ΚΑΙΝΟΤΟΜΟΣ ΕΡΕΥΝΑ ΣΤΟ ΔΙΑΣΤΗΜΑ

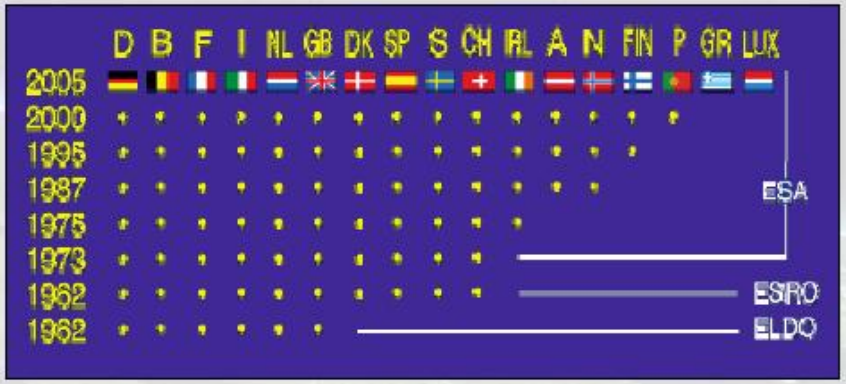
Ν. Κ. Σπύρου
Εργαστήριο Αστρονομίας, Τμήμα Φυσικής, ΑΠΘ

Θεσσαλονίκη, Απρίλιος 2009

ESA Member States

ESA has 17 Member States :

- Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Norway, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom.
- Hungary, the Czech Republic and Romania are European Cooperating States.
- Canada takes part in some projects under a cooperation agreement.



ΔΙΚΤΥΑΚΟΙ ΤΟΠΟΙ

http://www.astro.auth.gr
(Link: ESA Activities)

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http://esa.int

Benny.Elmann-Larsen@esa.int
ISS Utilisation Department
HUMAN SPACEFLIGHT Newsletter

Marie-Pierre.Havinga@esa.int
ESA ISS Science & System - Operations Status Report #27 is online
http://www.esa.int/SPECIALS/Columbus/SEM61O05VQF_0.html

esa

Human Spaceflight Science Newsletter

FEBRUARY 2009

The **ISS Utilisation Department** of the **Directorate of Human Spaceflight** releases a Newsletter on latest science highlights

Click on one of the headlines below to go to the relevant topic

FEATURES

Human Spaceflight

Science Newsletter

January2009

The **ISS Utilisation Department** of the **Directorate of Human Spaceflight** releases a Newsletter on latest highlights

Click on one of the headlines below to go to the relevant topic

FEATURES

- **<u>ΔΙΑΣΤΗΜΙΚΟΙ ΣΤΑΘΜΟΙ</u>**
- **Salyut (1-7) (USSR)**
- **Skylab (USA)**
- **Spacelab (EUROPE, ESA)**
- **Mir (USSR, RUSSIAN FEDERATION)**
- **International Space Station (ISS; USA, RUSSIAN FEDERATION, ESA, CANADA, JAPAN)**

The International Space Station programme

Source: NASA

The International Space Station Partners

Canadian Space Agency

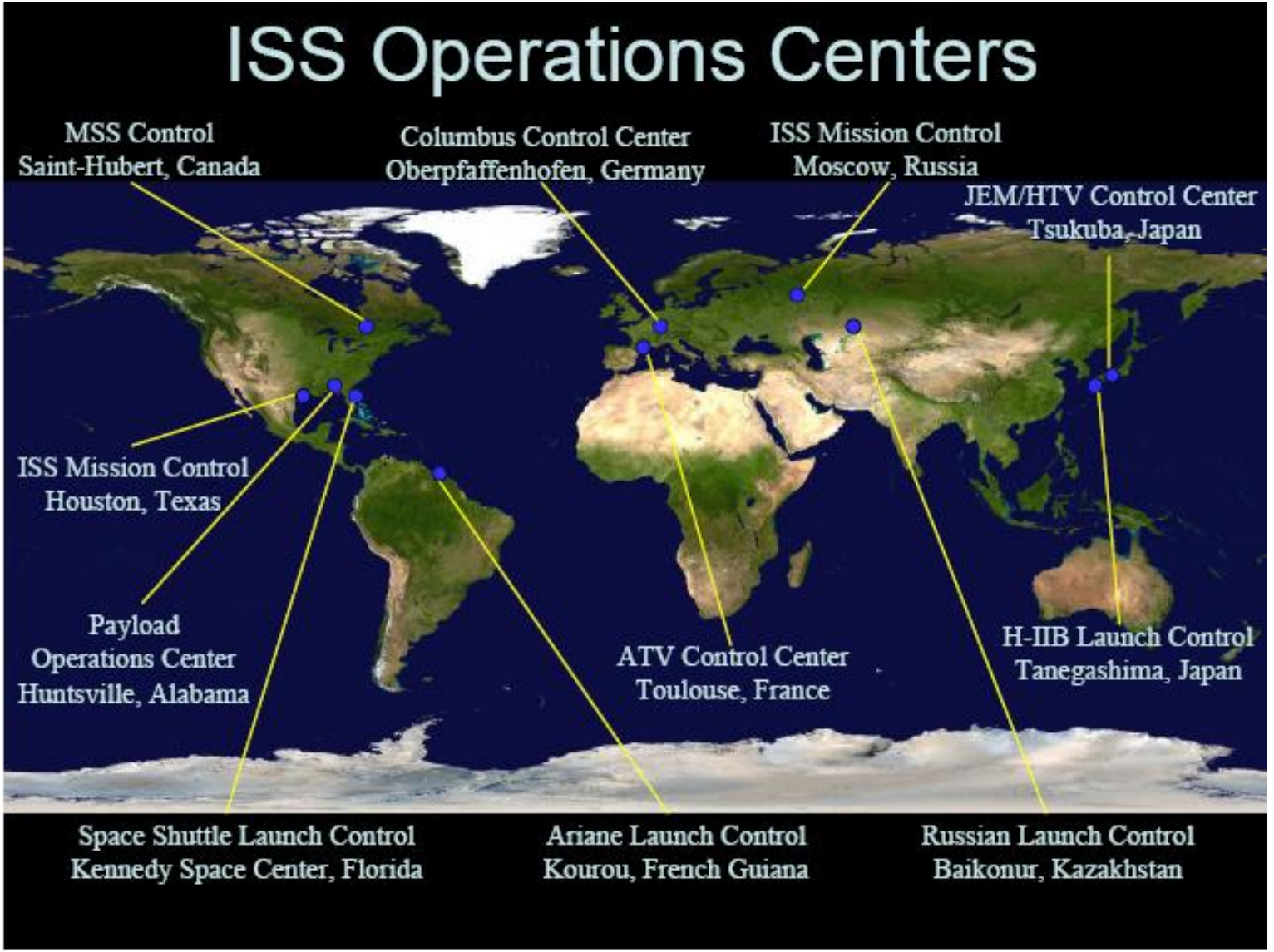
European Space Agency

Japan Aerospace Exploration Agency

National Aeronautics and Space Administration

Russian Federal Space Agency

Credits: Mr. W. Gerstenmaier, NASA

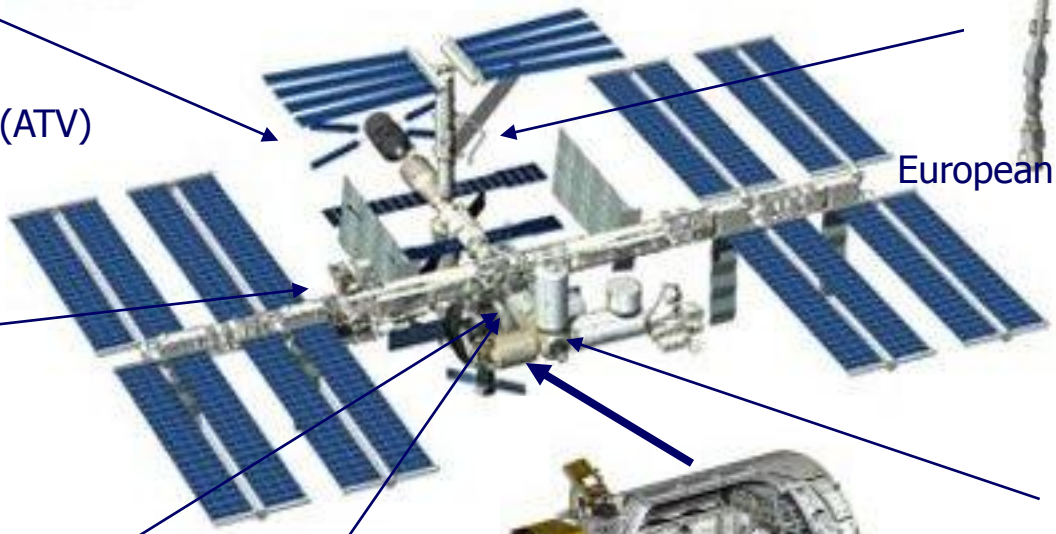

ISS Operations Centers
MSS Control
Saint-Hubert, Canada
Columbus Control Center
Oberpfaffenhofen, Germany
ISS Mission Control
Moscow, Russia
JEM/HTV Control Center
Tsukuba, Japan
ISS Mission Control
Houston, Texas
Payload
Operations Center
Huntsville, Alabama
ATV Control Center
Toulouse, France
H-IIB Launch Control
Tanegashima, Japan
Space Shuttle Launch Control
Kennedy Space Center, Florida
Ariane Launch Control
Kourou, French Guiana
Russian Launch Control
Baikonur, Kazakhstan

European participation in the ISS

Automated Transfer Vehicle (ATV)

European Robotic Arm (ERA)

