Human Spaceflight
SPACE FOR LIFE

Human SpaceFlight Programmes

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Outline

- The International Space Station Programme
- Columbus
- ATV
- ELIPS-3/AO 2009
- European Astronaut Corps
- ARV
- Lunar Cargo Lander
- Human Exploration Enabling Activities
- Current / Possible Participations of PECS Countries to HSF Programmes
- Conclusions

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, the pinnacle of space exploration
- It is the most interdisciplinary space activity,
  - In direct involvement with the astronauts
  - Opening the door of the research in µ-g
  - Pushing international space organisations to sustaining cooperation
  - Contributing to improve technology and quality of life on Earth
  - And much more…

The International Space Station partners

- The Canadian Space Agency
- The European Space Agency
- The Japan Aerospace Exploration Agency
- The National Aeronautics and Space Administration
- The Russian Federal Space Agency

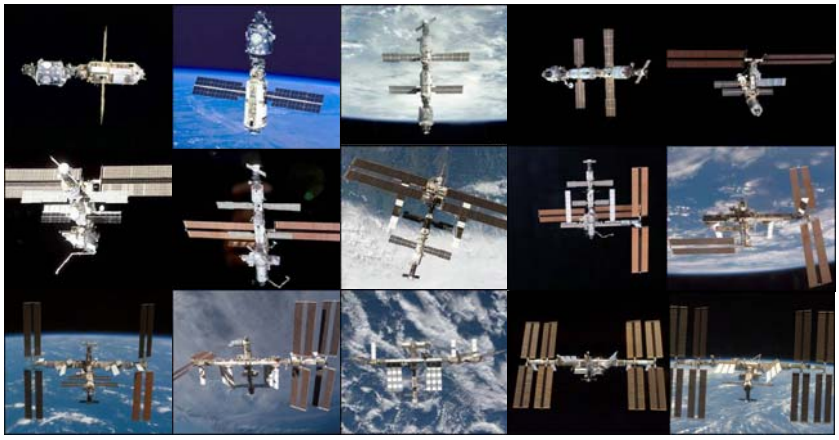
The International Space Station programme

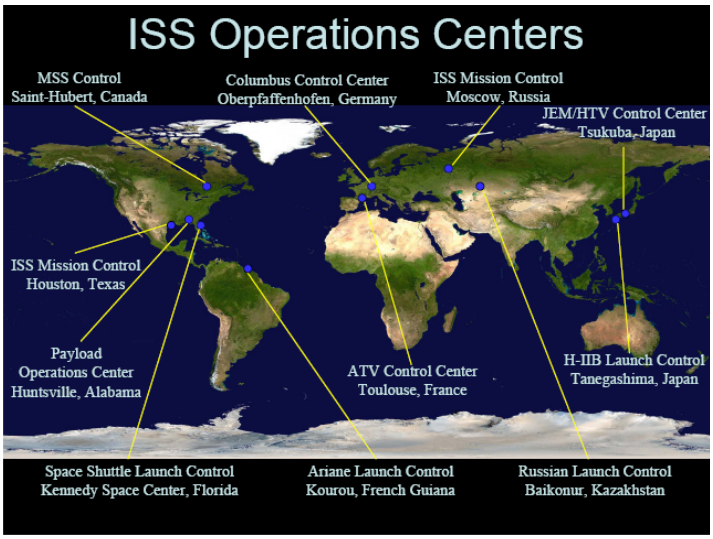
The first element of the Station was launched in 1998. Since then:

- 87 launches occurred
- 180 people from 14 countries have visited the ISS

- 20000 meals were served onboard
- The ISS has involved more than 100.000 people from 16 countries
- The mass is now about 350 tons
- Construction shall be completed by 2010

Evolution of the ISS, 1998 to Today





Credits: Mr. W. Gerstenmaier, NASA

Research Onboard the ISS

- 157 new research investigations were operated between 2001 and 2008, engaging over 5000 scientists world-wide:
  - Human Health and performance for long duration missions
  - Exercise, pharmacological and nutritional countermeasures
  - Effects of radiation environments
  - Crew interactions and human factors

