Human Spaceflight
SPACE FOR LIFE

Human Space Exploration in Europe

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Human Spaceflight

Sending humans into space is the most complex and expensive amongst the space activities,
however it is the most rewarding because:

- It is the main reason to explore space, it is the pinnacle of space exploration...

Human Spaceflight

..And it is

- Allowing direct involvement with the astronauts
- Opening the door of the research in microgravity
- Pushing international space organizations to sustaining cooperation
- Contributing to improve technology and quality of life on Earth

And much more…

The International Space Station programme

Source: NASA

The International Space Station Partners

Canadian Space Agency

European Space Agency

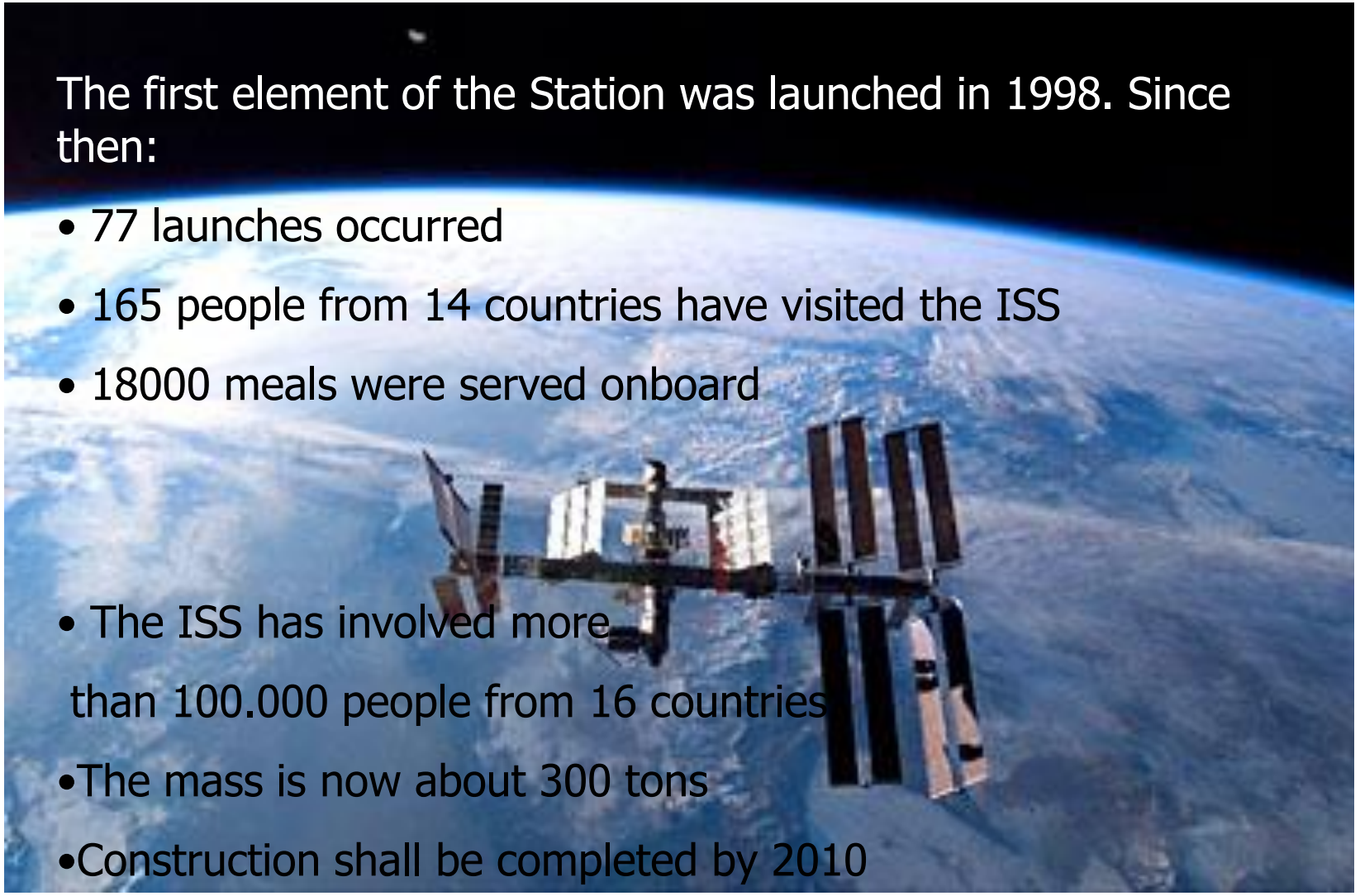
Japan Aerospace Exploration Agency

National Aeronautics and Space Administration

Russian Federal Space Agency

Credits: Mr. W. Gerstenmaier, NASA

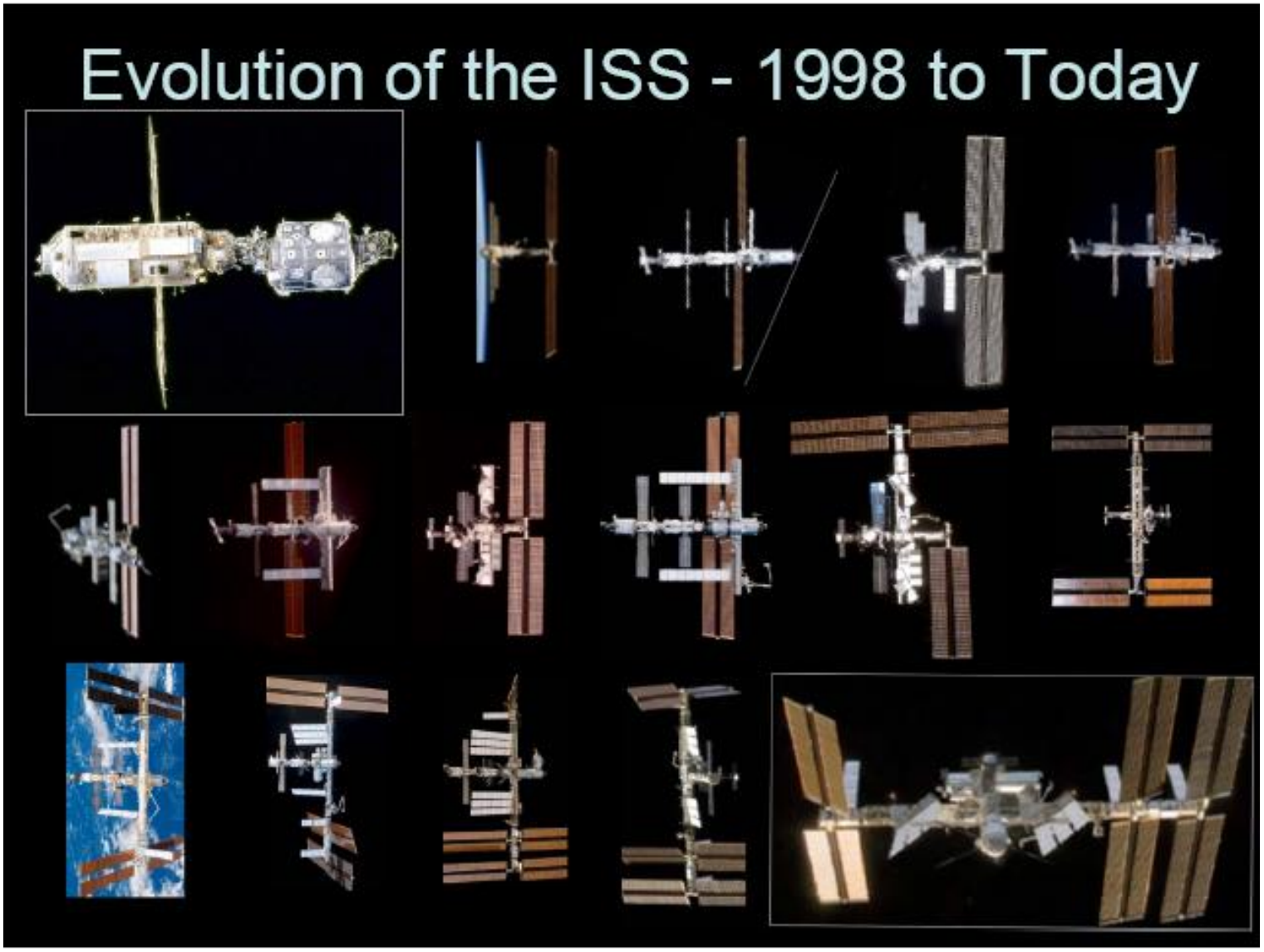
The International Space Station programme



