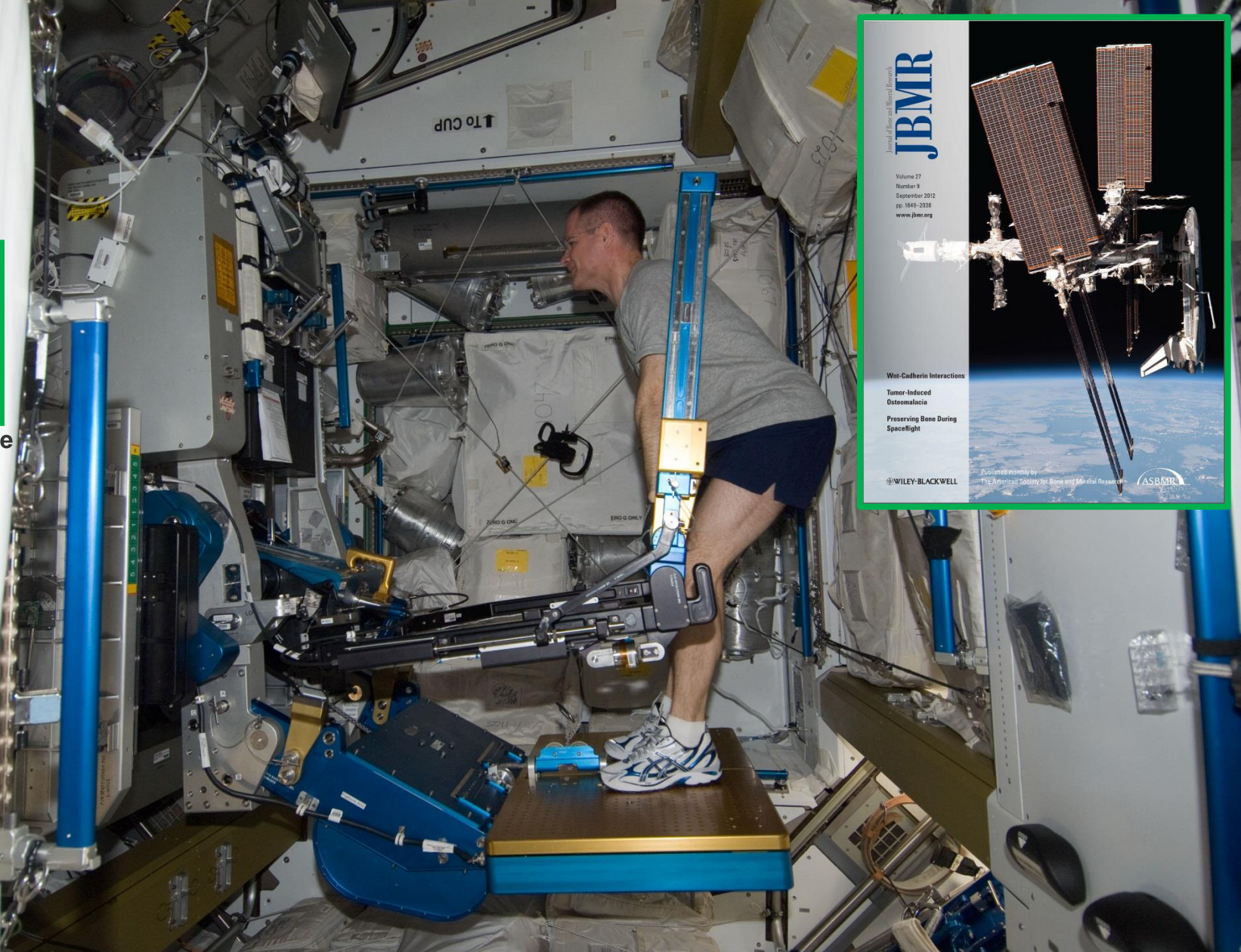




Normal Bone



Osteoporotic Bone



JBMR
Journal of Bone and Mineral Research

Volume 27
Number 9
September 2012
pp 1845-2018
www.jbmr.org

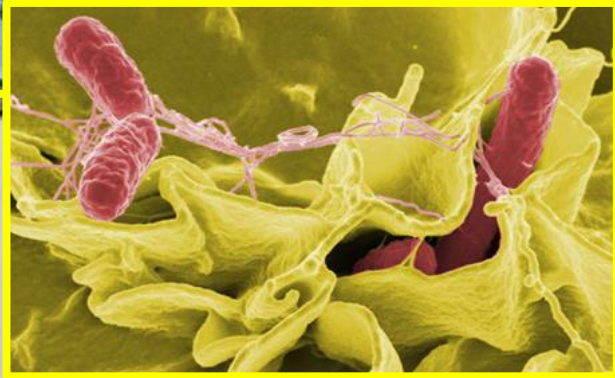
Wnt-Cadherin Interactions
Tumor-Induced Osteomalacia
Preserving Bone During Spaceflight

© WILEY-BLACKWELL

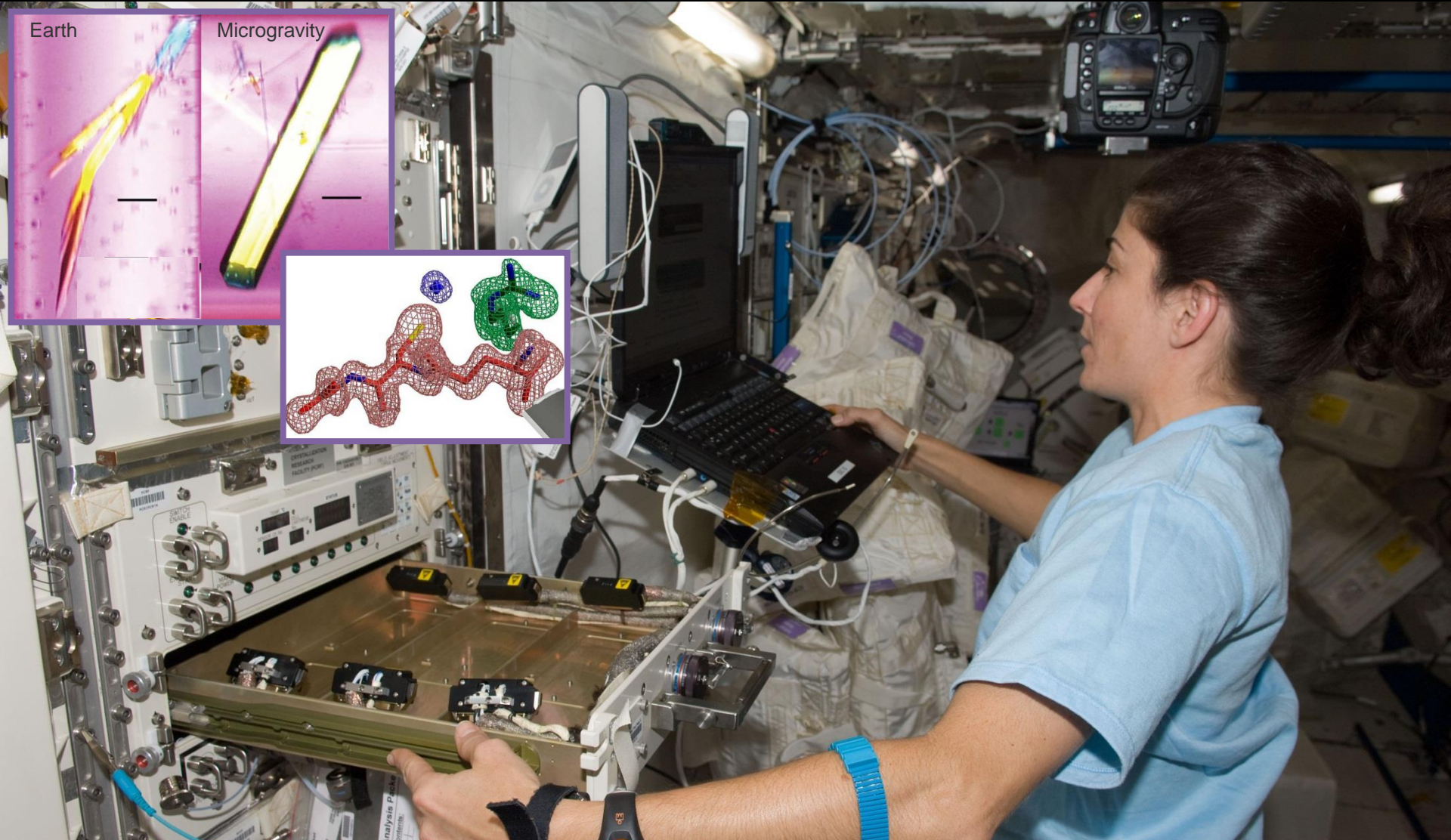
Published monthly by
THE AMERICAN SOCIETY FOR BONE AND MINERAL RESEARCH

