



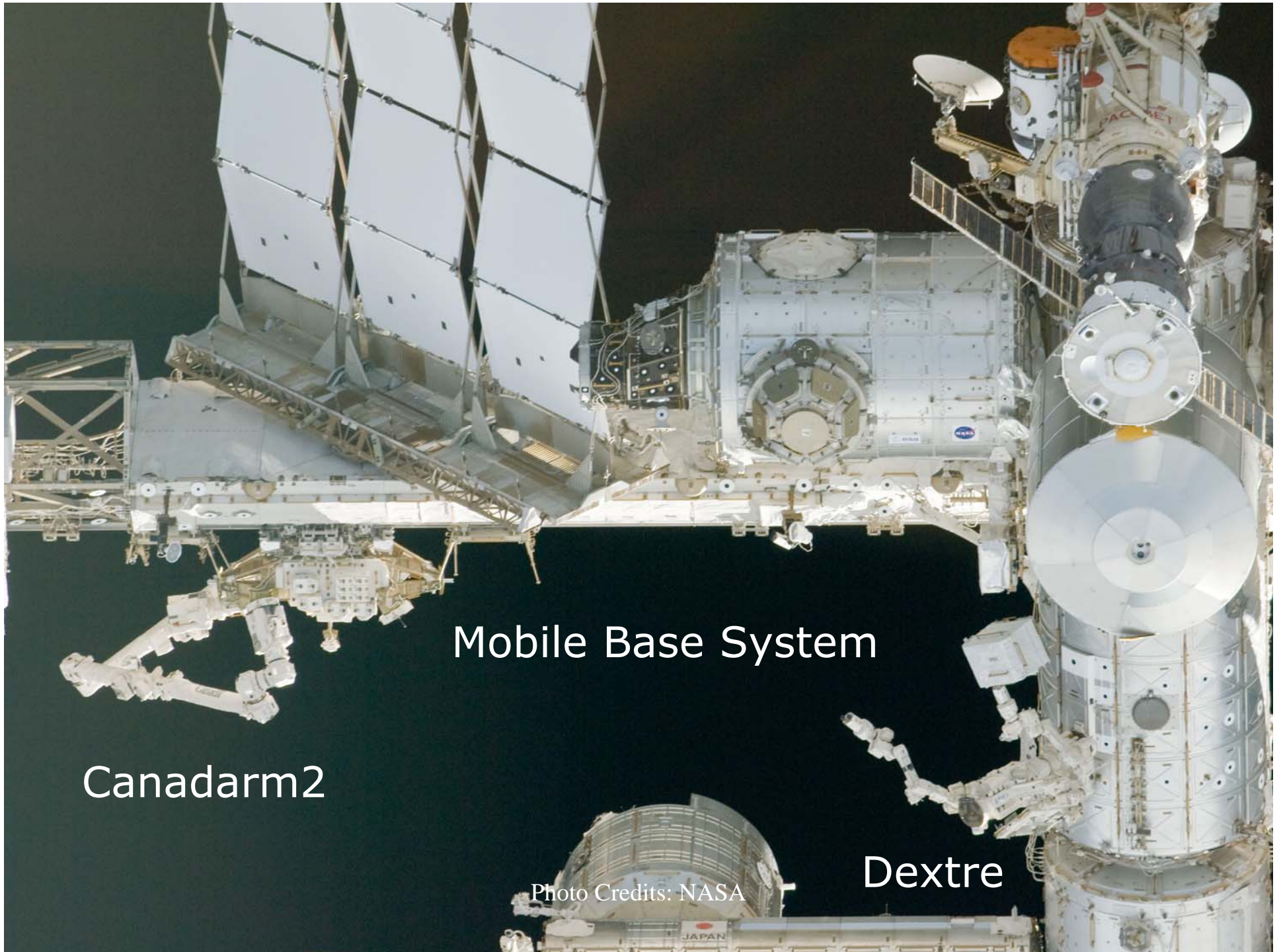
Canada's Contribution to the International Space Station

Nicole Buckley
November 15, 2011

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Mobile Base System

Canadarm2

Dextre

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Canadarm2 - April 2001



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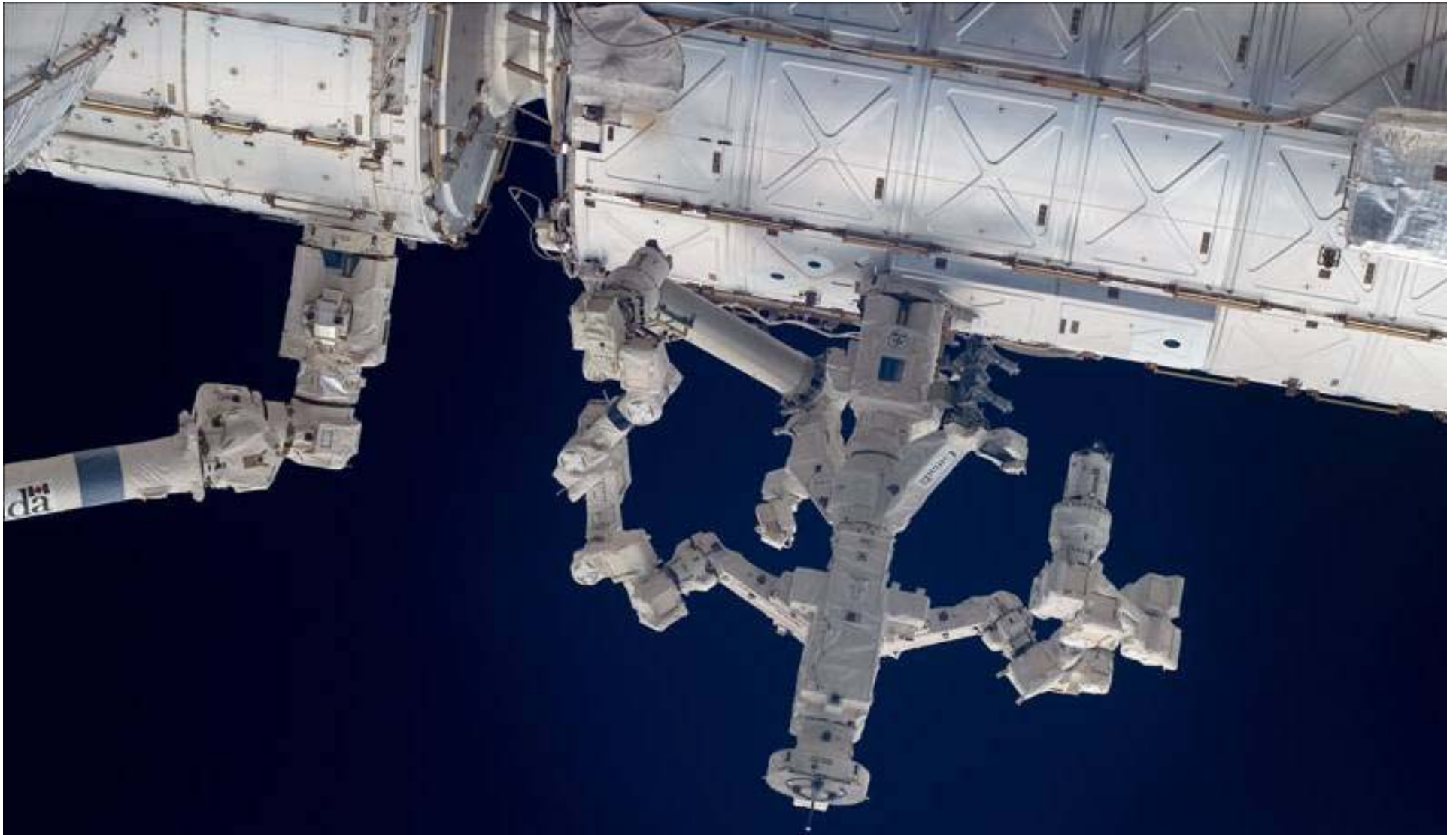
Mobile Base System - June 2002



