

ΕΛΛΑΔΑ-ΔΙΑΣΤΗΜΑ-ΠΡΟΟΠΤΙΚΕΣ

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Εργαστήριο Αστρονομίας, Τμήμα Φυσικής, ΑΠΘ

Θεσσαλονίκη, 25 Μαΐου 2011

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.

	D	B	F	I	NL	GB	DK	SP	S	CH	IRL	A	N	FIN	P	GR	LUX
2005	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2000	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1995	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1987	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1975	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1973	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1962	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
1962	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

ESA
ESRO
ELDO

- **ΔΙΑΣΤΗΜΙΚΟΙ ΣΤΑΘΜΟΙ**
- **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



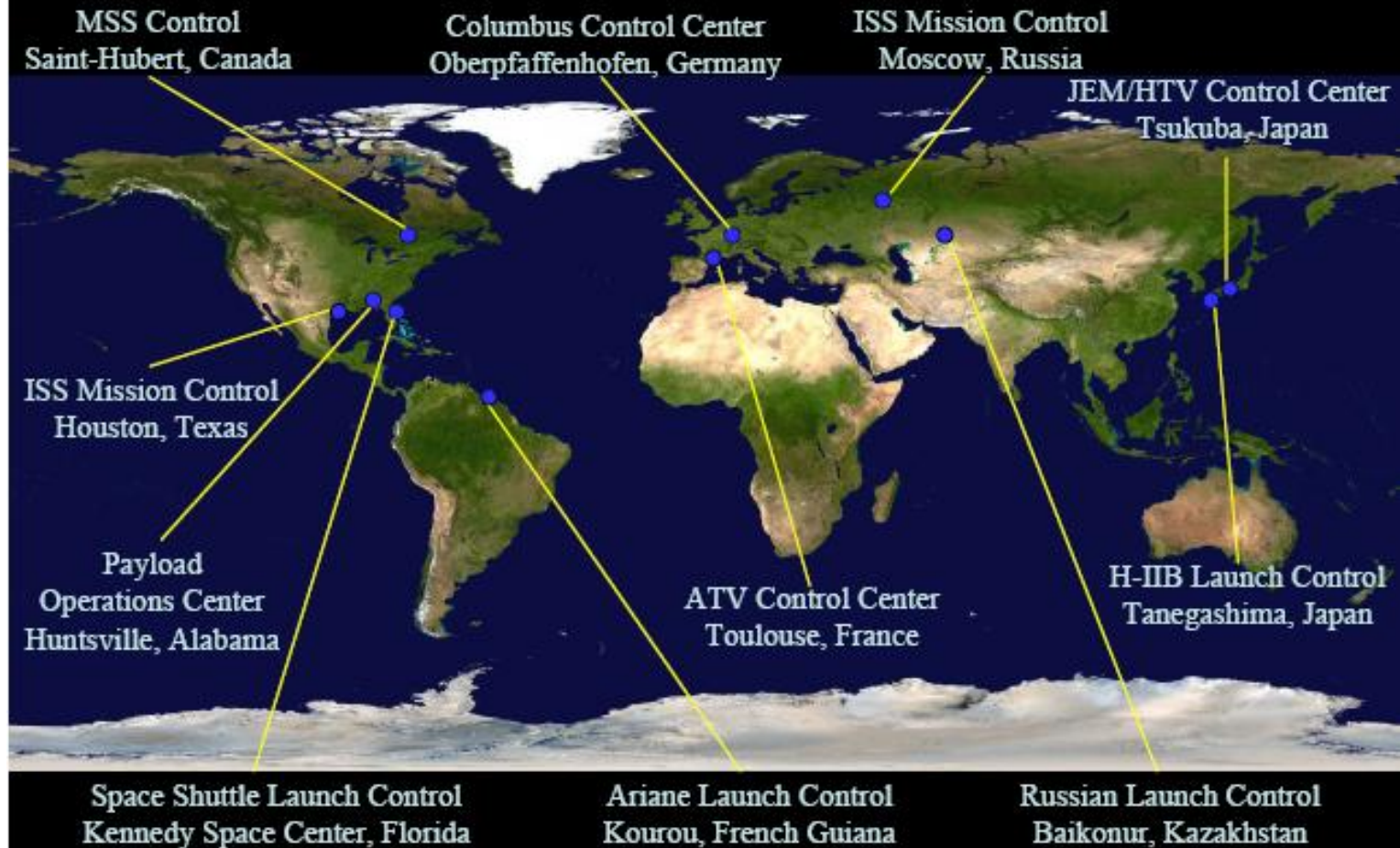
National Aeronautics and Space Administration



