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

Julie A. Robinson, Ph.D.,
ISS Program Scientist, NASA
UN Expert Meeting
Human Space Technology, Malays
November 2011

International Space Station

Created by a partnership of 5 space agencies representing 15 countries

10 years and over 30 missions to assemble

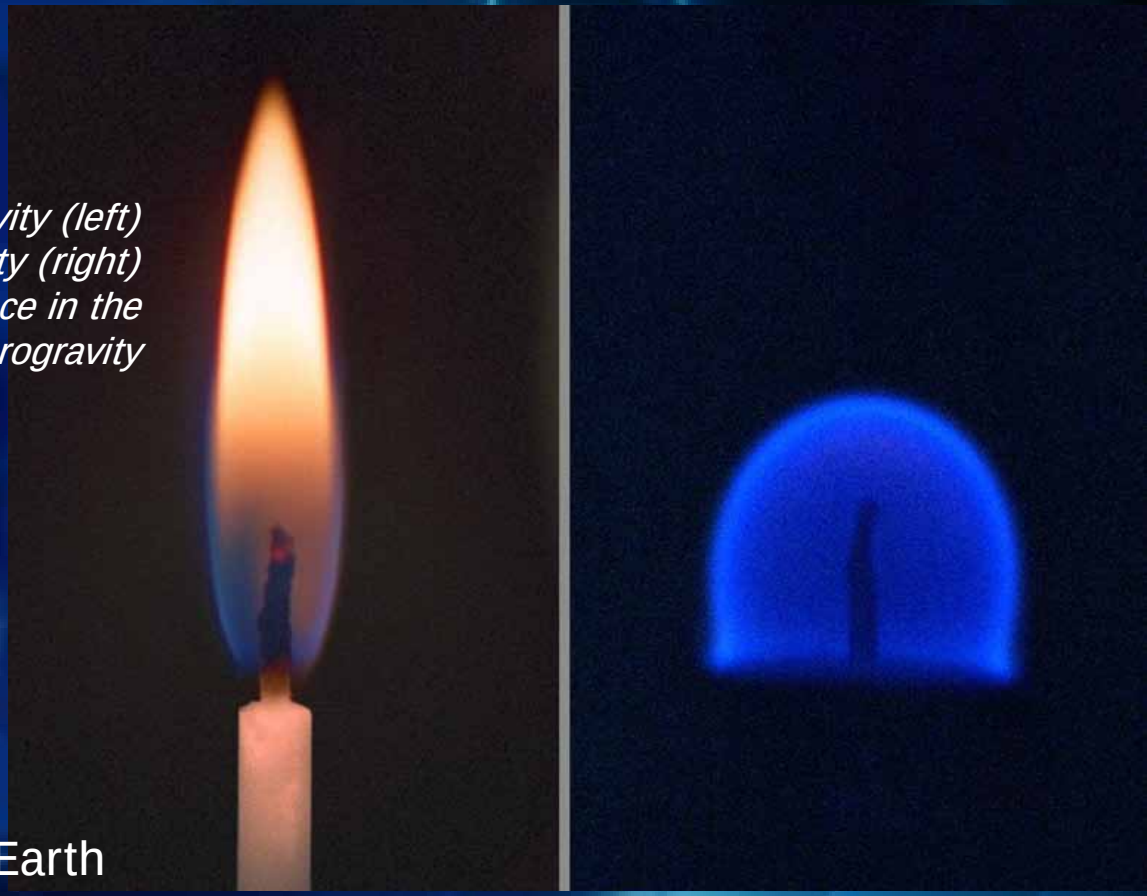
International Space Station Unique Features

- 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?