13 October 2011

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Special Purpose Dexterous Manipulator "Dextre" March 2008

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ISS Assembly Tasks

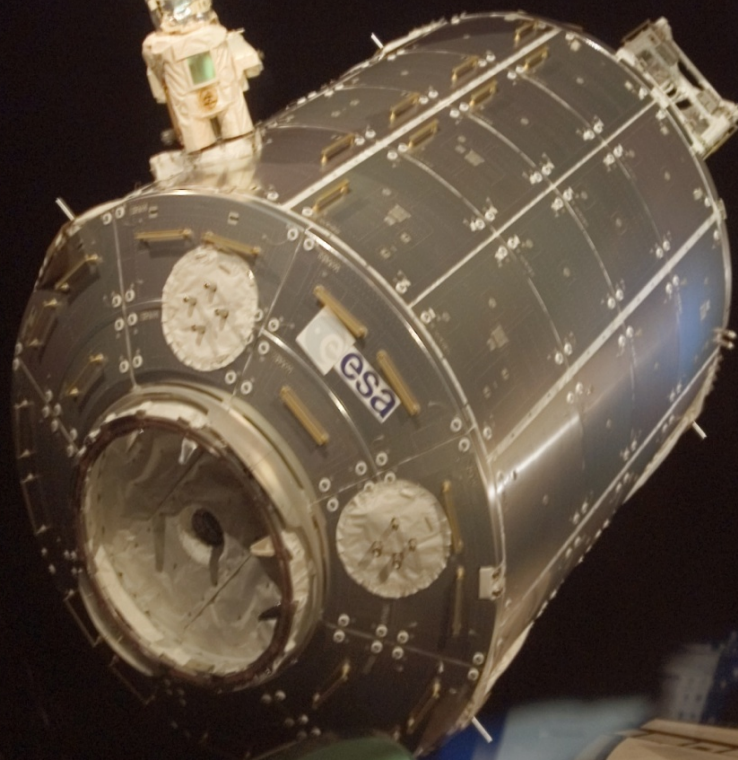


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EVA Support

