



The European Space Sciences Committee

*4 May 2017
Washington, DC*

*Athena Coustenis, ESSC Chair
Nicolas Walter, ESSC Executive Secretary*



The European Science Foundation Hosts Scientific Expert Boards and Committees

Composed of high-level independent researchers or research managers to provide targeted expert advice in areas of science, policy, infrastructure, environment and society in Europe:

- Nuclear Physics European Collaboration Committee (NuPECC)
- **European Space Sciences Committee (ESSC)**
- Marine Board (EMB)
- Committee on Radio Astronomy Frequencies (CRAF)
- Materials Science and Engineering Expert Committee (MatSEEC)

ESSC Chair: Athena Coustenis, Paris Observatory and CNRS, France

Astronomy and Fundamental Physics

Earth Sciences

- **Panel Chair:** Stéphane Udry, Université de Genève, Switzerland
- Conny Aerts, Katholieke Universiteit Leuven, Belgium
- Paolo De Bernardis, Rome "La Sapienza" University, Italy
- Chris Done, University of Durham, United Kingdom
- Michael Perryman, University College Dublin, Ireland
- Jordi Torra, Universidad de Barcelona, Spain
- **Panel Chair:** Ian Brown, Stockholm University, Sweden
- Laurence Eymard, Université Pierre et Marie Curie, France
- Andreas Kääb, University of Oslo, Norway
- Maarten Krol, University of Wageningen, Netherlands
- Rosemary Morrow, LEGOS-OMP, France
- Sindy Sterckx, VITO, Belgium
- Pepijn Veefkind, Royal Netherlands Meteorological Institute, Netherlands

Life and Physical Sciences in Space

Solar System Exploration

- **Panel Chair:** Dominique Langevin, Université de Paris-Sud, France
- Sarah Baatout, Belgian Nuclear Research Centre (SCK-CEN), Belgium
- Alexander Chouker, Hospital of the Ludwig-Maximilian University, Germany
- Berndt Feuerbacher, DLR, Germany
- Helen Fraser, The Open University, United Kingdom
- Anne Pavy Le Traon, University Hospital of Toulouse, France
- Roberto Piazza, Milano Politecnico, Italy
- Peter Preu, DLR, Germany
- Hubertus Thomas, DLR, Germany
- **Panel Chair:** Hermann J. Opgenoorth, Swedish Institute of Space Physics, Sweden
- Mahesh Anand, The Open University, United Kingdom
- Ester Antonucci, Torino Observatory of Astronomy, Italy
- Luisa M. Lara Lopez, Instituto de Astrofisica de Andalucia -CSIC, Spain
- Franck Montmessin, CNRS, France
- Karri Muinonen, University of Helsinki and National Land Survey, Finland
- Gerhard Paar, Joanneum Research, Austria
- Petra Rettberg, DLR, Germany
- Robert Wimmer-Schweingruber, University of Kiel, Germany

"The mission of the ESSC is to provide an independent voice on European space research and policy. It is the ESF's expert body on space research"

International Environment

European Union

- FP7/H2020 Space Advisory Group (individuals)
- Horizon 2020 stakeholder consultations
- Direct interactions with programme executives

National Space Agencies

- Annual meeting with ESSC Funding Organisations
- UKSA's SPAC
- Swedish national committee

ESA

- Council at Ministerial level
- High-level Science Policy Advisory Committee (ex-Officio)
- Scientific advisory committees at programme level (ex-Officio)
- Meetings with programme executives