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

- 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

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

Cargo Capability

Proton
Progress

Ariane 5
ATV

HII
HTV

Falcon 9
Dragon

Taurus II
Cygnus

ROSCOSMOS

esa

JAXA

SpaceX

Orbital

An International fleet of space vehicles that delivers propellant, supplies and replenishes science experiments

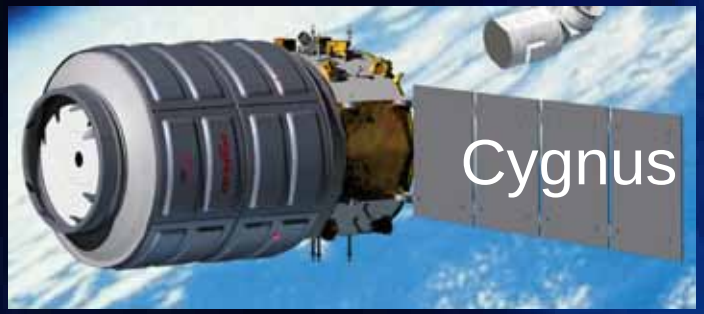
ISS Cargo Vehicles

Progress

Cargo Capacity
2,250 kg

ATV (ESA)

Cargo Capacity
5,500 kg

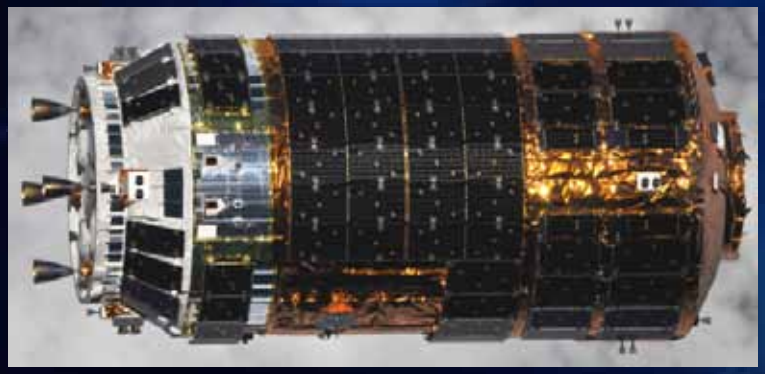


Cygnus (Orbital)

Cargo Capacity
2,000 kg

Dragon (SpaceX)

Cargo Capacity
3,100 kg ascent



HTV (JAXA)

Cargo Capacity
5,500 kg

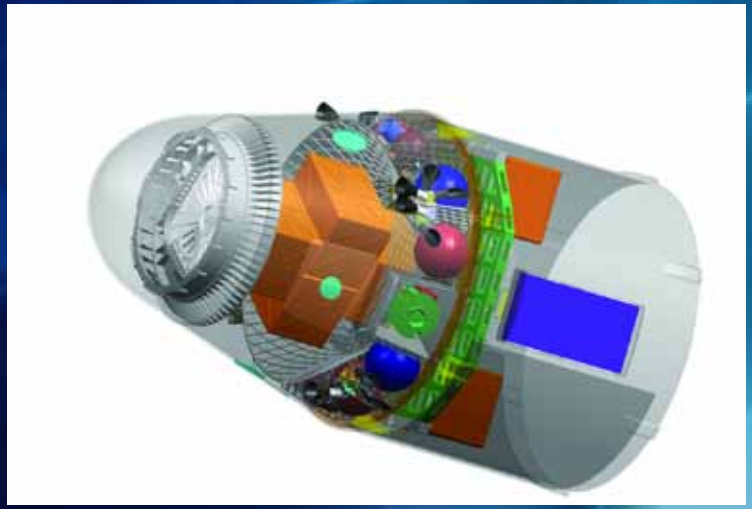
Crew/Cargo Launch with Capability

Soyuz

Cargo Capacity
3 crew
170 kg ascent

Soyuz

3 crew
Cargo Capacity 50 kg descent



Dragon (SpaceX)

Cargo Capacity
2,500 kg descent

Research Resources on ISS

Biology and Biotechnology, Earth and Space Science, Educational Activities, Human Research, Physical & Material Sciences, Technology Demonstration

NASA Research Infrastructure

2 Human Research Facility Racks

6 ExPRESS Racks

Materials Science Research Rack

Fluids Integrated Rack (FIR)

Combustion Integrated Rack (CIR)

Window Observational Research Facility

Muscle Atrophy Research Exercise System (MARES)

MELFI-3

ExPRESS-7 and 8

Added for ISS National Lab

Microgravity Science Glovebox (MSG)