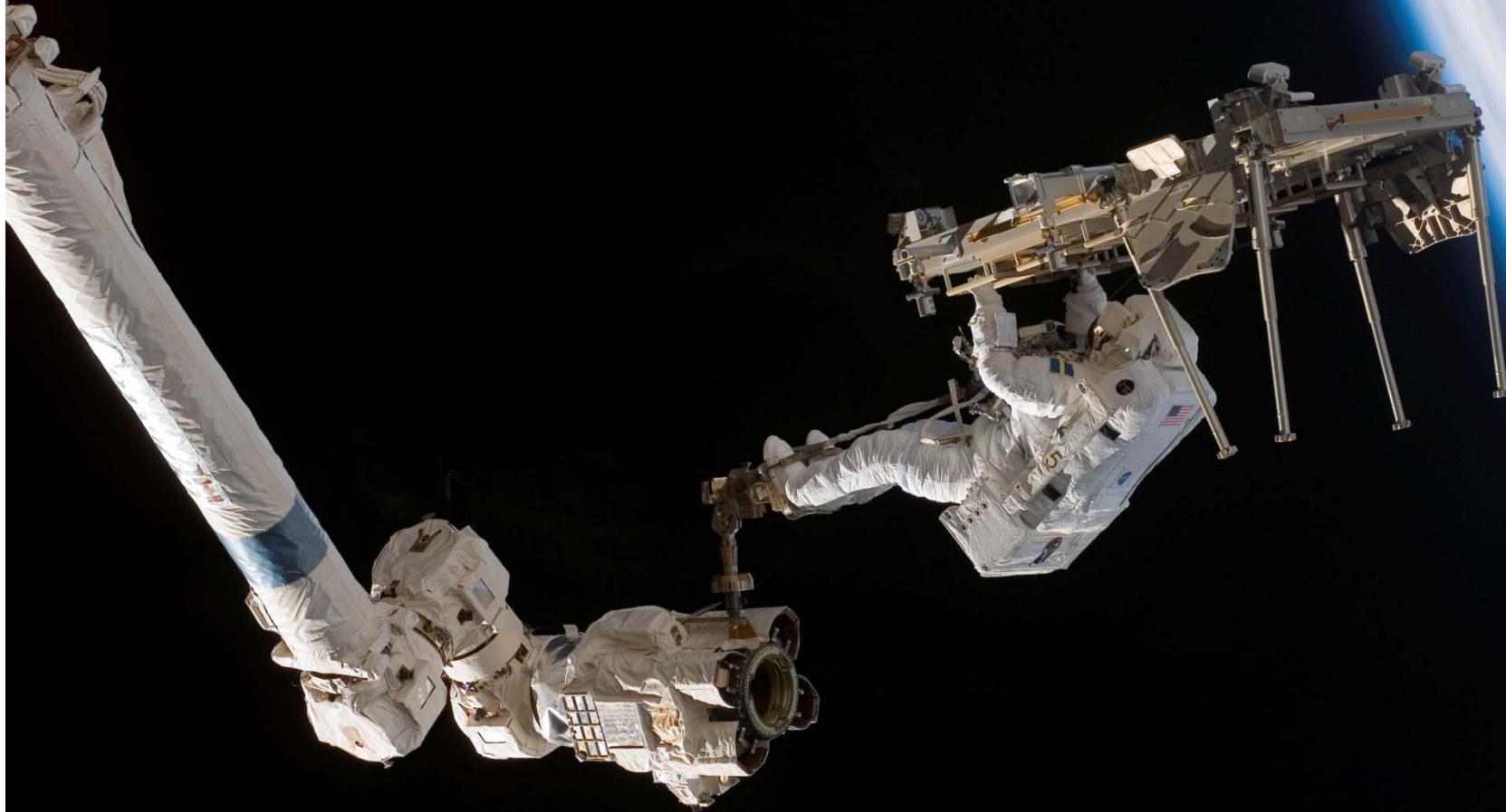


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ISS Resupply

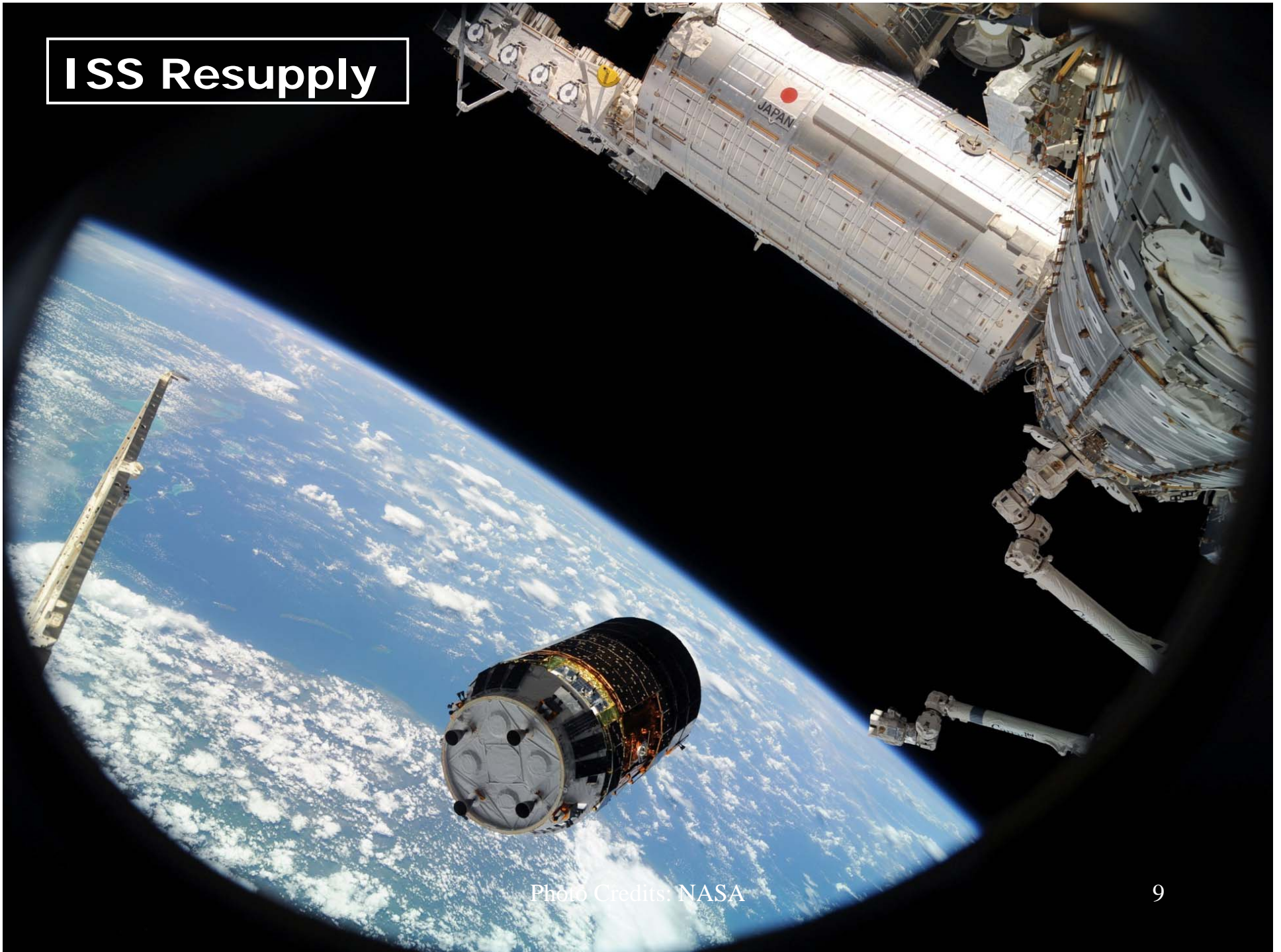


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ISS External Maintenance



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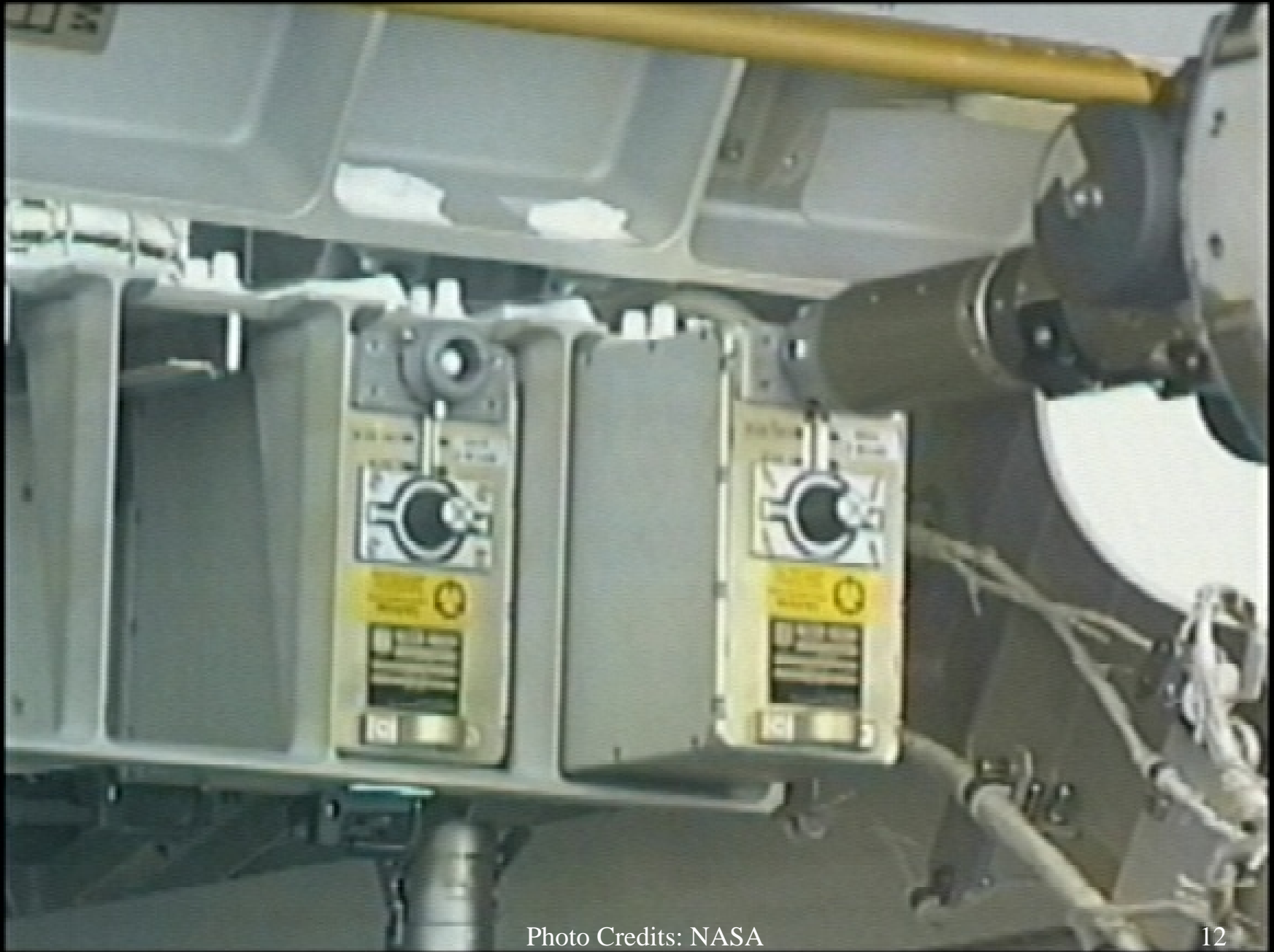