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


Evolution of the ISS - 1998 to Today

The International Space Station programme

Mission STS 126 was just concluded, upgrading the ISS,

soon to welcome 6 permanent crew members

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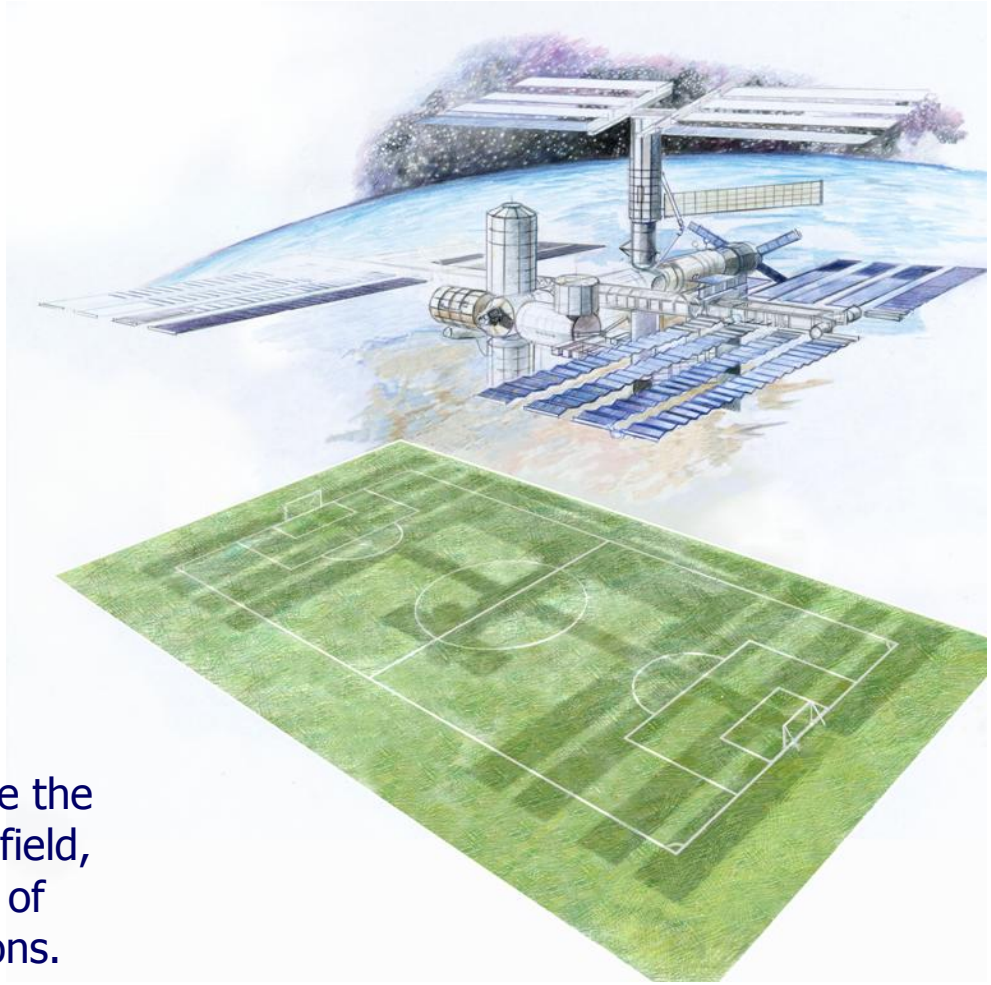
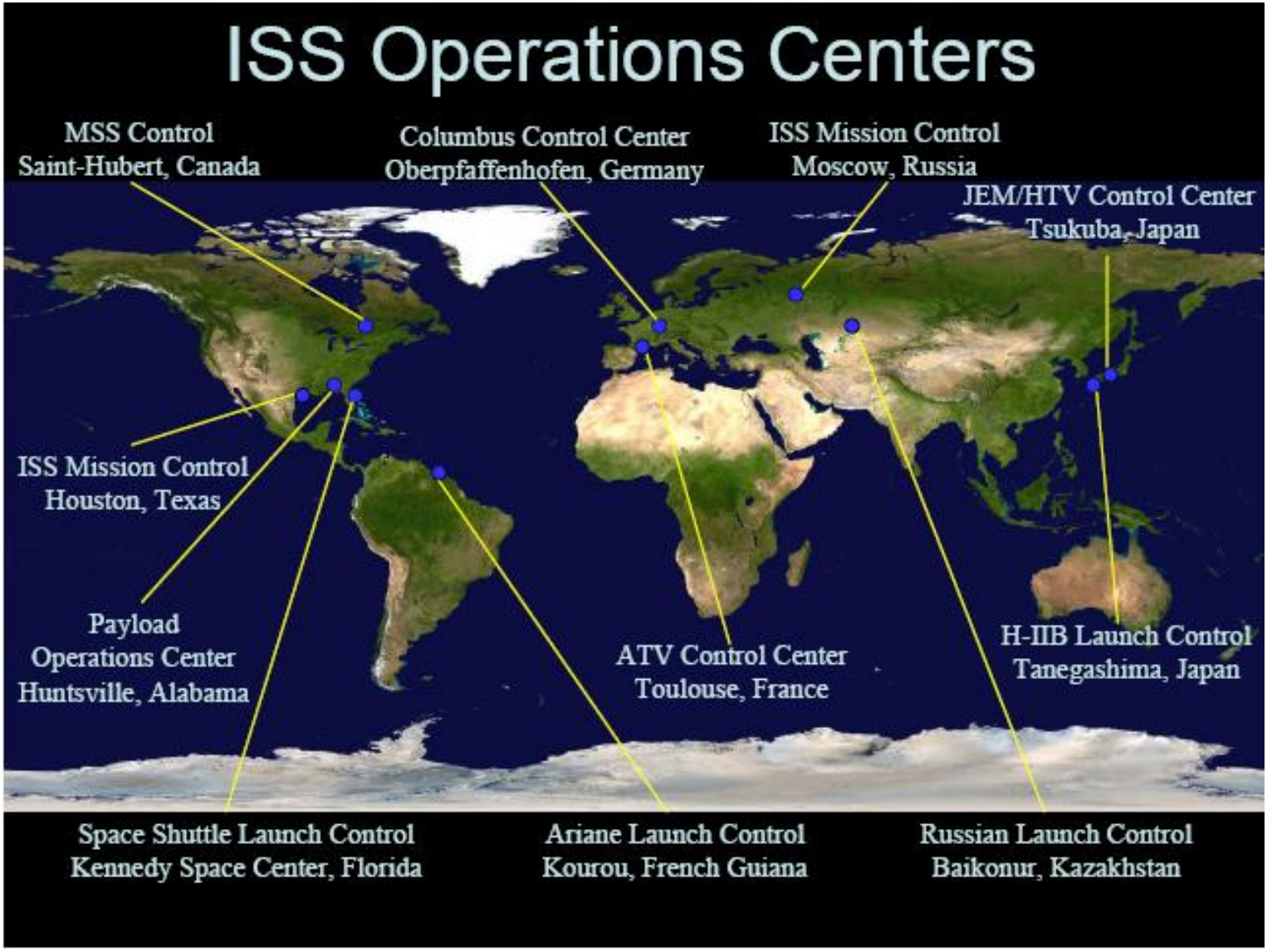
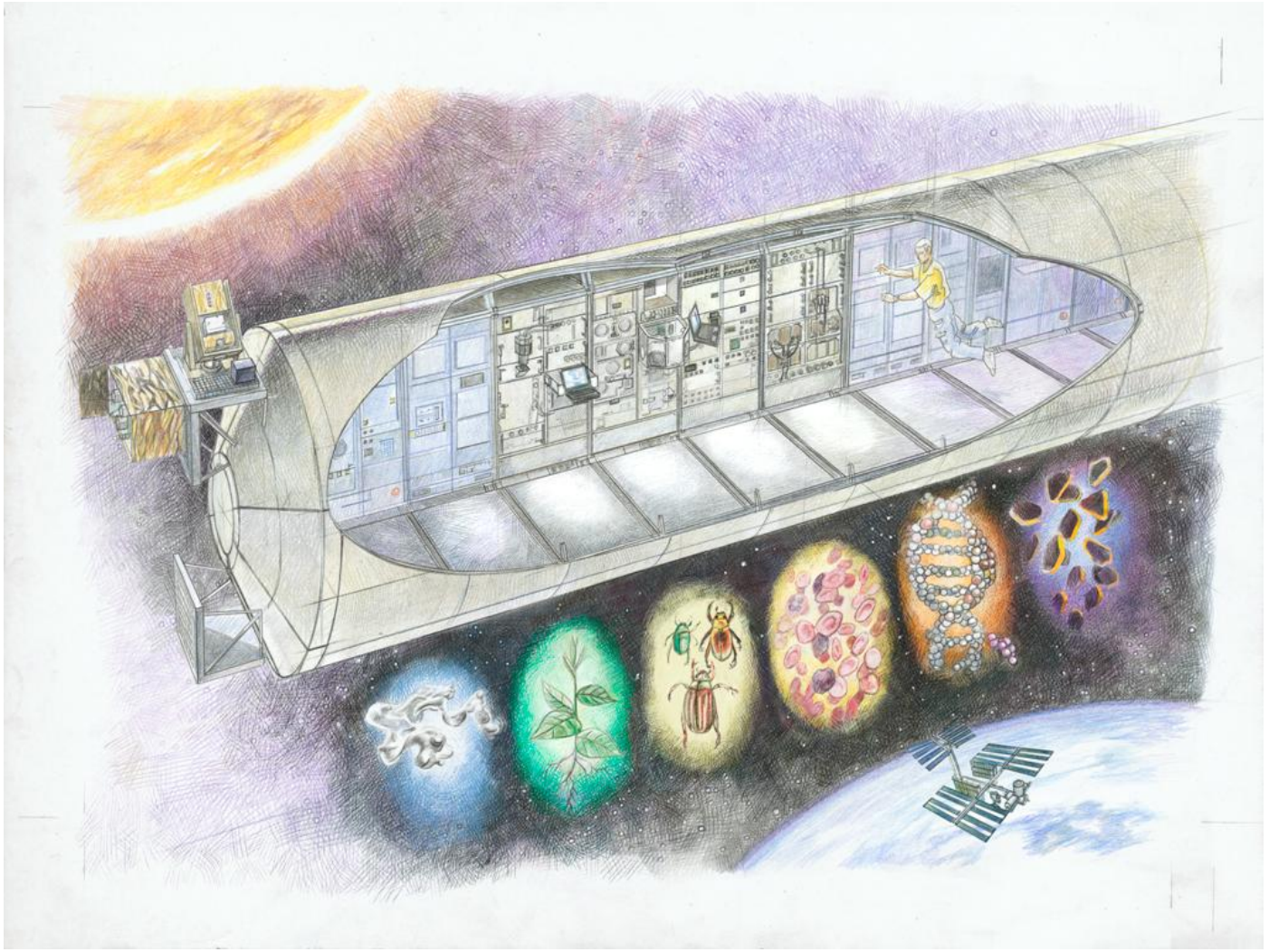
The International Space Station programme