DMS-R: ESA's Data Management System for the Russian Segment of the ISS



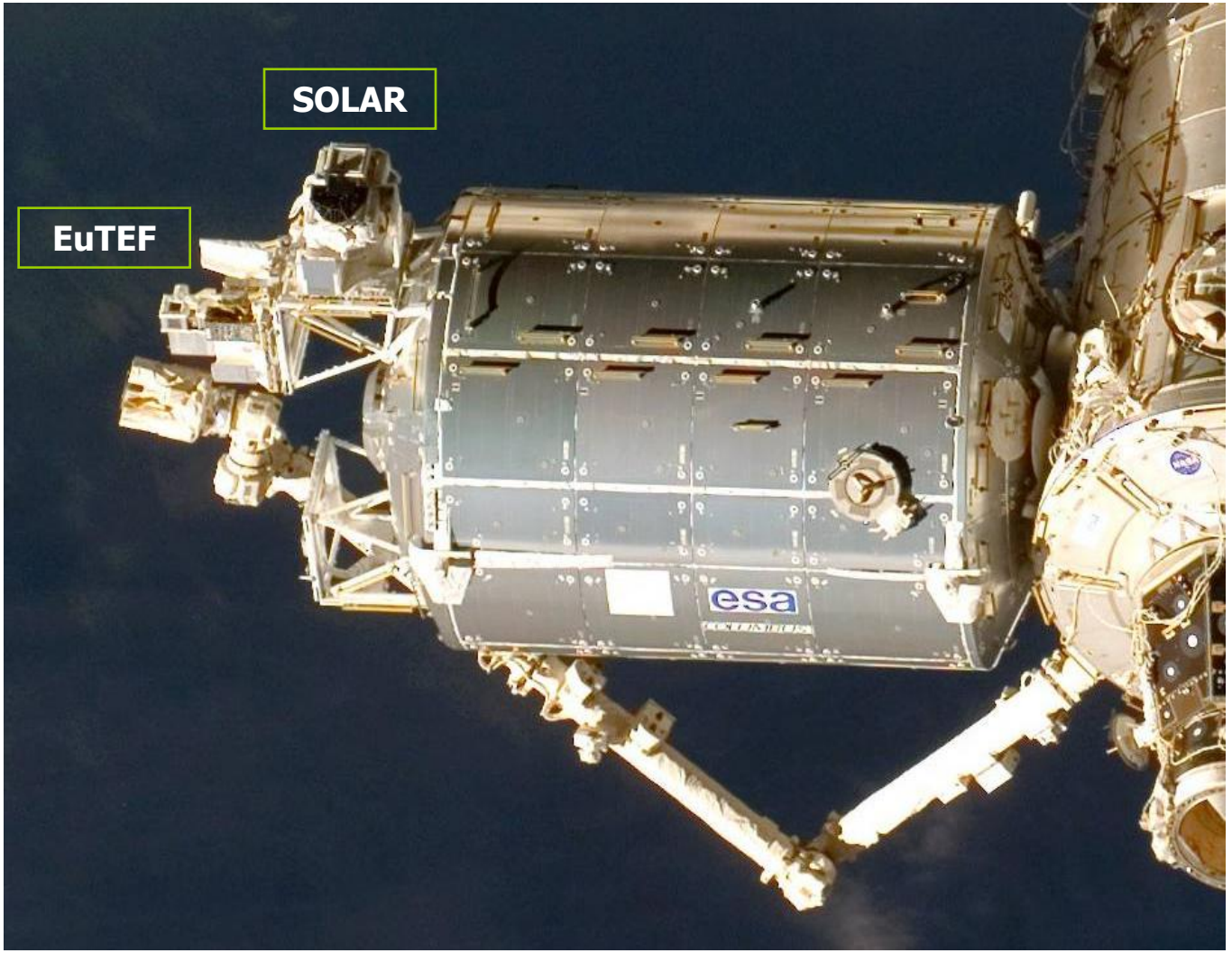
Node 2

Node 3

Columbus laboratory and its payload facilities

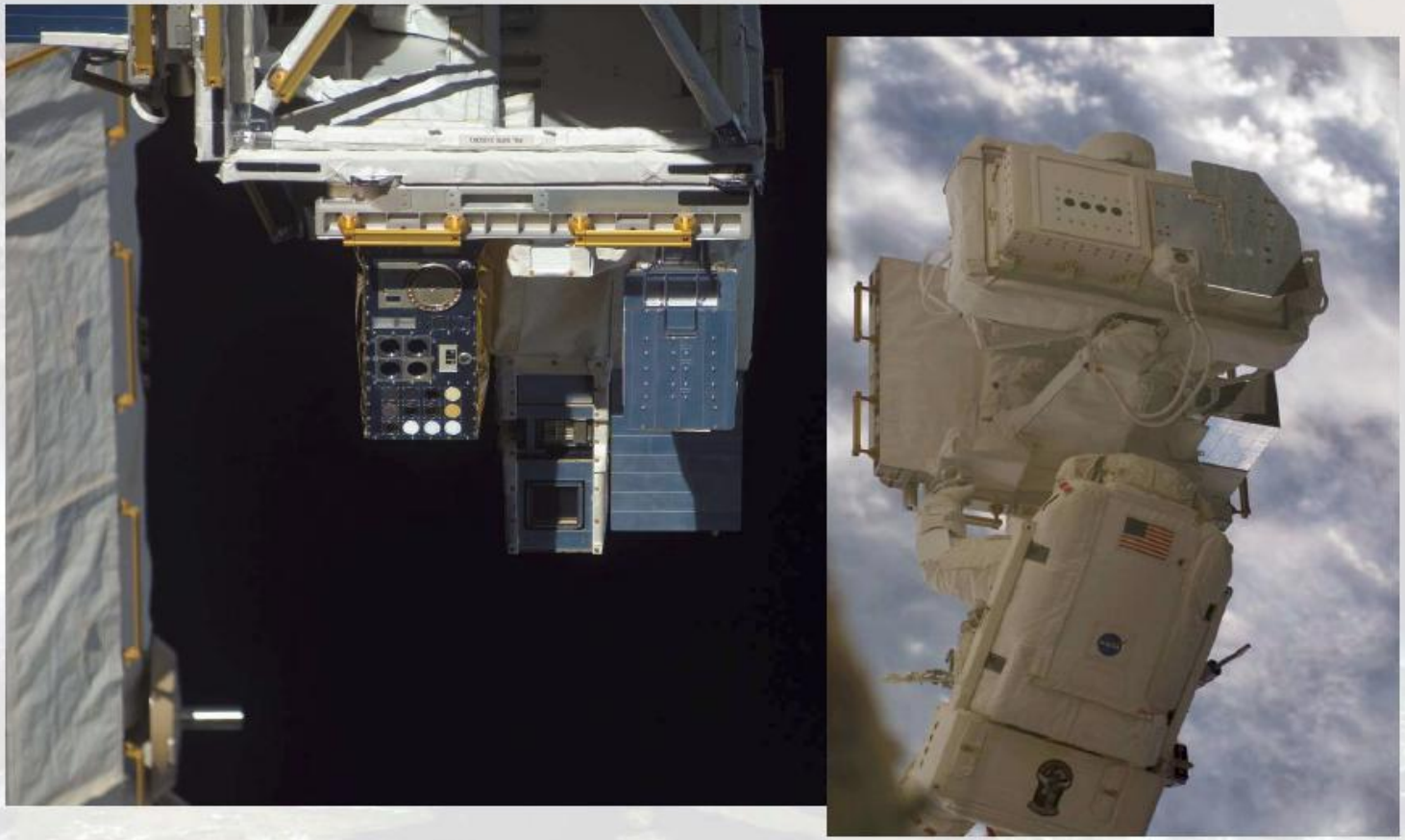
Cupola

Columbus External Payloads



COLUMBUS

EuTEF and SOLAR on EPF



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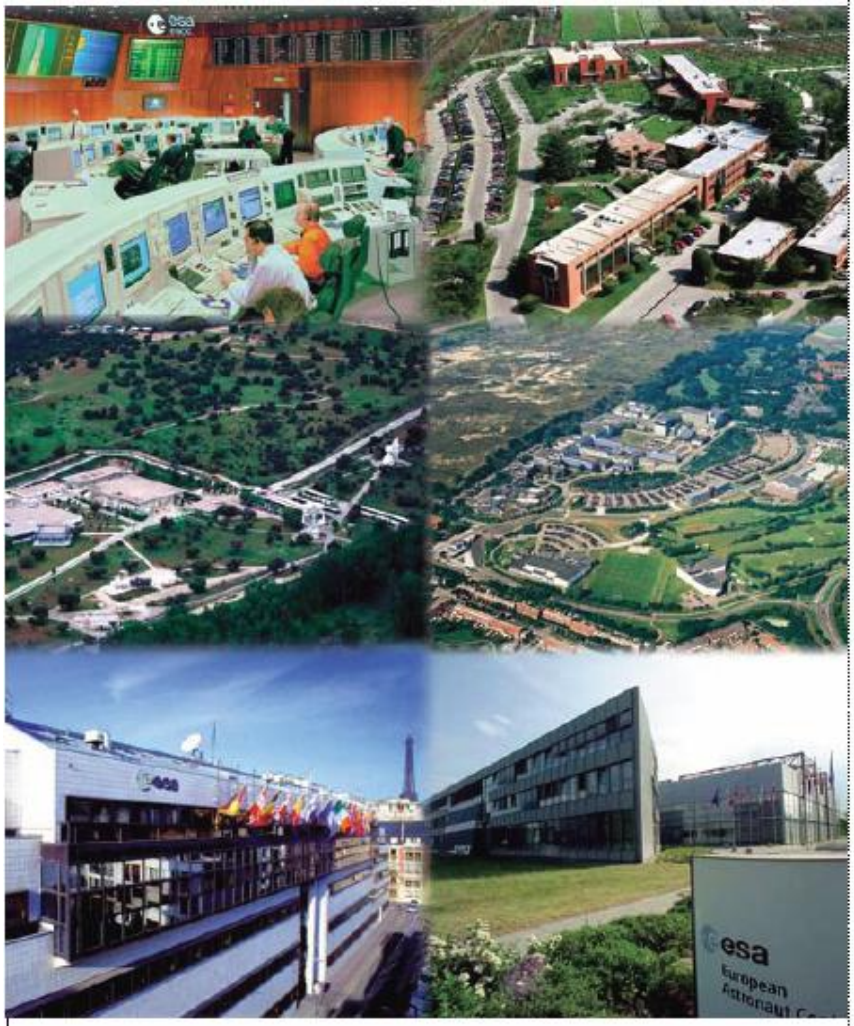
  ESA Human Spaceflight Programme
  Communication Officer
  markus.bauer[@]esa.int

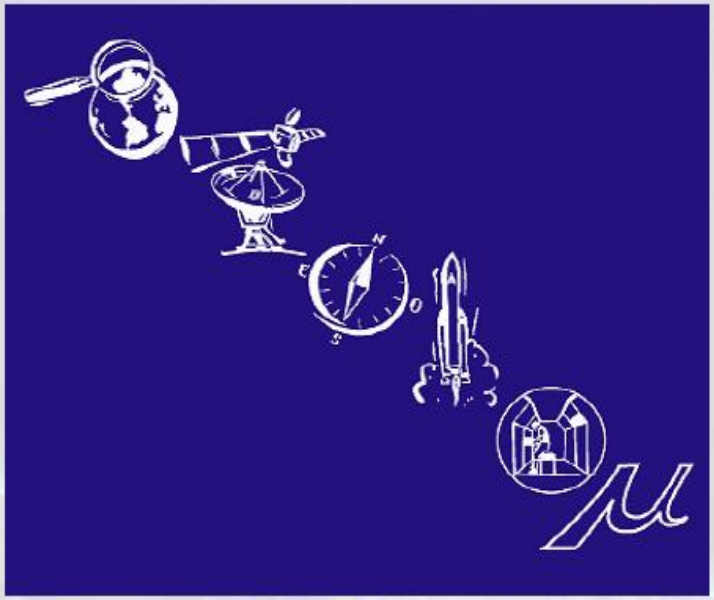


Some of ESA's sites in Europe. *Top left, the Mission Control room at ESOC, Darmstadt, Germany. Top right, aerial view of ESRIN in Frascati, Italy. Middle left, ESAC near Madrid in Spain. Middle right, an aerial view of ESTEC in the Netherlands. Bottom left, ESA headquarters in Paris. Bottom right, EAC near Cologne, Germany.*

All member states participate in activities related to space science and in a common set of programmes: the mandatory programmes.

In addition, members chose the level of participation in optional programmes :

- Earth observation
- Telecommunications
- Navigation
- Launcher development
- Manned space flight
- Microgravity research
- Exploration



Basic Principles: - approval by boards of national delegates
- geographical return of funds

Research cornerstones

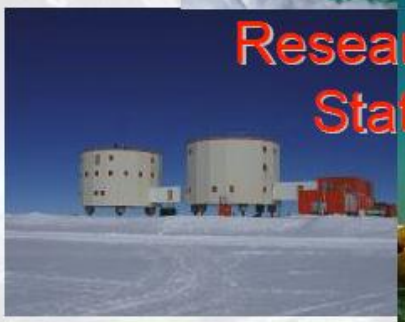
Determined by European Science Foundation in 2005.