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Canadian Space Agency
Agence spatiale
canadienne

Technology Development

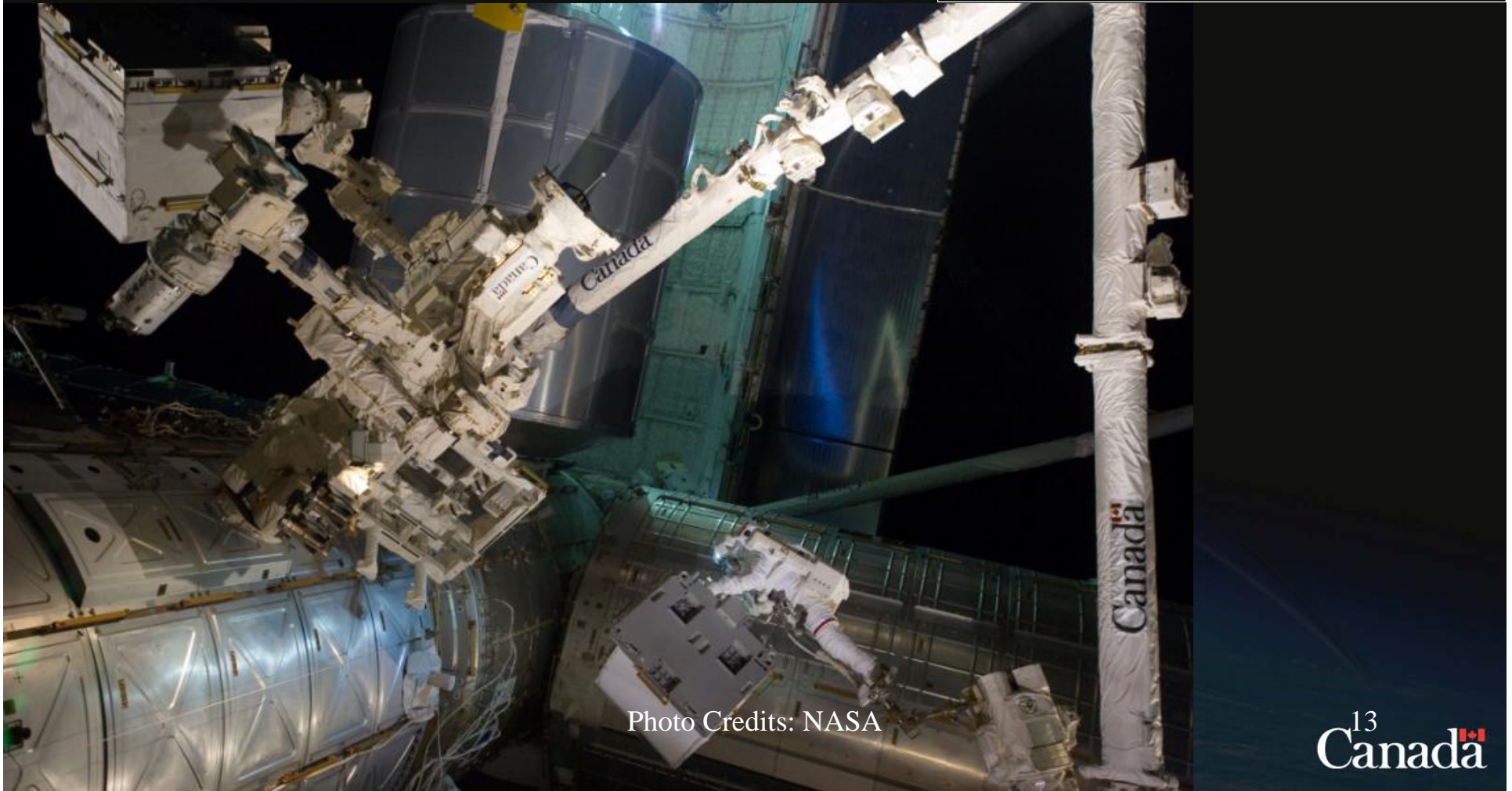
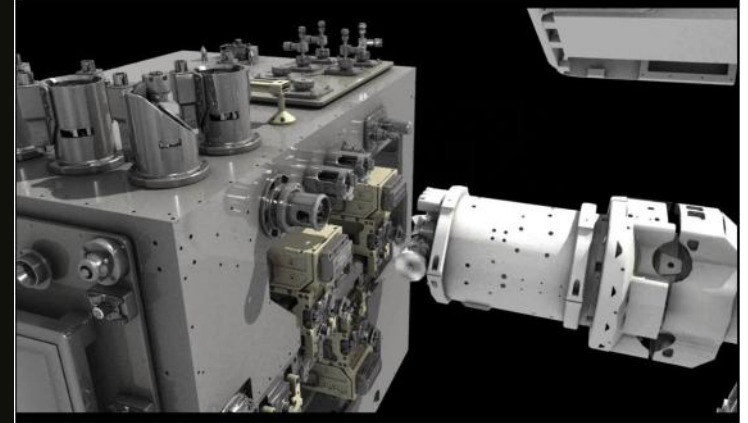


