U.S. Research & Technology Development on the International Space Station

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UN Expert Meeting
Human Space Technology, Malaya
November 2011
International Space Station

Created by a partnership of 5 space agencies representing 15 countries

10 years and over 30 missions to assemble
International Space Station Unique Features

• Continuous access to a sustainable microgravity platform
• Access to the ultra high vacuum of space
• Continuous presence in space
• Continuous 30kw steady state power for payloads at a unique altitude
• Continuous human presence and payload to orbit and return capability
International Space Station Key Features

- Supports both external and internal research
- Automated, human, and robotic operated research
- Exposure to the thermosphere
- Nearly continuous data and communication link to anywhere in the world
- Modularity and maintainability built into the design ensures mission life, allows life extension, vehicle evolution and technology upgrades
Why Microgravity Research?

- Gravity is a constant force on Earth
- It cannot be completely controlled or removed in experiments
- It dominates and masks other forces in processes
- The ISS provides a laboratory environment to control this force

A candle flame in Earth's gravity (left) and microgravity (right) showing the difference in the processes of combustion in microgravity
Disciplines that use the Laboratory

• Biology & Biotechnology
• Human Physiology & Performance
• Physical Sciences
• Technology Development & Demonstration
• Earth and Space Science
• Education
International Space Station Facts

Spacecraft Mass: +800,000 lb (+362,874 kg)
Velocity: 17,500 mph (28,200 kph)
Altitude: 220 miles above Earth
Power: 80 kW continuous
An international fleet of space vehicles that delivers propellant, supplies and replenishes science experiments.
ISS Cargo Vehicles

ATV (ESA)  Cargo Capacity  5,500 kg

Cygnus (Orbital)  Cargo Capacity  2,000 kg

HTV (JAXA)  Cargo Capacity  5,500 kg

Progress  Cargo Capacity  2,250 kg

Dragon (SpaceX)  Cargo Capacity  3,100 kg ascent
Crew/Cargo Launch with Capability

**Soyuz**
Cargo Capacity
3 crew
170 kg ascent

**Dragon (SpaceX)**
Cargo Capacity
2,500 kg descent
Research Resources on ISS

NASA Research
- Space Operations
- Exploration Systems
- Science Mission
- Office of Chief Technologist

US National Laboratory
- Commercial Sector
- Non-profit organizations
- U.S. Government Agencies

International Partner Research

Russian Research

Biology and Biotechnology, Earth and Space Science, Educational Activities, Human Research, Physical & Material Sciences, Technology Demonstration
ISS Research Planned Research
(Expeditions 27/28, April 2011 – October 2011, data as of January 31, 2011)

- Expeditions 27/28
  - 96 U.S.O.S.-integrated investigations
    - 15 new investigations
    - 39 International Partner investigations
    - 19 National Lab investigations
  - > 300 scientists

Number of Investigations, Expeditions 27/28

Scientific Disciplines
- Human Research
- Physical Sciences
- Earth and Space Science
- Technology
- Biology and Biotechnology
- Education

- NASA, 57
- JAXA, 20
- ESA, 16
- CSA, 3

- 13 new investigations
- 39 International Partner investigations
- 19 National Lab investigations
- > 300 scientists
Microbial Vaccine Development

Human Health

Top image credit: Pacific Northwest National Laboratory
Bottom image credit: Rocky Mountain Laboratories
Source: ISS Program Scientist, NASA
Insight into Immune Function - Human T-Lymphocytes

Source: ISS Program Scientist, NASA
Mitigating Bone Loss

Phase 1 studies (~11 major publications)

Phase 2 studies

Source: ISS Program Scientist, NASA
Space Materials Technology

Physical Science

Source: ISS Program Scientist, NASA
Earth Observations - Climate change, and dynamic events

Earth Science

Source: ISS Program Scientist, NASA
X-ray Monitoring - JAXA  MAXI data combined with SWIFT data for first observation of a relativistic x-ray burst from a supermassive black hole destroying a star.

Source:  Goddard Simulation of the Event, JAXA/Rikken, ISS Program Scientist, NASA

Space Science


Source:  Goddard Simulation of the Event, JAXA/Rikken, ISS Program Scientist, NASA
Search for Origins of the Universe - The Alpha Magnetic Spectrometer (AMS-02)

Source: ISS Program Scientist, NASA
Multi-body Maneuvering in Space - Spheres

Space Science

Source: ISS Program Scientist, NASA
Robotic Refueling Mission (RRM) is an external *International Space Station* experiment that paves the way for future robotic refueling missions. It demonstrates robotic refueling tasks and servicing technologies in a zero-g environment. It uses of the ISS Special Purpose Dexterous Manipulator (also known as “Dextre”) to validate tasks, tools, and techniques needed to repair “legacy” satellites not designed to be refueled in orbit. Robotic refueling extends the lifetime of satellites, allowing owners and operators to gain additional years of use from assets already operating in space.

Source: ISS Program Scientist, NASA
ISS Research & Technology
http://www.nasa.gov/iss-science/

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ISS Research Blog “A Lab Aloft”
http://go.usa.gov/atl