- COSPAR Science Advisory Committee (ex-Officio)
- Observer to UN OOSA

- US National Academies Space Studies Board
- CAS/NSSC
- JAXA
- IKI

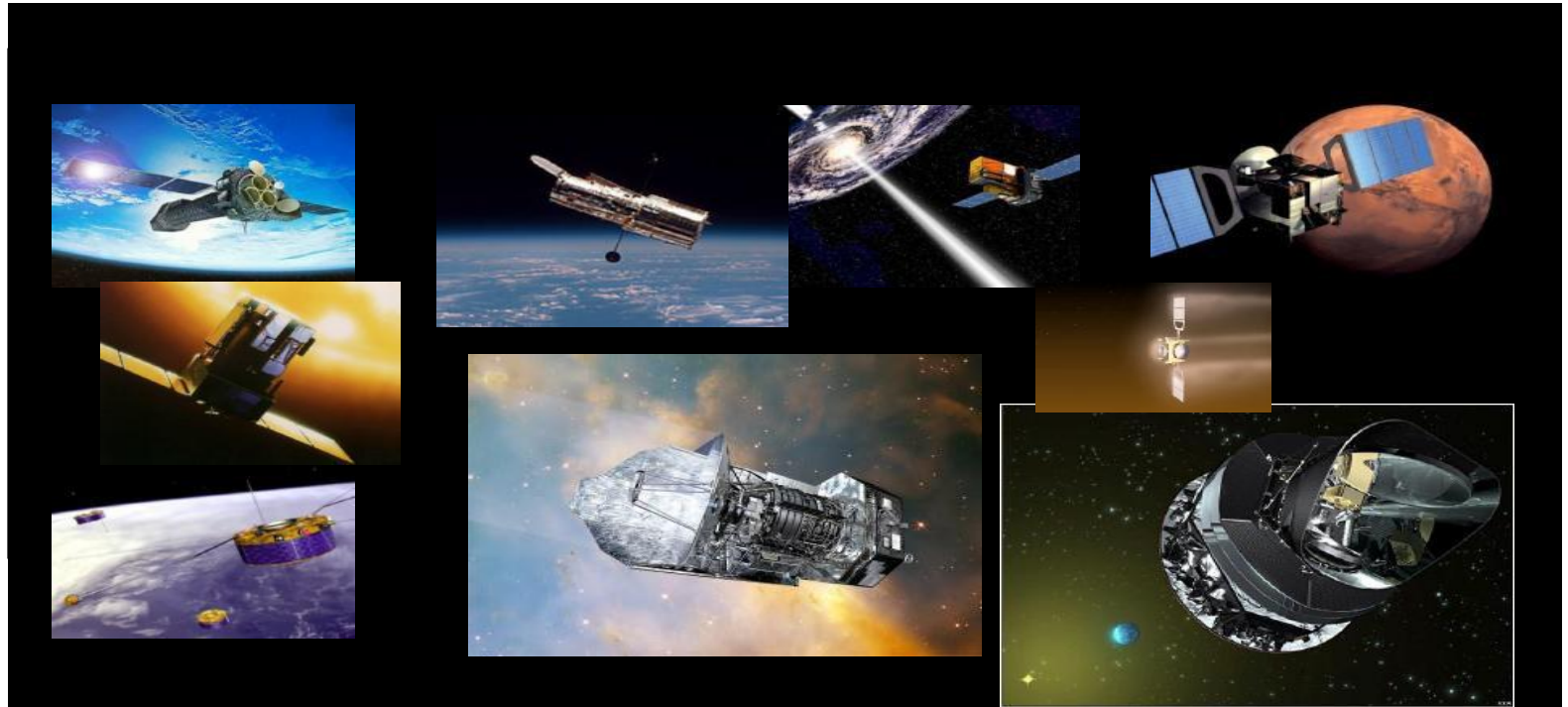
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**ESSC inputs on the ESA
programmes at the 2016 Council
Ministerial Level**
Lucerne, Switzerland
1-2 Dec. 2016

Interactions with ESA

- Interactions with DG and ESA Directors
- Participation to HESAC, HiSPAC and SSAC meetings
- Contribution and participation to the ESA Council at Ministerial Level in Luzern, Switzerland, 1-2 Dec. 2016 and statement on the outcome and follow-up plans
- > ESSC Recommendations and contribution on the ESA program proposals
 - **Science Mandatory programme**
 - **Human and Exploration programme**
 - **Earth Observations programme**
 - **Space Situation Awareness programme**

ESA Science Mandatory Programme



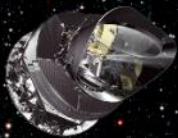
- To enable the European scientific community to achieve and sustain excellence in science through a cutting-edge scientific programme meeting the challenges of worldwide research.
- To be a pillar in the creation and maintenance of space skills and capabilities for Europe, including advanced technologies, key for the competitiveness of European industry on the worldwide scene.
- To fascinate, inspire and motivate European citizens.

→ ESA'S FLEET ACROSS THE SPECTRUM



Thanks to cutting edge technology, astronomy is unveiling a new world around us. With ESA's fleet of spacecraft, we can explore the full spectrum of light and probe the fundamental physics that underlies our entire Universe. From cool and dusty star formation revealed only at infrared wavelengths, to hot and violent high-energy phenomena, ESA missions are charting our cosmos and even looking back to the dawn of time to discover more about our place in space.