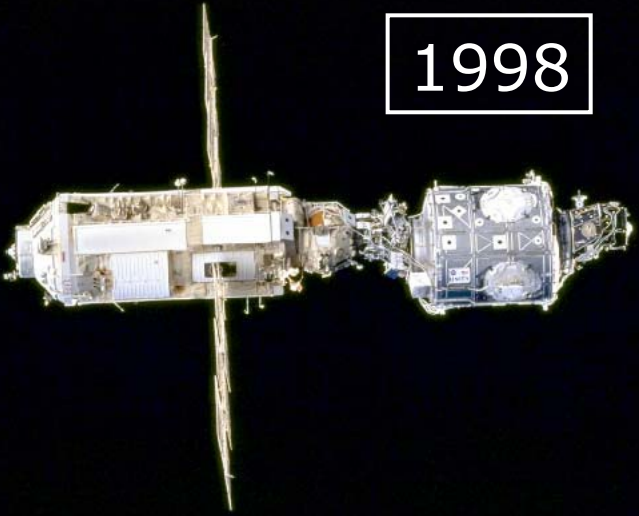
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Canadian Mission Operations Centre

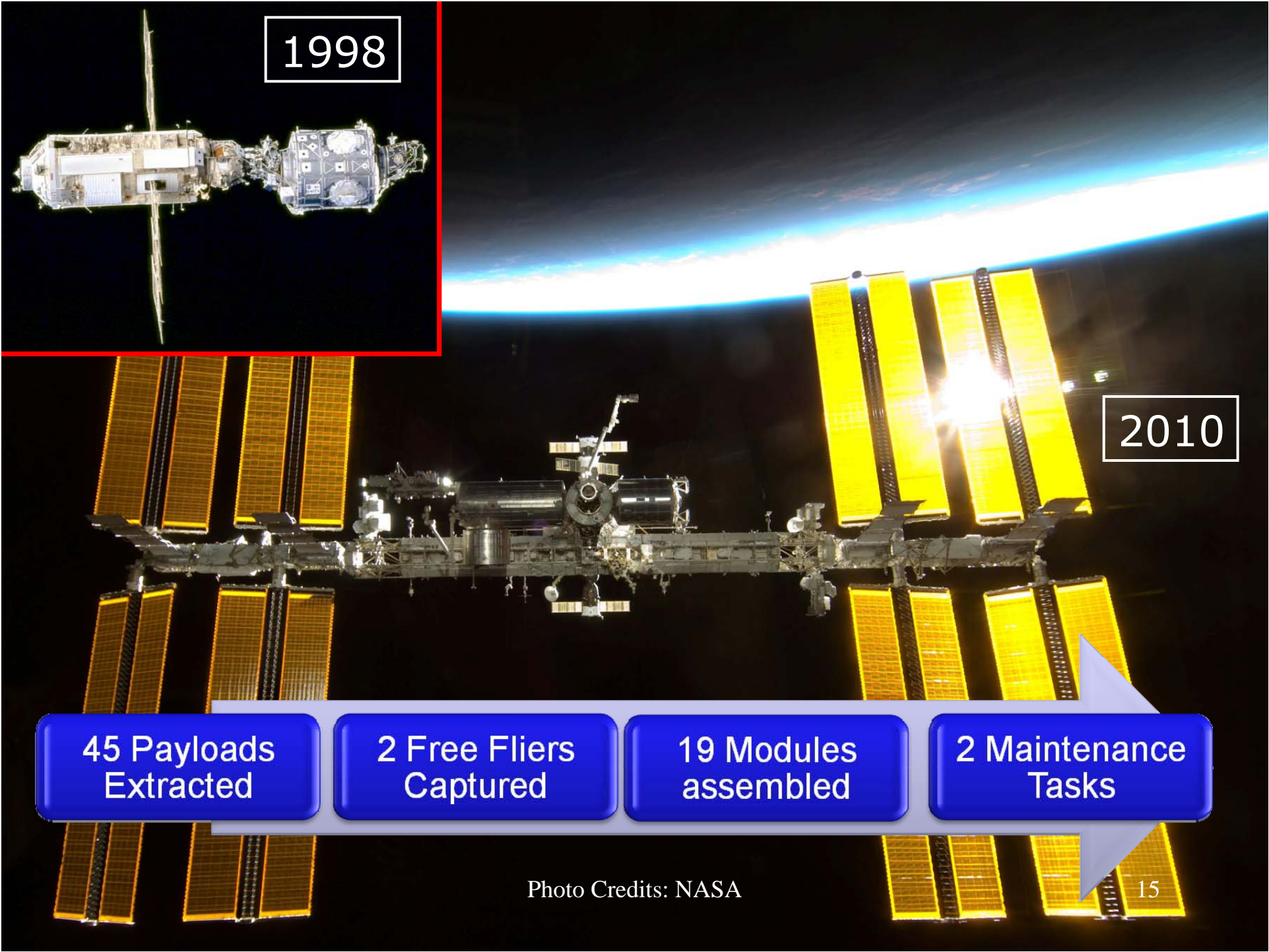


Photo Credits: NASA

1998



2010



45 Payloads
Extracted

2 Free Fliers
Captured

19 Modules
assembled

2 Maintenance
Tasks

Photo Credits: NASA



Canada can make use of ISS

- Astronaut flights
- Access to transport
- Access to stowage
- Access to crew-time
- Access to facilities (subject to agreements)



CSA and the ISS

- ISS is not a *future* destination
- Since 2001, CSA has used it for research
- CSA has an active program for utilization
 - Solicit new ideas
 - Develop ISS activities
 - Implement on ISS
- CSA has solid experience on ISS
- CSA is a trusted partner and active member of relevant working groups



CSA ISS Activities

- Space Robotics: Canadian industry specialization
 - Canadarm2 and Dextre: Canadian contributions to ISS
- Technology Development
 - Reduce risks
 - Enable human exploration of space
 - Enable research
- Scientific Research
 - Contribute to and make use of facilities
 - Basic and applied research
- Outreach and Education
 - Unique facility and opportunity