2 Minus Eighty-Degree Laboratory Freezers for ISS (MELFI)

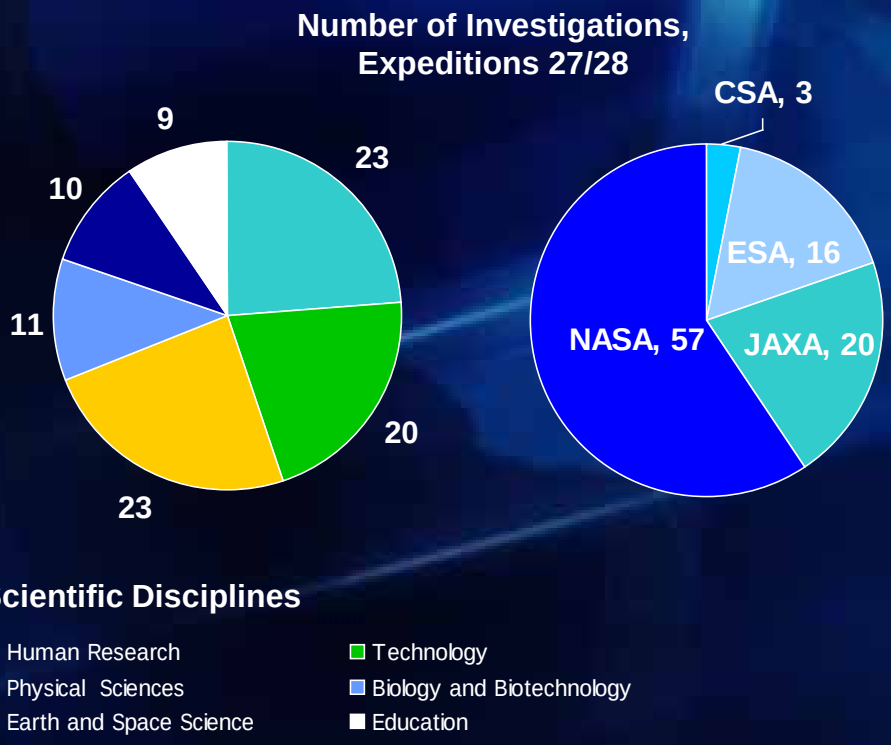
2001-2010

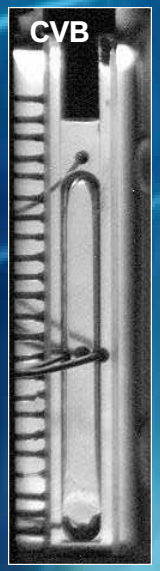
Source: ISS Program Scientist

ISS Research Planned Research

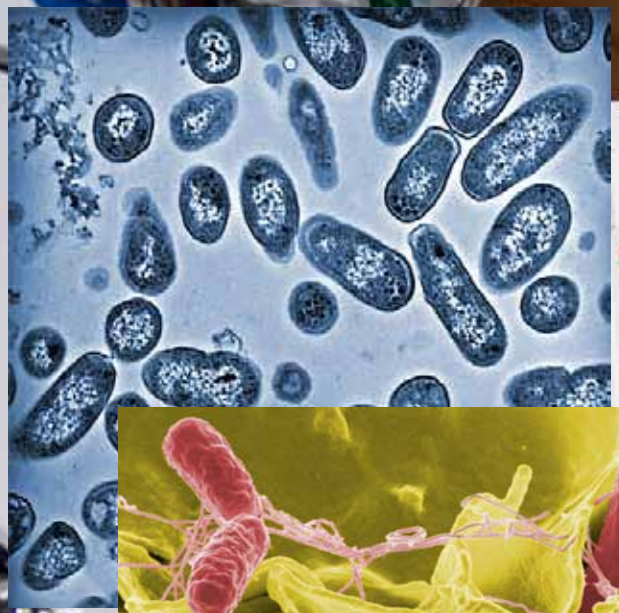
(Expeditions 27/28 , April 2011 – October 2011, data as of January 31, 2011)