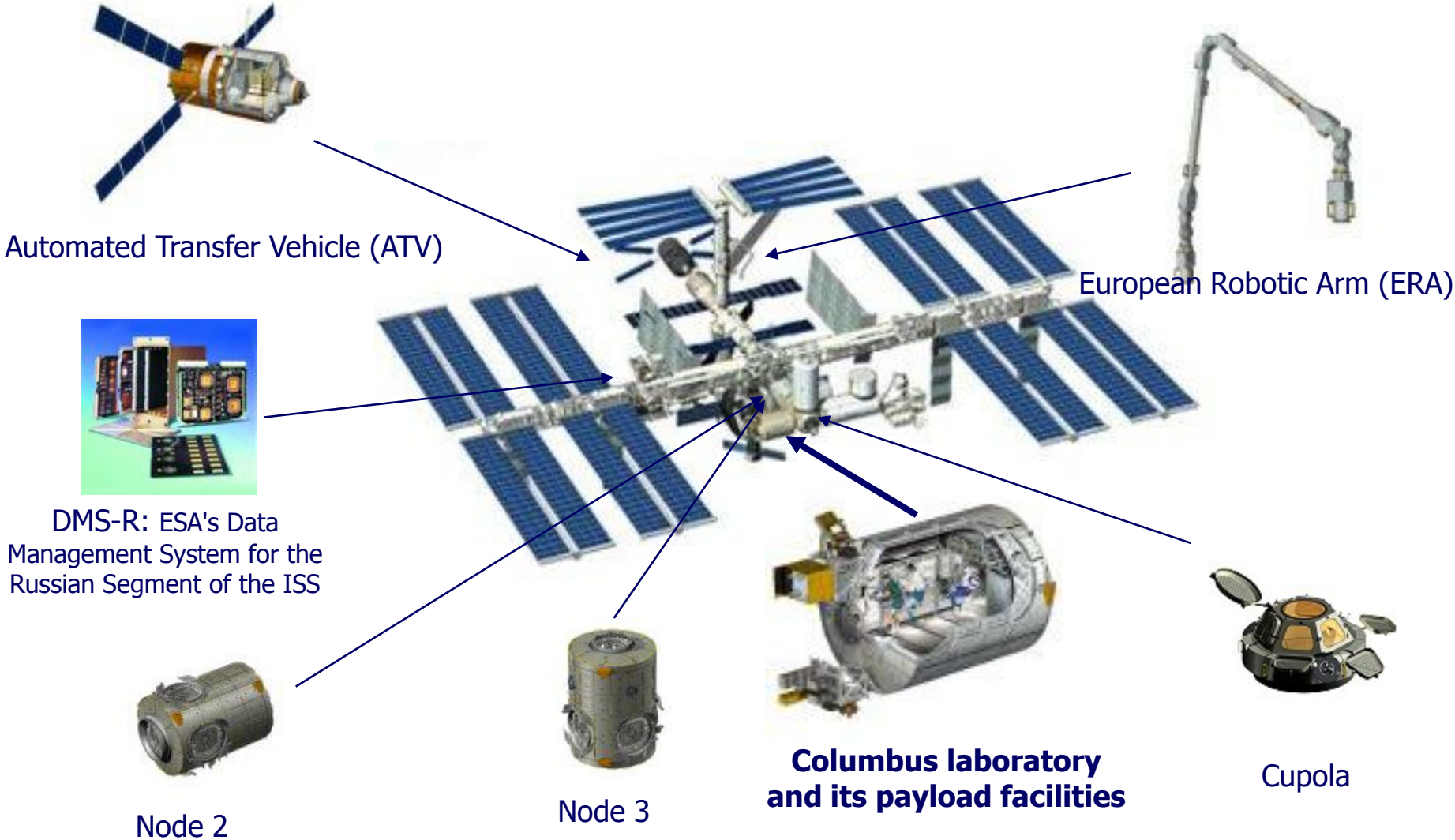
Russian Federal Space Agency



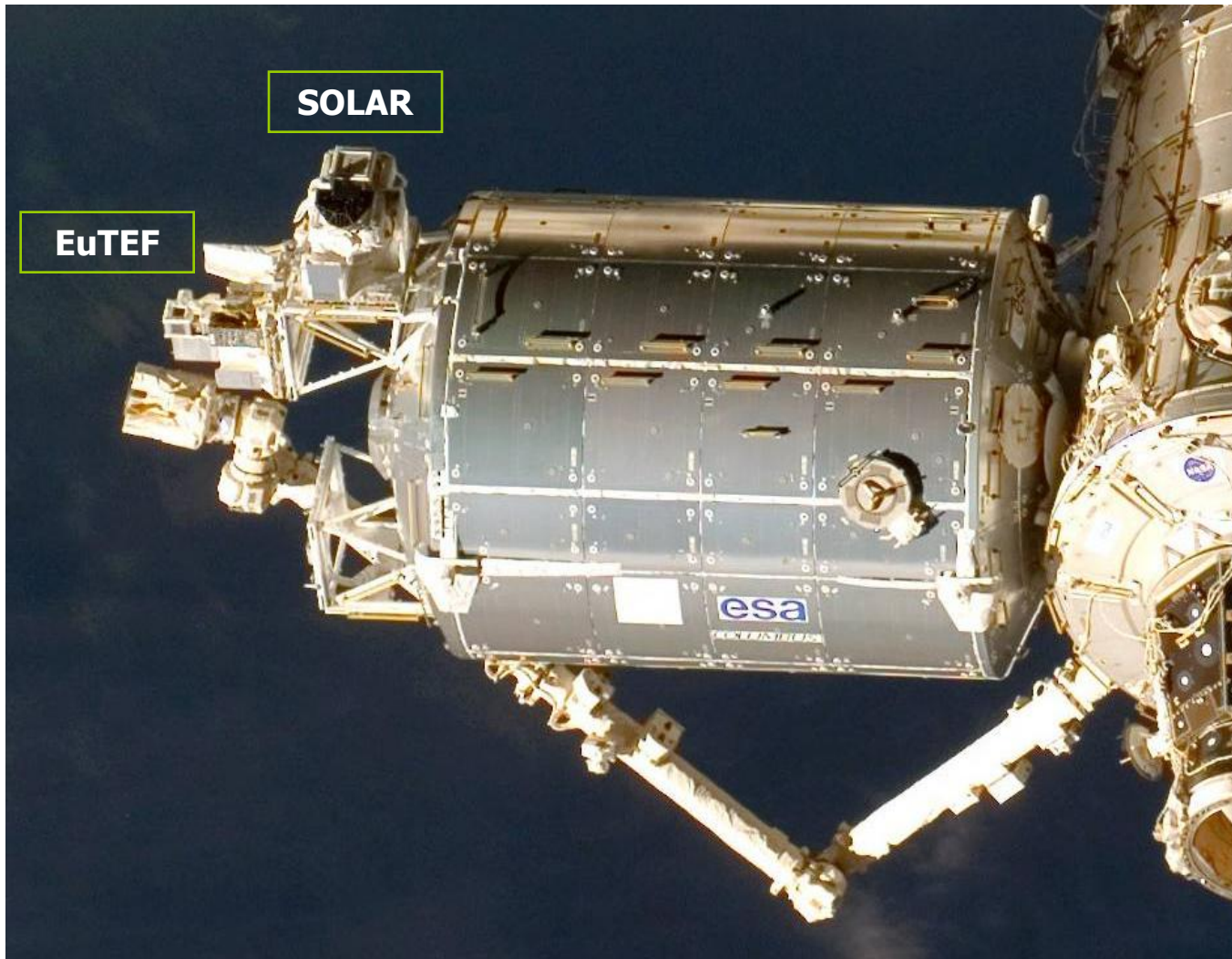
ISS Operations Centers



European participation in the ISS



Columbus External Payloads





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

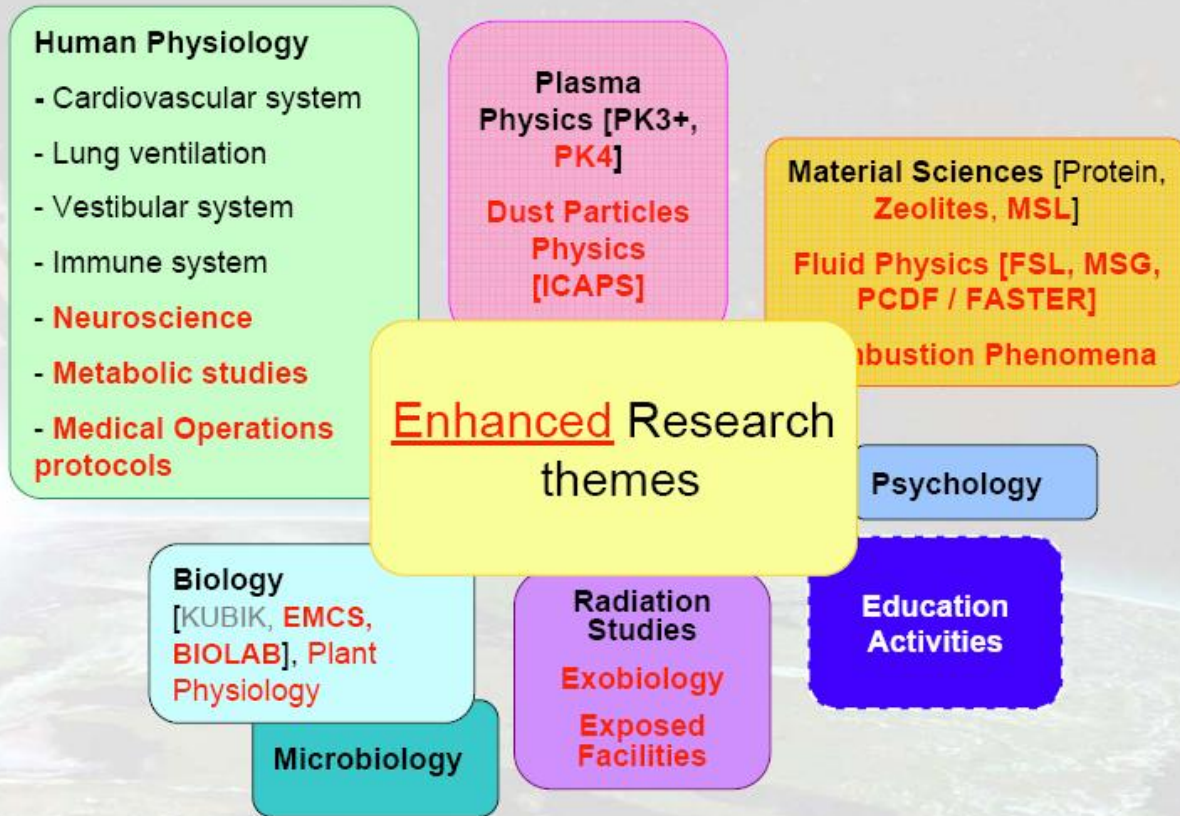
- Integrative gravitational physiology
- Non-gravitational physiology of spaceflight
- Countermeasures

•Planetary Exploration

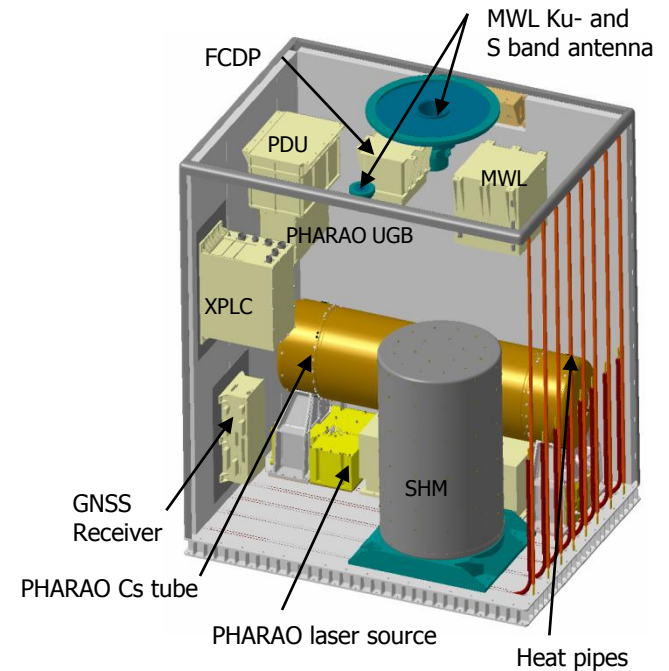
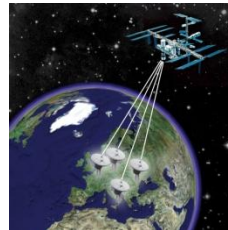
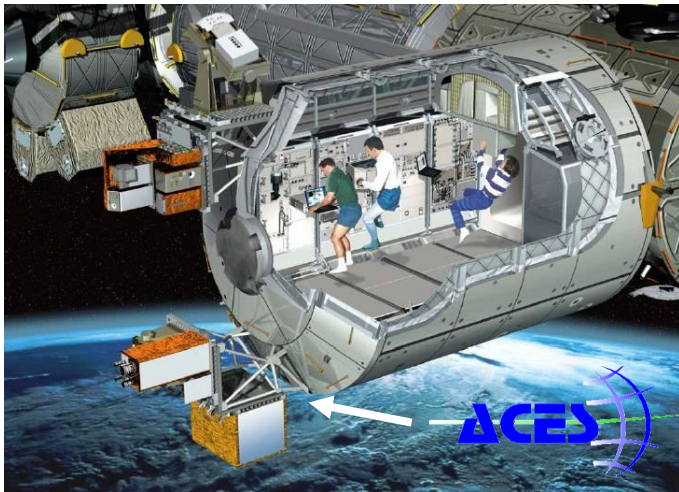
- Origin, Evolution and Distribution of life
- Preparation of Human Planetary Exploration



... 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

ESA Experimental Program Overview

HUMAN RESEARCH

*3D Space
Card
EPM- Neurospat
EPM - Passages
SOLO
Thermolab
Vessel Imaging
Ground Experiments
(EKE, OTOLITH, ZAG)*

BIOLOGY

*CFS-A
Genara-A*

RADIATION DOSIMETRY

*ALTEA-Shield
DOSIS
Matroshka-Kibo*

FLUID PHYSICS

*Geoflow-2
SODI-Colloid*

MATERIALS SCIENCE

MSL/MICAST

**TECHNOLOGY
DEMONSTRATIONS**

*Vessel ID System
ERB-2*

SOLAR PHYSICS

Solar

EDUCATION

ESA Greenhouse

Human Research

▪ European Physiology Modules:

*Again used during Incr 26 for **NEUROSPAT** experiment in Feb 2011 (two separate experiments covering brain processing and prefrontal brain function and spacial cognition) and **PASSAGES** experiment in Jan, Feb and Apr 2011 to test how astronauts interpret visual information in weightlessness.*

A new video unit for the European Physiology Modules was uploaded on ATV-2 in February.

Experiments included Paolo Nespoli as test subject.