- Fundamental Physics
  - Physics of Plasmas and solid or liquid dust particles
  - Cold Atom Clocks, Matter Waves and Bose-Einstein Condensates
- Fluid, Interface and Combustion Physics
  - Structure and dynamics of fluids and Multi-phase Systems
  - Combustion
- Material sciences
  - Thermophysical properties of Fluids for Advanced Processes
  - Materials designed from Fluids
- Biology
  - Molecular and Cell biology
  - Plant Biology
  - Developmental Biology
- Human Physiology
  - Integrative gravitational physiology
  - Non-gravitational physiology of spaceflight
  - Countermeasures
- Planetary Exploration
  - Origin, Evolution and Distribution of life
  - Preparation of Human Planetary Exploration

ELIPS

Human Spaceflight
SPACE FOR LIFE

European Life and Physical Sciences in Space



Research and applications from the Space Station to future Human Exploration.

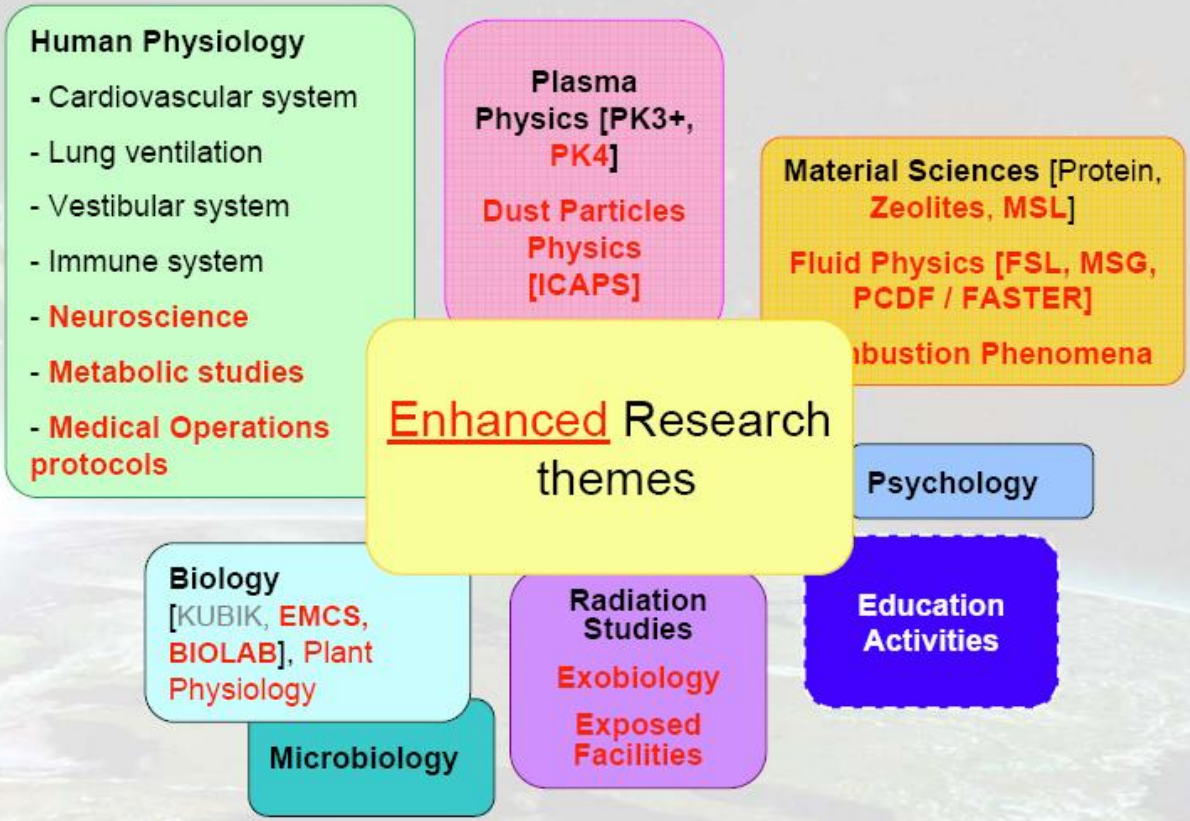
Marc Heppener

Head of Science and Applications

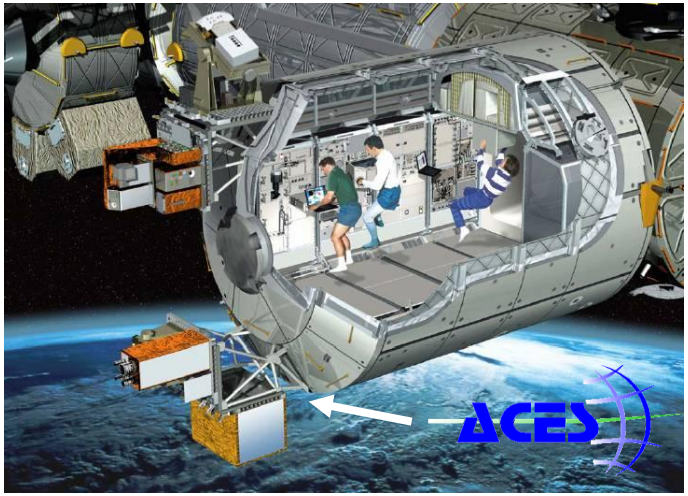
Human Spaceflight

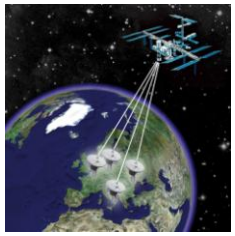
SPACE FOR LIFE

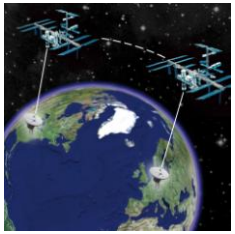
… significantly enhanced ISS research capabilities given by Columbus

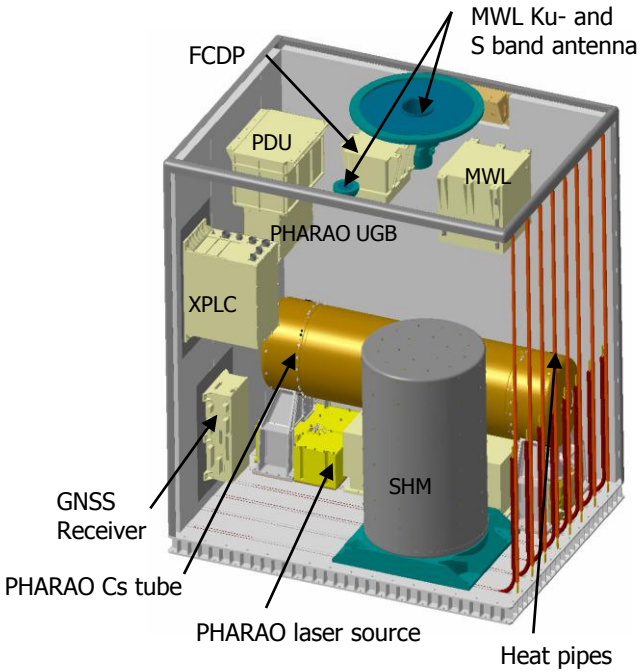


Columbus Future External Payload Facilities: ACES - Atomic Clock Ensemble in Space









- Performs fundamental physics experiments based on performances derived from its cold atoms Caesium clock and its Space Hydrogen Maser. The clock signal is sent to ground using a dedicated microwave link.
- Allows comparison of clocks with a precision of 10-16 and a stability of 10-16/day
- Used for test of relativity theory, search for variation of the fundamental constants, relativistic geodesy, etc..
- Estimated mass : 350 Kg

European Transportation

Advanced Re-entry Vehicle -ARV-

- General objectives:
  - Step 1: cargo transportation to and from ISS by 2015
  - Step 2: crew transportation to and from Low Earth Orbit by 2020
  - Activities for the period 2009-2010
    - Phase A of cargo transportation
    - Preliminary definition of Ariane 5 modification for human transportation

Overview of relevant aspects for Human flights

Human Spaceflight
SPACE FOR LIFE

Medicine: •Gravity related health issues (e.g., bone and muscle mass loss, cardiovascular deconditioning, immune system) •General health issues (e.g., related to long-term isolation and confinement) •Development of countermeasures	**Psychology:** •Basic issues of environmental engineering, incl. habitat design, scheduling of work… •Specific psychological measures, e.g. crew selection/composition, pre-flight psychological training…
Radiation: •Risk assessment (incl. radiobiology, effects of heavy ions) •Surveillance (e.g. Dosimetry) •Countermeasures (e.g., radiation shielding, active passive)	**Life Support Systems (LSS):** •Determine efficiency of physico-chemical/ biological LSS in closed habitats •Environmental Monitoring

European ISS Research Facilities

Human Spaceflight
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- ISS-Columbus
  - Rack Facilities:
    - Biolab
    - European Physiology Modules with CDL, MEEMM, PK-4
    - Fluid Science Lab with FSL-ECx
    - European Drawer Rack with PCDF, KUBIK, FASTER, EML
    - Microgravity Science Glovebox with Inserts
    - European Modular Cultivation System (in EXPRESS rack)
    - Human Research Facility -1
    - Human Research Facility -2 with PFS
    - HRF-MARES
    - FlyWheel Exercise Device
  - External Payload Facilities:
    - EuTEF with 9 instruments
    - SOLAR with 3 instruments
- ISS-Destiny
  - Rack Facilities:
    - Material Science Lab with SCA
    - Portable Pulmonary Function System
    - MELFI

Biolab, which supports experiments on micro-organisms, cell and tissue culture, and even small plants and animals;

FSL, looking into the complex behaviour of fluids, which could lead to improvements in energy production, propulsion efficiency and environmental issues;

The European Physiology Modules facility, which supports human physiology experiments concerning body functions such as bone loss, circulation, respiration, organ and immune system behaviour in weightlessness; and

The European Drawer Rack, which provides a flexible experiment carrier for a large variety of scientific disciplines.

- **EUROPEAN SCIENCE ANT RESEARCH FACILITIES**
- **(inside "Columbus")**
- **Biolab** and WAICO experiment
- **Fluid Science** Laboratory and Geoflow experiment
  European Drawer Rack including the **Protein Crystallisation** Diagnostics Facility
  European Physiology Modules and NeuroSpat experiment
- **SOLO** experiment
- 3D-Space experiment
- **Flywheel Exercise Device**
  Pulmonary Function System in Human Research Facility 2
- European Modular **Cultivation System**
- Microgravity Science Glovebox
- **EUROPEAN SCIENCE ANT RESEARCH FACILITIES**
- **(outside "Columbus")**
- **EuTEF**
  SOLAR

Some achievements

Human Spaceflight
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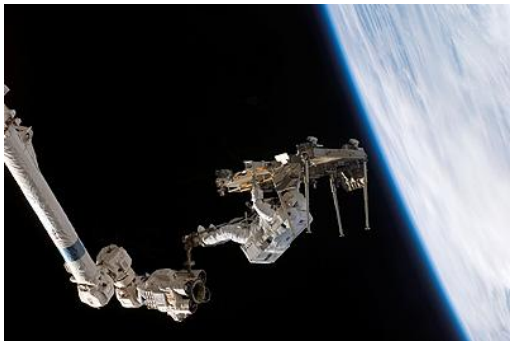
- **Fundamental research:**
  - Gravity sensing mechanisms in plants and mammalian cells
  - Atypical development of vestibulo-ocular reflexes in amphibian embryos
  - Role of sodium uptake, caloric uptake and food supplements
  - New phenomena in cardiovascular research
  - Large density fluctuations in diffusion under microgravity
  - Importance of contact dynamics in clustering of granular material
  - Description of phase transitions in complex plasma's
- **Applied research:**
  - Development of advanced intermetallics for manufacturing lightweight turbine blades
  - Better understanding of heat-transfer and fluid storage for space applications
  - Patent on the use of NO as diagnostic for lung embolism and related diseases
  - Development of advanced biotechnological and biomedical diagnostics of bone
- **Exploration related research:**
  - Research into biological effects of space radiation
  - Survival of multi-cellular organisms in space (Lichen)
  - First studies on crew health, psychological effects in isolated, hazardous environment (Concordia, Mars-500)
  - Topical Team initiated on Mg-based alloys for Mars rovers

