European Programme for Life and Physical Sciences in Space

- ELIPS -

Period 4

The Participating States

Austria; Belgium; Canada; Czech Republic; Denmark;

France; Germany Greece; Ireland; Italy; Netherlands;

Norway; Poland; Romania; Spain; Sweden;

Switzerland; United Kingdom

The European Programme for Life and Physical Sciences and Applications in Space (**ELIPS**) allows Europe:

- to capitalize on its investments into the ISS infrastructure
- to use independent mission platform assets in order to enable world leading contributions to progress in the areas of:

- Fundamental research, in both physical and life sciences;
- Applied research, and industry-driven R&D to meet the challenges to society in the 21st century;
- Preparation of Human Exploration of space;
- Development of advanced technologies to support the optimum utilisation of ISS and future space infrastructures
- Education.

Goals of the ELIPS-4 programme

are to provide Europe with a solid basis for achieving major progress in:

1. Continued focused **Fundamental Research in Life and Physical Sciences in Space**
   within the following 6 main research disciplines:

   - Fundamental physics
   - Materials sciences
   - Fluid physics and Combustion
   - Exobiology
   - Biology
   - Human physiology and performance

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2. Applied Research and industrial R&D, addressing societal needs in for example:

- Supporting the understanding of biological mechanisms and organs functions as well as the development of diagnostics and novel treatments for age-related human diseases
- Supporting the development of new advanced materials for a variety of industrial applications including new energy sources for reducing energy needs and climate change
- Supporting the implementation of industry-driven R&D and technology demonstrations, making end-user industries beneficiaries in research exploiting the specific features of the *Columbus* environment and other platforms

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3. Enabling Research and Technological Development for Human Exploration in the areas:

- Radiation biology and physiology
- Health care and human performance under extreme conditions
- On-orbit analysis technologies
- Food production in space
- Fluids processing in space
- Materials exposure and advanced materials
- Space technology testing
- Educational activities, exploiting the ISS and using the European astronauts as ambassadors of science and technology towards the younger generations.

Programmatic Objectives

Grand Theme 1. Cosmic Climate

- **Planets as systems and systems of planets**

  The role of life in them and their habitability.

- **Exoplanets**

  a unique opportunity to study large samples of planetary systems with quite different planetary atmospheres from those within the solar system.

- **Solar System missions**

  the study of ‘life’ under extreme conditions within our solar system.

- **Earth Observation – the climate of our planet - System Earth**

- **Navigation satellites** as a contribution to the continuous global monitoring of the Earth’s ionosphere and atmosphere.

Grand Theme 2: Understanding Gravity

- Understanding Dark matter, Dark energy and the asymmetry of matter and antimatter in the universe.
- **Gravity and the origin of the large-scale structure of the Universe, leading to the testing of General Relativity on the largest accessible scales.**
- Detection of gravitational waves.
- Tests of strong field General Relativity in the vicinity of black holes and in the very early Universe.
- **New generation clocks with the objective of accuracy 10^{-18} using atomic clocks.**
- Definition of time entirely by precise clocks in space.
- Testing General Relativity by orders of magnitude better precision than at present.

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- The detection of undulations and fabric of space-time.
- **The mass distribution in the Earth and the planets, potentially by gradiometry using atomic interferometry**
- **Matter under zero gravity - from 'classical' fluid physics and materials sciences to studies of matter at the quantum level.**

Grand Theme 3: Life in the Universe

- **The formation and evolution of the chemical elements, galaxies, stars and planets**
- **Pre-biotic molecules and the origin and evolution of life in the Universe. Life signatures/condition.**
- Water in the Universe, understanding planetary systems, planetary and exo-planetary atmospheres, oceanography, global change
- Environmental conditions in planets and exoplanets.
- **Conditions in the early Earth, life migration.**
- **Role of gravity in the development and functioning of organisms**
- **The study of life and human performance under extreme conditions within our solar system. Extremophiles/adaptation strategies.**
- **Radiation biology, integrated human space physiology, space psychology, human performance under extreme conditions.**
- **Impact of human exploration on individuals and society (including Earth applications of space research)**

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Grand Theme 4: Cosmic Magnetism and High Energy Particles in Space

- The origin of cosmic magnetism
- Magnetic signatures in Cosmic Microwave Background observations
- **The physics of cosmic rays up to the very highest energies.**
- Very-high energy physics with very-low temperature atoms.
- **The local space environment and the protection of astronauts, including magnetic shielding.**

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The research goals of ELIPS will be achieved through:

- **continuing optimum use of:**
  - **the European *Columbus laboratory***
  - ***the European resources and capabilities available on the International Space Station*;**
- ***autonomous European mission capabilities for performing microgravity or radiation related research*;**
- ***ground-based facilities included for resource-efficient preparatory activities prior to space experiments.***

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Major operating principles:

- ✓ **the programme is science- and applications-driven**
- ✓ **the programme is structured as an *envelope programme*:**

  As such it is *flexible in its contents* to adapt to science and application needs and generates a long-term programmatic and financial perspective.

Technical Content of Period 4

Science Core Activities

General Activities:

- Experts, Advisory Groups, User Information
- Topical Teams
- Ground-based Facilities
- Support to Applied Research Projects and Industry-driven R&D
- EC Projects initiation/coordination
- Education and Outreach
- General Studies

ISS Utilisation Hardware Development

- Pre-Phase A: Feasibility Studies
- Phase A/B: Development Studies
- Phase C/D/E: New Payload Developments

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Non-ISS Payloads/Missions/Campaigns

- Bed-rest studies
- Isolation studies
- Baseline Data Collection
- Parabolic Flights and Drop Towers
- Sounding Rockets

Human Exploration Technologies Component

Analysing Interferometer for Ambient Air (ANITA-2)

Full development of the necessary payload models for a long-term flight demonstration on ISS.