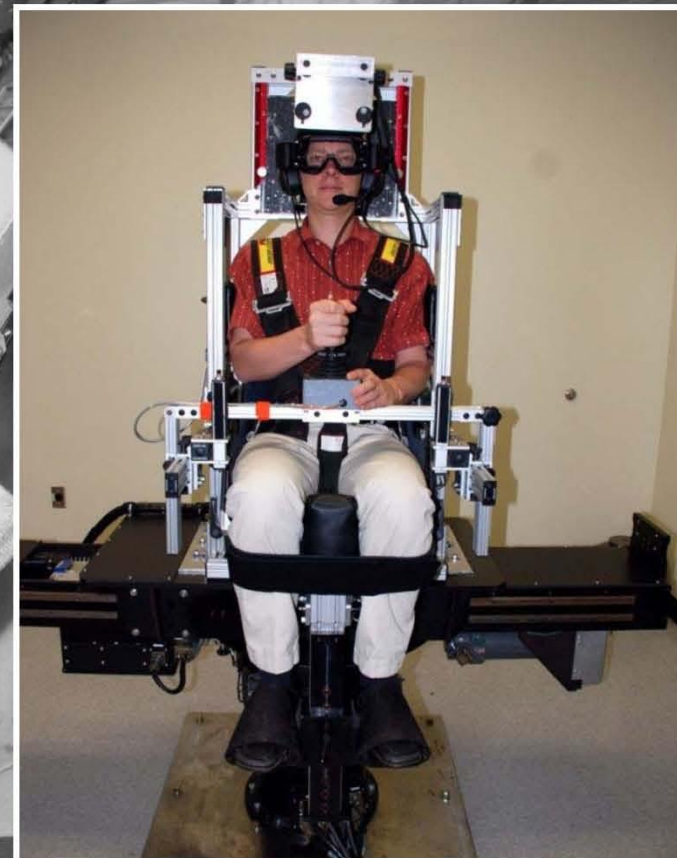
Human Research

- **Portable Pulmonary Function System:** Supports broad range of physiological research experiments. Continued use (combined with exercise) for undertaking **EKE** experiment and ESA's **THERMOLAB** experiment in conjunction with NASA's **VO2 Max** experiment (Feb, Apr).
- **Stand-Alone and Other Experiments:**
 - **3D SPACE:** Undertaken in Jan, Feb and Apr. Different subjects including Paolo Nespoli. Covering 'spaceflight-related decreases in vertical perception'. All 8 valid subjects now complete. Early results indicate altered 3D perception in weightlessness.
 - **SOLO: Sodium Loading in Microgravity (SOLO)** experiment PCBA software updated in January. Paolo Nespoli first SOLO sessions in Feb. Incr 23/24 blood/urine samples for in MELFI returned on STS-133/ULF-5 on 9 March.



Human Research

- **Stand-Alone and Other Experiments:**
 - **CARD:** *How weightlessness affects the regulation of blood pressure. New holter upload on 41P. Paolo Nespoli started CARD experiment in April. First results indicate confirmation experiment hypothesis (low blood pressure in space & systemic dilation of peripheral resistance vessels).*
 - **VESSEL IMAGING:** *Additional measurements in Dec 2010 to evaluate changes in central and peripheral blood vessel wall properties. On hold due to HRF Ultrasound.*
 - **Ground Experiments:** *Continued data collection for **OTOLITH** (Otolith assessment during postflight re-adaptation), and **ZAG** (investigation of astronaut's perception of motion and tilt and level of performance).*



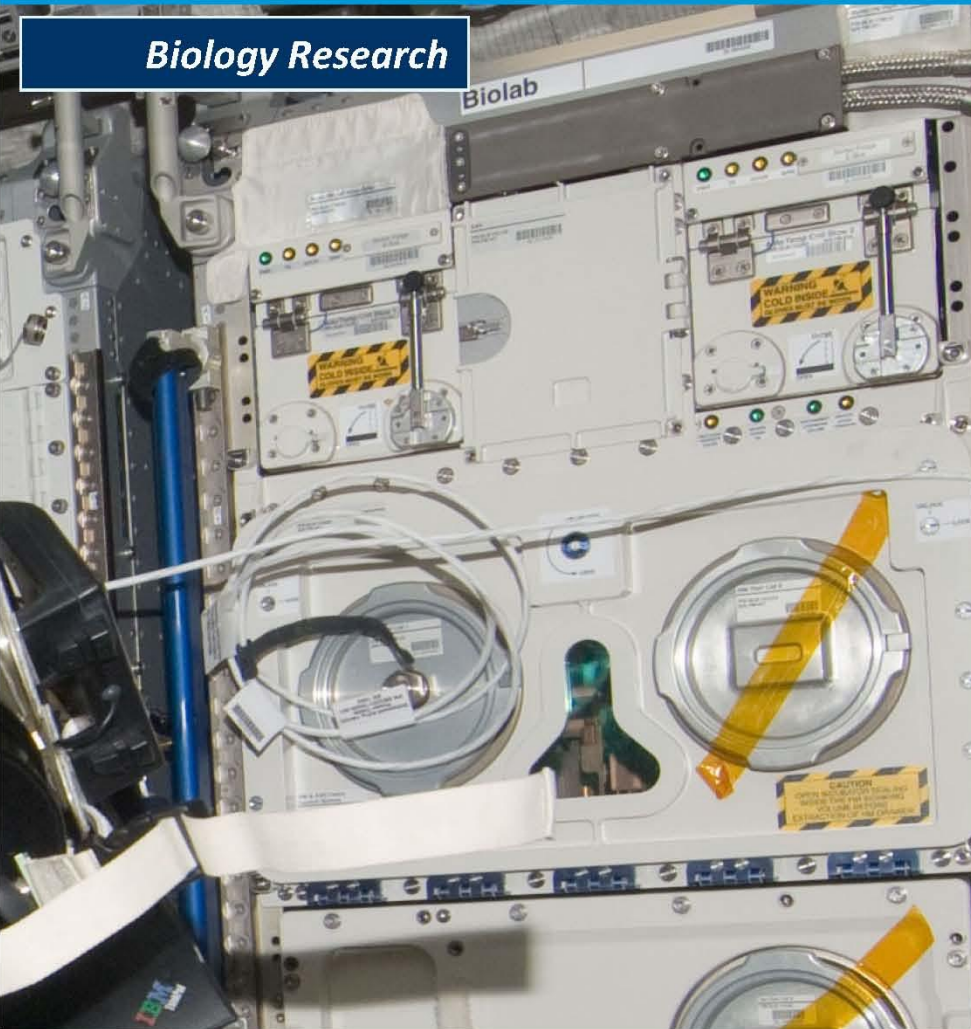
Biology Research



- **CFS-A:** *Coloured Fungi in Space* is examining survival and growth of different coloured fungi species. Relevant to spacecraft contamination, panspermia and planetary protection issues. STS- 133 upload of four bio-containers with samples in February. Three bio-containers with live cultures were returned with STS-133 which landed on 9 March. Fourth bio-container with dry spores still on orbit.

Significant post-flight analysis already done by the science team on returned samples: Different growth rates for the aerial and for the submerged mycelium are observed.

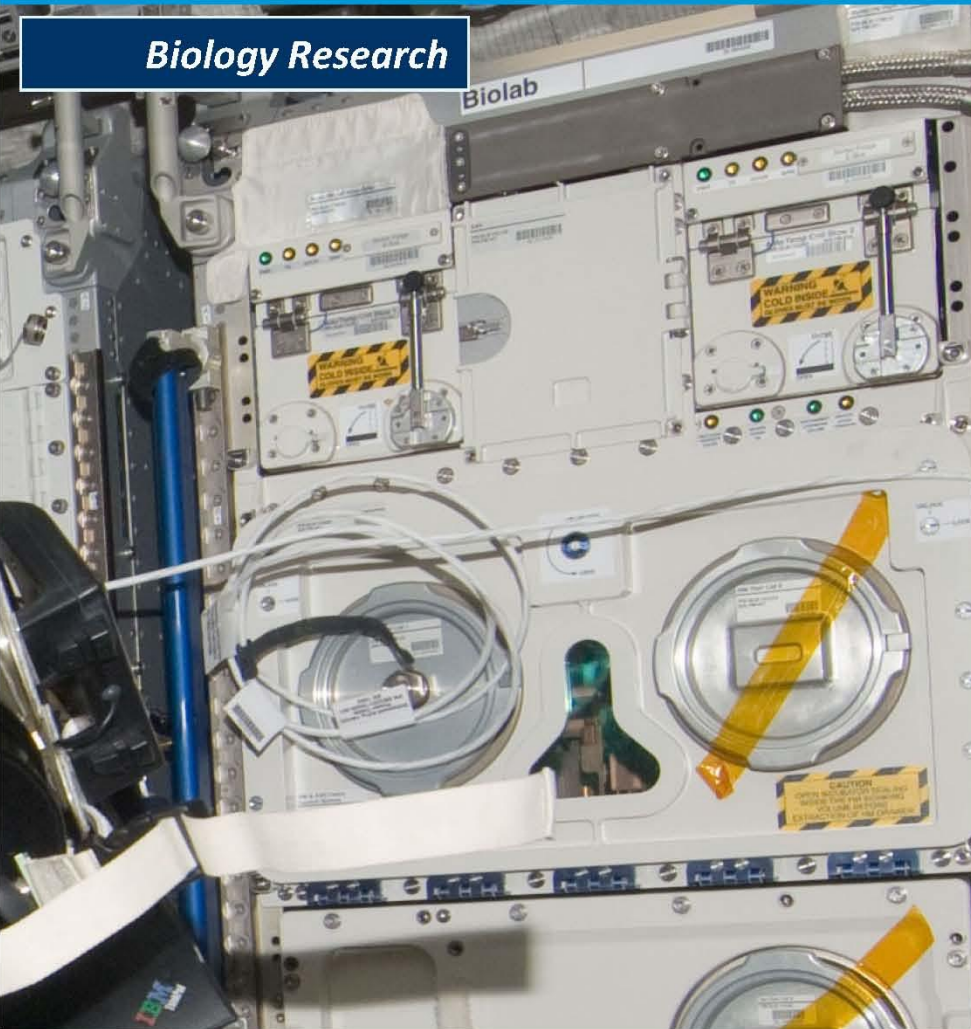
Biology Research



- **Genara-A:** Carried out in the EMCS in July 2010. Studying plant (*Arabidopsis*) growth at molecular level in weightlessness. Samples in frozen storage were returned on STS-133/ ULF-5 in March and are back with science teams. Seedlings in top Cultivation Chambers showed good growth.