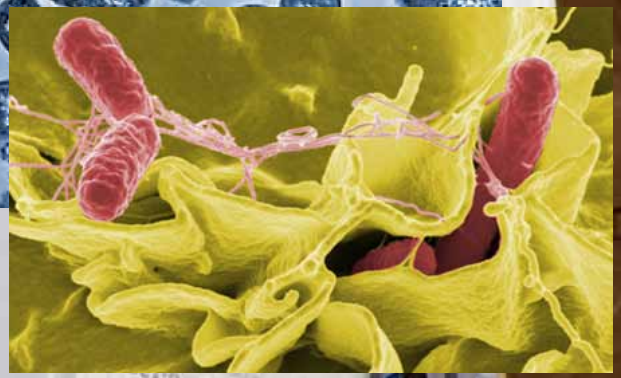
- Expeditions 27/28
  - 96 U.S.O.S.-integrated investigations
    - 15 new investigations
    - 39 International Partner investigations
    - 19 National Lab investigations
  - > 300 scientists





Human Health





Microbial Vaccine Development

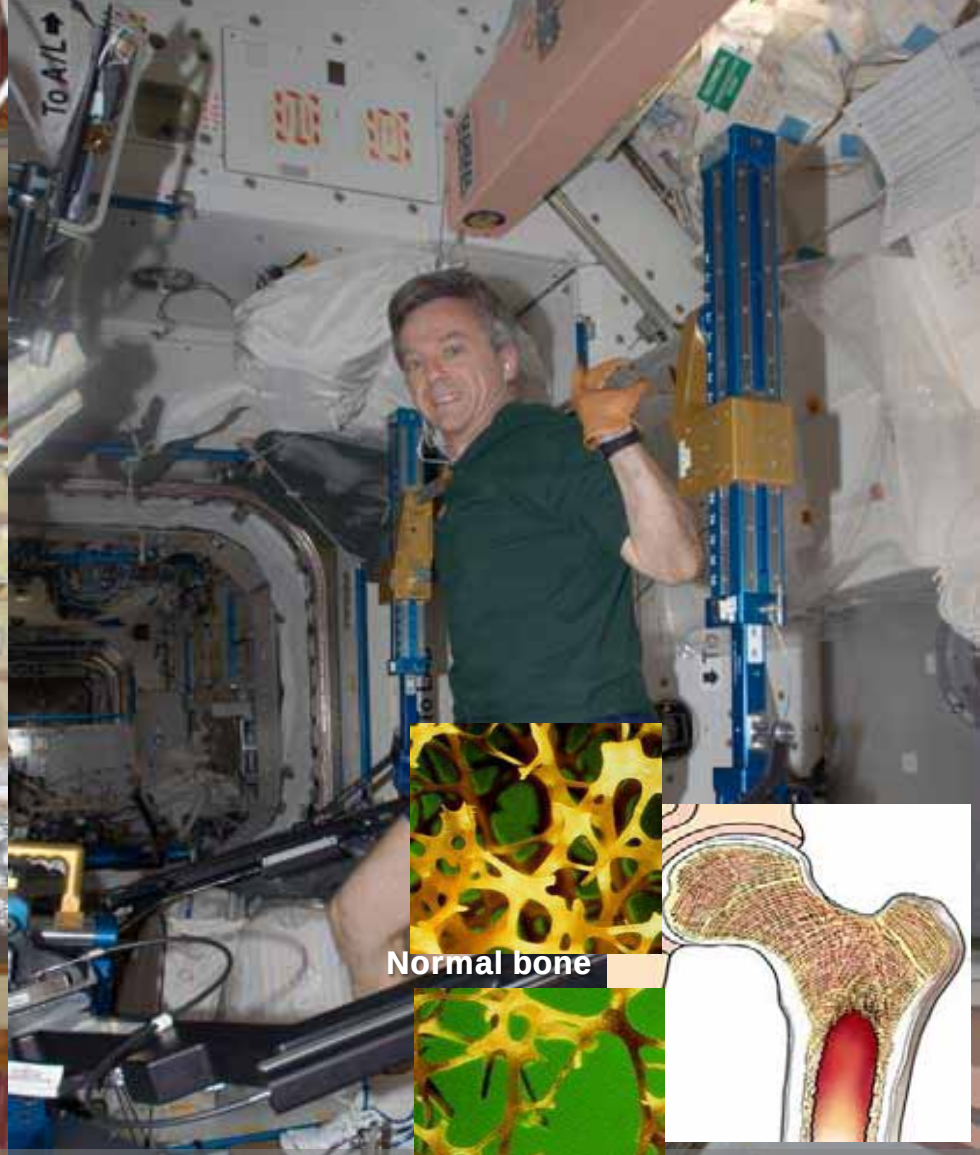
Top image credit: Pacific Northwest National Laboratory