ASBMR

Preventing Bone Loss - High intensity resistive exercise, along with adequate calorie intake and Vitamin D helps to prevent bone loss in space.



Microbial Vaccine Development - Bacteria flown in space may be more pathogenic. The controlling genes responsible are the target of possible vaccines for Salmonella and MRSA.

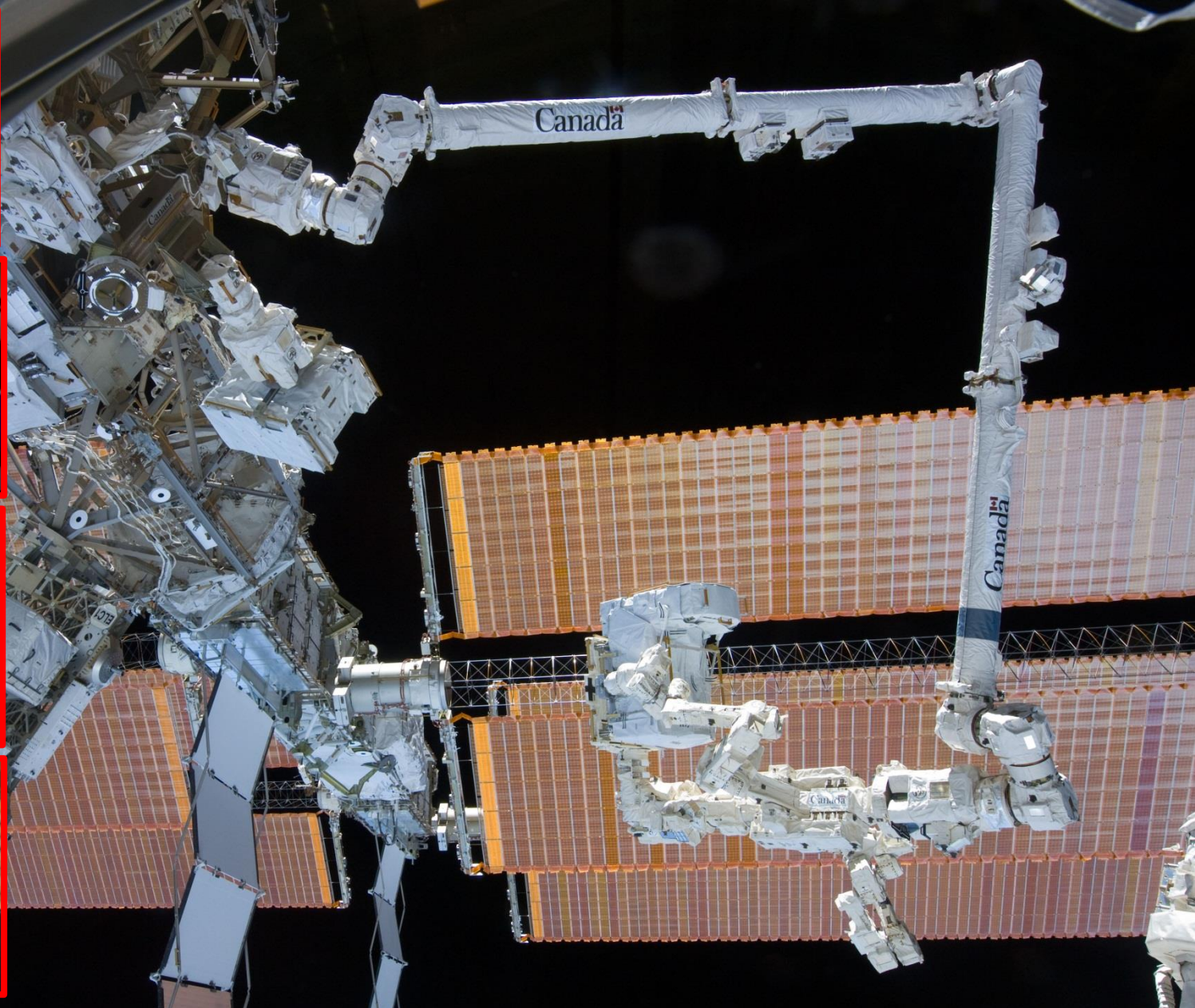


Protein Crystal Growth - Improved structure of biological proteins grown in microgravity can lead to better pharmaceuticals on Earth.