Biology Research



- **Biolab:** *Following extensive ground-commanded functional testing undertaken via the MUSC USOC and Col-CC, a recovery plan has been implemented. Biolab Handling Mechanism Gripper returned on Soyuz 24S, Microscope and Spectrophotometer packed for return on STS-134/ULF-6. TripleLux experiments' planning has been revised.*

Fluid Science

- **GEOFLOW-2:** in ESA's Fluid Science Laboratory. Continued experiment runs through Incr 27 into into Incr 28. On conclusion FSL Video Management Unit to be removed and returned on STS-135/ULF-7 in July.

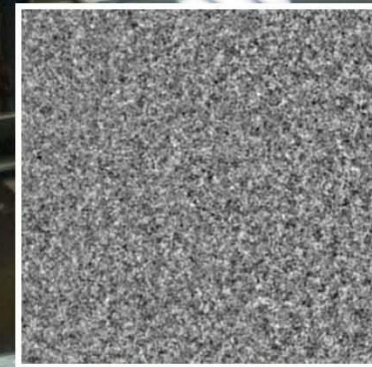
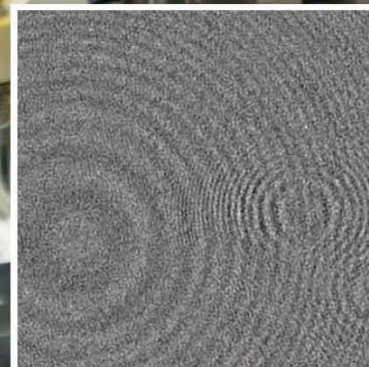
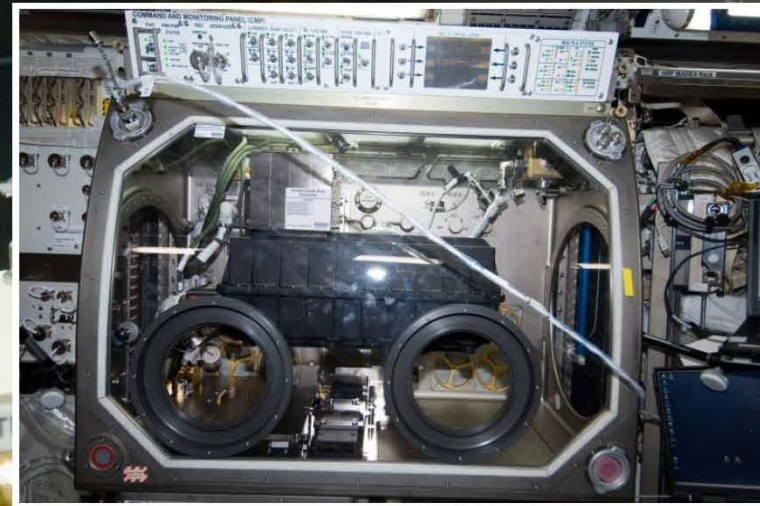


Fluid Science

SELECTABLE OPTICAL DIAGNOSTICS INSTRUMENT (SODI)

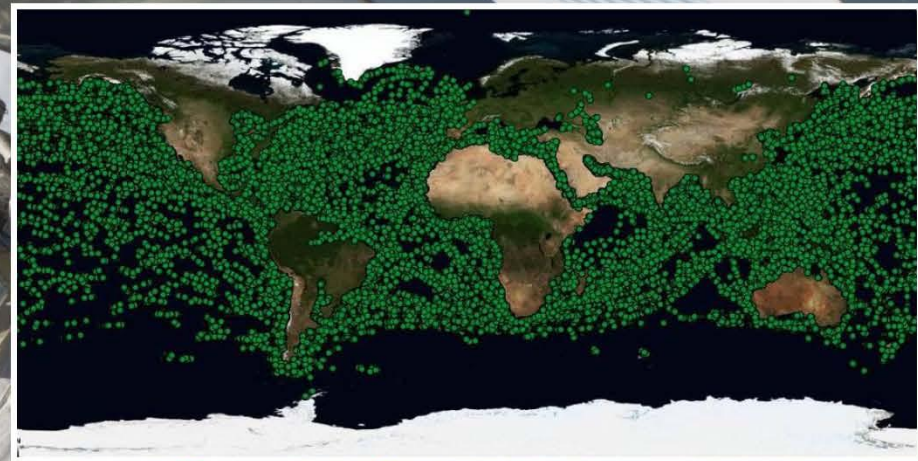
- **SODI - COLLOID:** *SODI - Colloid completed and successful operations and science acquisition in Microgravity Science Glovebox in Sept/Oct 2010. Several bonus science runs performed. Aggregation temperatures determined, and dynamics of aggregation studied for the first time. Promising preliminary results. Experiment data undergoing analysis with the science team after flash disks returned on STS-133/ULF-5 which landed on 9 March.*

Promising applications in optical components. Second of 3 SODI experiments in MSG. Follows on from 'Influence of Vibrations on Diffusion in Liquids' (IVIDL) from Oct 2009 to Jan 2010.



Technology Demonstrations

- **VESSEL ID SYSTEM:** *is demonstrating the space-based capability of identification of maritime vessels and testing the ability of an external grappling adaptor to accommodate small payloads. Installed in Columbus in May 2010 and continuously acquiring data. Problem encountered after swap to LuxAIS receiver on 27 Sept. 2010 Swapped back to NORAIS receiver in October and still working extremely well. Failed LuxAIS receiver returned for analysis/repair with Soyuz 24S in March.*



Technology Demonstrations

- **Erasmus Recording Binocular 2:** *High definition ESA 3D video camera which provides a vastly improved 3D video effect for mapping the Station. Commissioned using EDR in September 2010. ESA astronaut Paolo Nespoli undertook first experiment recording session with the device on 8 Jan and again in March. Data Hard Disk return on STS-134/ULF-6. More free use of ERB-2 being developed.*



Radiation Dosimetry

- **ALTEA-Shield:** *a better understanding of interaction between cosmic rays and brain function, as well as testing different types of shielding material.*

Hardware setup by Paolo Nespoli on 23 April for continuation of SURVEY part of experiment which ran for 2 months from September 2010. Science acquisition continued from 25 April.



Radiation Dosimetry

- **DOSIS:** Continued mapping of nature and distribution of the radiation field inside Columbus using active DOSTEL detector. Second DOSTEL unit packed for return to Earth on Soyuz 25S in May 2011.
- **MATROSHKA-KIBO:** study of radiation absorption on the ISS using a simulated human Phantom in the Japanese Kibo Laboratory. Facility disassembled and passive dosimeters removed and returned for analysis on Soyuz 24S in March.



Exposure Facilities

- **SOLAR:** continues to study the Sun's irradiation with unprecedented accuracy, currently for more than 3 years. Has produced excellent scientific data during Sun observation cycles.

Exposure Facilities



- **Expose-R:** *nine different exobiology experiments. Deployed outside ISS since March 2009. Mission extended based on Roscosmos request. Retrieved during Russian EVA on 21 Jan. Sample trays returned on STS-133/ULF-5 on 9 March. Disassembled at DLR for return to science teams.*



Education



- **ESA Greenhouse:** *education project where the concept of fresh food production in space is related to the biology and science curriculums of 12 -14 year olds through film/live link activities. On-orbit activities with ESA astronaut Paolo Nespoli ended. On ground activities continuing with Mars 500 Crew.*
- **'Mission X: Train Like an Astronaut:** *including ISS live links with Nespoli, this project aimed to create positive awareness of human spaceflight activities and make European astronauts an inspiring model for a healthy lifestyle among young people. (8-12 yrs)*
- **ISS Ham Radio** – *ESA astronaut Paolo Nespoli carried out an extensive number of radio contacts with schoolchildren and students from the ISS.*

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
SPACE FOR LIFE

- **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:**

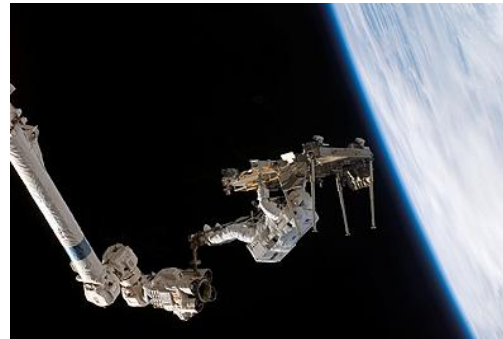
- Development of advanced intermetallics for manufacturing lightweight turbine blades
- Better understanding of heat-transfer and fluid storage for space applications
- Patent on the use of NO as diagnostic for lung embolism and related diseases
- Development of advanced biotechnological and biomedical 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