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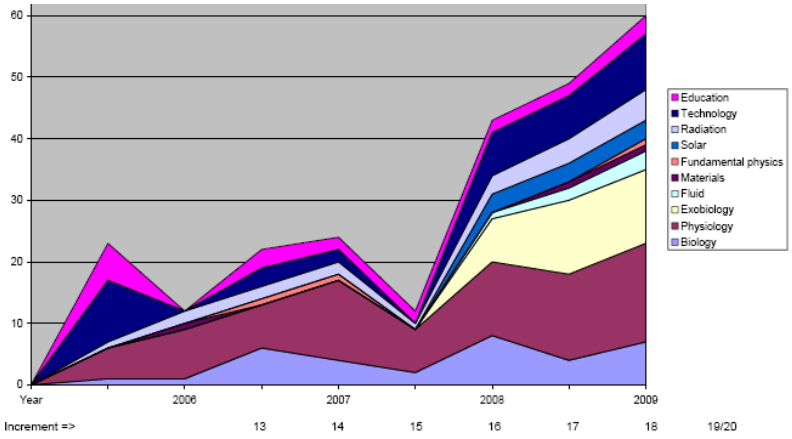
European Experiments on the ISS

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



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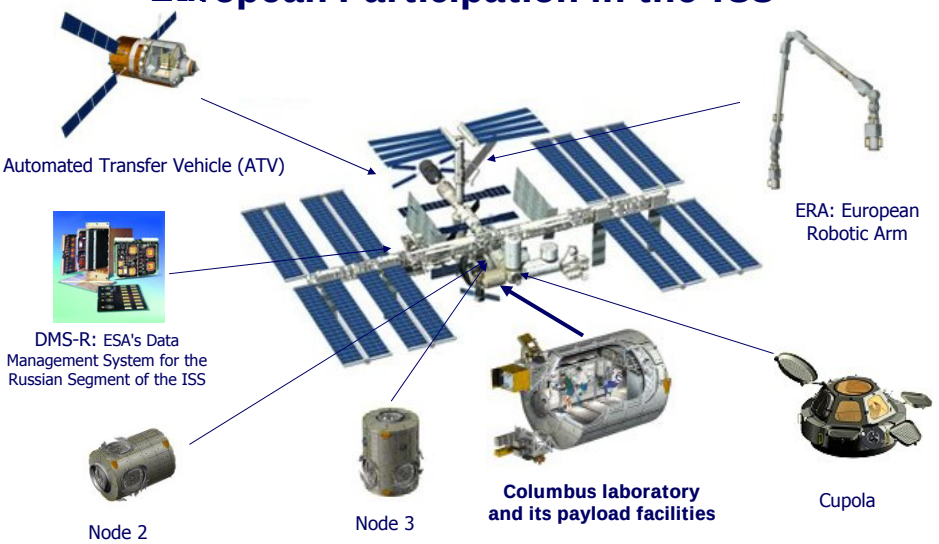
European Participation in the ISS



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Columbus Internal Payload Facilities

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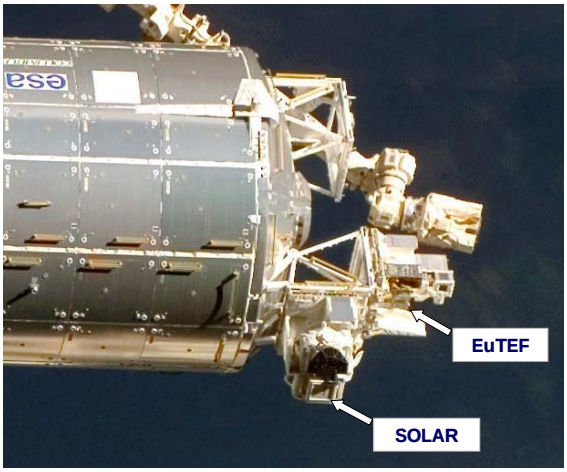
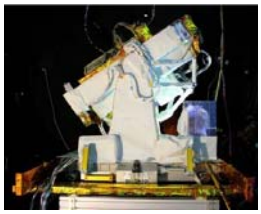
External Payload Facilities In-Orbit Configuration





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Columbus Launch / Early Operation

5th February 2008

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Columbus Berthing / Attaching

12th February 2008

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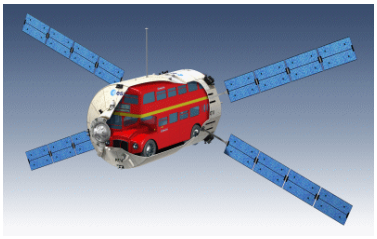
ATV – Automated Transfer Vehicle