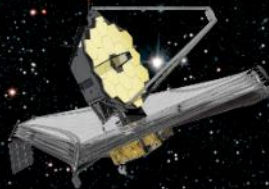
planck
Looking back
at the dawn of time



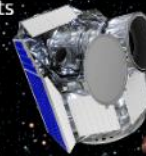
herschel
Unveiling the cool
and dusty Universe



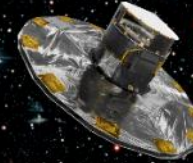
jwst
Observing the first light



cheops
Sizing and first characterisation
of exoplanets



gaia
Surveying a billion stars



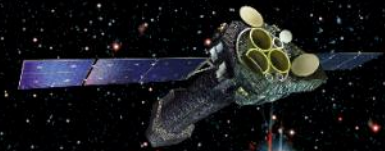
euclid
Exploring the dark Universe



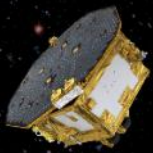
hst
Expanding the frontiers
of the visible Universe



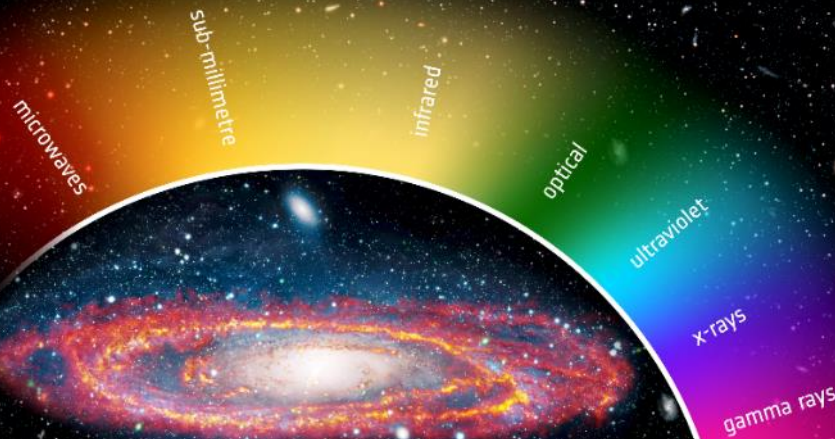
xmm-newton
Seeing deeply into the hot
and violent Universe



**lisa
pathfinder**
Testing the technology
for gravitational
wave detection



integral
Seeking out the extremes
of the Universe





venus express
Studying Venus' atmosphere

juice
Studying Jupiter's icy moons

proba-2
Observing coronal dynamics and solar eruptions

bepicolombo
Exploring Mercury

cassini-huygens
Studying the Saturnian system and landing on Titan

mars express
Investigating the Red Planet

rosetta
Chasing a comet

solar orbiter
The Sun up close

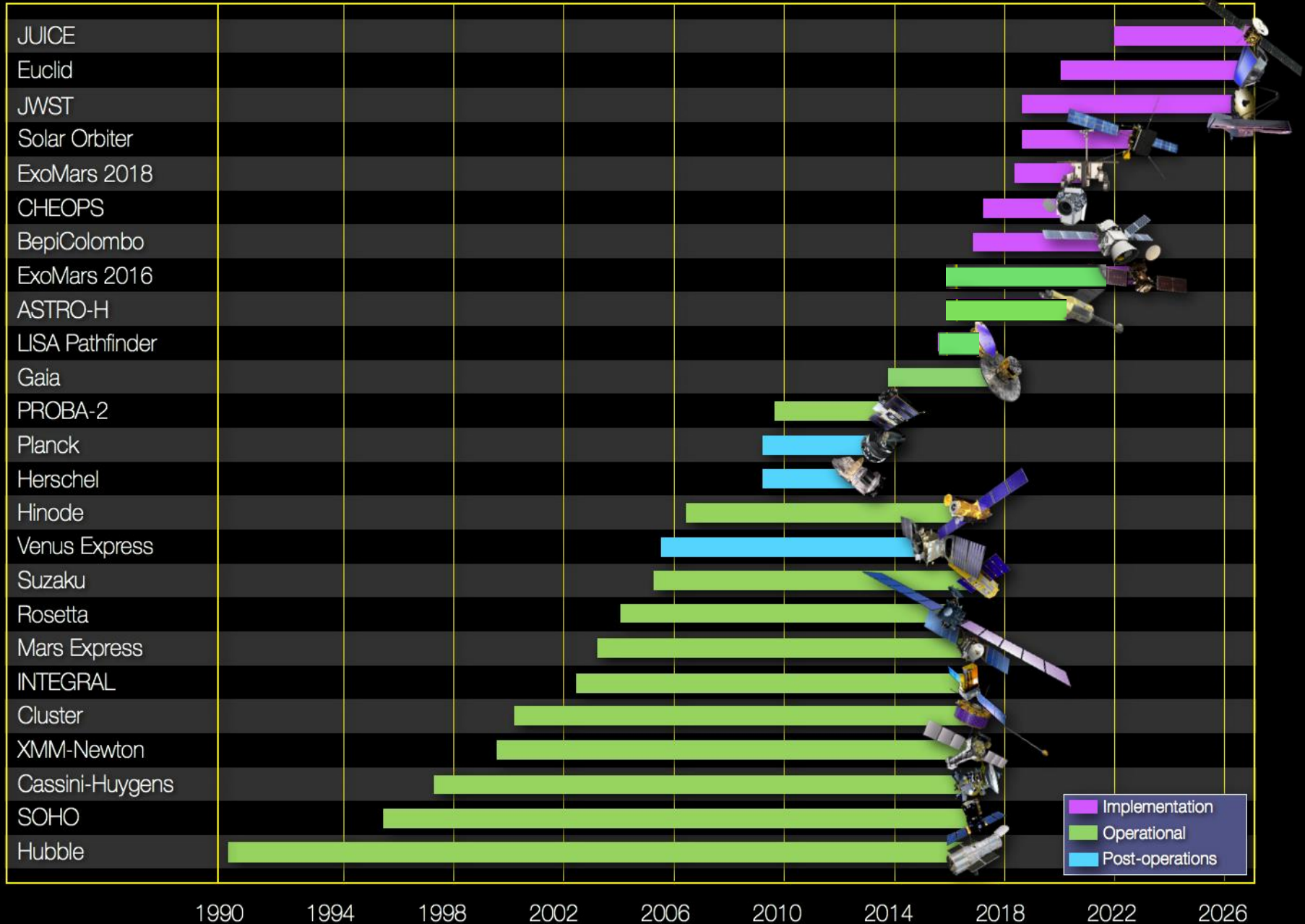
cluster
Measuring Earth's magnetic shield