Human Spaceflight
SPACE FOR LIFE

(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

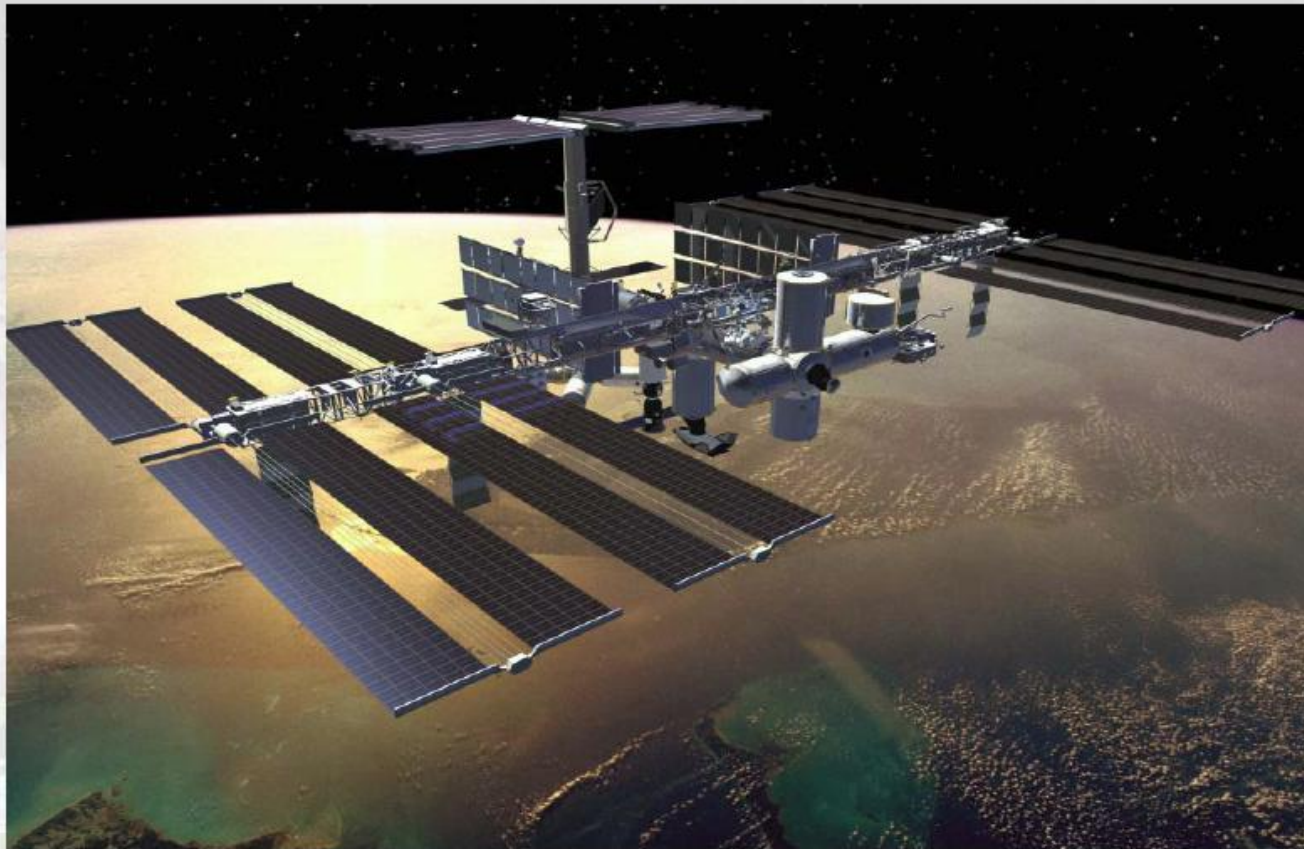
“Your neuro-vestibular, cardio-vascular, and musculo-skeletal systems can’t support you anymore.”





The International Space Station (ISS)

Human Spaceflight
SPACE FOR LIFE





ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE

June 1999





ISS Assembly On-Orbit Configurations

Human Spaceflight
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September 2000





ISS Assembly On-Orbit Configurations

Human Spaceflight
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December 2000





ISS Assembly On-Orbit Configurations

Human Spaceflight
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April 2001



ISS Assembly On-Orbit Configurations

Human Spaceflight
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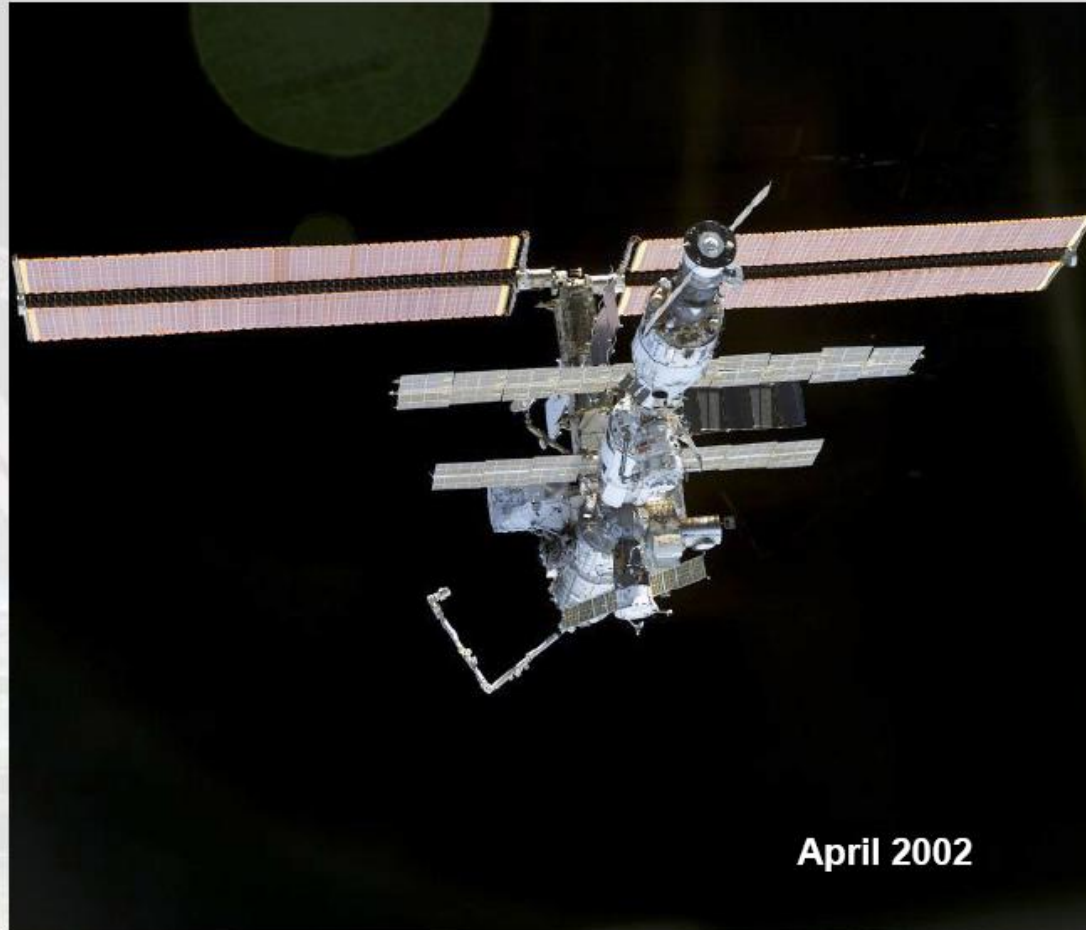