European Astronauts

- ESA has an Astronaut Corps of 8 Astronauts from Germany, France, Italy, Belgium, Netherlands, Sweden
- 13 European Astronauts have flown to the ISS so far








European Astronauts

- A new astronaut selection process opened in May 2008
- More than 8000 applications were received from all over Europe
- 4 candidates shall be selected by May 2009

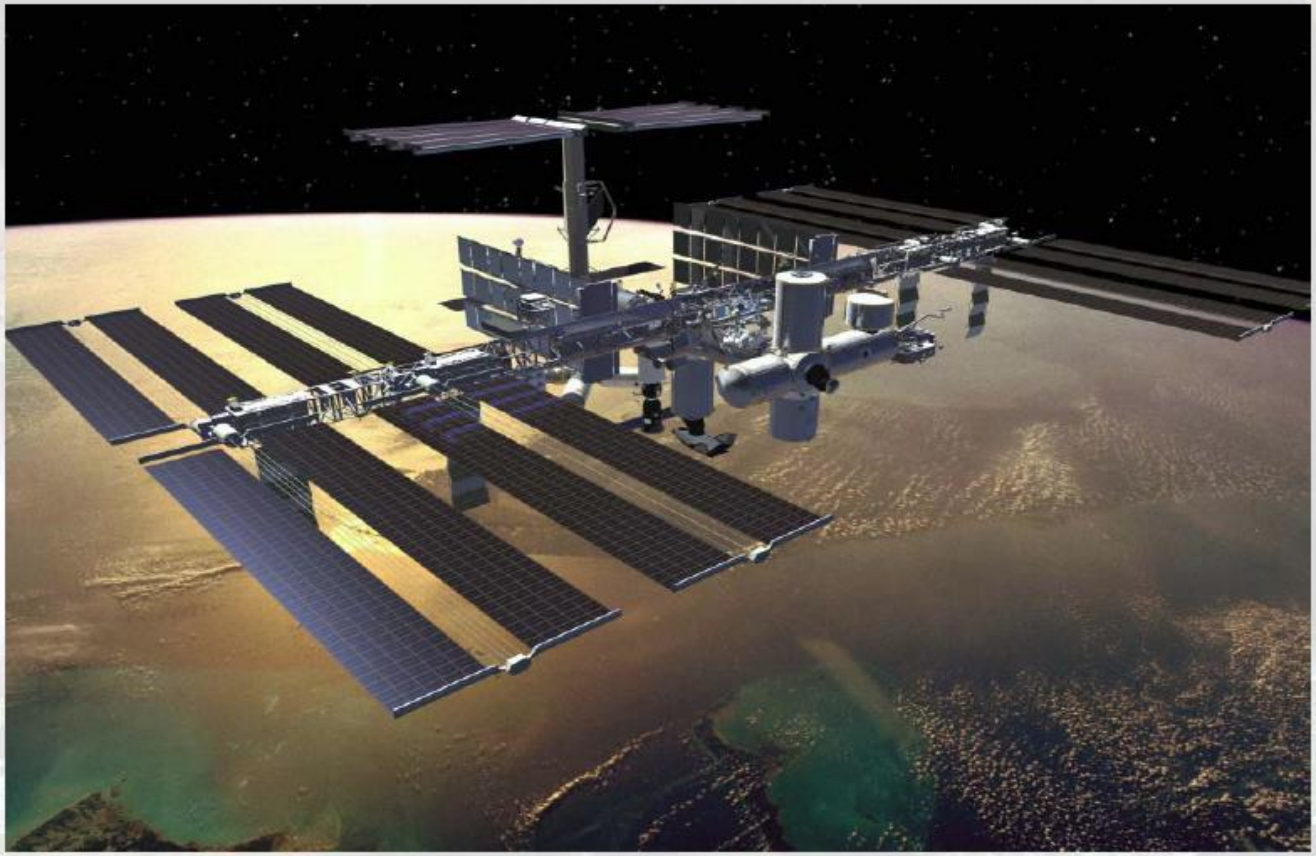
The Right Stuff around 1870

(Norwegian Royal Navy)

Single men, perfect health, considerable strength, perfect temperance, cheerfulness, ability to read and write English, prime seamen of course. Norwegians, Swedes and Danes preferred. Avoid English, Scottish and Irish. Refuse point blank French, Italian and Spaniards

"Your neuro-vestibular, cardio-vascular, and musculo-skeletal systems can't support you anymore."

The International Space Station (ISS)



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE

ISS Assembly On-Orbit Configurations

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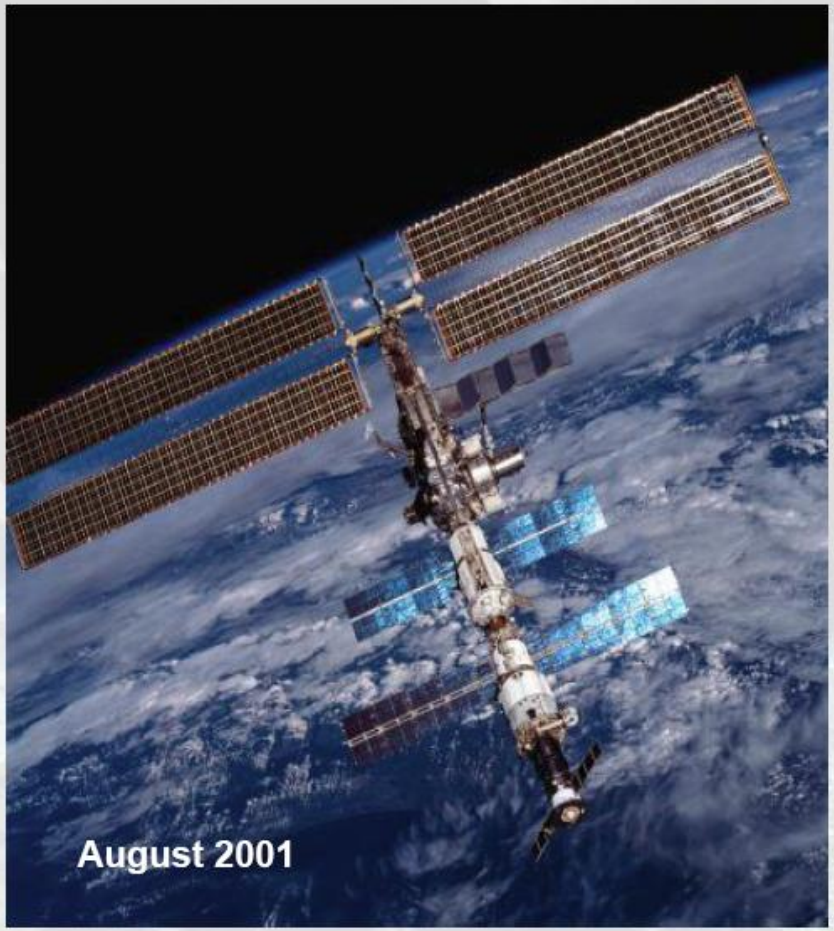

ISS Assembly On-Orbit Configurations

Human Spaceflight
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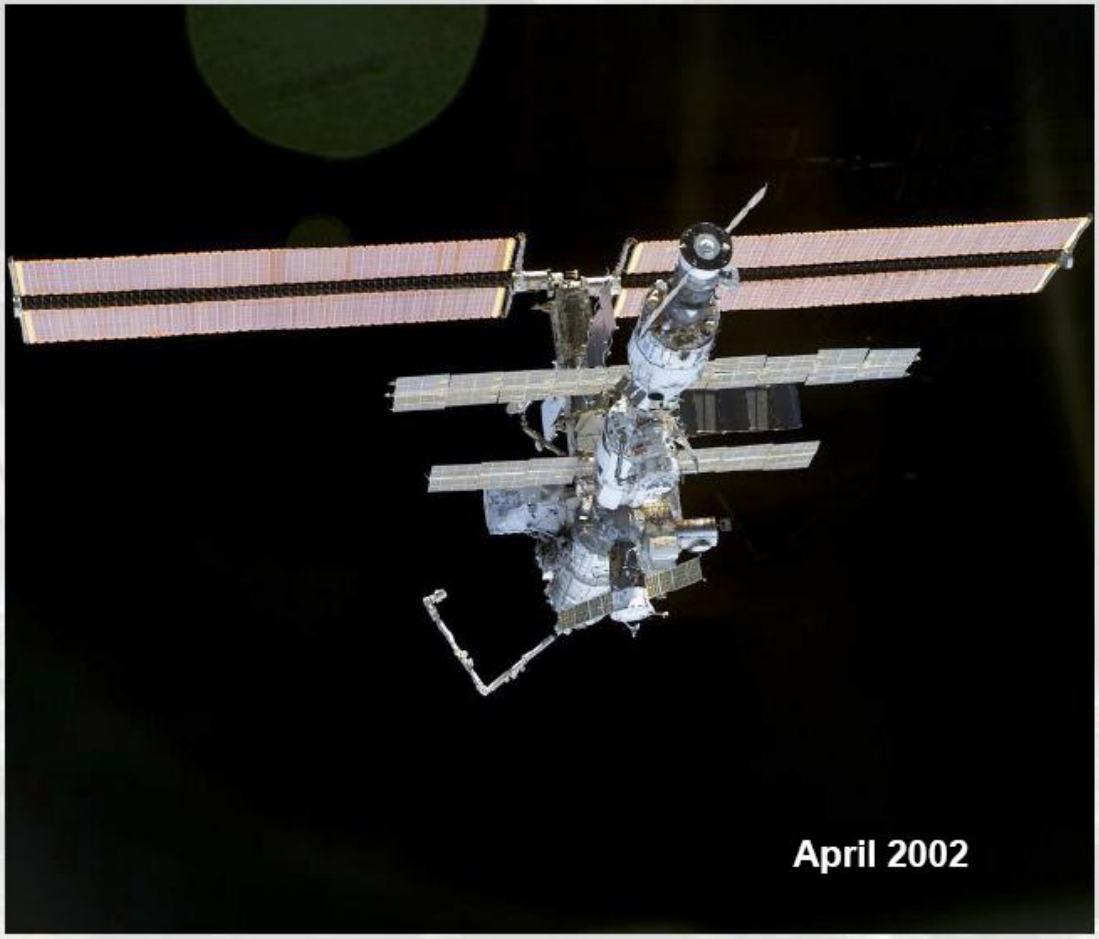

ISS Assembly On-Orbit Configurations

Human Spaceflight
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S112E05823