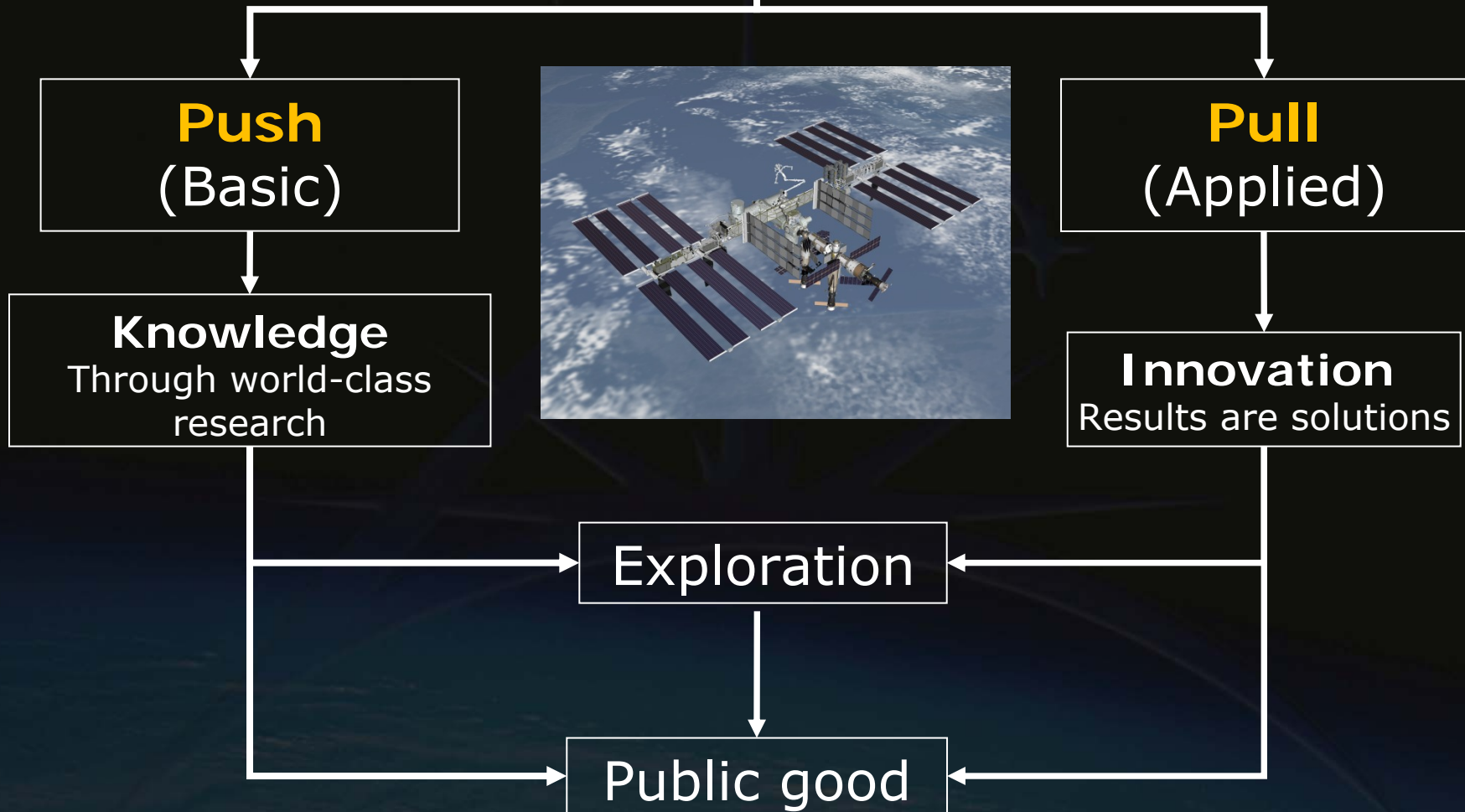
Our Interests

- Science
- Technology





ISS Strategic Approach





CSA Health Interest

- Make space safer for humans
 - Identify risks
 - Mitigate risks
 - Develop countermeasures
 - Science and technology
 - Remote care medicine
- Improve health on Earth
 - Complement knowledge acquired on Earth
 - Accelerate Earth applications



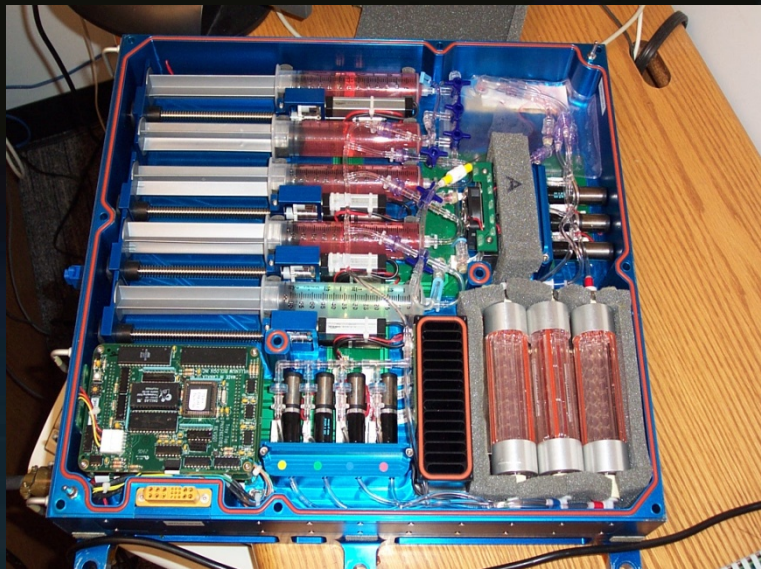
Space is **ICE**:

- Isolated
- Confined
- Extreme





- Bioanalysis
- Biodiagnostics
- Remote care medicine
- Textiles



Canadian micro flow-cytometer for space applications



Needs

- Operational Space Medicine
- Space Life Science research



Technology

- Institut national d'optique
- fibre optics
- blood cell function and number
- cell bound or soluble molecules: hormones, viral molecules, bone markers...



ISS utilization

- Health monitoring
- Environment monitoring
- Space Life Science studies



Earth applications

- Health care (stress, HIV, cancer, cardiovascular)
- Agriculture (cattle health, resource management)