August 2001



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



April 2002



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



October 2002

S112E05823



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



December 2002

S113E05448



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



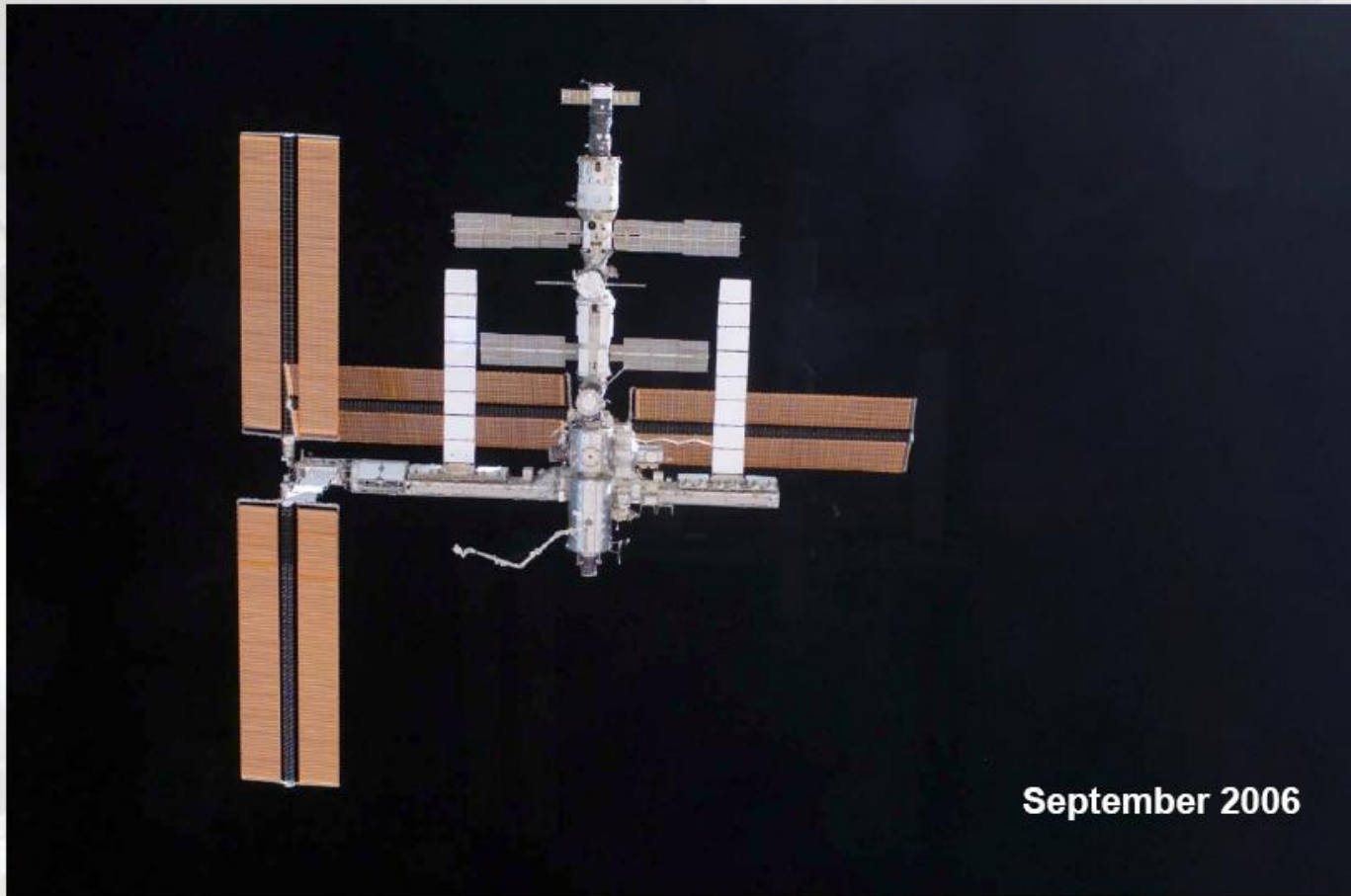
July 2005

S114E7219



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



September 2006

S115E06723



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE

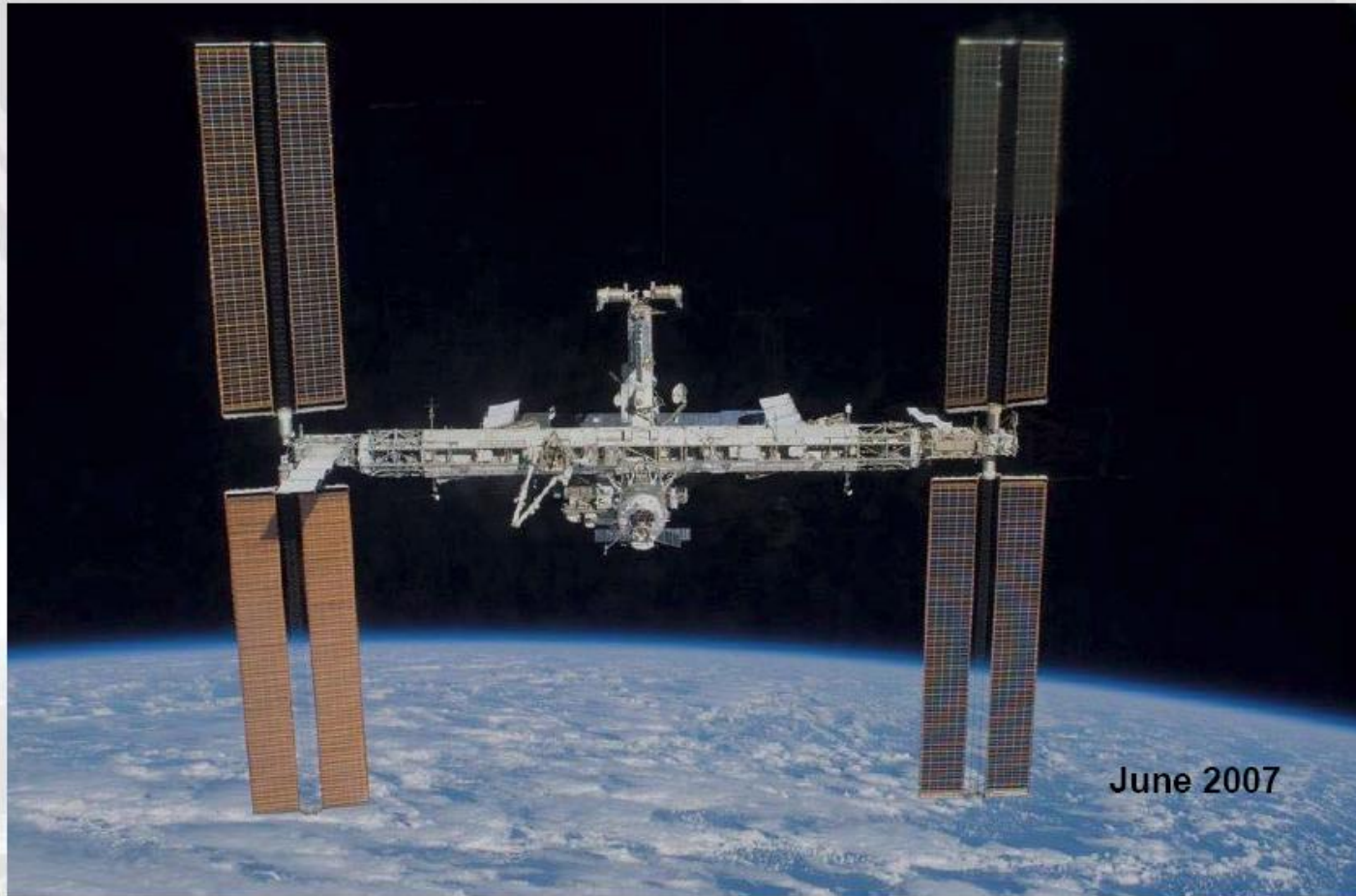


December 2006



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



June 2007



ISS Assembly On-Orbit Configurations

Human Spaceflight
SPACE FOR LIFE



November 2007

S120E009604



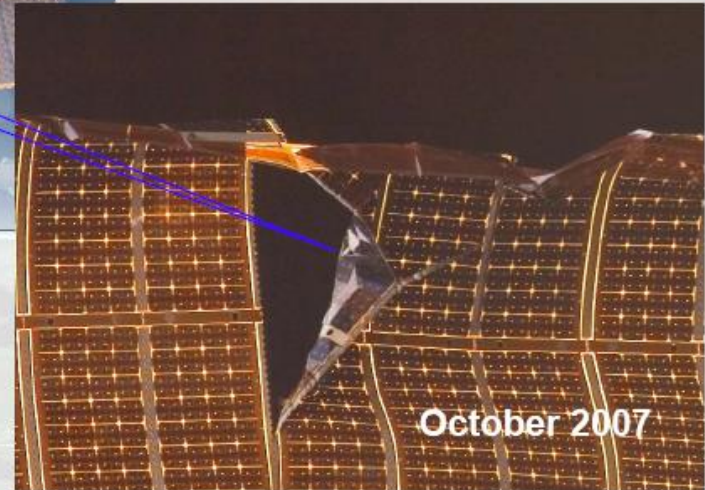
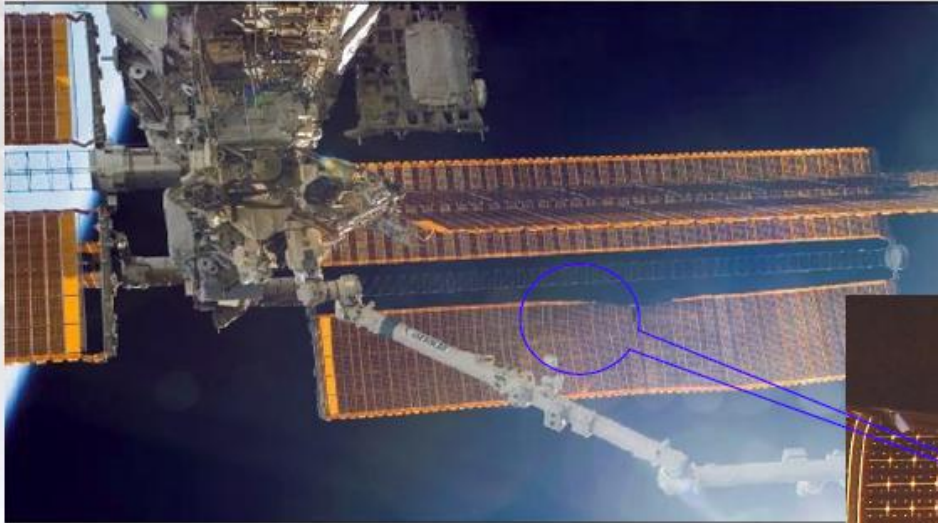
Solar array troubles

Human Spaceflight
SPACE FOR LIFE

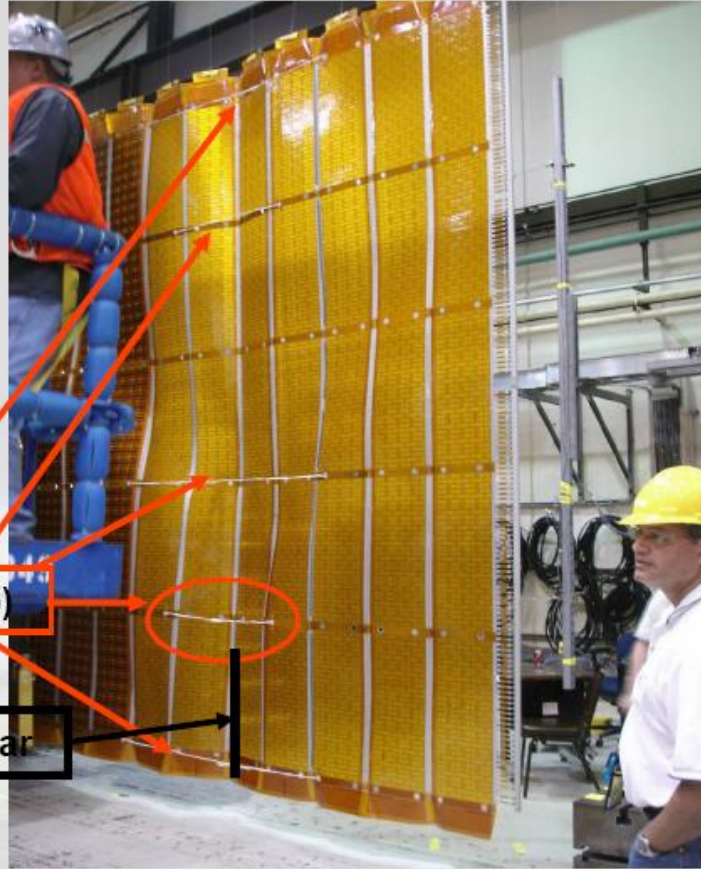


January 2007

P6 array blanket damage



“Cufflinks” repair straps to give structural strength to torn array



Cufflinks (5)