ISS Assembly On-Orbit Configurations

Human Spaceflight
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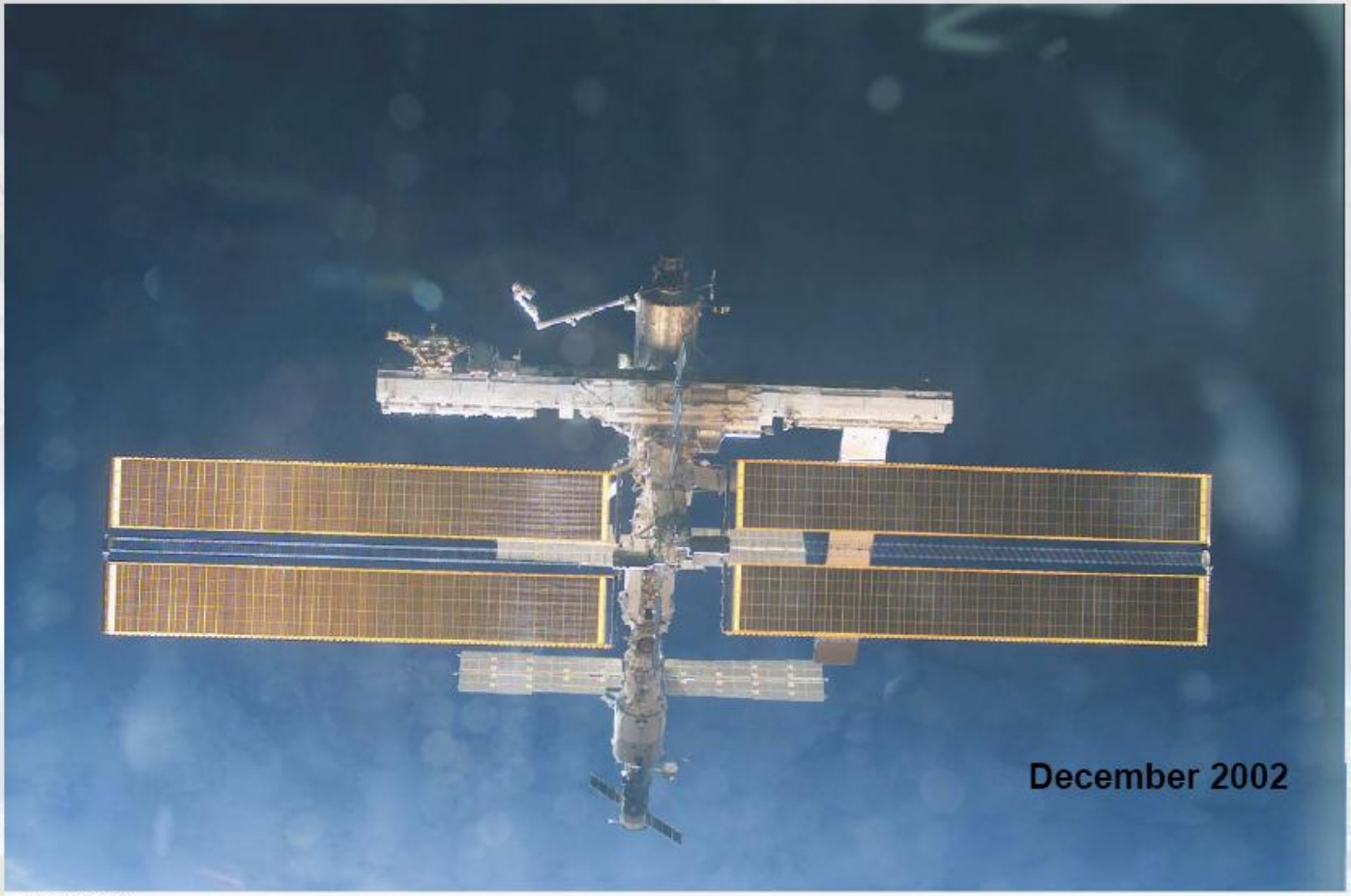

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ISS Assembly On-Orbit Configurations

Human Spaceflight
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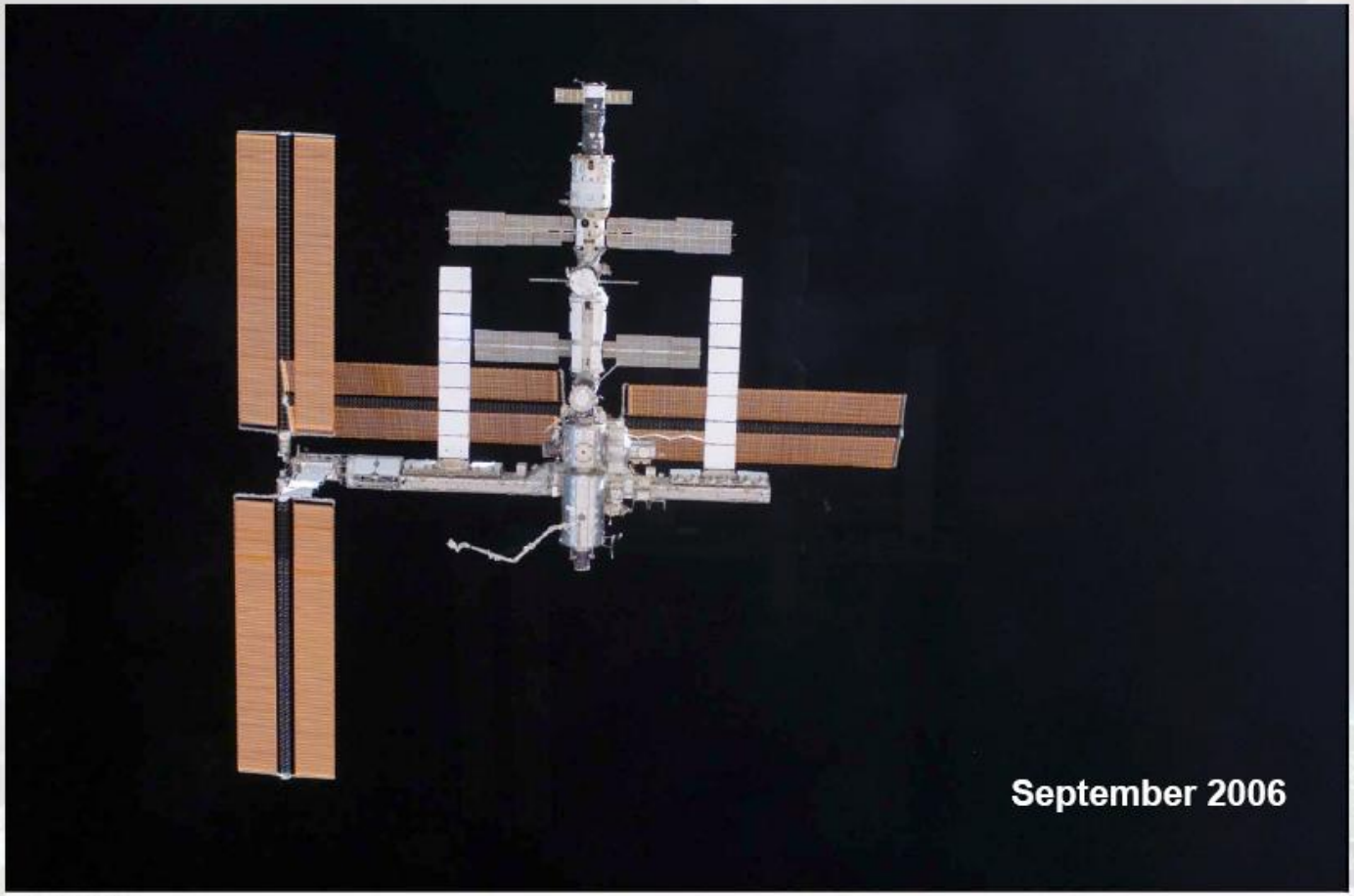
ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



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ISS Assembly On-Orbit Configurations

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ISS Assembly On-Orbit Configurations

Human Spaceflight
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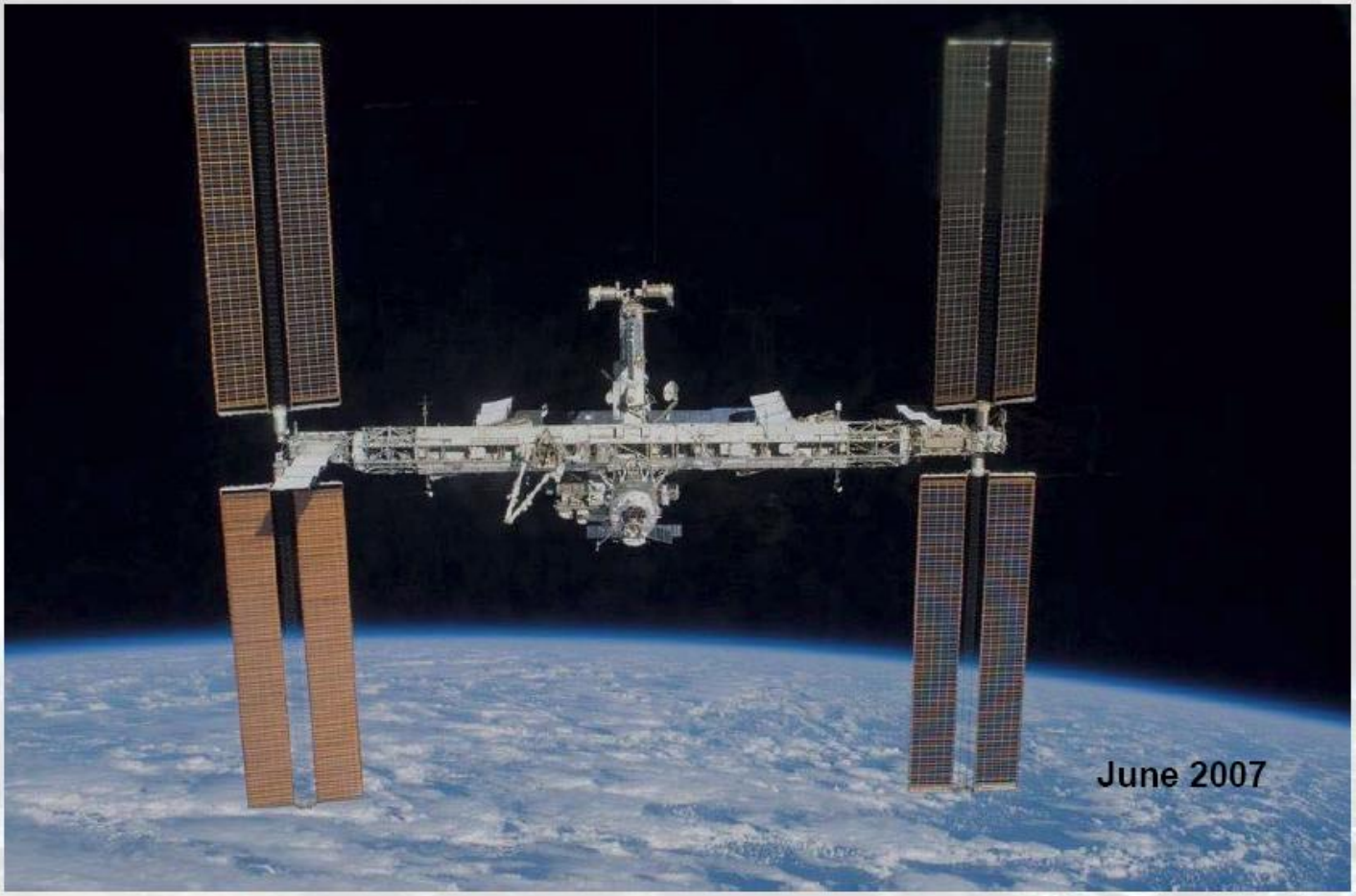