Microbial Detection in Air System for Space (MiDASS)

Full development of the necessary payload models for a long-term flight demonstration on ISS.

Micro-Ecological Life Support System Alternative (MELiSSA)

Further technology development and advancement of technology readiness level in various focal areas.

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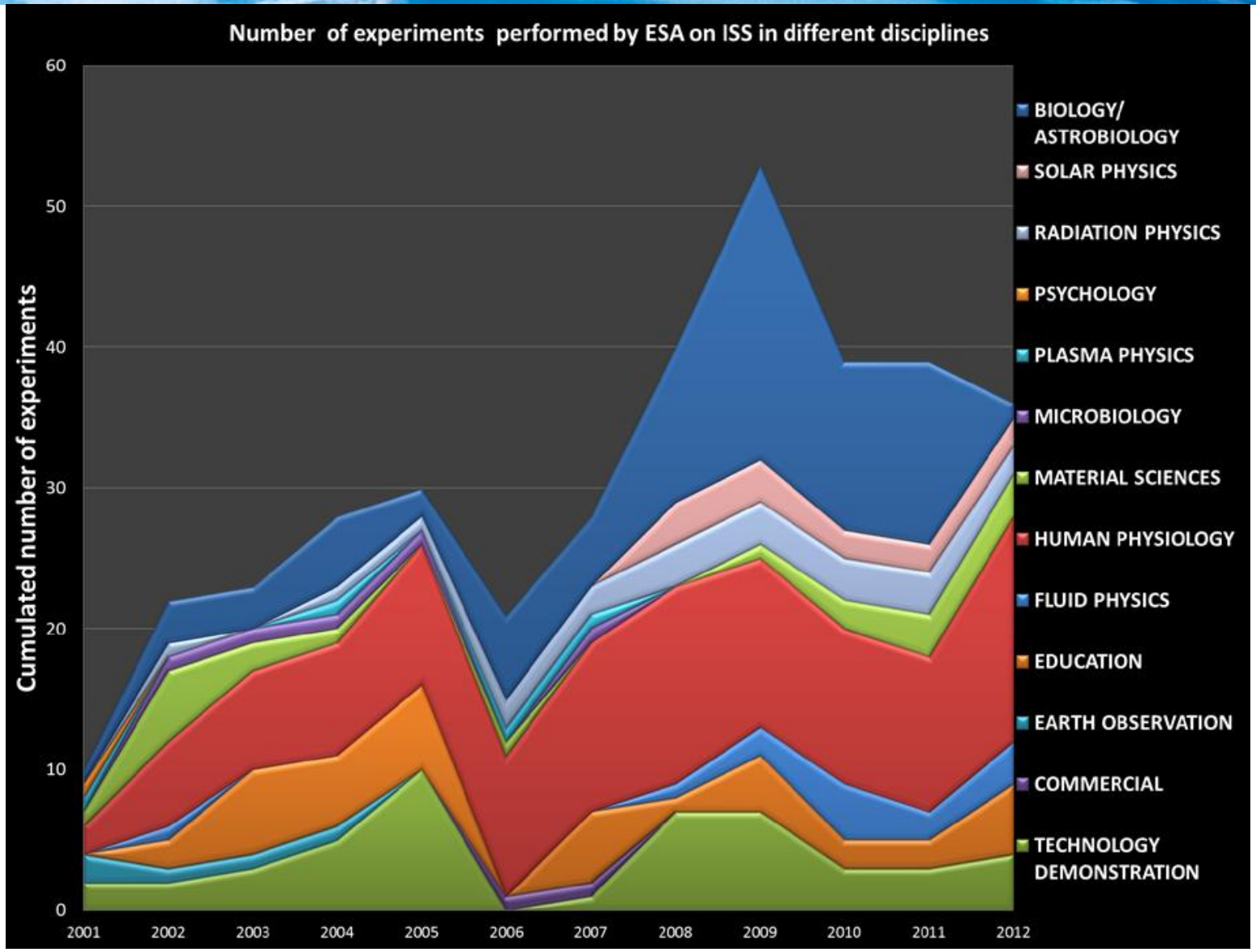

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In due time ***new dedicated Announcements of Opportunity (AO) will be considered***

The possibility of industry taking itself the initiative of soliciting access to space for proprietary R&D is foreseen when industry will present a request for a space relevant experiment.

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Applied Research and Industrial R&D

The following **research topics** are subject of ***a marked interest from end-users:***

- Mastering the structure and dynamics of soft matter towards new products and processes
- Lightweight and advanced materials to reduce energy needs and climate change
- Advanced heat transfer systems for energy savings and high energy density components
- Biotechnological application of the processes based on modified cellular function under altered gravity conditions such as plant growth
- Development of tissue engineering from stem cells, through application of altered gravity techniques
- Diagnostics and treatment of in particular age-related diseases like osteoporosis, cardiovascular diseases or equilibrium problems.
- Development of novel nutrition strategies and products

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On *the International Space Station* until at least 2020 and beyond…

The ELIPS programme Period 4
starts in 2013 with a duration of 4 years

By the end of 2015, a decision on the continuation of the programme with Period 5 shall be taken by Participating States