philae
Landing on a comet

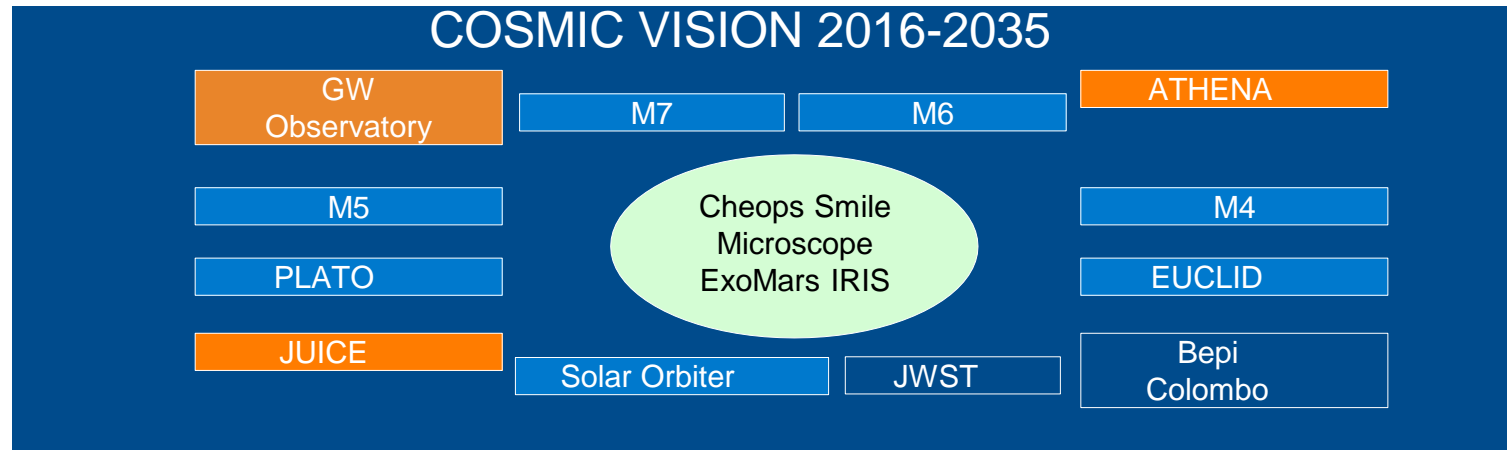
→ ESA'S FLEET IN THE SOLAR SYSTEM

The Solar System is a natural laboratory that allows scientists to explore the nature of the Sun, the planets and their moons, as well as comets and asteroids. ESA's missions have transformed our view of the celestial neighbourhood, visiting Mars, Venus, and Saturn's moon Titan, and providing new insight into how the Sun interacts with Earth and its neighbours. The Solar System is the result of 4.6 billion years of formation and evolution. Studying how it appears now allows us to unlock the mysteries of its past and to predict how the various bodies will change in the future.