ISS Assembly On-Orbit Configurations

Human Spaceflight
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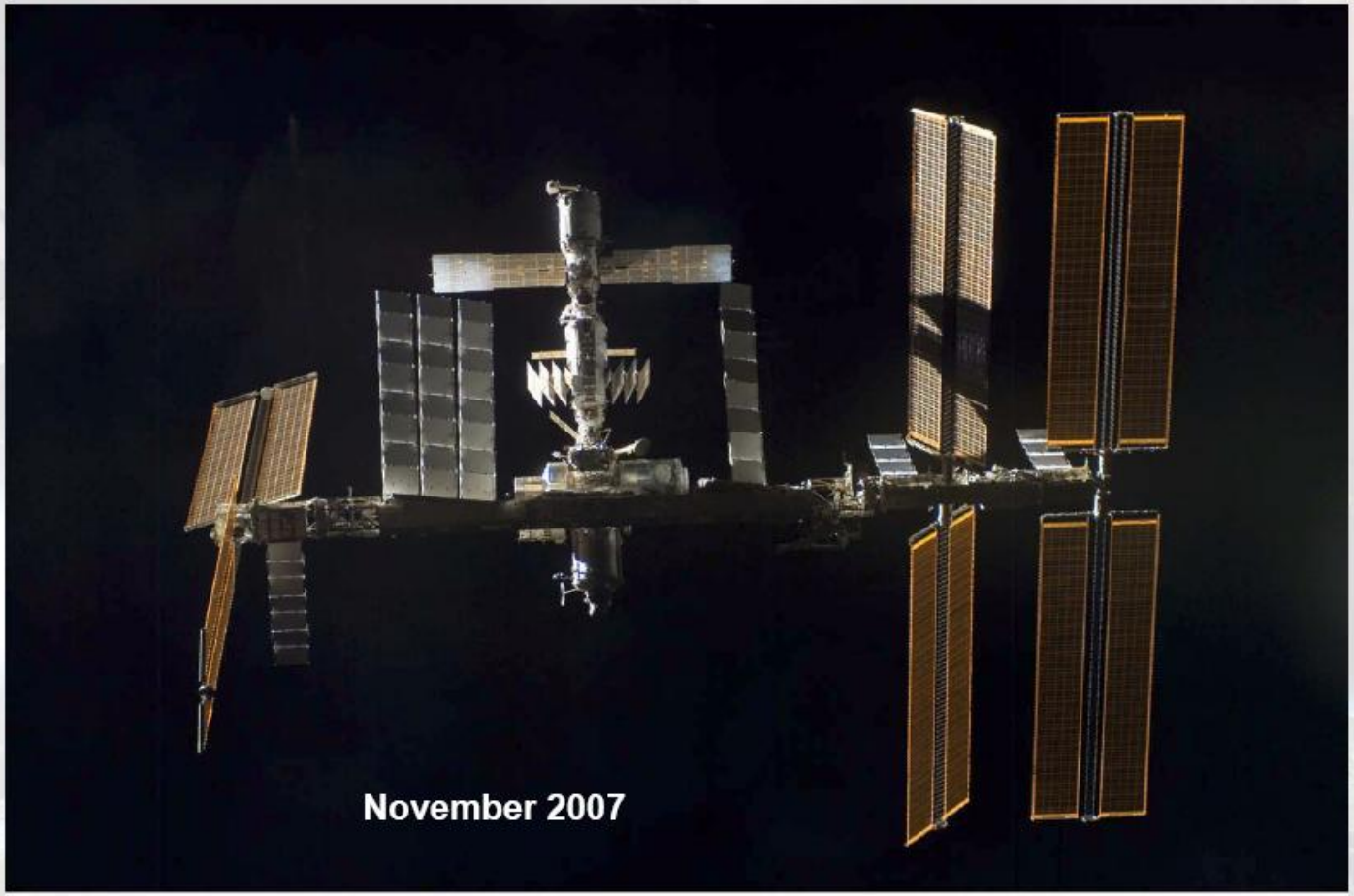
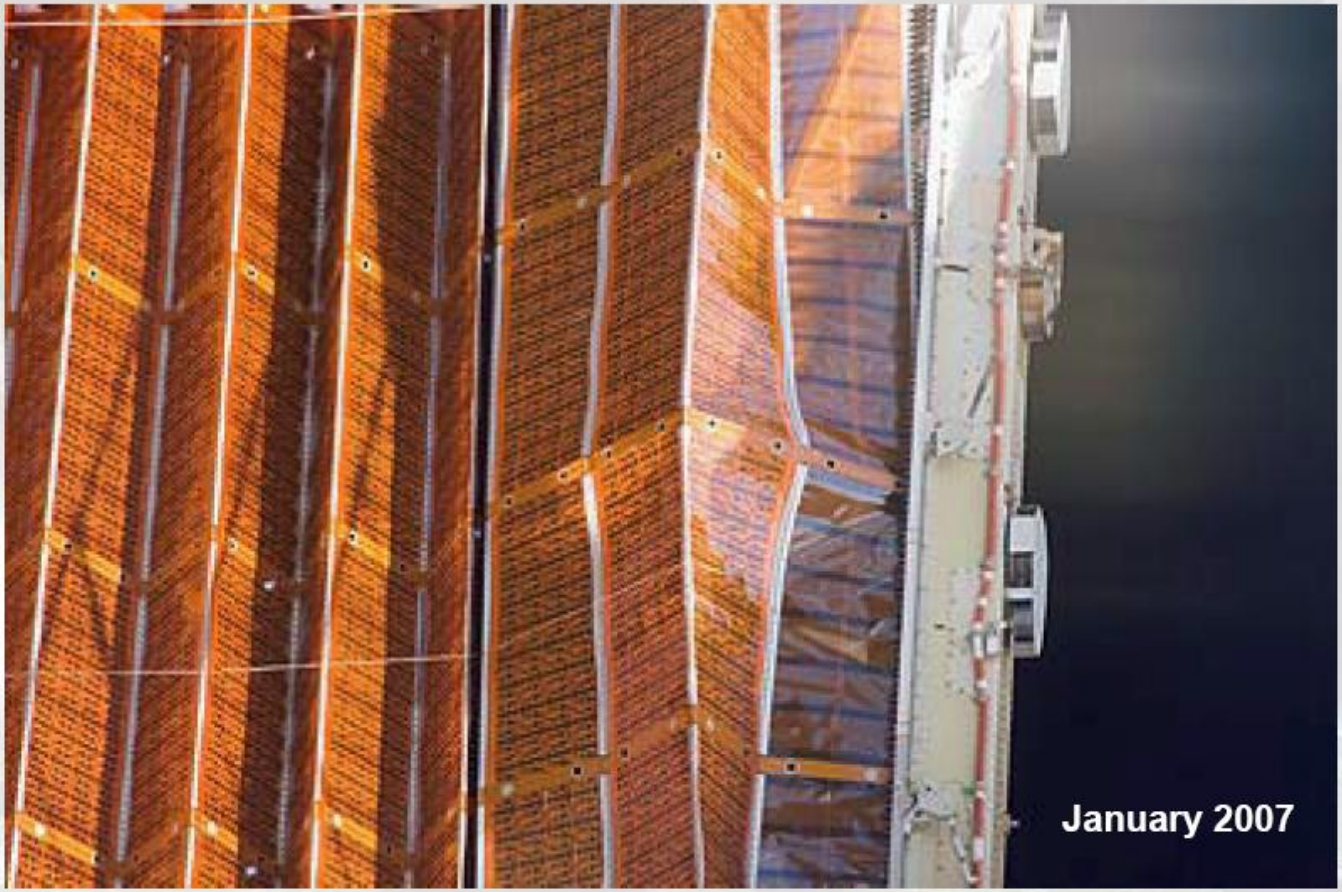


S120E009604

Solar array troubles



Human Spaceflight
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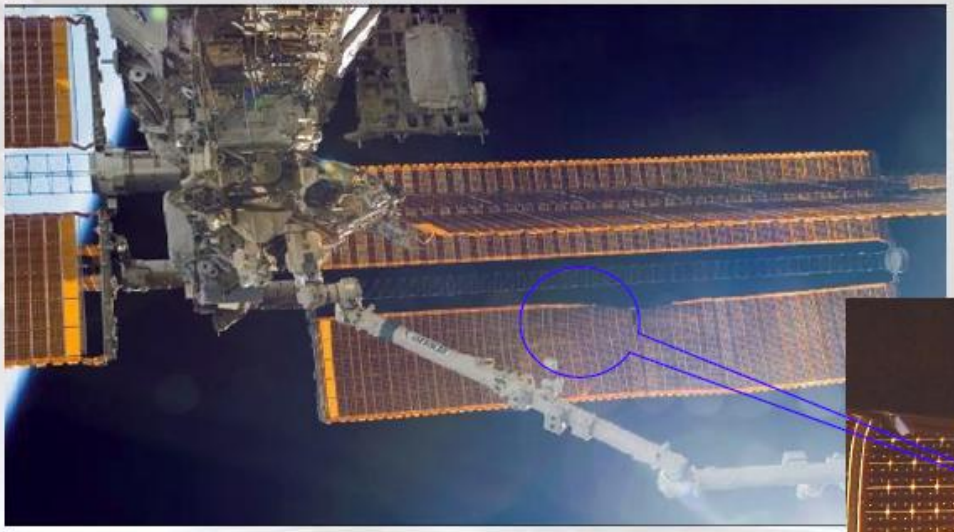
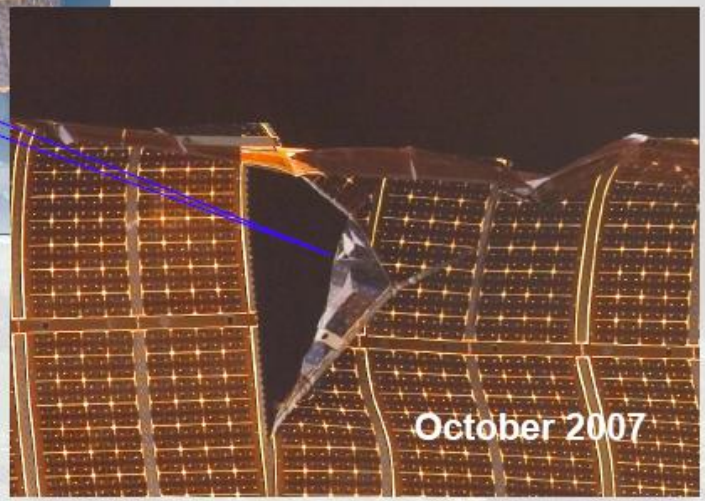
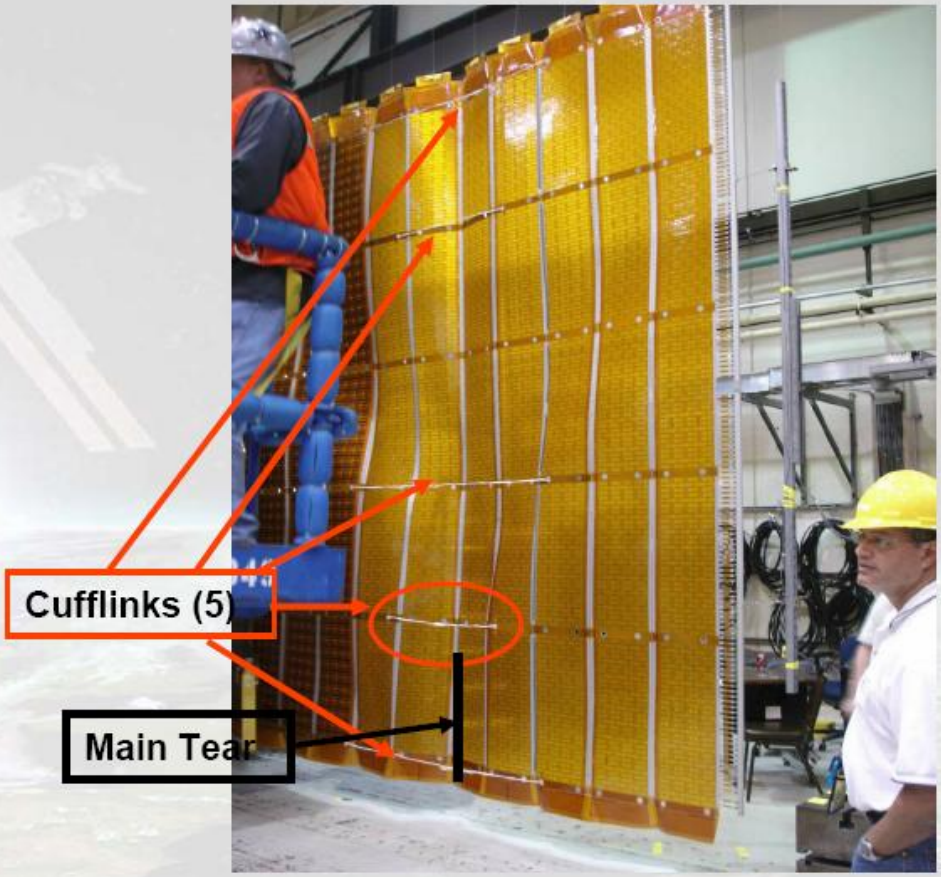
P6 array blanket damage