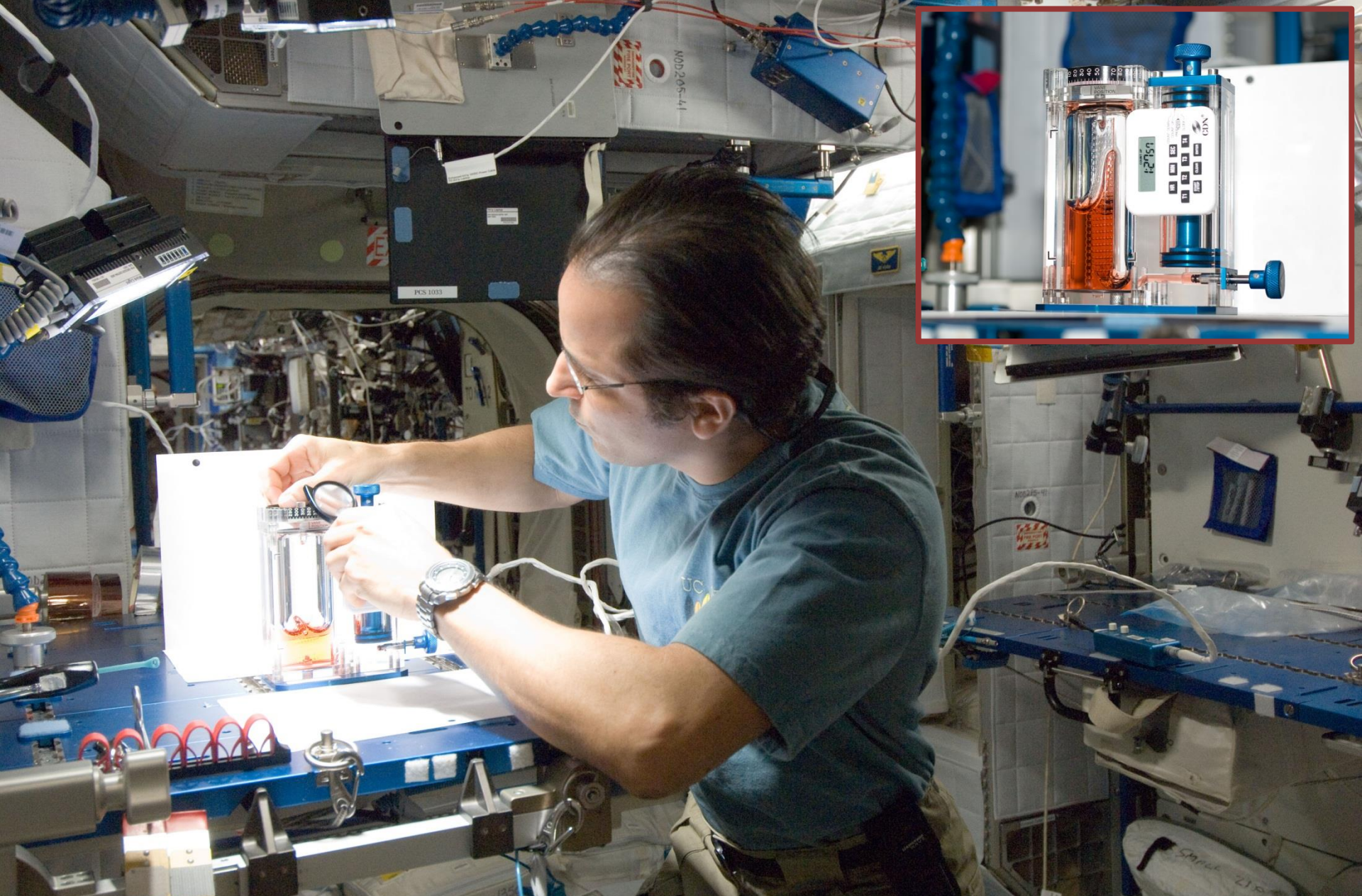
Check out: [ReelNASA: ISS Protein Crystal Growth](#)



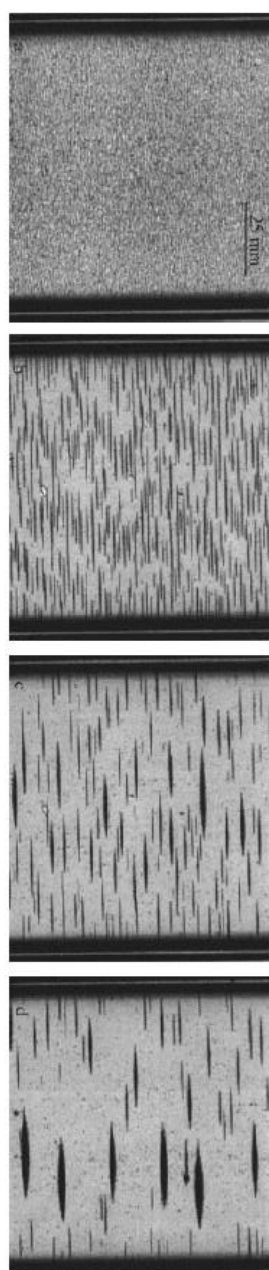
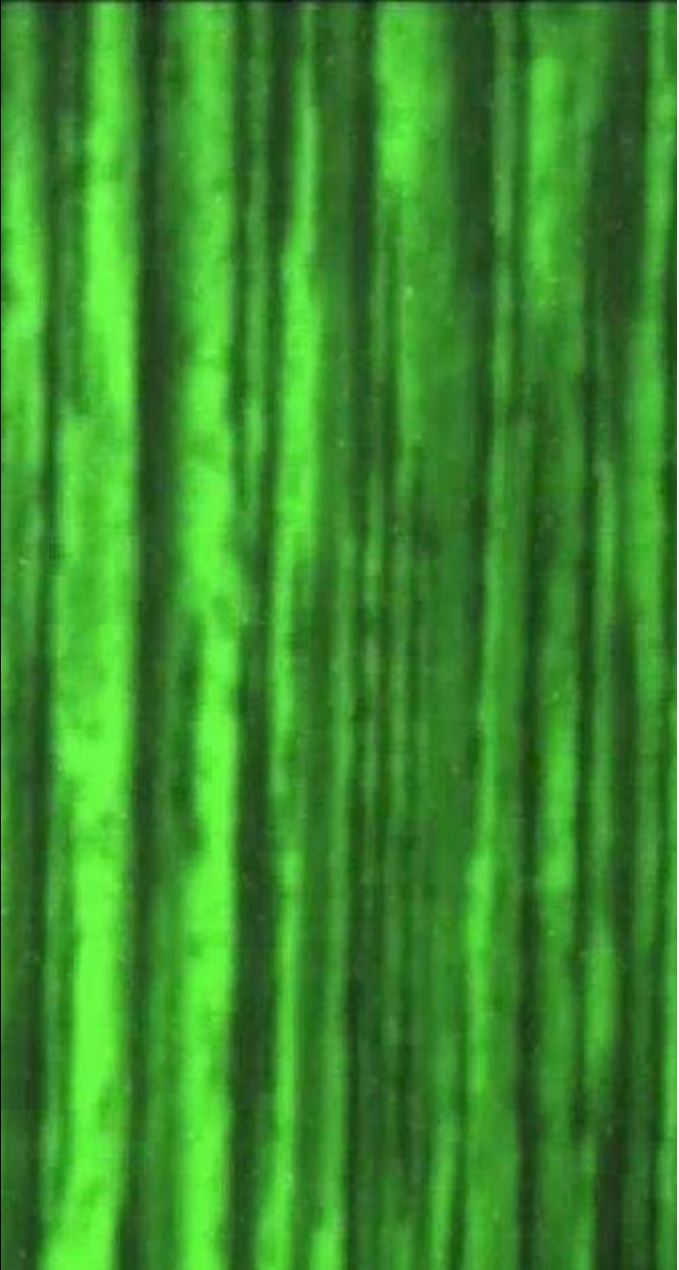
Clean Water – The technologies that ensure clean water on ISS have been commercialized for use in remote regions and for disaster relief.