Bottom image credit: Rocky Mountain Laboratories

Source: ISS Program Scientist, NASA

Insight into Immune Function– Human T-Lymphocyte s

Source: ISS Program Scientist, NASA



Normal bone

Osteoporitic bone

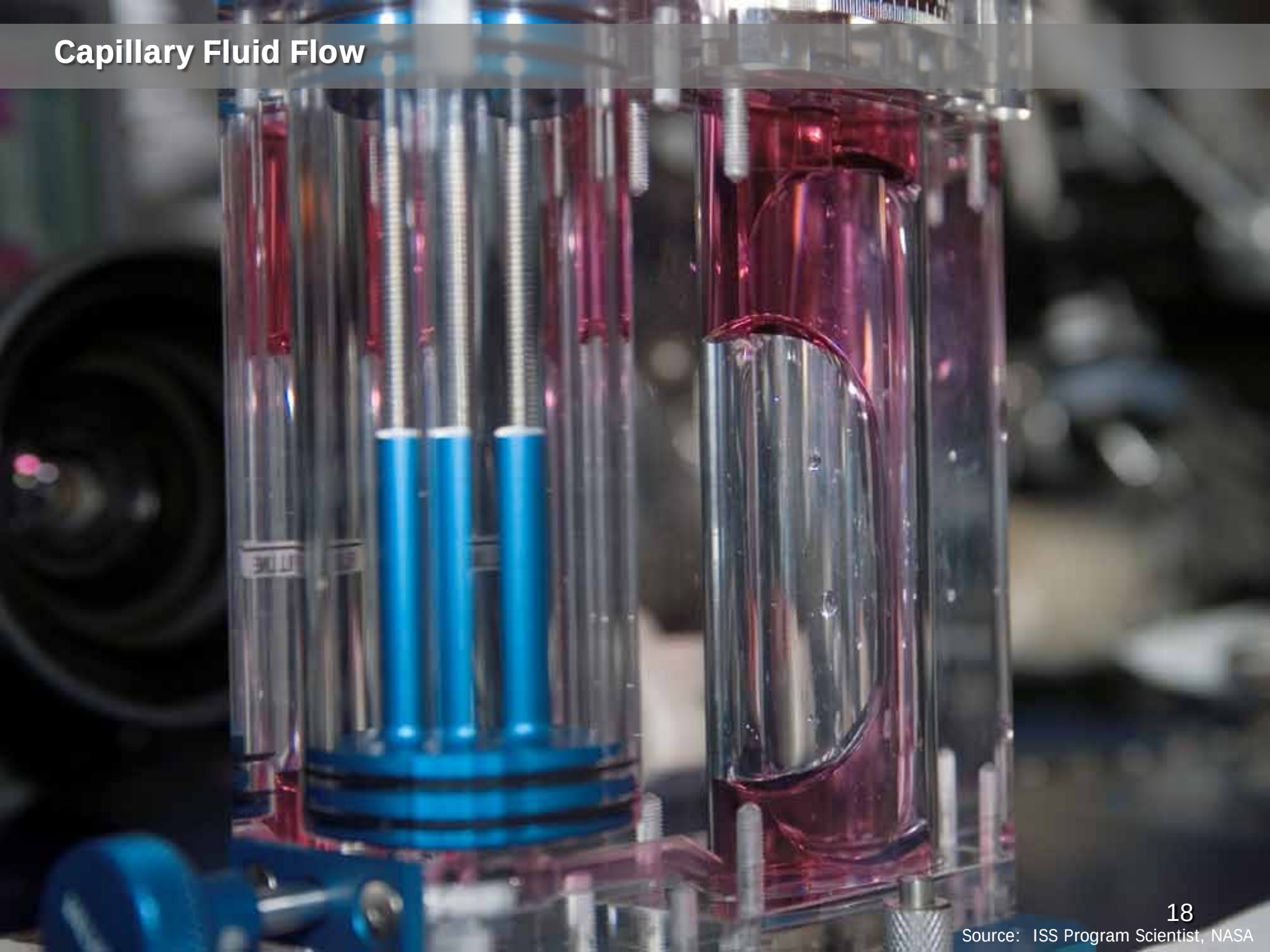
Mitigating Bone Loss
Phase 1 studies (~ 11 major publications)
Phase 2 studies