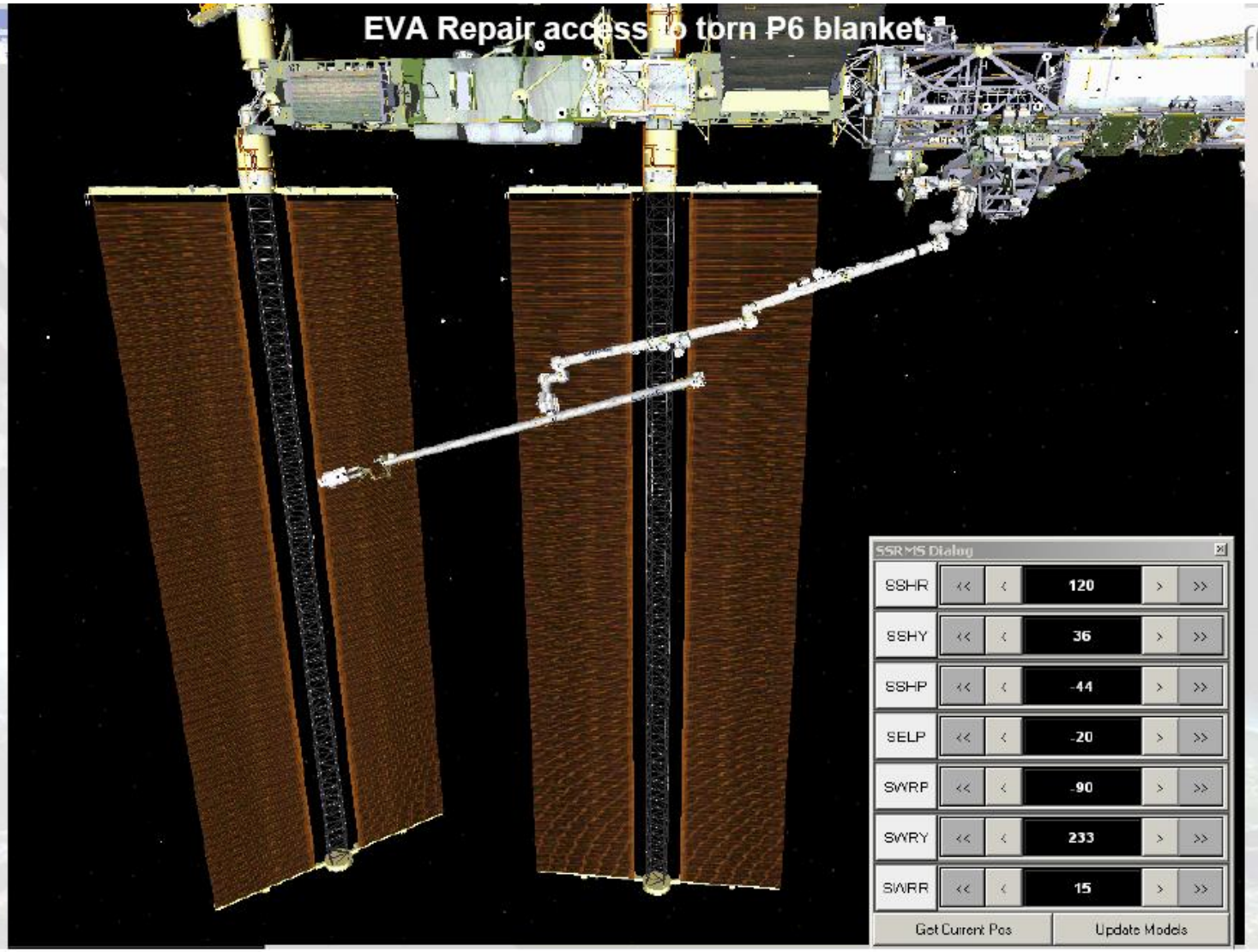
"Cufflinks" repair straps to give structural strength to torn array



EVA Repair access to torn P6 blanket

ISS016E008937

EVA Repair access to torn P6 blanket



COLUMBUS

Human Spaceflight
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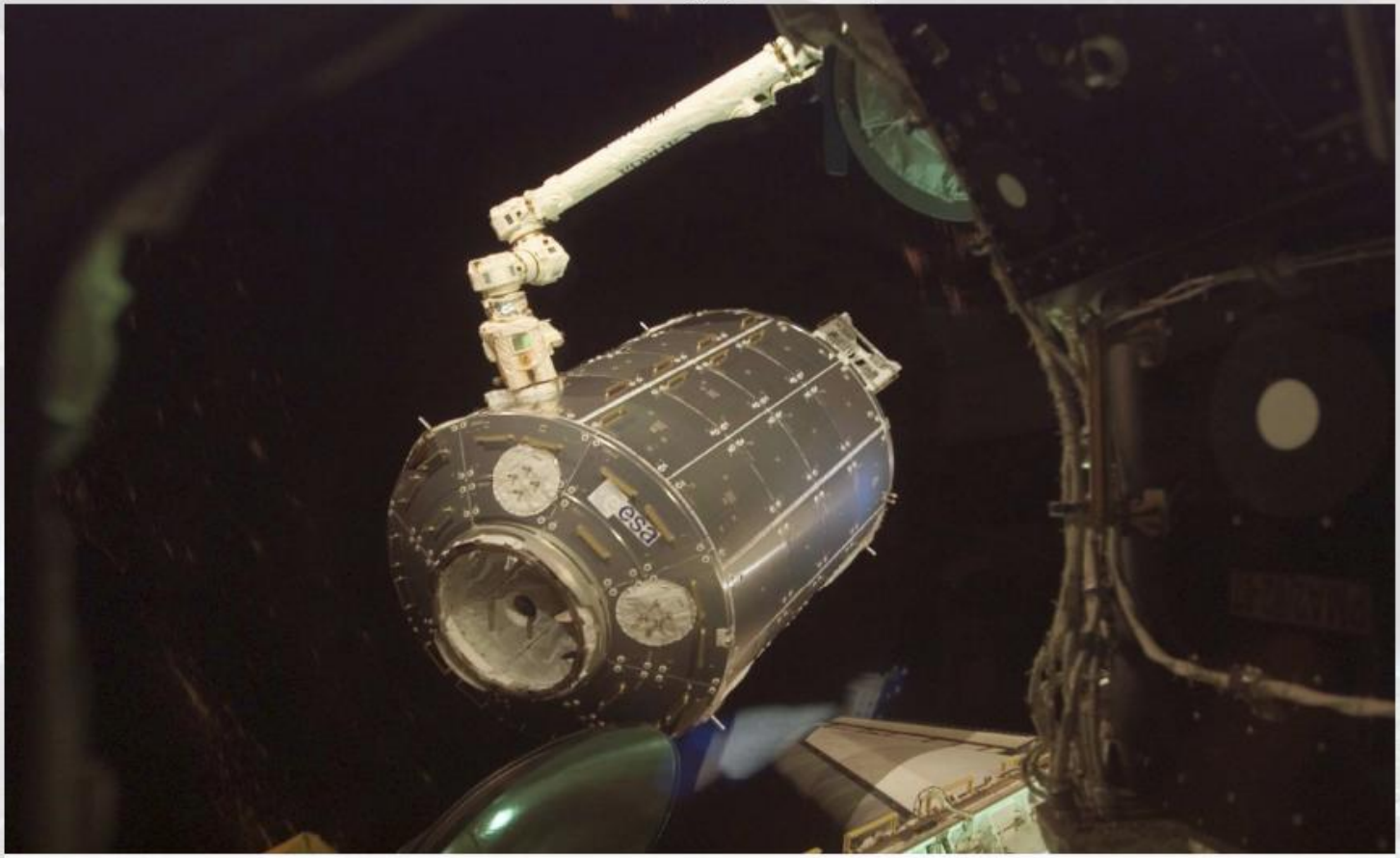
Launch (070208)

COLUMBUS

Human Spaceflight
SPACE FOR LIFE

Docking (110208)