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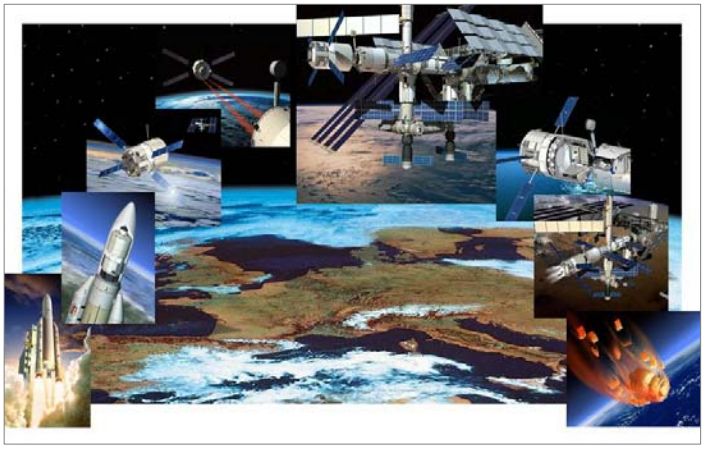
The Jules Verne Mission

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



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The Jules Verne Mission

- Launch, 09th March 2008

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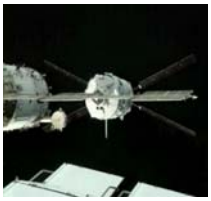
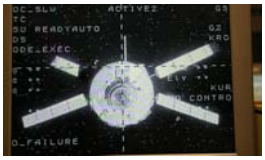
The Jules Verne Mission

- Demonstration days:
DD1 to 3,500m on 29/03/08
DD2 to 11m 31/03/08
- Docking, 03/04/08



- Undocking on 05/09/08



•Destructive re-entry on 29/09/08 at 1355 over unpopulated area of South Pacific

The Jules Verne Mission Highlights

- 5 ISS orbit re-boosts performed
- 1 ISS debris avoidance manoeuvre performed
- ISS attitude control performed during various mission phases
- 2375kg of fuel used during all ISS propulsive support
- 860kg of fuel transferred to Russian Service Module
- 1150kg of dry cargo uploaded
- 830kg of waste downloaded

European Life and Physical Science and Applications in Space (ELIPS-3)

The main activities are:

- General activities
  - Topical Teams
  - Ground-based research
  - Microgravity Applications Programme (MAP)
  - Industry-driven R&D projects
  - Education
- ISS Utilisation hardware development

  Pre-phase A: Feasibility studies, Phase A/B: Development studies, Phase C/D: Development projects
- Non-ISS payloads

  Parabolic flights, sounding rockets

Announcement of Opportunities for Experiments in Low Gravity, 2009

- Released on May 15th, 2009
  http://www.esa.int/spaceflight/ao2009
- Main focus of solicitation is ISS in the field of Life and Physical Science
- Proposals are solicited also for bed rest and sounding rockets
- Schedule: Letter of intent: June 15th, 2009
  Proposal submittal: September 14th, 2009
  Selection: End 2009
- PECS Countries scientists can submit proposals, not as Principal Investigator (PI) but only as Co-Pi's, since these countries did participate in the ISS development

European Astronaut Corps

- ESA has an Astronaut Corps of 8 Astronauts from Germany, France, Italy, Belgium, Netherlands, Sweden

- 13 European Astronauts had flown to the ISS so far, and today, Frank de Winne (14) has lifted off from Russia as the first ESA ISS Commander.
  C. Fugelsang (15) shall fly next August.

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New European Astronauts

- 6 new astronauts were recruited in May following a selection process started in March 2008; About 8400 applications were received from all over Europe.
- The new astronauts are:

- Samantha Cristoforetti, Italian
- Alexander Gerst, German
- Andreas Mogensen, Danish
- Luca Parmitano, Italian
- Timothy Peake, British
- Thomas Pesquet, French

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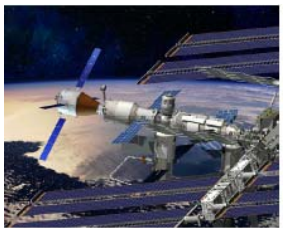
ARV - Automatic Re-Entry Vehicle

•The first step of the development programme will include over the period 2009-2010:

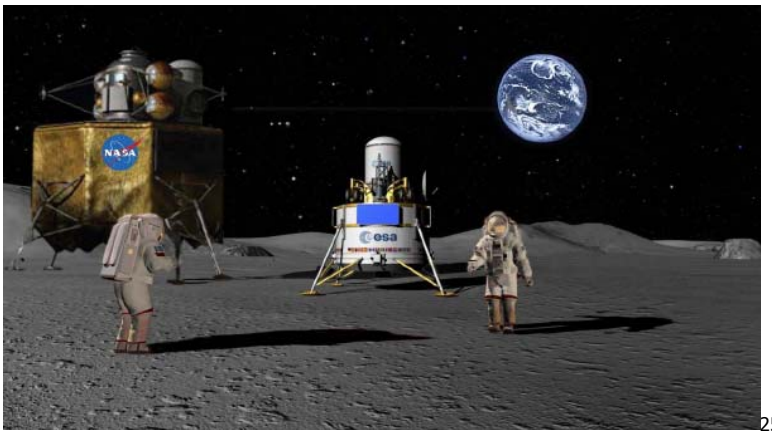
- Phase A of the cargo transportation and download system development
- Preliminary definition of the Ariane 5 modifications and additions for adaptation of the launch vehicle to human spaceflight, including its ground segment requirements
- Preliminary definition of the design constraints derived from crew specific and operational aspects and the crew escape system

• Decision expected at the next ESA Council at Ministerial level in 2011 on the full development of the cargo transportation system and its operational phase



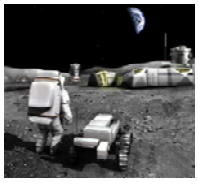
Lunar Cargo Lander

- Development of Lunar Lander, complementary to the US logistics aimed at returning humans to the Moon



Human Exploration Enabling Technologies

- **Exploration Scenarios**
  - Exploration Scenario studies will support the definition of possible European and International exploration activities, taking into account the need for Europe to develop a common vision and long term strategic planning for exploration.
  - Initialisation of selected phase A activities on promising exploration elements
- **Early Activities – Human Capability Development**
  - Objectives
  - To prepare Europe for future participation in Human spaceflight exploration missions by further developing enabling capabilities
  - Activities to be pursued during the next period include:
  - Development of strategic long term habitation and life support systems
  - Development of resources and energy management systems



Current Hungarian Participation in Human Spaceflight

- **SURE Projects:**
  - **Neurospat:** Cf. specific slide
  - **Focus:** Cf. specific slide
  - **Tritel:** Cf. specific slide

- **Non-SURE Projects:**
  - Development of a new space furnace called MICAST HUNGARY III
  - Participation in the EXPOSE-R consortium experiment
  - Dose distribution measurements by passive detectors inside the ESA Columbus module of the ISS as part of the DOSIS project
  - MAP project on chemo-hydrodynamic instabilities in chemical reactions
  - Phase field modelling of solidification and front-article interaction in peritectic systems
  - Study and modelling of nucleation and phase selection phenomena in undercooled melts: application to magnetic alloys of industrial relevance.

FOam Casting and Utilisation in Space (FOCUS)

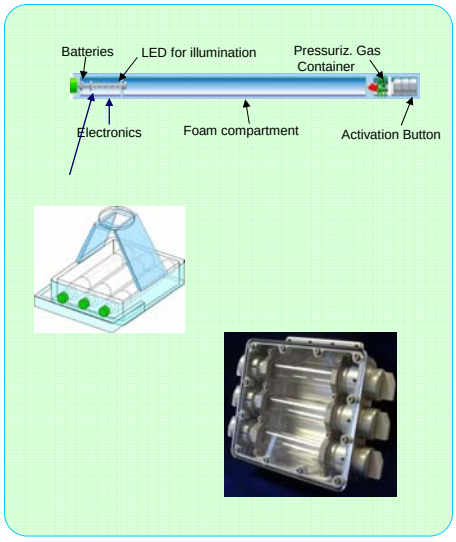
Research Objective:
- Producing and utilising metal foams in space

With Admatis Ltd.

Hardware Readiness:
- Under development (with ESA expert support)
- FM to be delivered by end 2009

Flight Readiness
- Flight safety reviews and Experiment Sequence Test still to be performed

Flight Schedule (TBC)
- Manifesting planned for end 2009/mid 2010



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NEUROSPAT

Research Objective:
- Prefrontal functions and spatial orientation

With the Psychological Research Institute of the Academy of Sciences

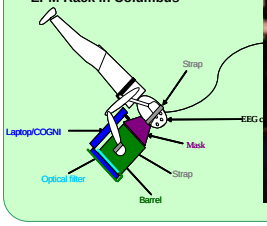
Hardware Readiness:
- Available
- EPM + MEEMM launched with Columbus
- Experiment Kit on 19S: Launch on Soyouz 19 Today, May 27th, with Frank De Winne

Flight Readiness
- Pre-flight BDC performed at CADMOS

Mission Schedule
- Flight experiments start in Incr. 20 (6/2009) with 2 human test subjects
- Tentatively another subject in Incr. 21 (10/2009)