Source: ISS Program Scientist, NASA

Physical Science

Source: ISS Program Scientist, NASA

Capillary Fluid Flow



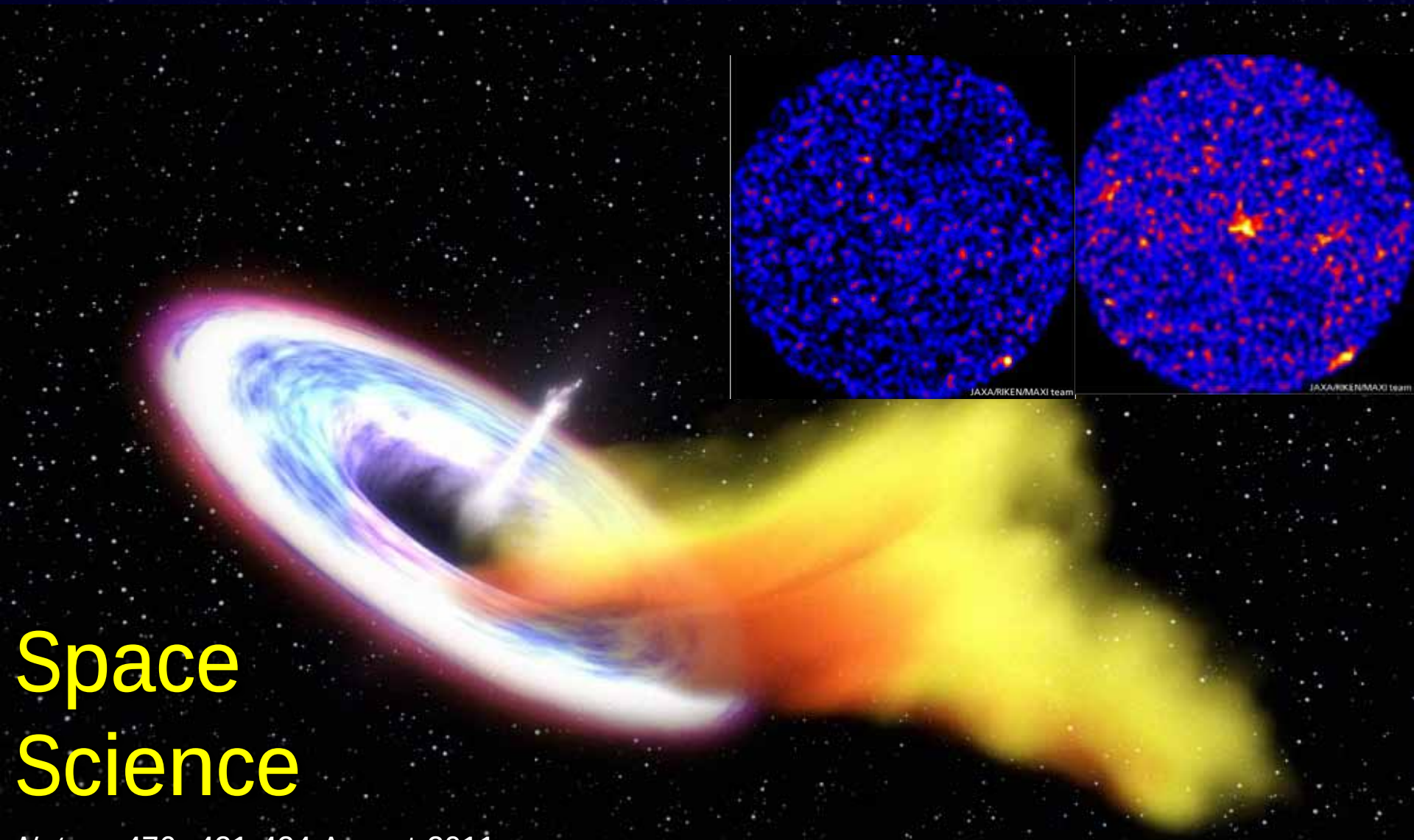
Source: ISS Program Scientist, NASA

Earth Observations – Climate change, and dynamic events