S122E007873

COLUMBUS

Attached to ISS

S122E008222

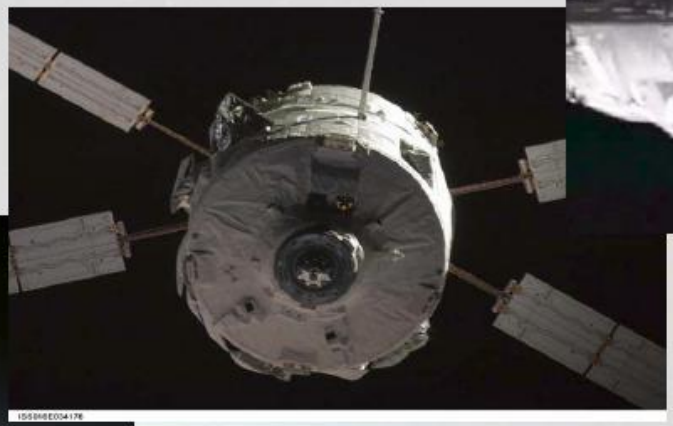
COLUMBUS

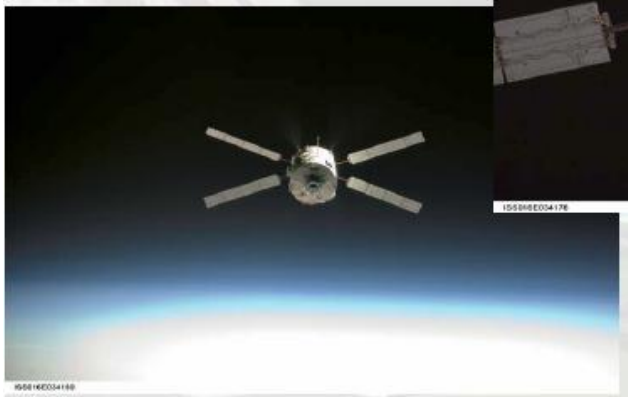
Facilities Set-up and first Utilisation

S122E008909

ATV

Docked and operational





3 April 2008

ISS Assembly Continues

Human Spaceflight
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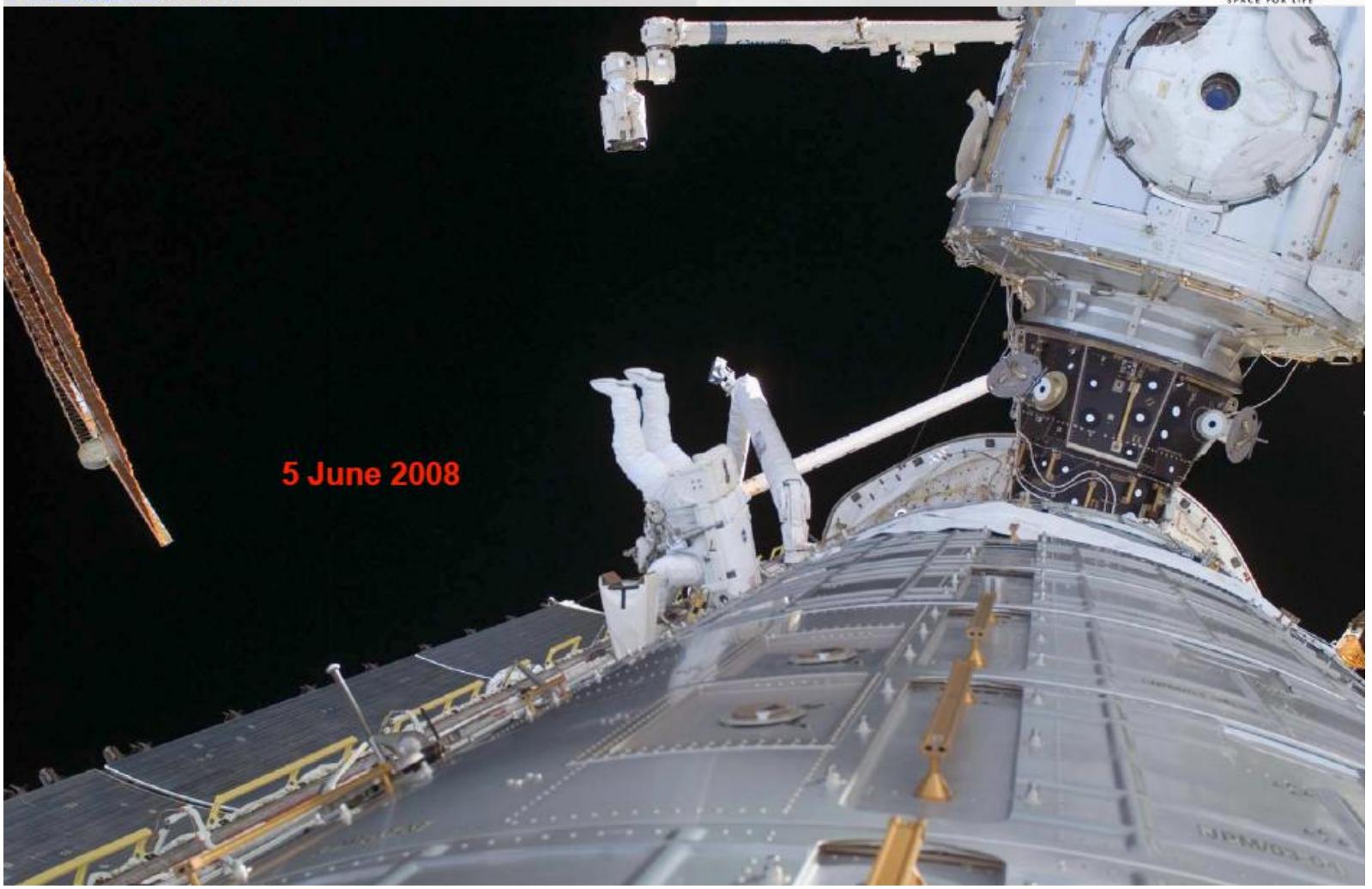
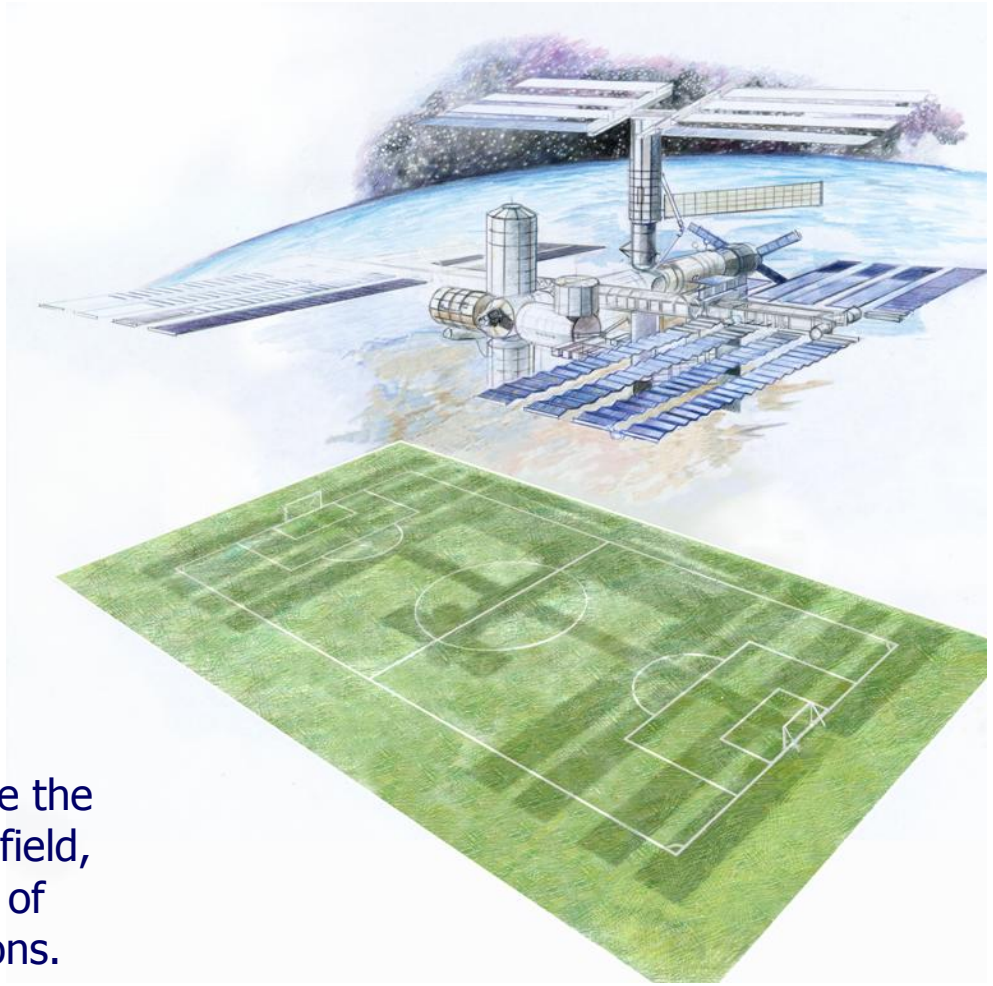
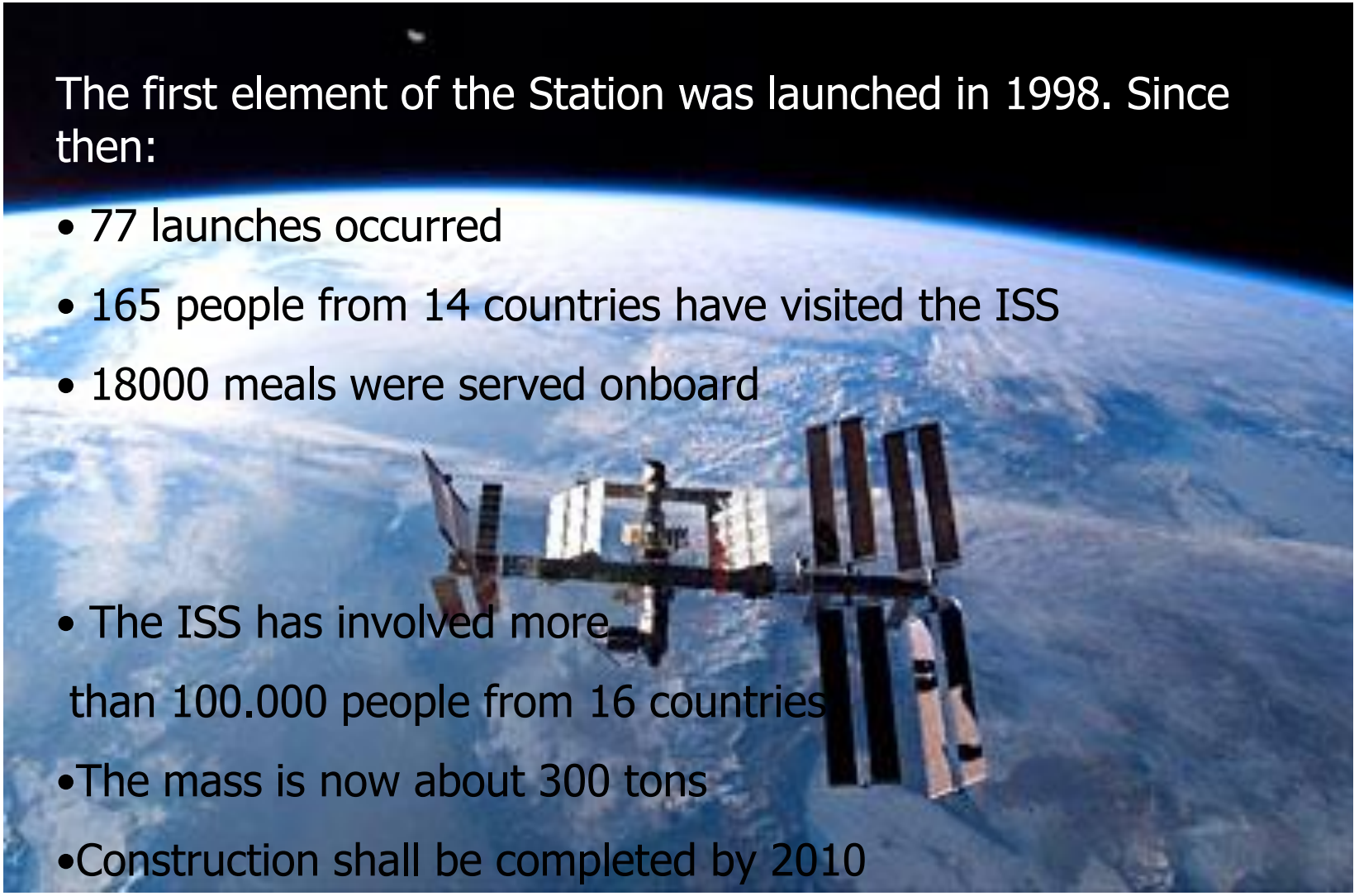


The International Space Station programme



The ISS, once completed, will be the size of a football field, and have a mass of more than 400 tons.

The International Space Station programme



The first element of the Station was launched in 1998. Since then:

- 77 launches occurred
- 165 people from 14 countries have visited the ISS
- 18000 meals were served onboard
- The ISS has involved more than 100.000 people from 16 countries
- The mass is now about 300 tons
- Construction shall be completed by 2010

Conclusion

- Europe has demonstrated its capability as a global space player in Human Spaceflight, similar to that of US and Russia, with the results achieved in the frame of its participation in the ISS programme
- European scientific and technological community shall make the best use of the capabilities offered to them by the Columbus Laboratory with its Payload Facilities
- Human space exploration is very challenging and ESA for its next projects needs all the skills it can gather in Europe
- **Greece has a unique opportunity to participate in the Human Spaceflight Programme with industries and scientific institutes, thus helping to shape the common European future in space**

- **<u>ΠΡΟΤΑΣΗ</u>**
- **Εισαγωγή στα προγράμματα διδασκαλίας της Ιατρικής Σχολής ενός μαθήματος σχετικού με τα τον Διεθνή Διαστημικό Σταθμό, το Ευρωπαϊκό Διαστημικό Εργαστήριο Columbus, την σχετική επιστημονική ιατρική έρευνα και τα αναμενόμενα οφέλη.**

European long-term research has started in Columbus ...