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


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

The International Space Station: An interdisciplinary laboratory

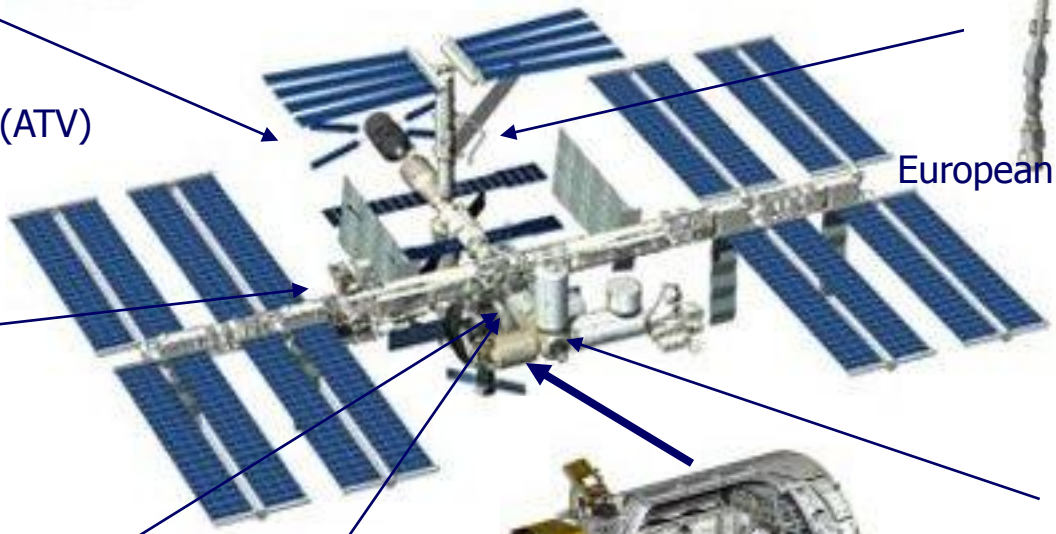


European participation in the ISS

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

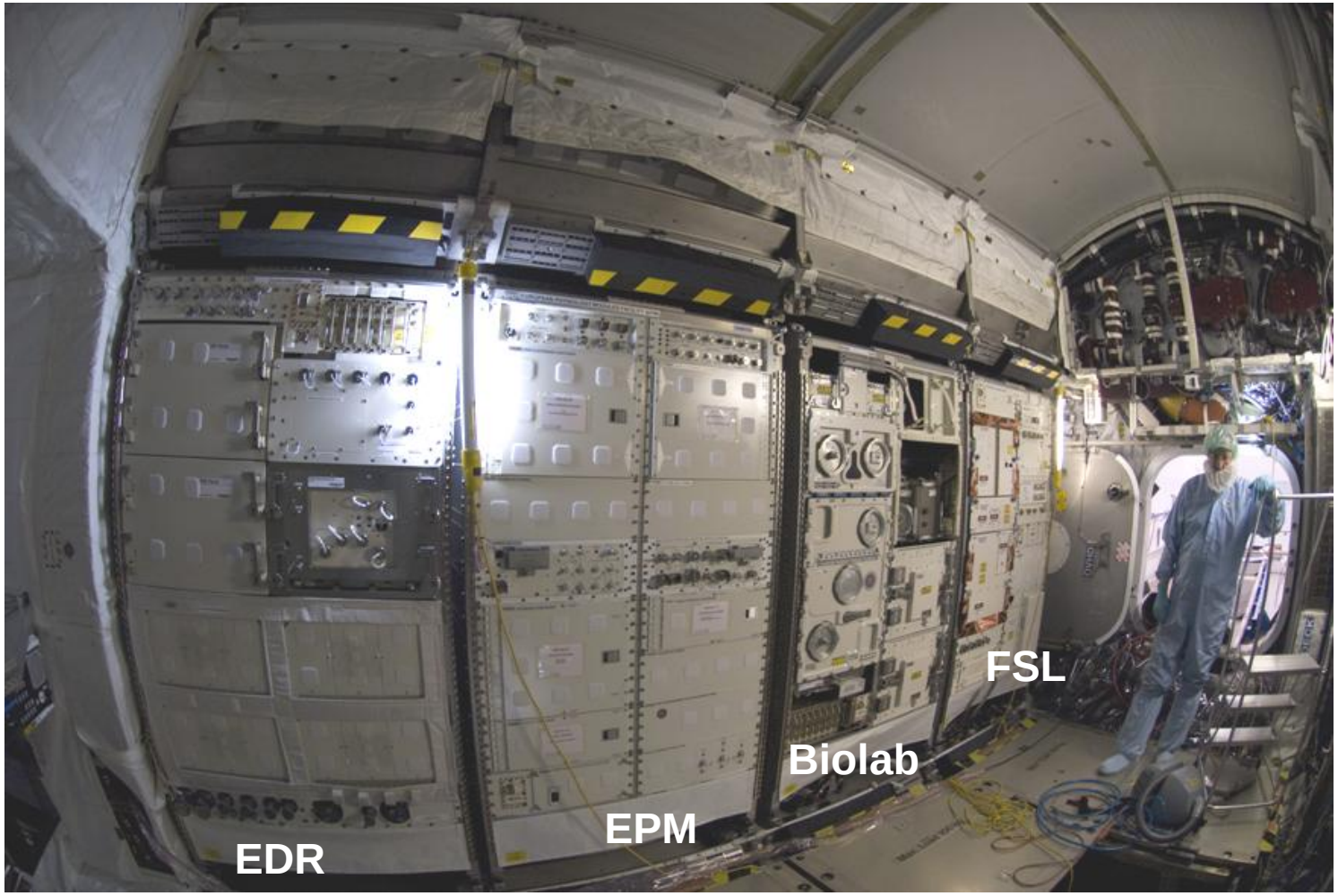
Columbus laboratory and its payload facilities

Cupola

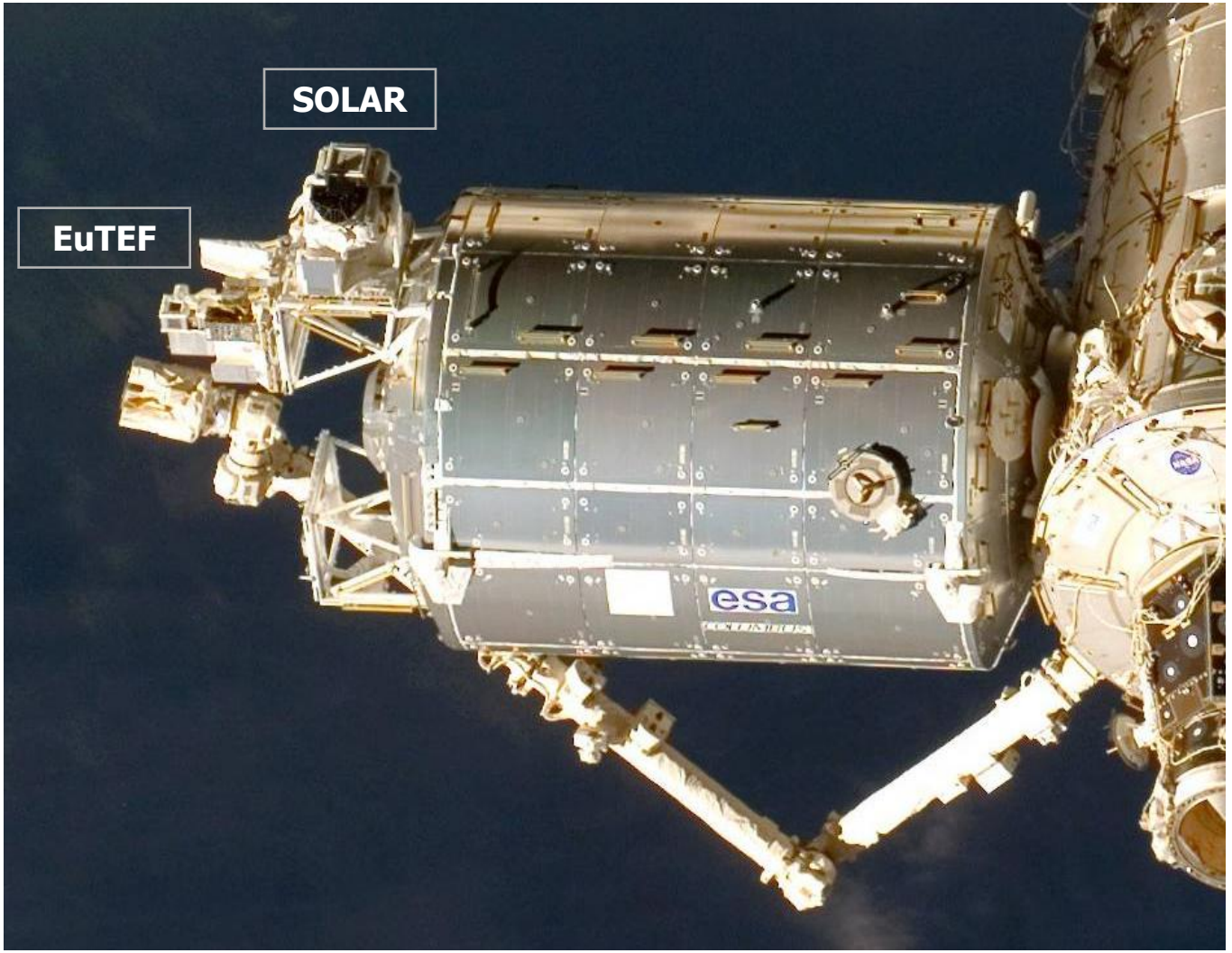
Columbus Laboratory and Payload Facilities