ISS015E10125

Source: ISS Program Scientist, NASA

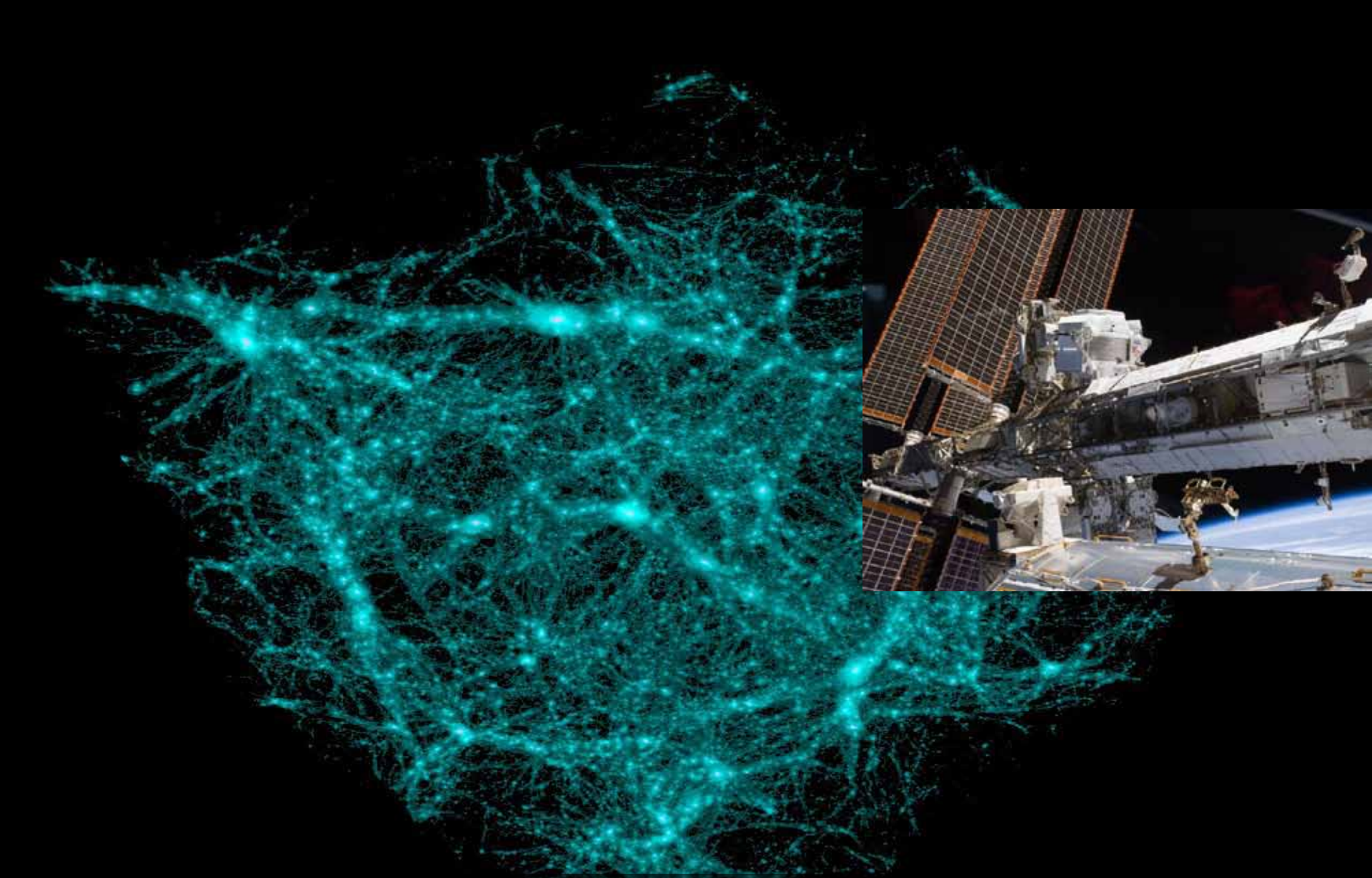
X-ray Monitoring – JAXA MAXI data combined with SWIFT data for first observation of a relativistic x-ray burst from a supermassive black hole destroying a star.