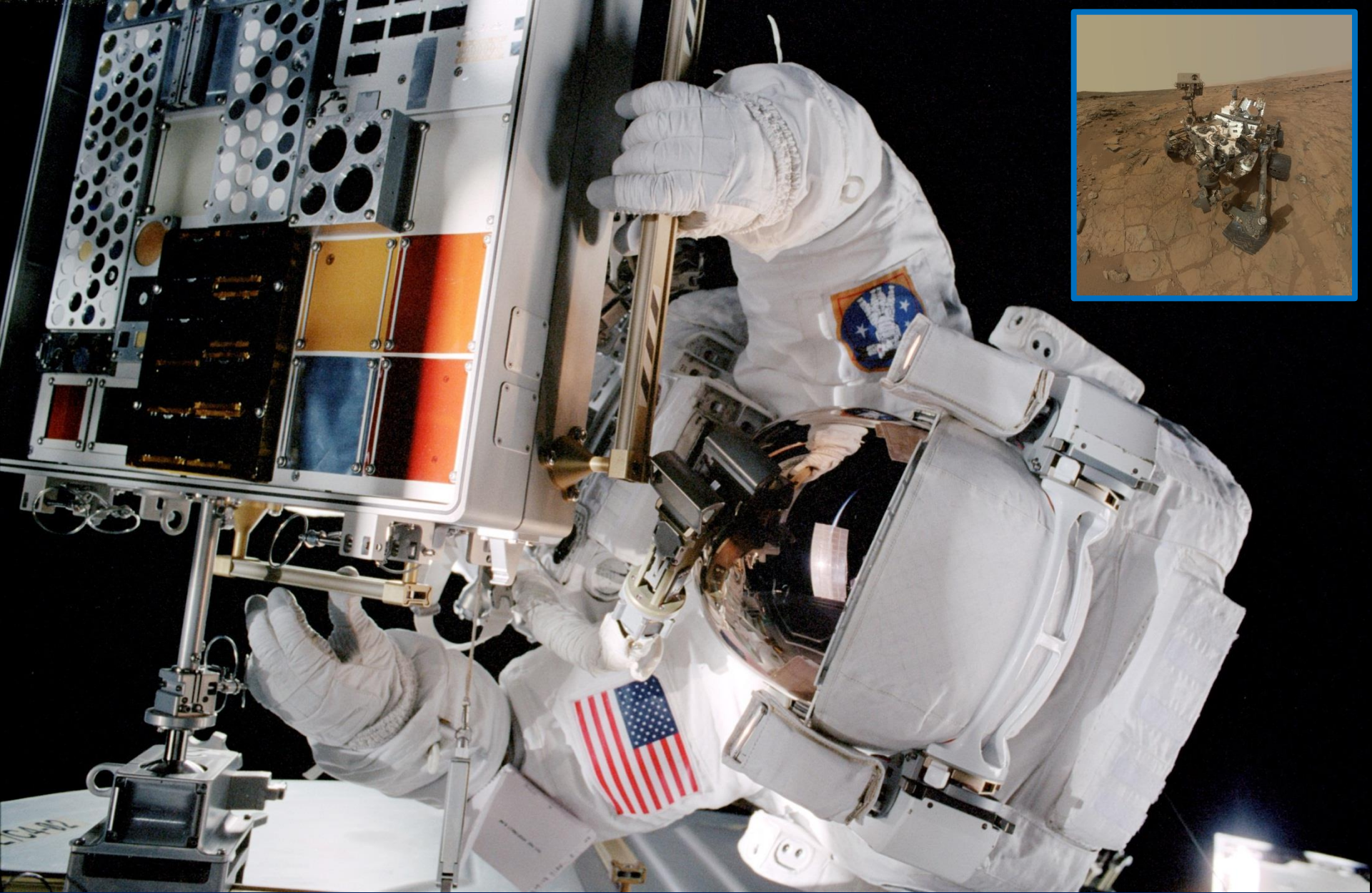
Robotic Surgery - The development of robotic arms for space missions has led to computer-assisted devices specifically designed for neurosurgery.



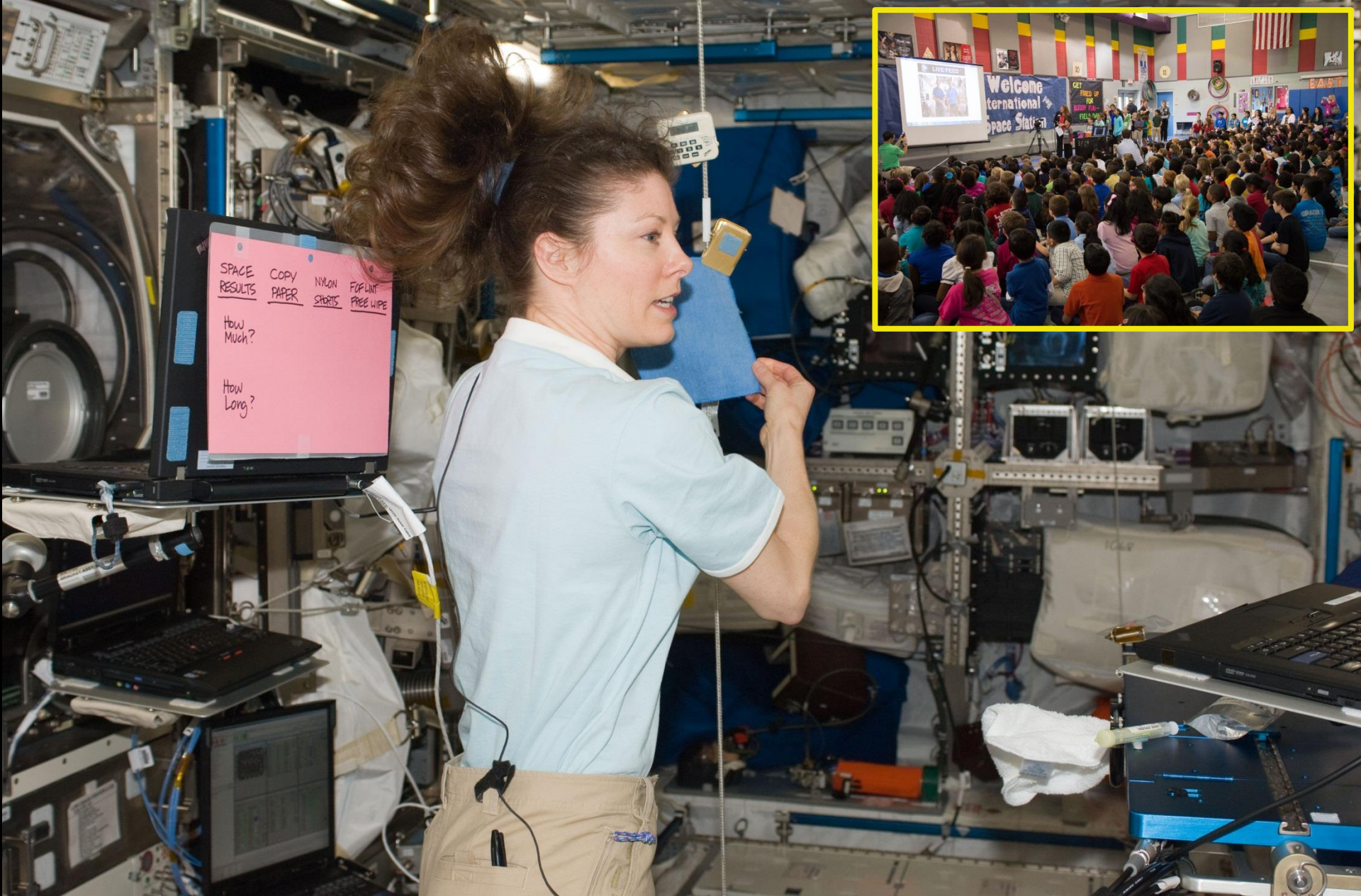
Fluid Behavior - Studies on liquid movement and surface tension are informing better spacecraft tanks and portable medical diagnostics on Earth.



Nanotechnology - Smart fluids change stiffness in response to magnetic fields and are already used in buildings and bridges in earthquake-prone regions.



Materials Testing - An electrically conductive coating was validated outside the space station; it now protects Mars Curiosity's power unit from static electricity.