- ESA initiated preliminary study on its participation in the ISS including Columbus in 1984, following invitation by The United States to join the programme
- Final decision on the development of Columbus and its payloads was made in Toulouse in 1995
- Columbus flight module with its payload facilities was delivered to Kennedy Space Center in May 2007
- Launch of Columbus on February 7th, 2008 (mission STS-122)
- Attachment of Columbus to the ISS on February 11th, 2008
- Europe now owns a permanent laboratory in space

Columbus Internal Payload Facilities



Columbus External Payloads



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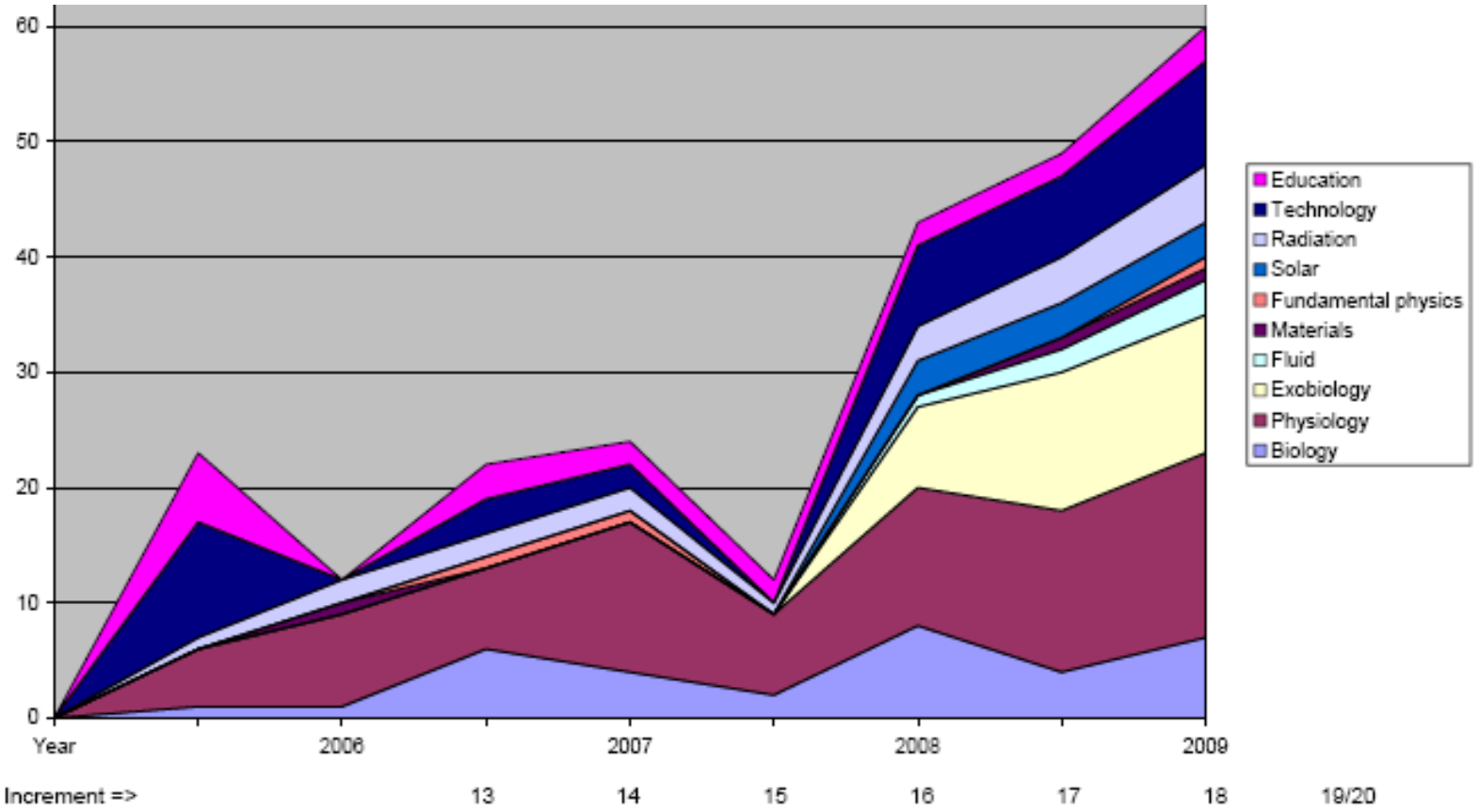
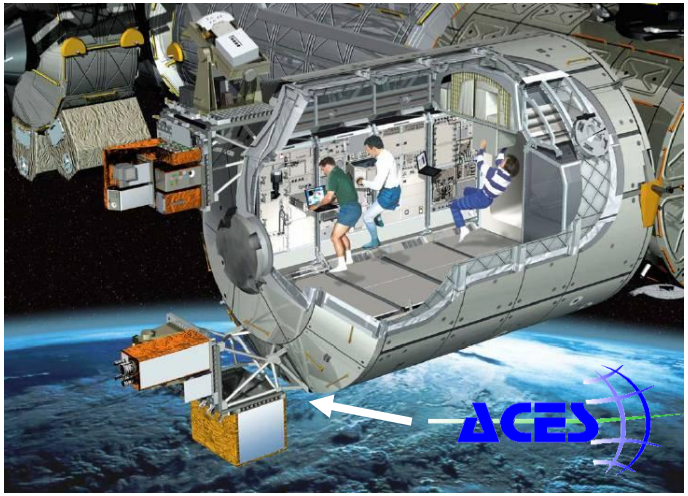
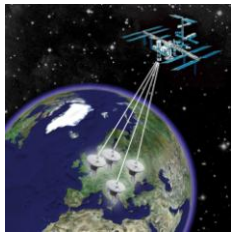
European Experiments on the ISS