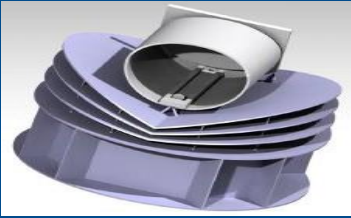
ESA science & robotic exploration missions



THE COSMIC VISION PROGRAMME

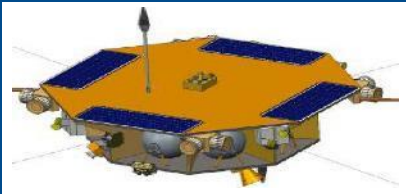


M4 Candidate Missions



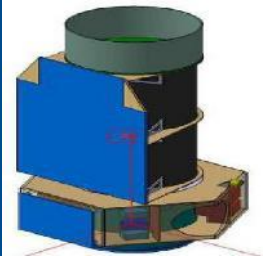
ARIEL

Exoplanet atmosphere spectroscopy in the IR ($\lambda = 2-8 \mu\text{m}$) for hot transiting planets. L2 orbit.



THOR

Understanding turbulent fluctuations in plasmas. Spinning S/C, in High Elliptic Orbit.



XIPE

Observatory for measuring the polarization of X-ray sources. LEO equatorial orbit 550 km

FUTURE L-CLASS MISSIONS



The ATHENA mission in Phase A study:
<http://www.the-athena-x-ray-observatory.eu/>



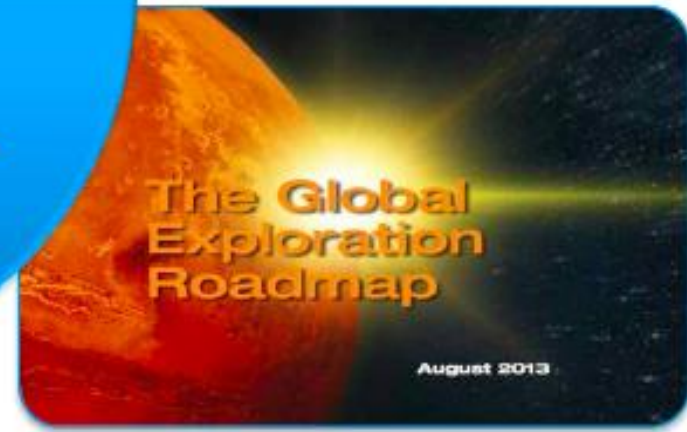
Science review of the LISA proposal received for the mission was completed late April 2017

ATHENA + –It was the result of the reformulation, in 2011, of the IXO mission, a next-generation facility to address some of the most fundamental questions in astrophysics and cosmology by investigating black holes and matter under extreme conditions, the formation and evolution of galaxies, clusters and the large scale structure, and the lifecycles of matter and energy.

The **LISA Gravitational wave Observatory** is a space mission designed to measure gravitational radiation over a broad band at low frequencies, from about 100 μ Hz to 1 Hz, a band where the Universe is richly populated by strong sources of gravitational waves. It will benefit from the results of the very successful LISA

Human and Robotic Exploration Programme: European Exploration Envelope (E3P) Proposal