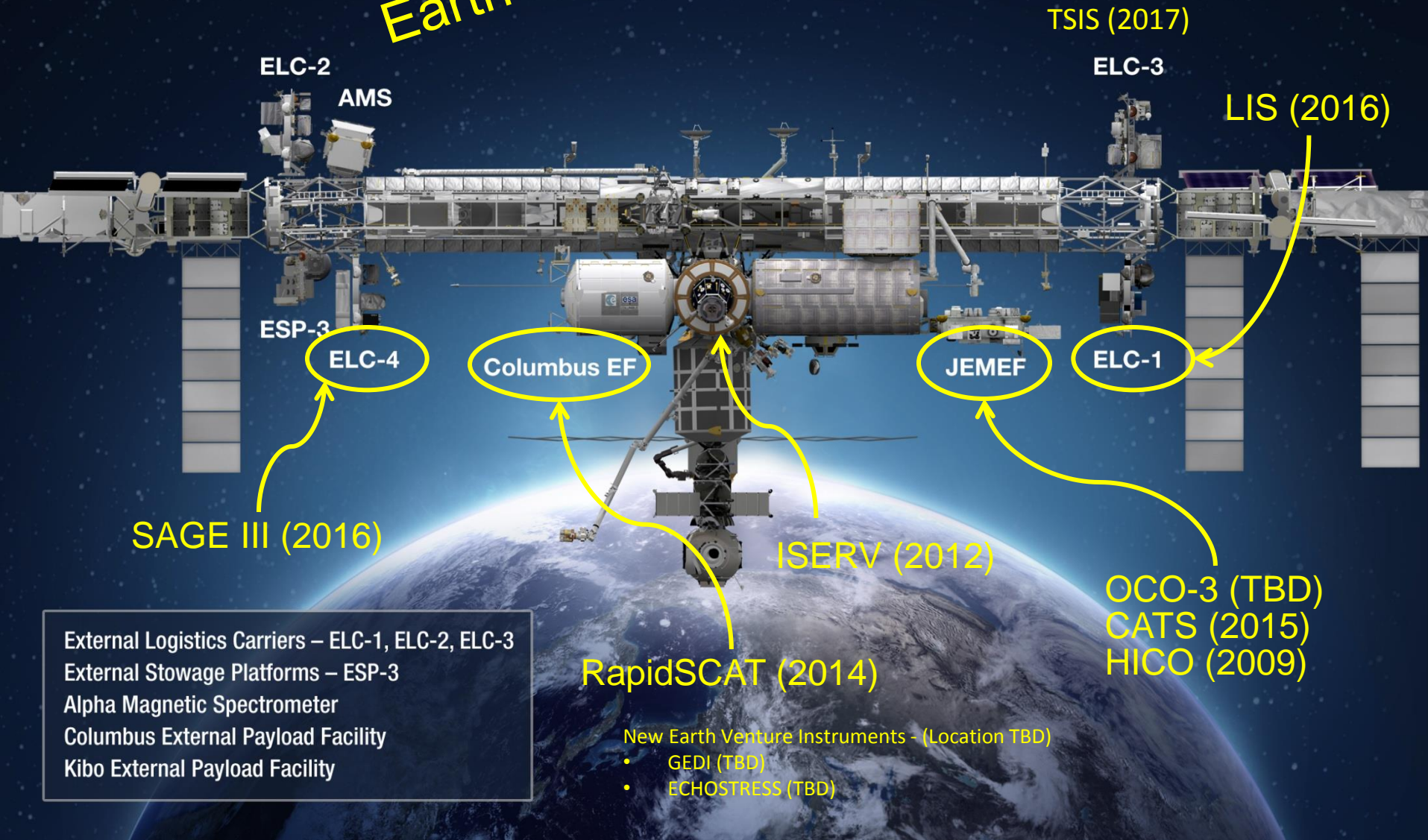
Education - 42 million students and 25,000 schools in 44 countries involved in space station education activities.



Disaster Response Networks - The space station is a unique vantage point for observing the Earth with both hands-on and automated equipment.

International Space Station

Earth Science Instruments



ELC-2

AMS

TSIS (2017)

ELC-3

LIS (2016)

ESP-3

ELC-4

Columbus EF

JEMEF

ELC-1

SAGE III (2016)

ISERV (2012)

OCO-3 (TBD)
CATS (2015)
HICO (2009)

RapidSCAT (2014)

External Logistics Carriers – ELC-1, ELC-2, ELC-3
External Stowage Platforms – ESP-3
Alpha Magnetic Spectrometer
Columbus External Payload Facility
Kibo External Payload Facility

New Earth Venture Instruments - (Location TBD)

- GEDI (TBD)
- ECHOSTRESS (TBD)

ISS Research Highlights: Increment 40

Examples of New Investigations

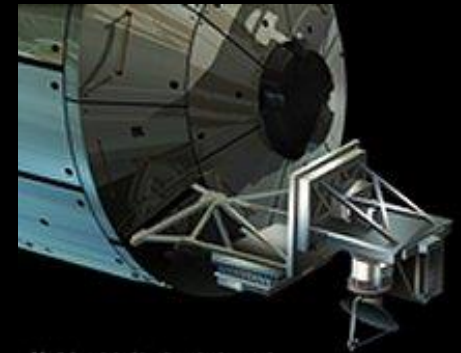
ISS-RapidScat is a scatterometer that will measure near-surface wind speed and direction over the ocean for use in weather forecasting and for monitoring large-scale changes in the Earth's climate.

Data will enhance the international scatterometer constellation, and extend the climate data record initiated by the QuikSCAT satellite.

Because of the unique orbit characteristics of the ISS, RapidSCAT will enable the first measurements of the systematic diurnal changes of winds over the ocean.

Earth Applications: ISS-RapidScat improves observations of wind processes that drive ocean circulation, waves, swell, distribution of nutrients, and severe weather, resulting in improved weather models used to forecast short-term and long-term climatic changes.

Space Applications: Improved understanding of the variability of sea surface winds between day and night could improve climate models and may affect future observation strategies, which in turn may lead to new mission designs. Placing the RapidScat instrument aboard station demonstrates faster space instrument deployment using existing infrastructure, rather than a dedicated satellite.