EPM Rack in Columbus

NEUROCOG-1 experiment by F. De Winne on ISS during Belgian Taxi Flight



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TRITEL

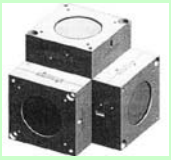
Research Objective:
- Measuring the dose of the astronauts caused by ionizing radiation

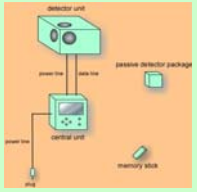
With the Atomic Energy Research Institute of the Academy of Sciences

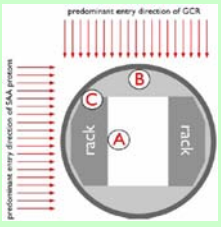
Hardware Readiness:
- Experiment under development, expected to be delivered in 2009
- FM to be delivered by End 2009

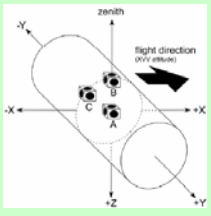
Flight Readiness
- TBD

Flight Schedule (TBC)
- Planned for 2010









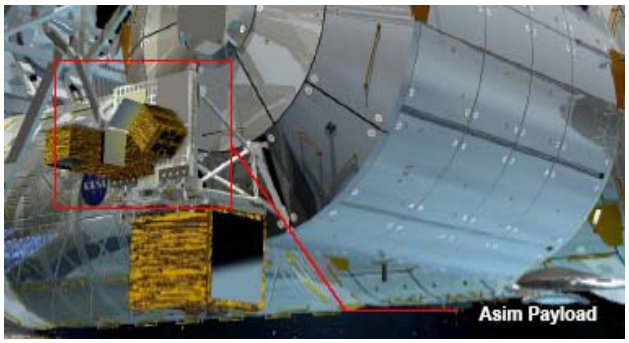
3 possible locations in COL (A, B or C)

Possible Future Hungarian participation

- As a PECS ESA member, Hungary has the possibility to participate in ESA programmes exploiting existing know-how in industrial and scientific niches not yet occupied by other countries.
- The present niches identified by ESA are:
  - Material Science (e.g. metallic frames, special furnaces)
  - Dosimetry
  - Human Factors
- Delegation is invited to comment

Current Polish Participation in Human Spaceflight

- **ASIM** (Atmosphere/Space Interactions Monitor), in the frame of ELIPS-3: Power supply subsystem



Possible Future Polish participation

- As a PECS ESA member, Poland has the possibility to participate in ESA programmes exploiting existing know-how in industrial and scientific niches not yet occupied by other countries.
- The present niche identified by ESA is:
  - Robotics
- Delegation is invited to comment

Current Romanian Participation in Human Spaceflight

- **SURE Project: CFS-A**

Research Objectives:
- Characterise the radiation environment of the ISS and estimate the absorbed dose and dose equivalent burden on astronauts aboard the ISS.

Hardware Readiness:
- Available (already for 18S in 3/2009)
- To be refurbished prior to next flight opportunity

Flight Readiness:
- Experiment Sequence Test performed
- Final preparation for next flight pending a firm manifesting decision (see below)

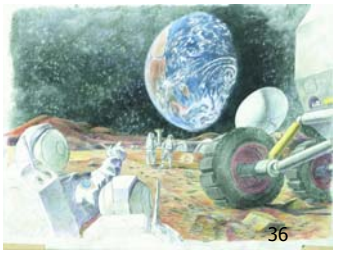
Flight Schedule (TBC):
- Manifesting attempt for 20S (9/2009); return in 2 steps (short- and long-duration parts)

Possible Future Romanian participation

- As a PECS ESA member, Romania has the possibility to participate in ESA programmes exploiting existing know-how in industrial and scientific niches not yet occupied by other countries.
- The present niches identified by ESA are:
  - Magnetic Fluids
  - Biology
- Delegation is invited to comment

Conclusion

- Human Spaceflight is the most complex endeavour in space requiring the use of many disciplines and expertise; for its next projects, ESA needs all the skills it can gather in Europe
- ESA has demonstrated its capabilities as a global space player with the outstanding results achieved so far: Columbus, ATV, Node 3...
- In the future, the EU shall participate in the Human Spaceflight activities, hopefully with ambitions commensurate to its economical dimension
- **ESA PECS countries have 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**



Additional information

- SURE Projects
- AO 2009
- European Astronauts

Cf. separated document