Europe's Space Exploration Vision

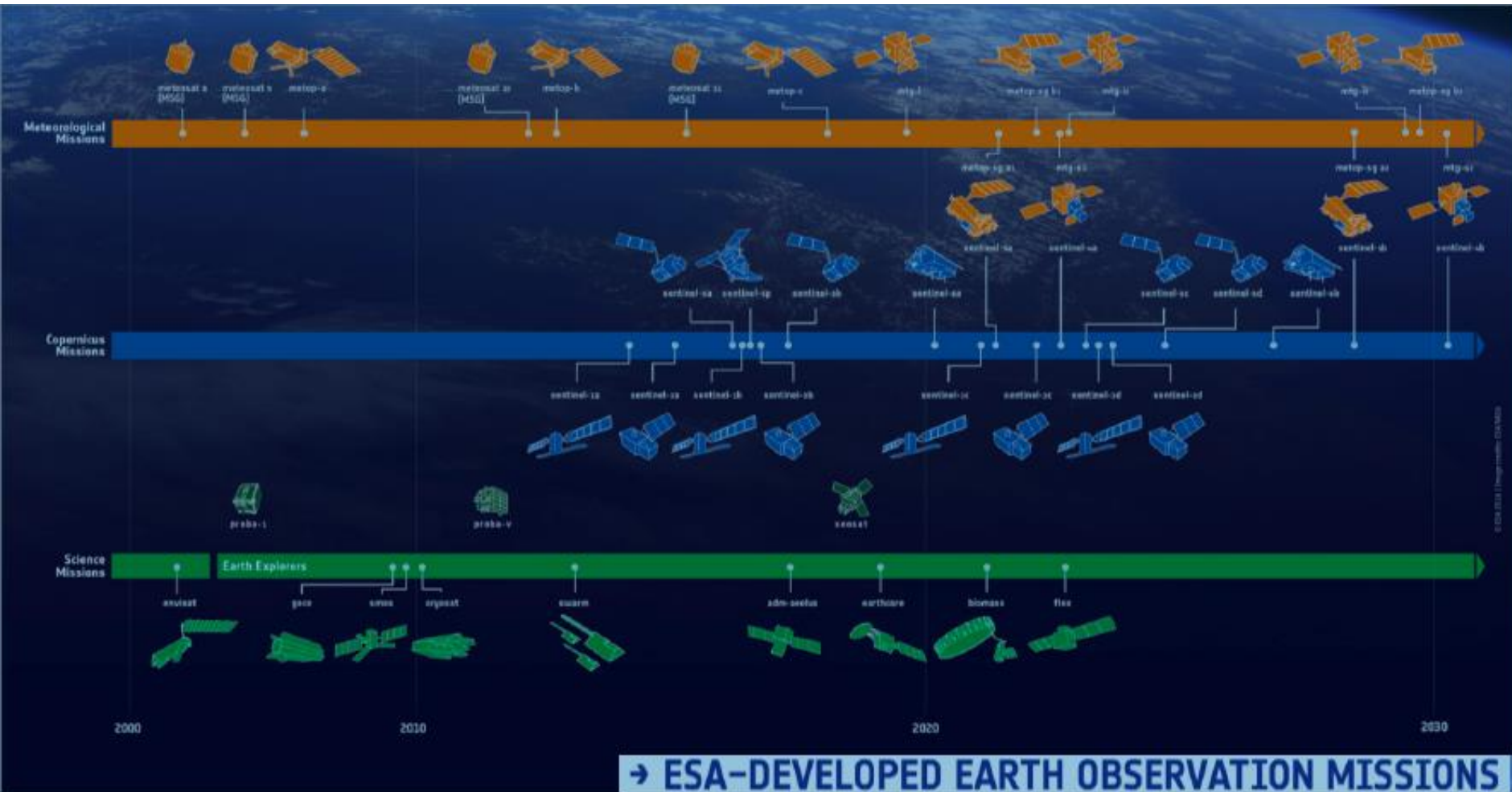


Activities in Period 1 financial envelope



Areas	Activites
ISS	<ul style="list-style-type: none">• ISS Operations until 2019• Finalisation of Orion ESM-FM1; procurement, assembly and testing of ESM FM 2 (barter element)• Start of complementary barter on Deep Space Habitat
ExoMars	<ul style="list-style-type: none">• 2016 mission and science operations (after end of nominal science)• 2020 mission full implementation: development, integration, testing
Luna-Resource Lander	<ul style="list-style-type: none">• Implementation of Phase C/D/E of PILOT• Implementation of Phase C/D/E of PROSPECT• Implementation of Ground operation support
SciSpaceE	<ul style="list-style-type: none">• Science support activities (Topical Teams, Application promotion)• Development ISS experiment facilities, instruments, cartridges, inserts• Hardware and mission cost of non-ISS platforms, including ground-based facilities, parabolic flights, sounding rockets and ESA participation in BION-M2
ExPeRT	<ul style="list-style-type: none">• Mission studies (up to Phase B1) with focus on Mars Sample return and Phobos Sample Return• Technology preparation for human and robotic missions• Preparation of new international collaborations• Spaceship EAC /Harwell Robotics and Autonomy Facility• At least one commercial partnership implemented

ESA Earth Observation programme



- Meteosat meteorological satellites since 1997
- ERS and ENVISAT: Earth's changing environment and climate
- ESA's Living Planet Programme for Science:
 - Earth Explorers (break-through technology and key science)
 - Earth Watch
- Copernicus Space Component:
 - Sentinels for long-term climate datasets (Sentinel 2B just launched)