ISS Research Highlights: Increment 40

Examples of New Investigations

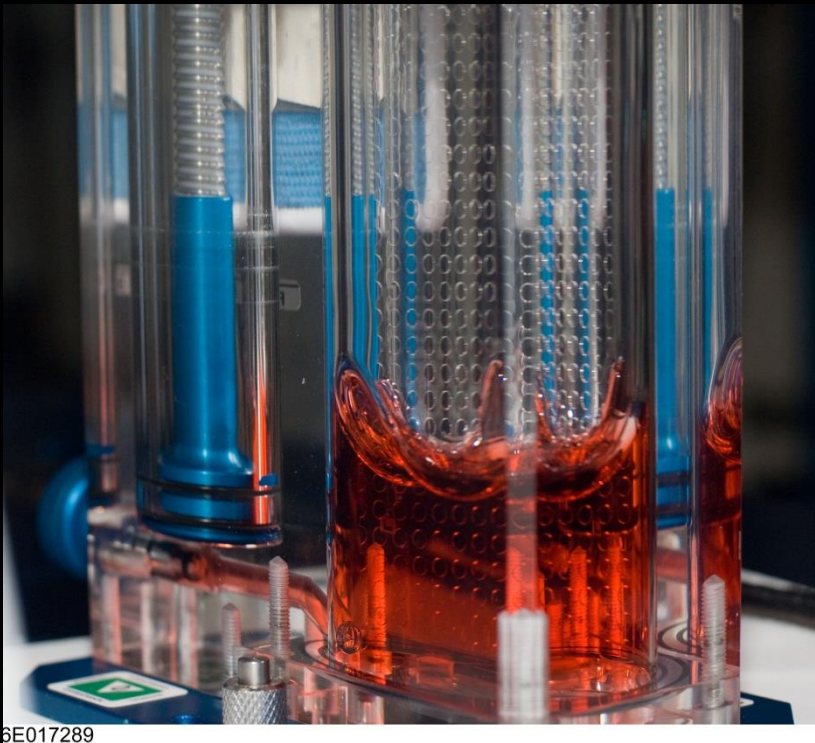
Force Shoes: Engineering evaluation of the XSENS ForceShoe™ system as a potential method to measure exercise loads during ARED sessions on ISS. Up to four astronauts will be recruited to collect a series of static and dynamic load measurements. The measurements will be used to quantify exercise load data for support of current and future human research.



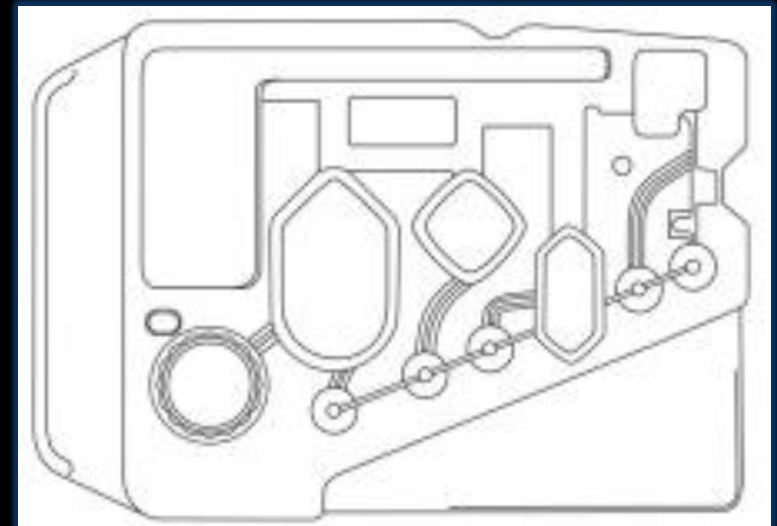
Comm Delay Assessment: Evaluation of the effects of delayed communications for interplanetary crews that have to handle medical and other emergencies in deep space. In addition to time delays, uncertainty in performing a new, crucial task can impact crew performance and interaction. Three crewmembers perform eight tasks, with and without 50-second delays added, that vary in criticality and familiarity.

Latest ISS Research News: Space-tested Fluid Flow Concept Advances Infectious Disease Diagnoses

A new instrument could improve diagnosis of HIV/AIDS in remote areas, thanks in part to knowledge gained from the Capillary Flow Experiments (CFE) on the behavior of liquids.



6E017289



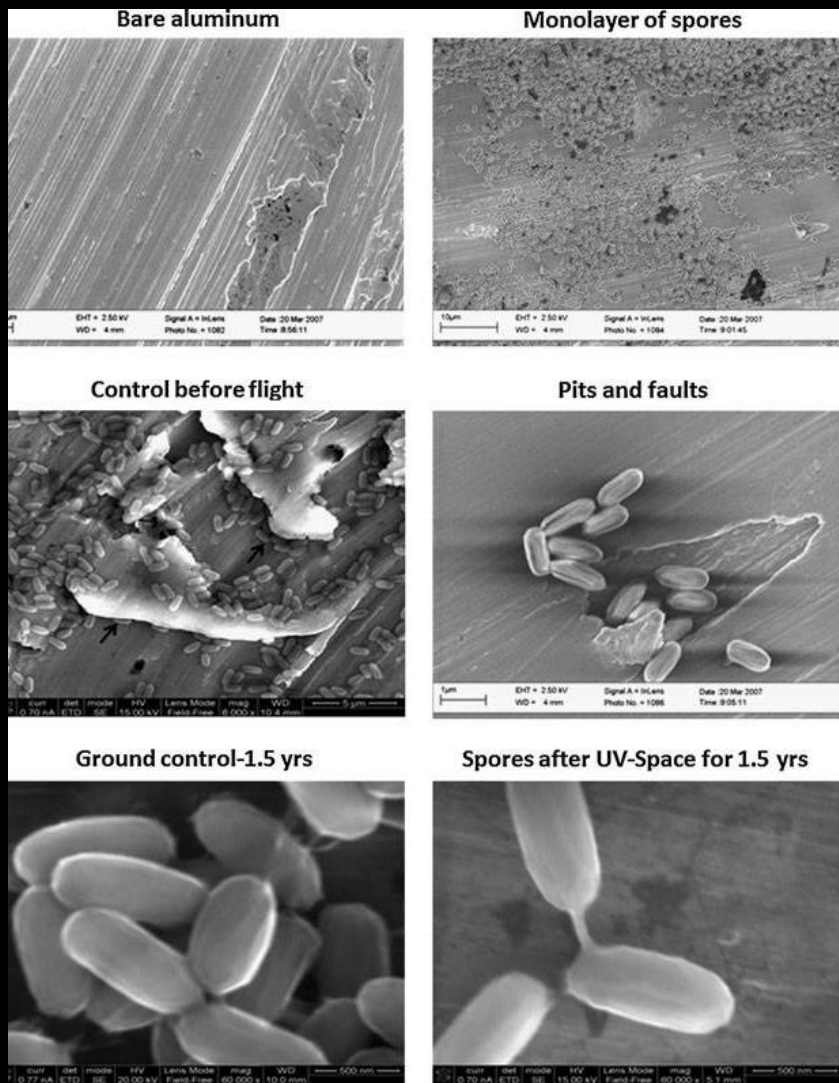
Schematic drawing of the HIV Viral Load testing cartridge. (Northwestern University)

Latest ISS Research News:

Survival of soil bacterial communities and rock-colonizing organisms after 1.5 years in space has implications for planetary protection and interplanetary exchange

Vaishampayan et al Nov 2012. *Astrobiology* (1). Onofri et al. Nov 2012. *Astrobiology* (2). Horneck et al. Nov 2012 *Astrobiology* (3).

High Mountain Lichen In natural rock habitat



Latest ISS Research News:

Gaining insight into the history and future of our universe

MAXI and SWIFT have gathered data that provides new evidence (via X-ray data from ignition of a nova¹ and behavior of a nearby Gamma Ray Burst of a nearby massive star collapse²) about the history, future, and expansion of our universe.

1) *Astrophysical Journal*, Nov 2013

2) *Science*, Jan 2014



This artist rendering shows the binary system of MAXI J0158-744, consisting of a white dwarf (left) and a Be star (right) (1).

Image Credit: Takuya Ohkawa



The Small Magellanic Cloud galaxy, pictured here, is a close neighbor of the Milky Way and the location of the MAXI J0158-744 ignition event (2).