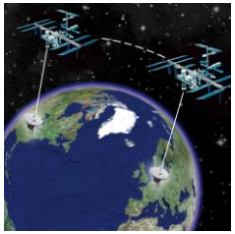
- About 300 European Scientists have carried out investigations
- Educational outreach reached hundreds of thousands students in schools, museums, and science centers in Europe

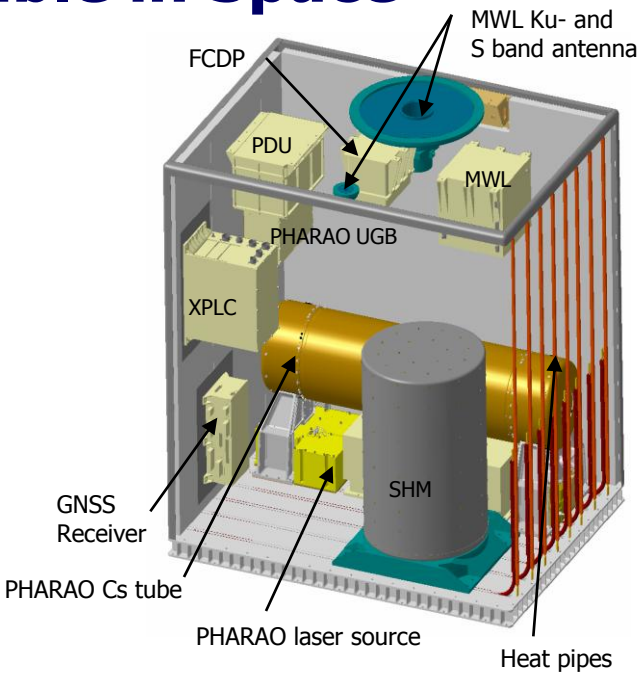


Columbus Future External Payload Facilities: ACES - Atomic Clock Ensemble in Space



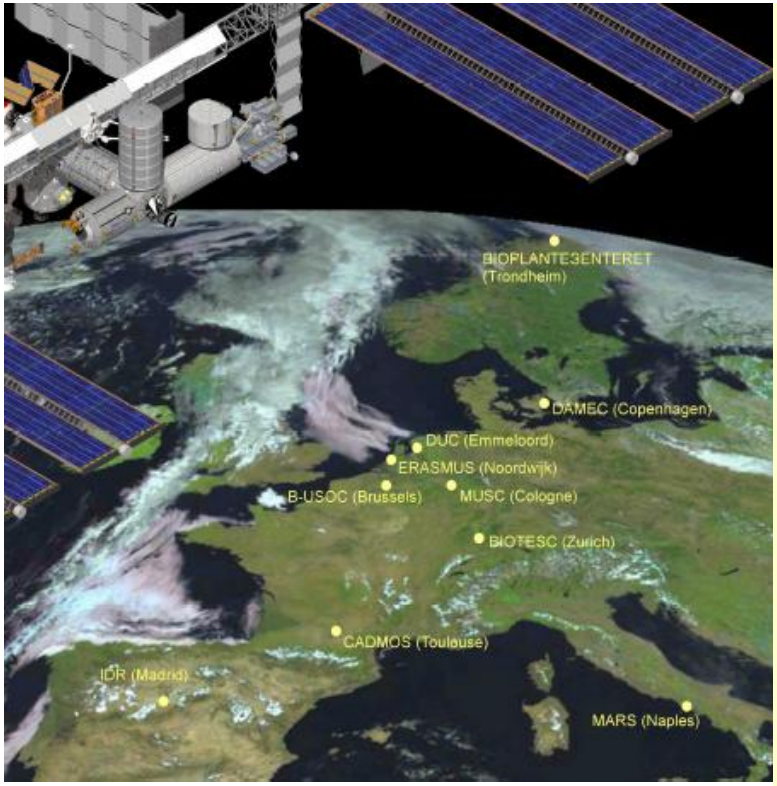






- Performs fundamental physics experiments based on performances derived from its cold atoms Caesium clock and its Space Hydrogen Maser. The clock signal is sent to ground using a dedicated microwave link.
- Allows comparison of clocks with a precision of 10-16 and a stability of 10-16/day
- Used for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

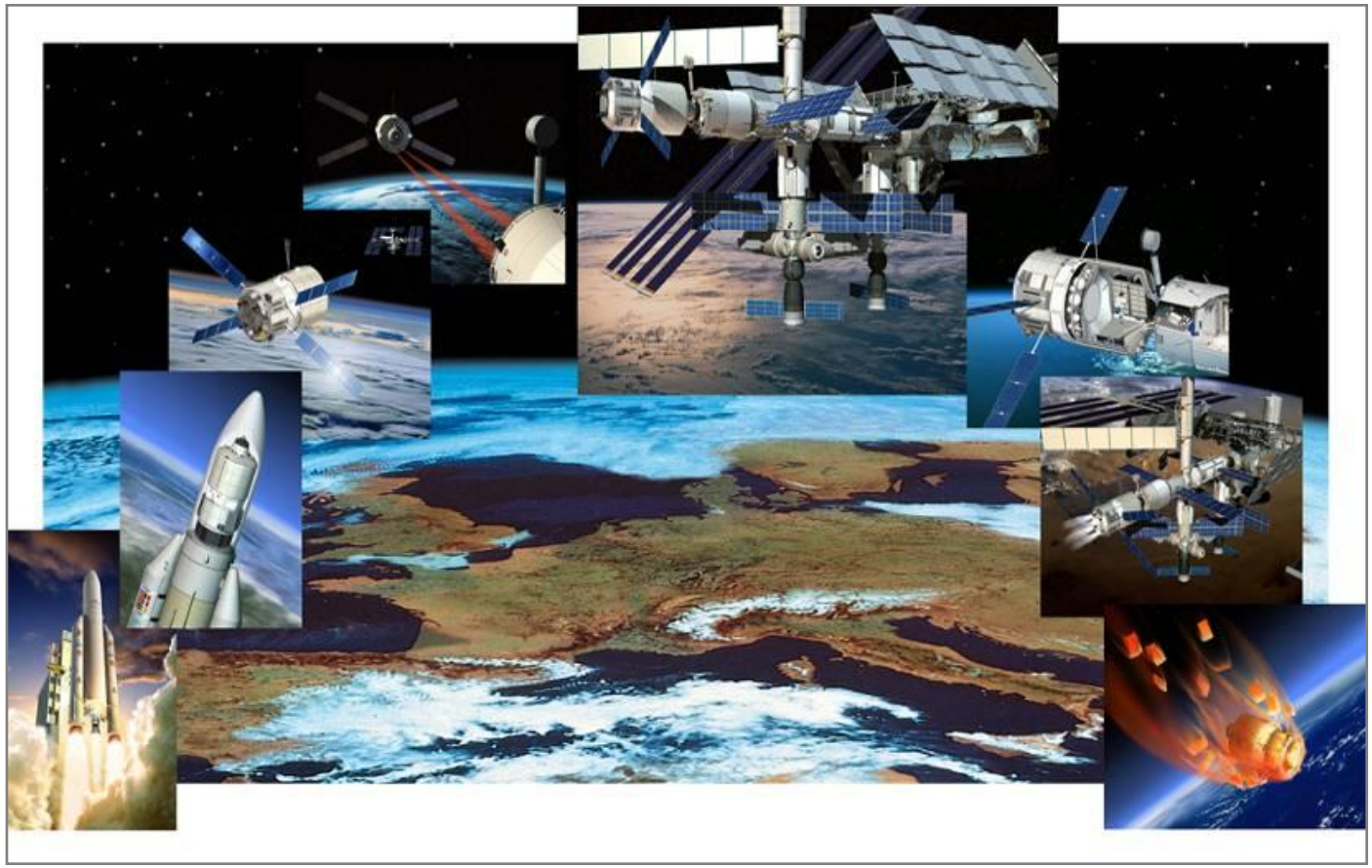
Columbus User Support and Operation Centres (USOCs)