Successes and objectives of the science mandatory programme

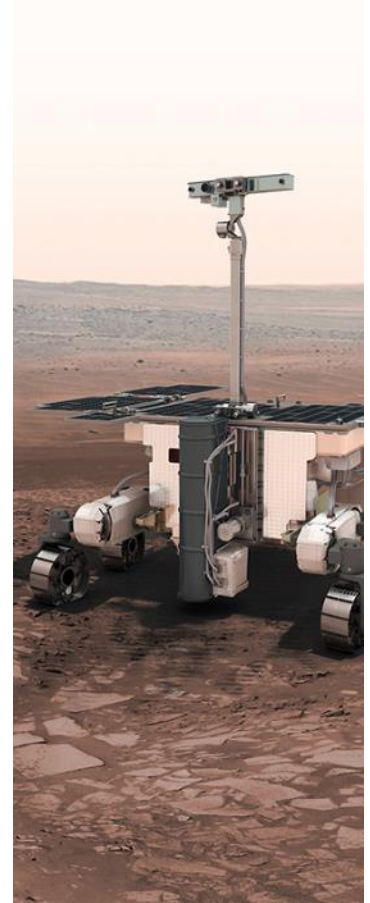
- The ESSC recognises the **structuring effect of the scientific programme** on the European scientific community and the involvement of this community in defining science priorities.
- The ESSC is considering very positively that ESA is effectively pursuing the **guidelines of the Cosmic Vision 2015-2025**, aimed to address fundamental scientific questions concerning: planetary system formation and evolution, emergence of life, solar system, origin of the Universe and its fundamental physical laws.
- The ESSC recommends that a **long-term scientific strategic vision and planning of the scientific programme** be further developed. Such a strategic vision, which of course includes some risk and complements and/or updates the Cosmic Vision programme, should be developed **in consultation with the scientific community and the international partners**.

Successes and objectives of the E3P programme

- The ESA exploration strategy is well reflected in the **E3P proposal**. We note the **outstanding outcome of the ELIPS programme** in increasing European knowledge, capacity and capability in fundamental and applied sciences as well as on exploration-related research.
- The programme proposed is well balanced for **science and technology**. It builds on current strengths and big successes and coherently connects the **continued efforts on ISS** with a promising exploration programme going from the **Moon** (including CisLunar Space) to **Mars** (and its moons).
- The ESSC strongly **supports the concept of an envelope programme for European robotic exploration and human spaceflight in LEO and beyond**. The ESSC particularly welcomes the coherent long(er)-term vision of the E3P approach, as it is forward-oriented, integrative, adaptive, and well balanced. The envelope approach should allow to retrieve the most out of each individual programmatic element and to contribute in making E3P an overall highly competitive programme on the international scene.

ESSC position on the outcome of ESA C-MIN

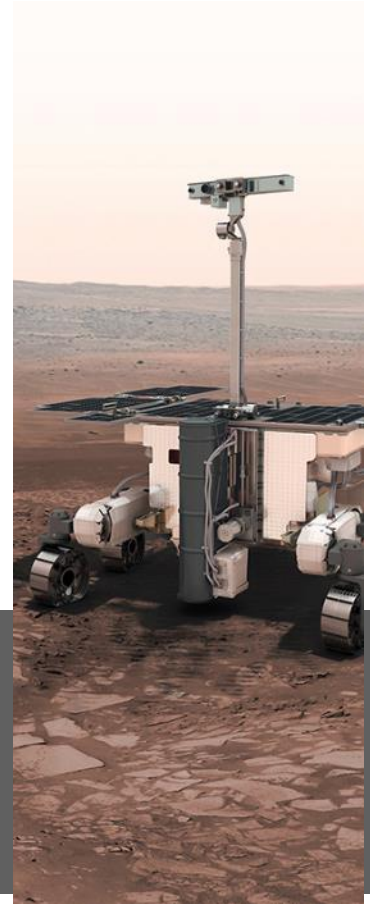
- ESA DG *Towards Space 4.0 for a United Space in Europe*. calls for a united and collaborative spirit across Europe and embraces a holistic approach to foster European identity, spirit and cohesion through excellence in space sciences and technology. It also sets the scene for an **improved coordination between ESA and the European Union institutions**
- Welcomed that **ExoMars is secured** - the benefits of separate budgets between mandatory and optional activities is highlighted
- Although rather high overall funding level, there is a **concern** about the fact that the interplay between the 1% increase and the contribution to ExoMars **will not allow for the scientific programme to compensate the inflation over the 2017-2021 period.**