Space Science

Nature, 476: 421-424 August 2011

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



Search for Origins of the Universe - The Alpha Magnetic Spectrometer (AMS-02)

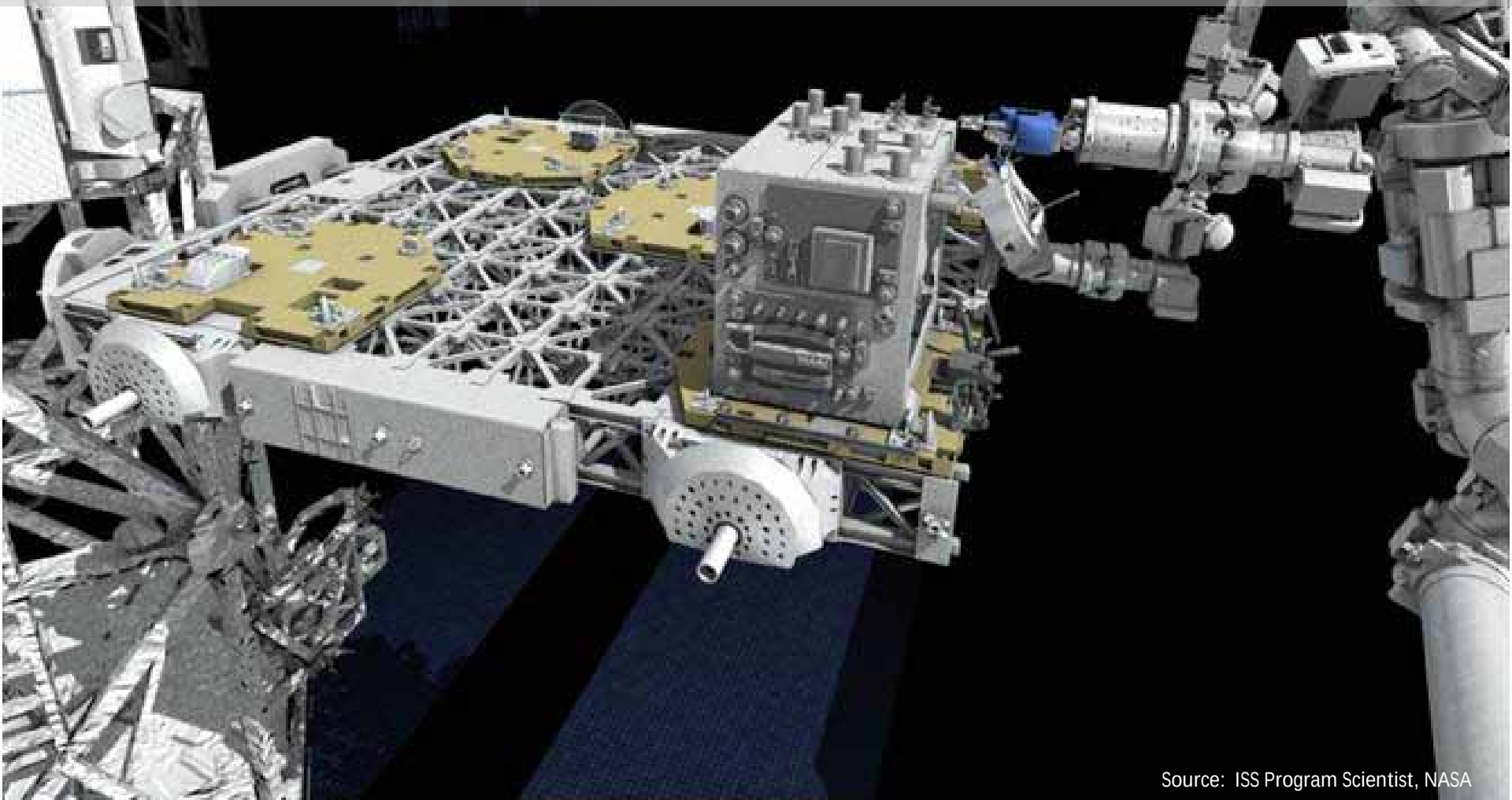
Source: ISS Program Scientist, NASA

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/

@ISS_Research

ISS Research Blog “A Lab Aloft”

http://go.usa.gov/atI