FACILITY	FACILITY RESPONSIBLE CENTRE (FRC)	FACILITY SUPPORT CENTRE (FSC)
Pressurised Rack Level Facilities (Class 1)		
BIOLAB	MUSC (Cologne)	BIOTESC (Zurich)
EDR	ERASMUS (Noordwijk)	DUC (Emmeloord) B-USOC (Brussels)
EPM	CADMOS (Toulouse)	DAMEC (Copenhagen)
FSL	MARS (Naples)	Ins. Da RIVA (Madrid)
Pressurised Sub-Rack Level Facilities (Class 2)		
EMCS	BIOPLANTESENTERET (Trondheim)	
MSL-SQF	CADMOS (Toulouse)	MUSC (Cologne)
MSL-LGF	MUSC (Cologne)	CADMOS (Toulouse)
PCDF		B-USOC (Brussels)
PFS		DAMEC (Copenhagen)
External (Unpressurised) Facilities		
SOLAR	B-USOC (Brussels)	
EuTEF	ERASMUS (Noordwijk)	
ACES	CADMOS (Toulouse)	
SPORT	MARS (Naples) MUSC (Cologne)	

The Jules Verne Mission

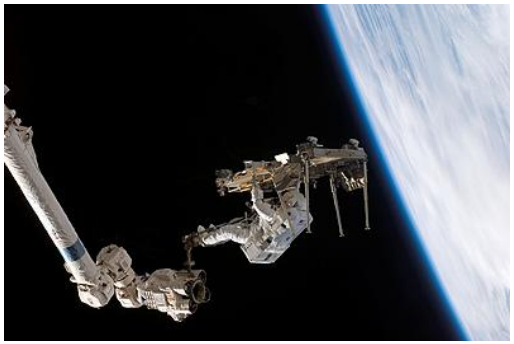
- **Jules Verne is the name of the first Automated Transfer Vehicle (ATV)**



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

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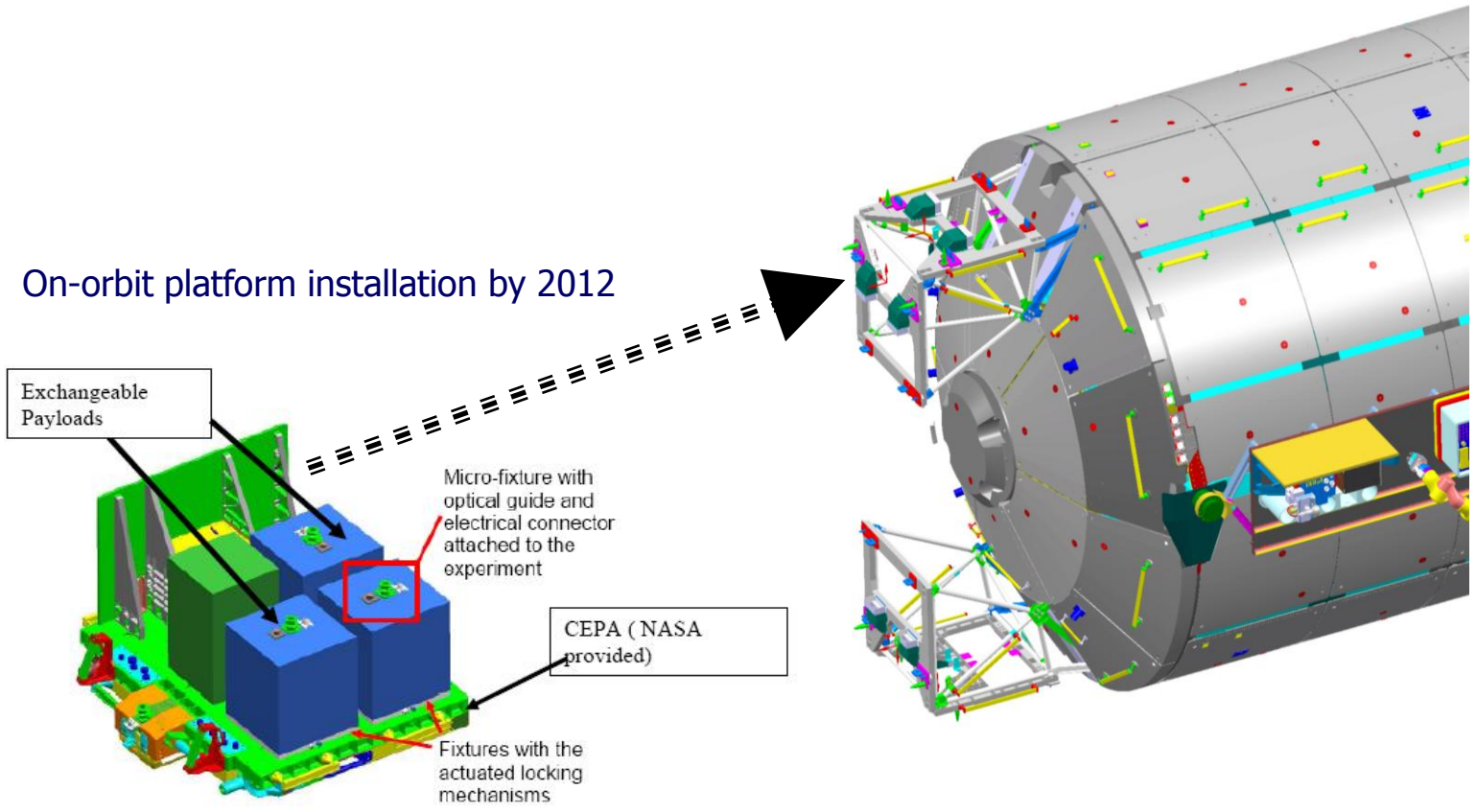
Opportunities for Greece to participate in the ISS Programme:

The Small Payloads External Robotic (SPERO) Platform

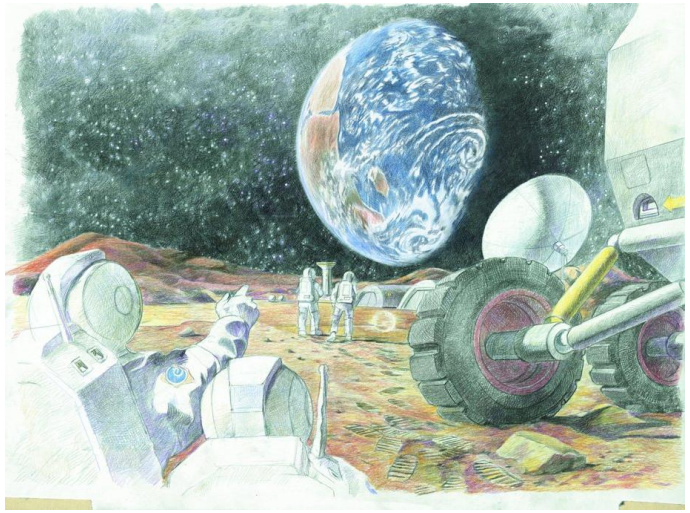
On-orbit platform installation by 2012



Europe beyond the ISS

•Europe, as a global space player in Human Spaceflight, is planning new activities:

- European Transportation
- Human Exploration Enabling Technologies



•Greece has now the possibility to participate in industrial and scientific niches not yet occupied by other countries, exploiting existing know-how

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European Transportation

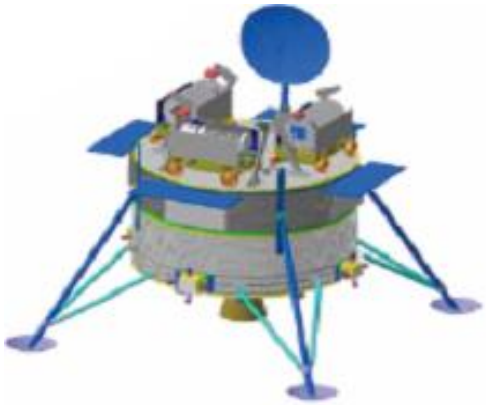
Advanced Re-entry Vehicle -ARV-

- 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

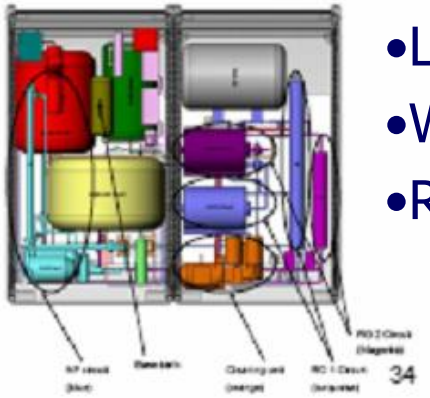
Human Exploration Enabling Technologies

- Exploration scenarios

- Lunar Lander Phase A Studies

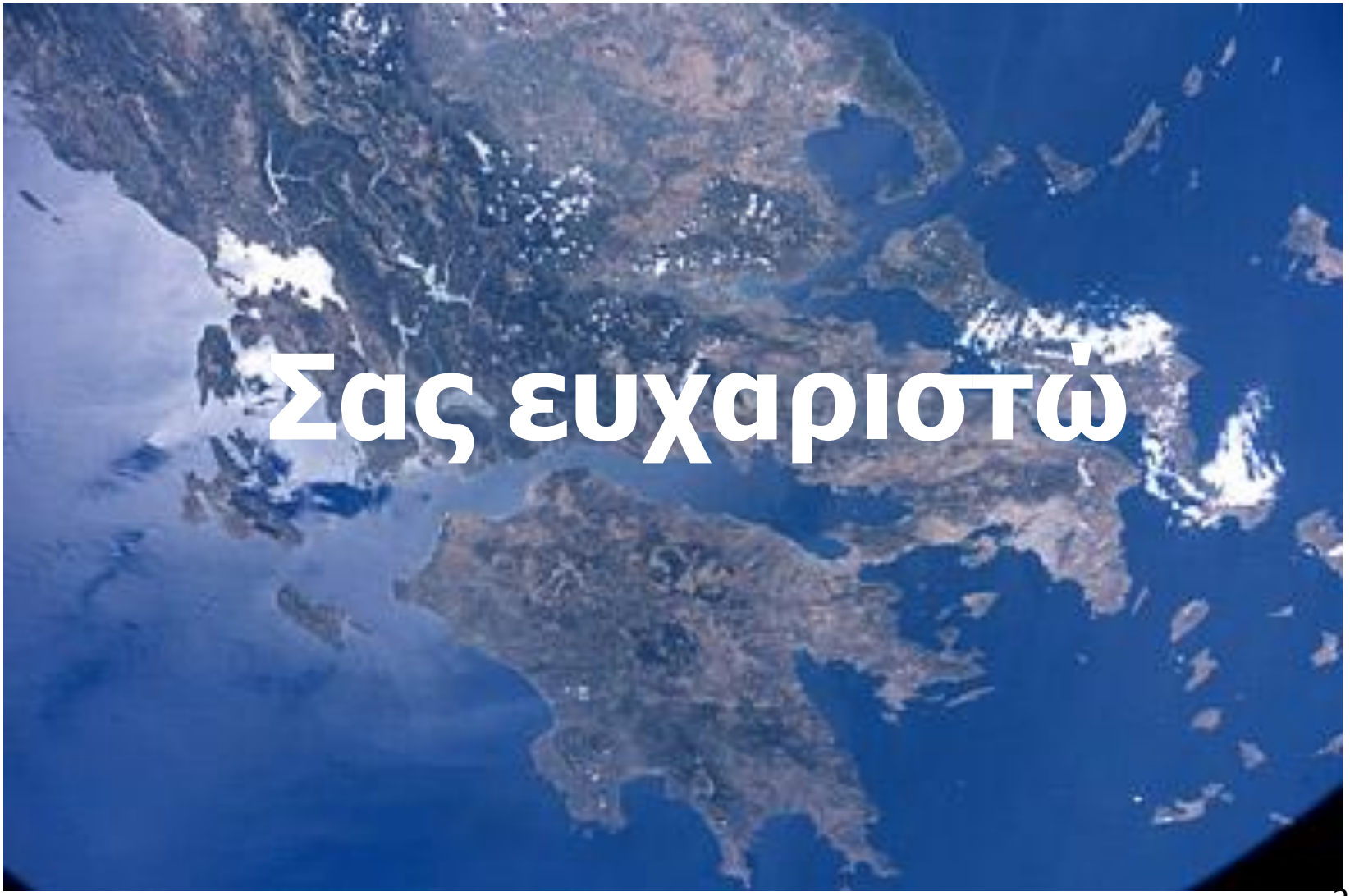


- Enabling capabilities:
  - Life support
  - Water treatment
  - Resources/ Energy management



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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