Main Tear



EVA Repair access to torn P6 blanket

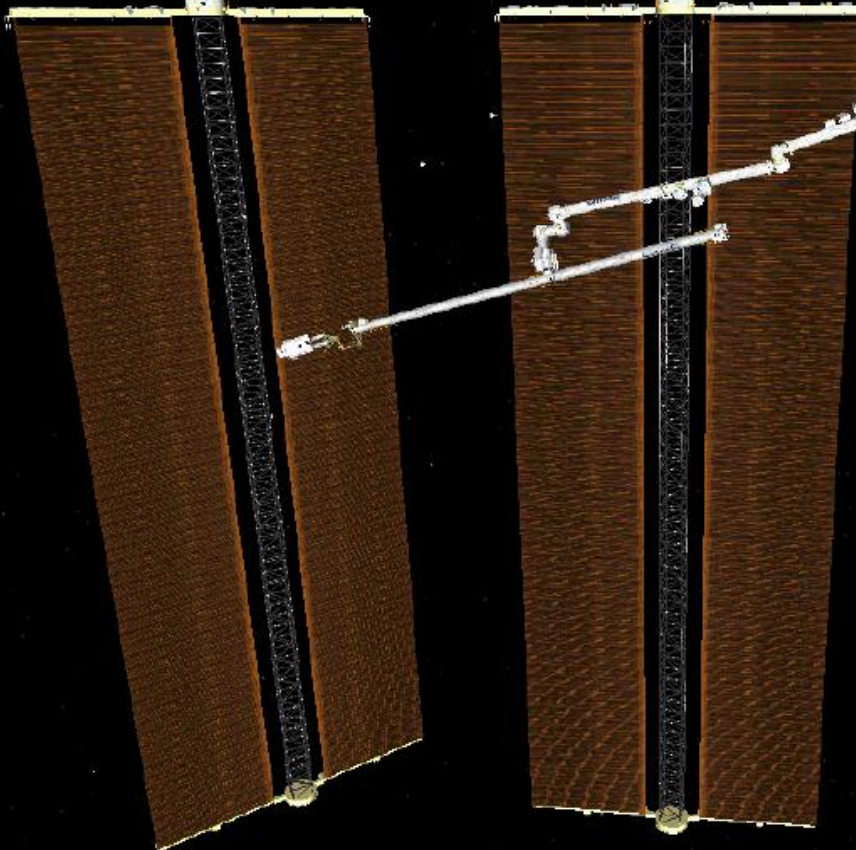
Human Spaceflight
SPACE FOR LIFE



ISS016E008937

EVA Repair access to torn P6 blanket

flight
1998



SSRMS Dialog

SSHR	<<	<	120	>	>>
SSHY	<<	<	36	>	>>
SSHP	<<	<	-44	>	>>
SELP	<<	<	-20	>	>>
SWRP	<<	<	-90	>	>>
SWRY	<<	<	233	>	>>
SWRR	<<	<	15	>	>>
Get Current Pos			Update Models		



COLUMBUS

Human Spaceflight
SPACE FOR LIFE

Launch (070208)





COLUMBUS

Human Spaceflight
SPACE FOR LIFE

Docking (110208)