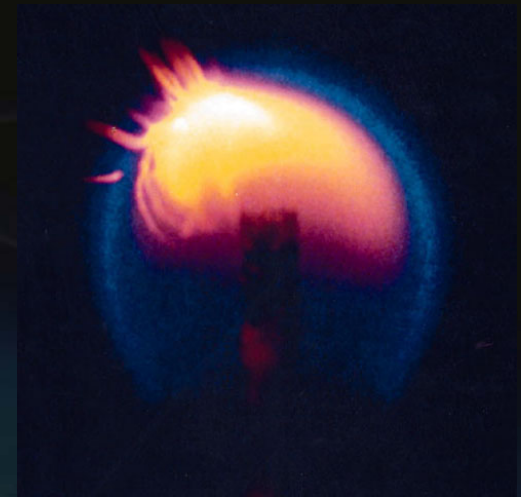
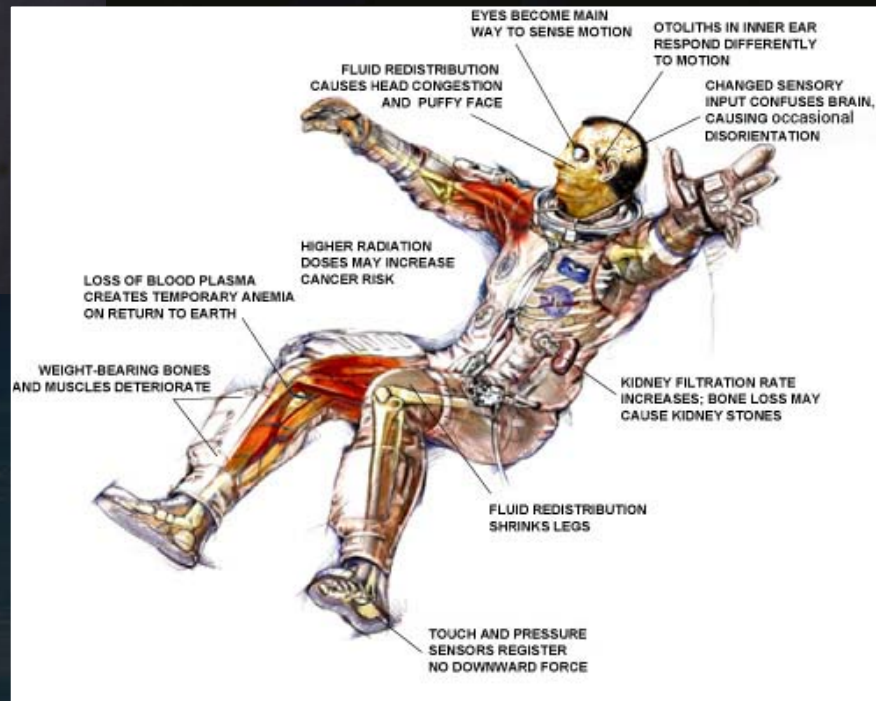


ADAMS Components

- New medical Concepts of Operation (CONOPS)
- Remote patient monitoring capabilities - ability to monitor and manage a sick or injured crewmember remotely
- Intelligent diagnostic systems
 - Smart, non-invasive physiological sensors
 - Computer-based medical decision support systems
- In-situ laboratory capabilities to allow point-of-care biological tissues and fluids analysis
- Remote Health Care Provider training program
- Medical simulation technologies, with space-based physiological models
 - Remote acquisition and maintenance of CMO medical skills



Microgravity





Similarities?

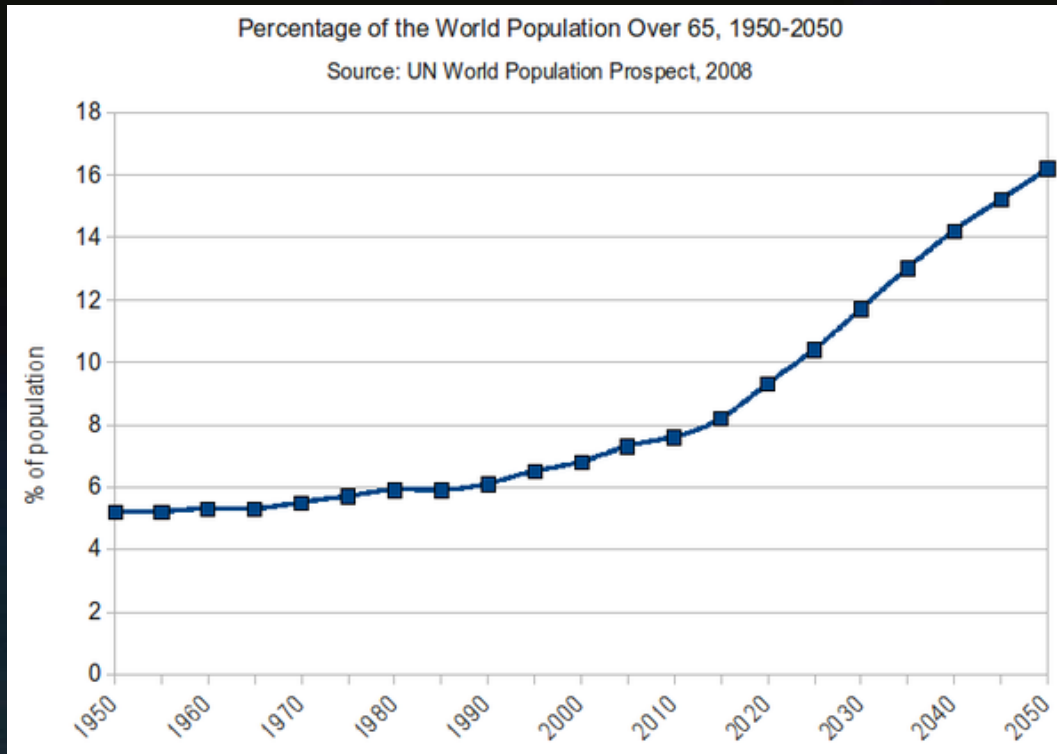


- Heart deconditioning
- Muscle atrophy
- Bone demineralization
- Degradation in motor skills/neural system
- Increased cancer risk



Aging Population

- Number of people older than age 65 expected to double between 1990 and 2020





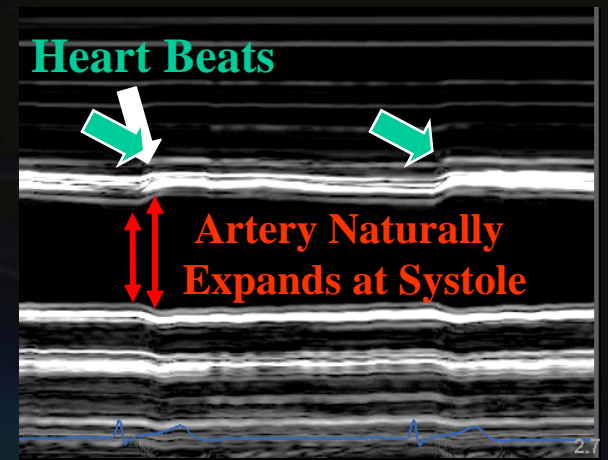
Vascular

Cardiovascular health consequences of long-duration spaceflight (VASCULAR)

Overall hypothesis: physical inactivity accelerates the “aging” of the cardiovascular system

Benefits:

- Understanding role of physical activity in daily life and the necessity for it
- Role of specific exercise programs in the maintenance of cardiovascular health
- Identification of markers of sedentary lifestyle on Earth, or of physical activity program





BISE



Body in space experiment

CSA sponsored, with use of ESA hardware (COGNI tunnel)

Objective: to better understand influence of gravity on perception of up/down

Benefits:

- Perception of up/down serious problem for astronauts.
- Tools developed can help people on prone to falling, including seniors and people with conditions like Parkinson's disease.



Hypersole

Objective:

To identify skin receptors influenced by weightlessness and measure the contribution of foot sole skin sensitivity to balance control.