Image Credit: Stéphane Guisard

HUMAN EXPLORATION

NASA's Path to Mars



EARTH RELIANT

MISSION: 6 TO 12 MONTHS
RETURN TO EARTH: HOURS



Mastering fundamentals
aboard the International
Space Station

U.S. companies
provide access to
low-Earth orbit

PROVING GROUND

MISSION: 1 TO 12 MONTHS
RETURN TO EARTH: DAYS

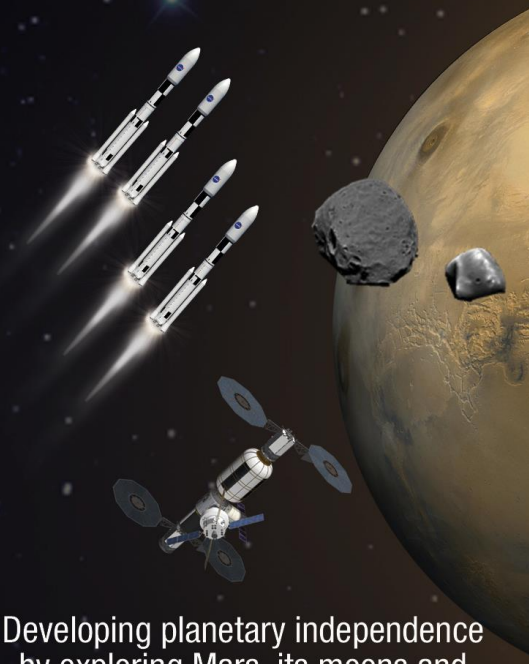


Expanding capabilities by
visiting an asteroid redirected
to a lunar distant retrograde orbit

The next step: traveling beyond low-Earth
orbit with the Space Launch System
rocket and Orion spacecraft

MARS READY

MISSION: 2 TO 3 YEARS
RETURN TO EARTH: MONTHS



Developing planetary independence
by exploring Mars, its moons and
other deep space destinations