S122E007873



COLUMBUS

Human Spaceflight
SPACE FOR LIFE

Attached to ISS



S122E008222

Facilities Set-up and first Utilisation



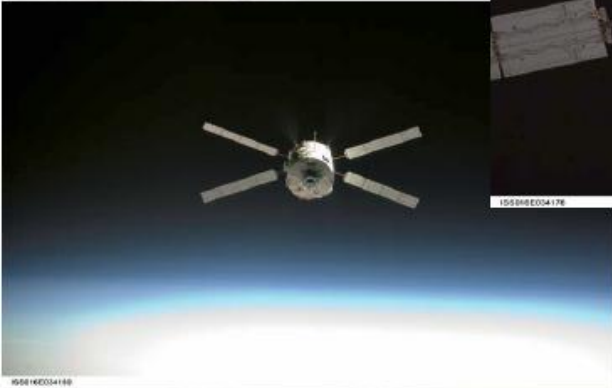
S122E008909



ATV

Human Spaceflight
SPACE FOR LIFE

Docked and operational



3 April 2008





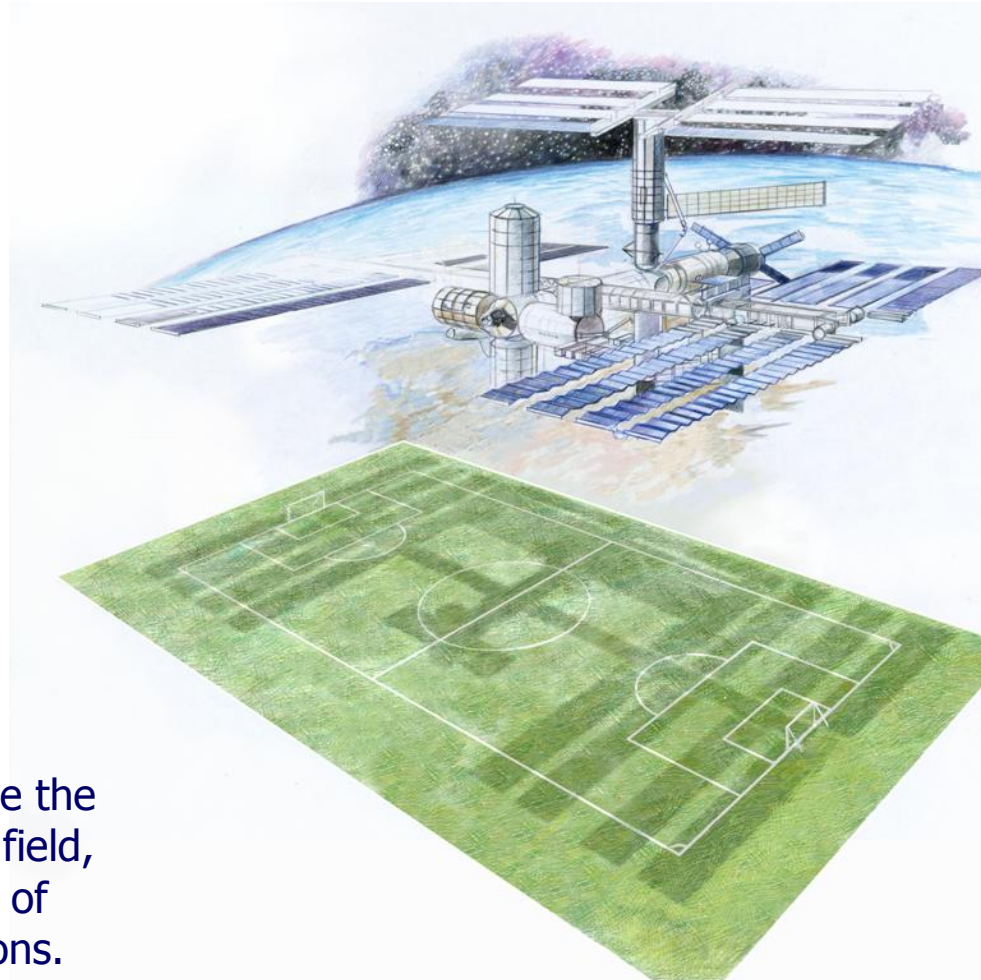
ISS Assembly Continues

Human Spaceflight
SPACE FOR LIFE



5 June 2008

The International Space Station programme

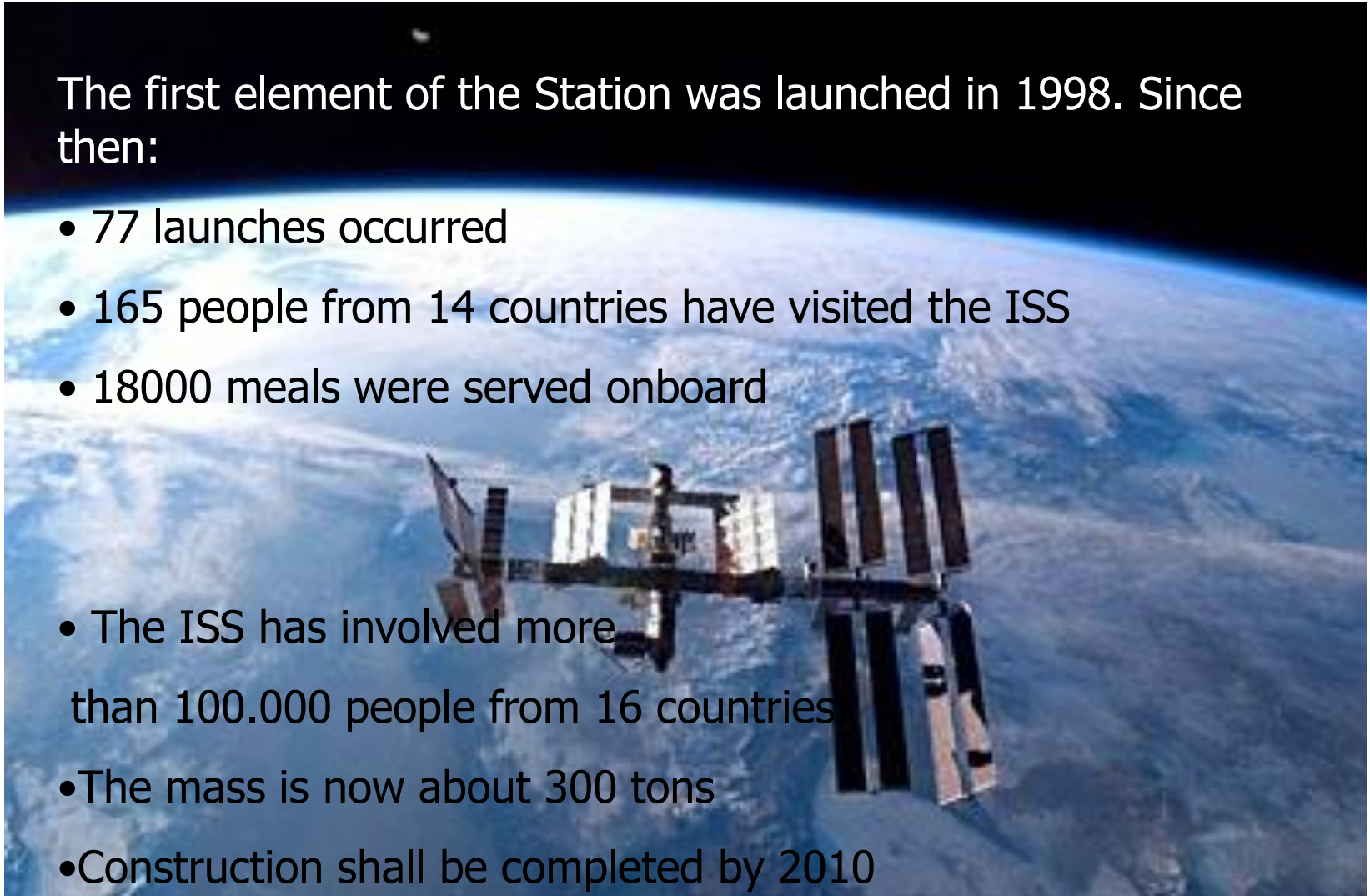


The ISS, once completed, will be the size of a football field, and have a mass of more than 400 tons.

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**



- **ΠΡΟΤΑΣΗ**
- **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 ...

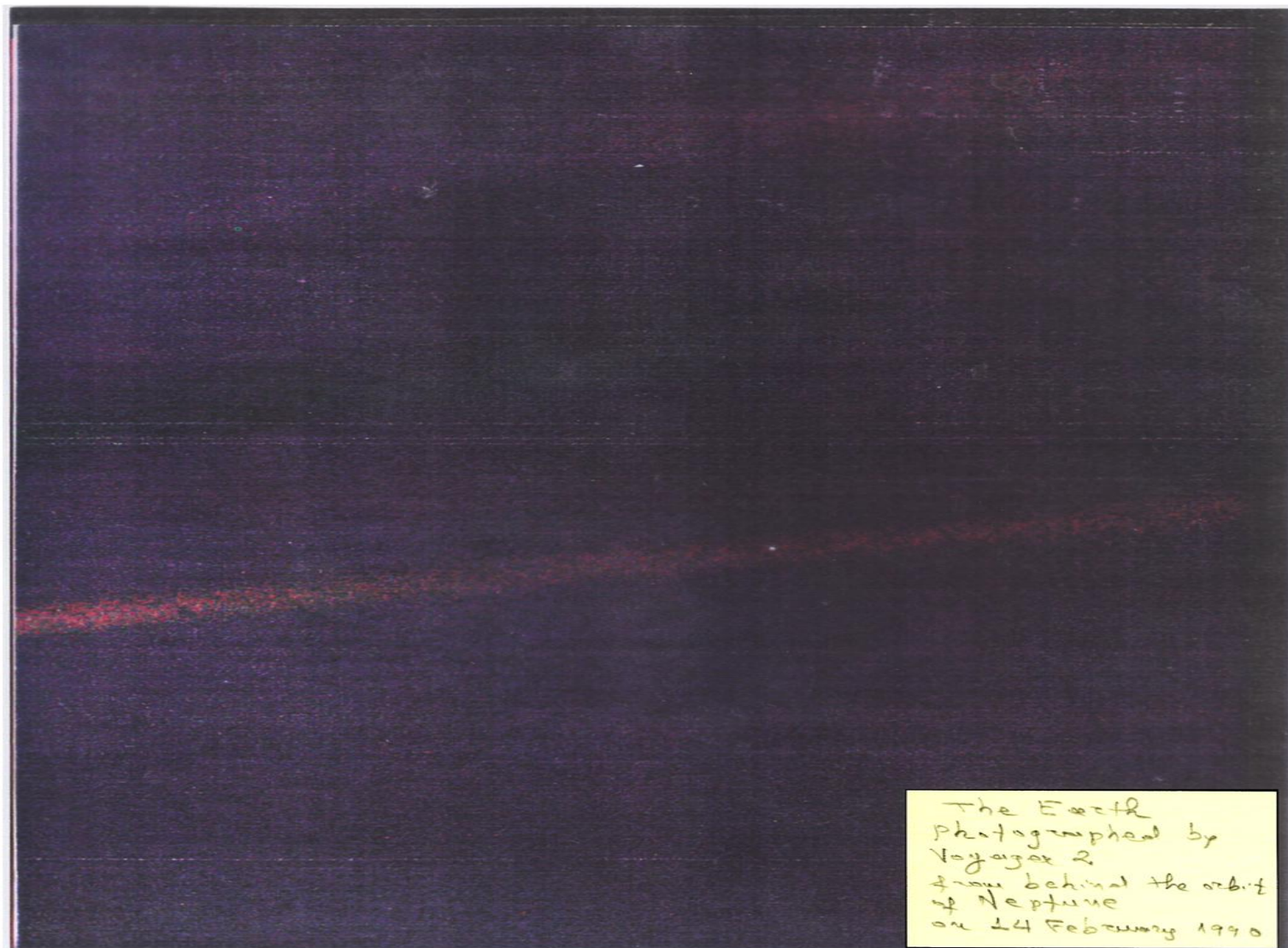








The whole Earth photographed
on the *Apollo 17* mission.
Courtesy NASA.



The Earth
photographed by
Voyager 2
from behind the orbit
of Neptune
on 24 February 1990





2010/10/05 16:16



2010/10/06 14:08

Giuseppe Balbaldi

Giovanni Caprara

ΔΙΑΣΤΗΜΑ Βάση Ευρώπη

Πώς ο Διεθνής Διαστημικός Σταθμός χρησιμοποιείται για την βελτίωση της ζωής στην Γη και για την συνέχιση της εξερεύνησης του Ηλιακού Συστήματος

Μετάφραση-Επιμέλεια
Νικόλαος Κ. Σπύρου
Κωνσταντίνη Ν. Σπύρου



SP

Space Base Europe, the book about the ISS, is now also available in a Greek edition.

The Greek edition, with 293 pages at No. 546, 52 Thessaloniki, Greece; Telemail: info @ universitystudiopress

Any questions on the Greek edition or activities at the Aristoteleion Univ.

Η έκδοση του «Ευρωπαϊκή Βάση Διαστήματος» είναι τώρα διαθέσιμη!

Πρόσφατα, κυκλοφόρησε στην Ελληνική γλώσσα η έκδοση «Ευρωπαϊκή Βάση Διαστήματος» με συγγραφείς Giovanni Caprara. Η μετ' Καθηγητή Αστρονομίας Ελλάδος στον Ευρωπαϊκό Μετεωρολόγιο και

ΣΗΜΕΙΩΣΗ

Το βιβλίο «ΔΙΑΣΤΗΜΑ / Βάση Διαστήματος», Μαιζέδο <http://www.universitystudio.com>
Οι ενδιαφερόμενοι με την προμήθεια του βιβλίου

SPACE Base Europe available in English and Greek

Space Base Europe, the book about the International Space Station by ESA's Giuseppe Reibaldi and noted Italian journalist Giovanni Caprara, is now also available in a Greek edition.

The Greek edition, with 293 pages and more than 260 illustrations, can be ordered (price €30) via University Studio Press, 32 Armenopoulou St., 546.32 Thessaloniki, Greece; Tel: +30 31 208 731 or +30 31209 637, Fax: +30 31 216 647, <http://www.universitystudiopress.gr/intro.htm>, email: info@universitystudiopress.gr

Any questions on the Greek edition should be addressed to University Studio Press (not to ESA). Further information on the book and on ESA activities at the Aristoteleion University of Thessaloniki can be found at www.astro.auih.gr (link: ESA Activities)

Η έκδοση του Ευρωπαϊκού Οργανισμού Διαστήματος (ΕΟΔ, European Space Agency, ESA) «SPACE Base Europe» είναι τώρα διαθέσιμη και στην Ελληνική γλώσσα, με 293 σελίδες και 263 εγχρωμές εικόνες και διαγράμματα!

Πρόσφατα, κυκλοφόρησε το βιβλίο με τίτλο «ΔΙΑΣΤΗΜΑ Βάση Ευρώπη». Το βιβλίο αυτό αποτελεί μετάφραση στην Ελληνική γλώσσα της έκδοσης του Ευρωπαϊκού Οργανισμού Διαστήματος (ΕΟΔ) με τίτλο «SPACE Base Europe» με συγγραφείς τον Executive του ΕΟΔ κo Giuseppe Reibaldi και τον διακεκομμένο Ιταλό δημοσιογράφο κo Giovanni Caprara. Η μετάφραση στην Ελληνική γλώσσα έγινε με επιμέλεια του κoυ Νικολάου Κ. Σπύρου, Καθηγητή Αστρονομίας στο Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης και Εθνικού Εκπροσώπου της Ελλάδος στον Ευρωπαϊκό Οργανισμό Διαστήματος (ΕΟΔ, ESA/PB-HME) και της Διδάκτορος Γεωλόγου-Μετεωρολόγου κας Κωνσταντίνας Ν. Σπύρου.

ΣΗΜΕΙΩΣΗ

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Οι ενδιαφερόμενοι μπορούν να απευθυνθούν στον ανωτέρω εκδοτικό οίκο και όχι στον ΕΟΔ για περισσότερες πληροφορίες και για την προμήθεια του βιβλίου στην τιμή των 30.00 Ευρώ ανά τεύχος.