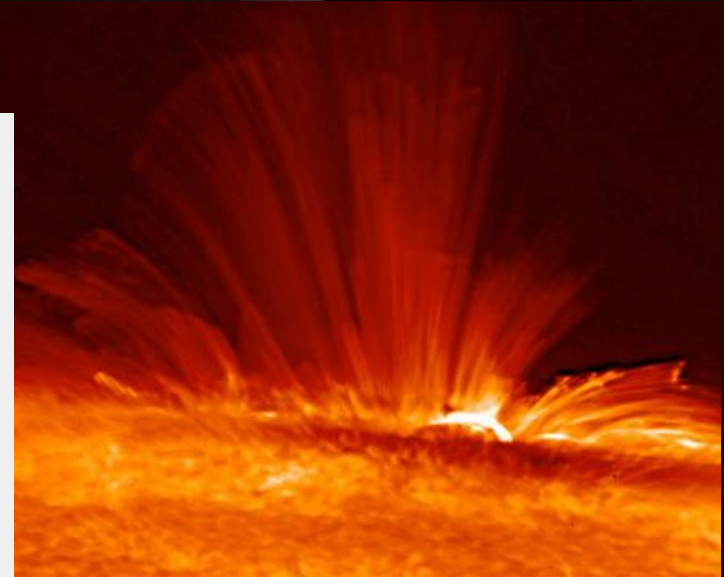
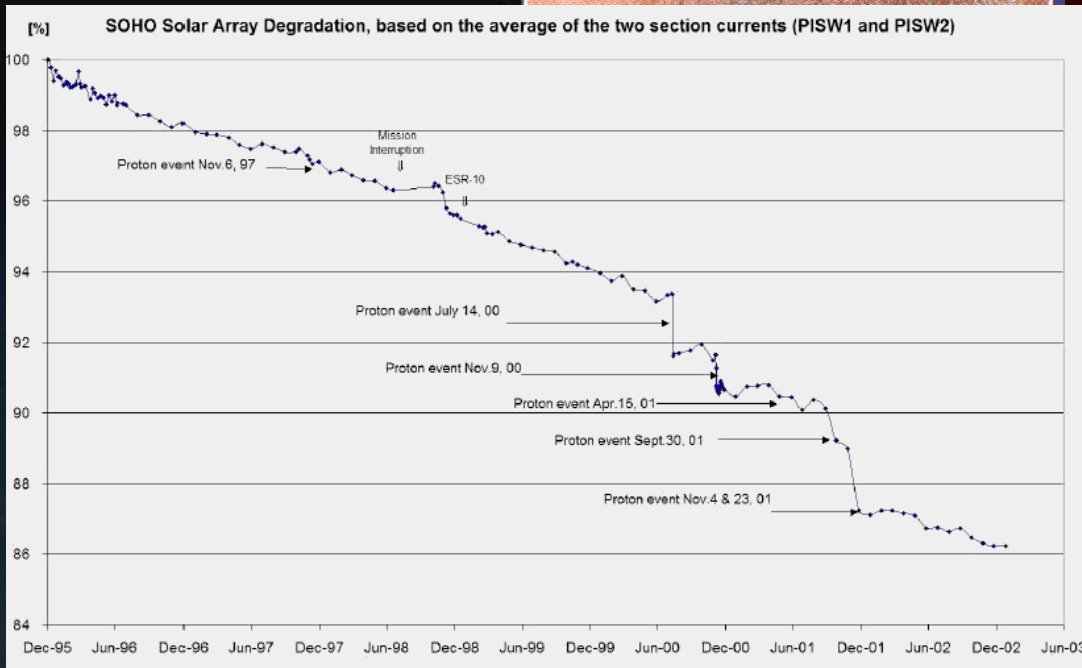
Skin sensitivity actually increases in correlation with balance deficiencies related to vestibular information.

Benefits:

- add significantly to existing studies of the aging process
- reductions in information relayed by skin sensors lead to a loss of balance control and, among the elderly especially, a greater incidence of falls



Space Radiation

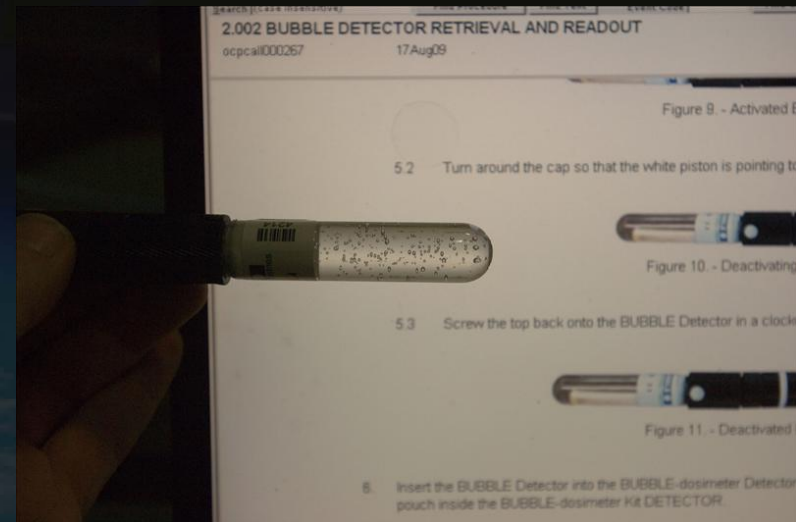




Radi-N

The RaDI-N Neutron Field Study is a collaboration between the CSA and RSC-Energia

Measures incidence and energy range of neutrons on ISS





Exploration Technology Demonstrations

1. Canadian On-Orbit Automated Servicing Experiment
2. Compact Fourier Transform Spectrometer for Space Exploration
3. Canadian Sweeping Energetic Particle Telescope (SWEPT)



Canadian On-Orbit Automated Servicing Experiment

- Future applications:
 - Assist in the repair and refueling of satellites;
 - removal of space debris from crowded orbital slots;
 - tracking and capture of sample return capsules;
 - new methods to assemble satellites.



Compact Fourier Transform Spectrometer for Space Exploration

- Lightweight, low-cost, low-consumption science instrument to probe the chemistry of the Earth's atmosphere.
- Build on SCISAT mission (which monitors pollutants in the Earth's atmosphere) technology and a similar version that will probe the atmosphere of Mars in 2016,



Robotic Refueling Mission – collaboration with Goddard Space Flight Centre

- NASA has developed tools and a mobile worksite for tech demo:
 - Satellite refuelling
 - Satellite Coolant valve manipulation
 - Satellite diagnostic board interface manipulation
- Requires Dextre to execute tasks on the RRM
- Novel tasks for Dextre and CSA's Mobile Servicing System (MSS) robotics in general



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<http://www.enjoyspace.com/en/news/the-station-to-avoid-a-traffic-jam>

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Thank you!

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