ORION



Space Launch System

21st Century Launch Operations



Orion Flight Manifest

FY
13

FY
14

FY
15

FY
16

FY
17

FY
18

FY
19

FY
20

FY
21

FY
22



EFT-1
2014



EM-1
2017
Uncrewed



AA2
2018



EM-2
2021
Crewed

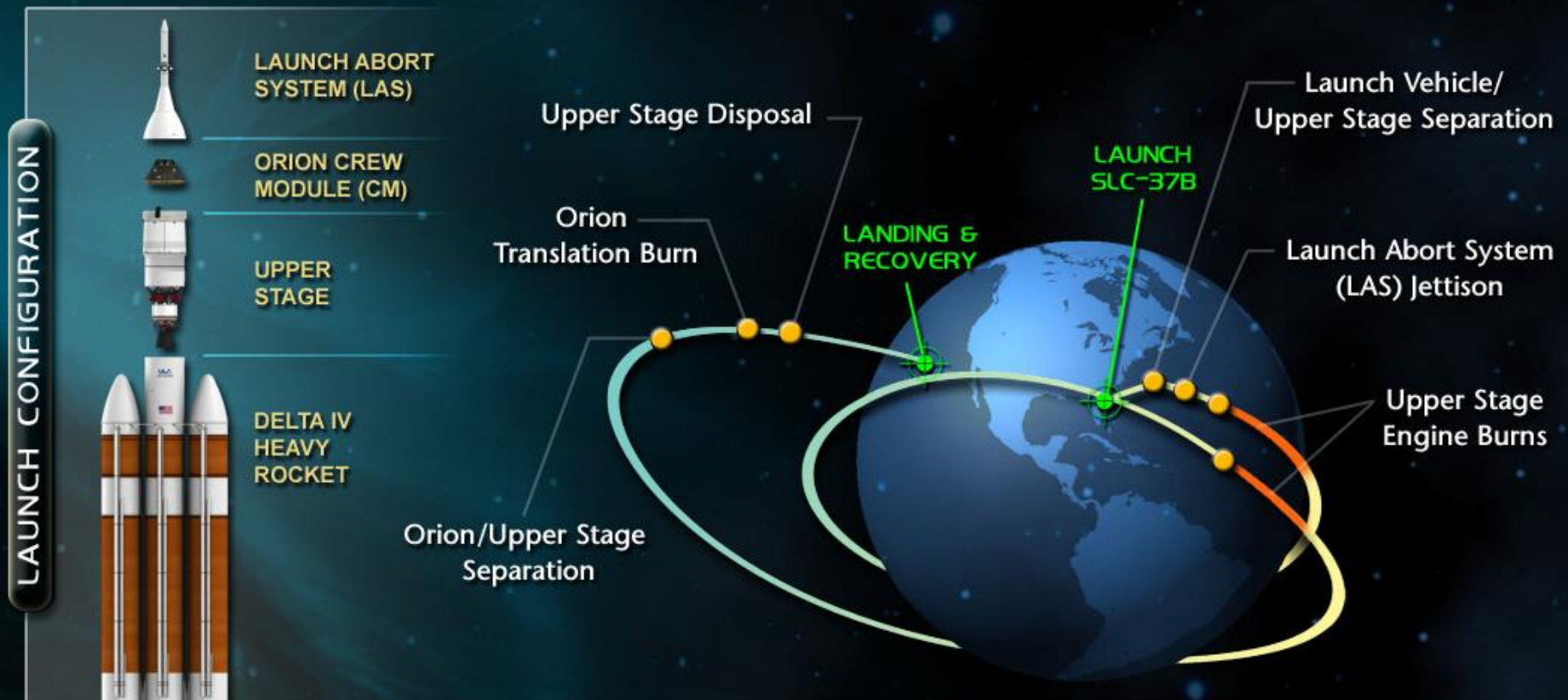


Exploration Flight Test 1 - 2014

EXPLORATION FLIGHT TEST ONE

OVERVIEW

TWO ORBITS • 20,000 MPH ENTRY • 3,671 MILE APOGEE • 28.6 DEGREE INCLINATION



CREW AND SERVICE MODULE

SERVICE MODULE

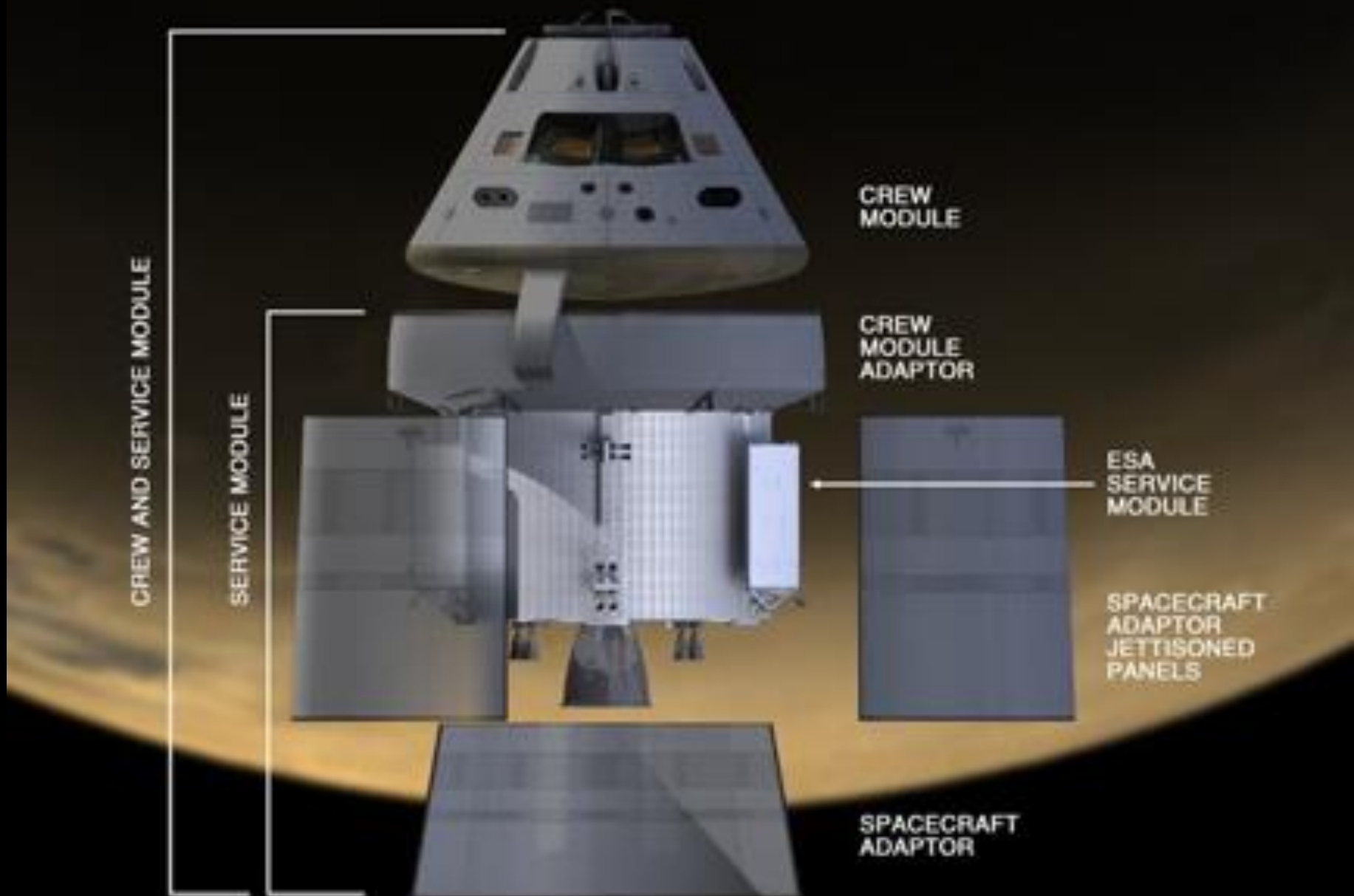
CREW
MODULE

CREW
MODULE
ADAPTOR

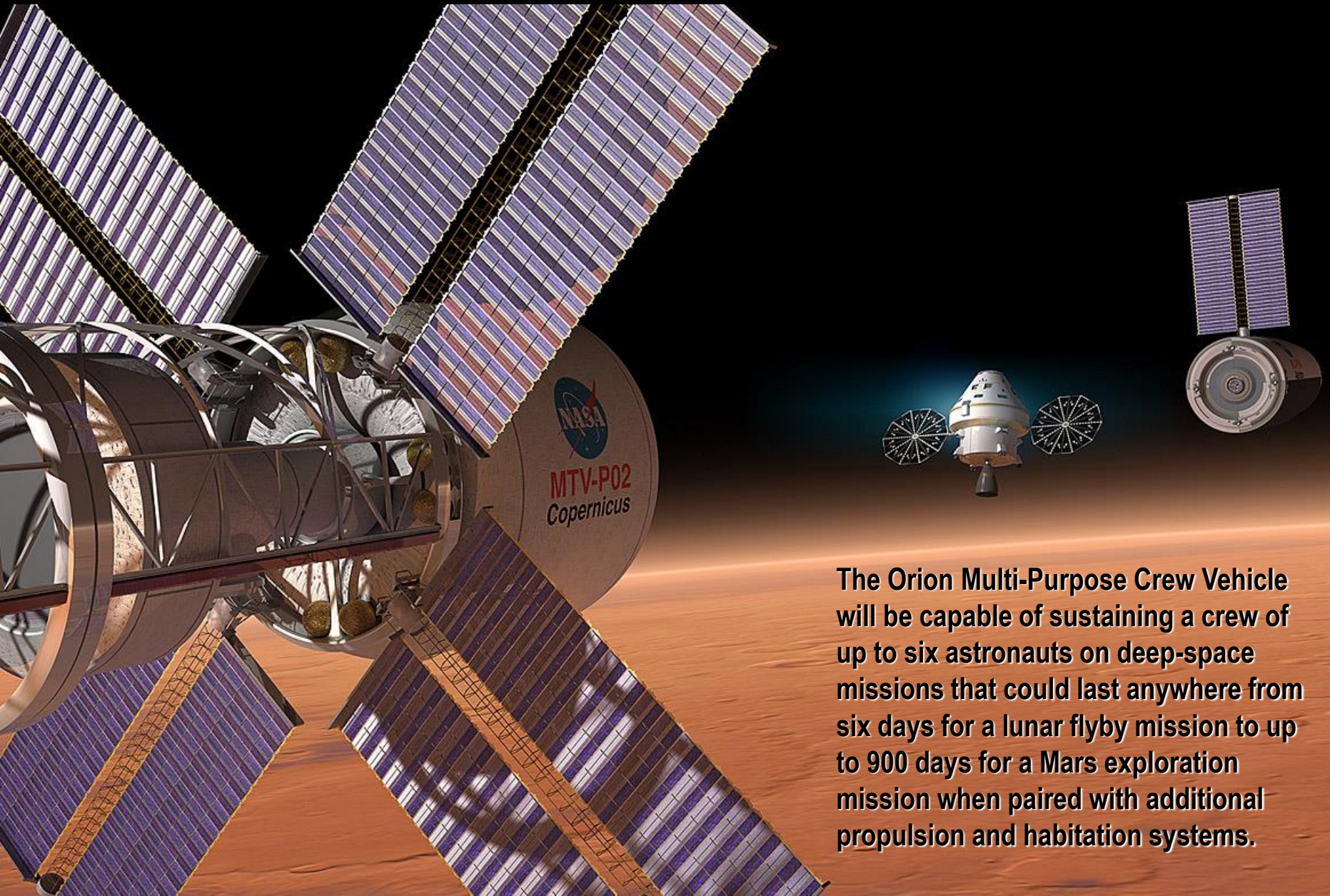
ESA
SERVICE
MODULE

SPACECRAFT
ADAPTOR
JETTISONED
PANELS

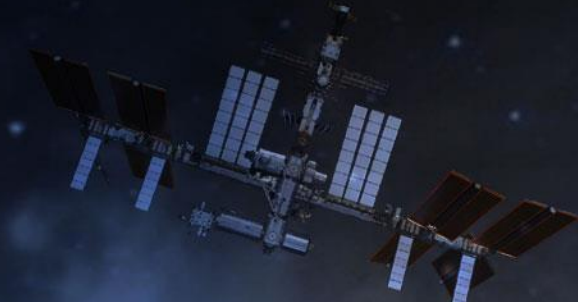
SPACECRAFT
ADAPTOR



Deep Space Exploration Vehicle



The Orion Multi-Purpose Crew Vehicle will be capable of sustaining a crew of up to six astronauts on deep-space missions that could last anywhere from six days for a lunar flyby mission to up to 900 days for a Mars exploration mission when paired with additional propulsion and habitation systems.



International Human Spaceflight Program Update- USA

Mike Fincke
NASA Astronaut