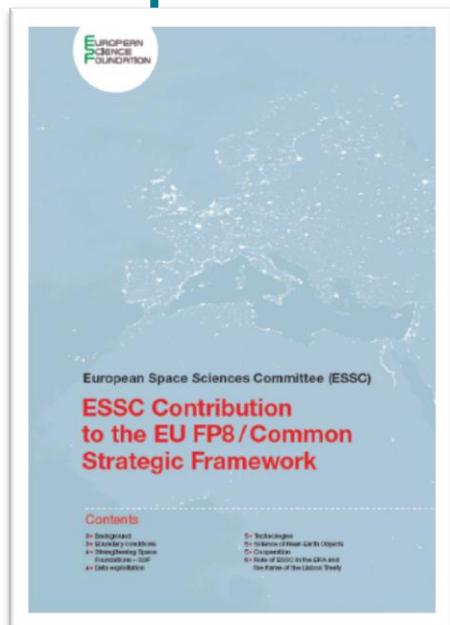
ESSC position on the outcome of ESA C-MIN

- Welcomed that the European Exploration Envelop Programme (E3P) concept is approved, however **regrettably the SciSpace element underfunded**
- EO - welcomed the level of funds allocated to the EarthWatch elements, but regret that the 5th phase of the **Earth Observation Envelop Programme has been underfunded by approximately 18%**
- SSA - Regrets that the **SSA programme has been underfunded by more than 50%** - It is also clear that SSA is an issue of common interest between ESA and the European Commission

Space science is not a cost, it is a high-return investment with a broad and exciting leverage effect on the people and the economy.



THE SPACE PROGRAMME WITHIN THE EUROPEAN COMMISSION



ESSC and the European Commission



Interactions with European Union and Commission

- ESSC contribution to the EC H2020 Work Programme consultation
- ESSC contribution to the European Space Strategy Consultation
- Contribution to the EC DG GROWTH Horizon 2020 SPACE Cons. Workshop
- Invitation to EC H2020 Space Programme Committee to present ESSC position on draft Work Programme
- ESA-EC Joint statement

European Space Strategy Consultation



- **ESSC Contribution Structure:**
 - Innovation for Space Sciences, Innovations for Citizens
 - Space Research at the service of the European citizens
 - Space Situational Awareness
 - Environmental Sciences
 - Health Research and Life Sciences
 - Material and Physical Sciences
 - Transversal issues
 - Big Data
 - Reaping the benefits of Cubesats
 - Strengthening European Scientific Capabilities
 - European Talents
 - European Structural Aspects
 - New EC Strategic Space Programme
 - The Need for an advisory Body for Space Sciences Serving Europe's Space Strategy

- Maximising the benefits of space for society and the EU economy
- Fostering a globally competitive and innovative European space sector
- Reinforcing Europe's autonomy in accessing and using space in a secure and safe environment
- Strengthening Europe's role as a global actor and promoting international cooperation

EC New Space Strategy For Europe

OPPORTUNITY FOR US INVESTIGATORS TO JOIN HORIZON 2020 PROJECTS



RESEARCH & INNOVATION
News Alert

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Public consultation: have your say on Horizon 2020

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Older news alerts

Friday, 28 October 2016
Human and Animal Health: Commission continues fight against Antimicrobial Resistance with announcement of second Action Plan

Monday, 24 October 2016
EU invests €10 million in expansion of high-speed internet access in Spain

Latest SME Instrument results: European Commission to invest €9.1 million in 189 innovative businesses

Friday, 21 October 2016
European Union invests €45 million into research to combat the Zika disease

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News Alert

EU-US agreement offers new opportunities for research cooperation

Brussels, 17 October 2016

European and American researchers will be able to work together more closely on projects funded under Horizon 2020, the European Union's research and innovation programme. This is thanks to an agreement concluded today between the European Commission and the US Government.

Carlos Moedas, European Commissioner for Research, Science and Innovation, said: "Bright ideas should know no boundaries, so European research and innovation is open to the world for

- Under the deal, US researchers who have their own funding source will be able to collaborate with EU projects without signing the EU grant agreement and binding themselves to EU regulations.

ESA AND EC JOINT STATEMENT ON SHARED VISION AND GOALS FOR THE FUTURE OF EUROPEAN SPACE (26 October 2016)

- Space is also an enabler for responding to societal challenges and it effectively contributes to smart growth, the competitiveness of the European economy, and produces highly qualified jobs.
- Space is expanding the frontiers of knowledge, is inspiring and motivating the next generations.
- Europe has had many successes from breakthrough science and exploration missions across the Solar system, its contributions to the International Space Station, the development of unique Earth's monitoring systems with the Copernicus and meteorology programmes, a cutting-edge global navigation infrastructure with Galileo and EGNOS, world leading commercial telecommunications constellations and launch systems, and a solid industrial base, among other.

ESA AND EC JOINT STATEMENT ON SHARED VISION AND GOALS FOR THE FUTURE OF EUROPEAN SPACE

- Our common European ambition is that Europe remains a world-class actor in space and a partner of choice on the international scene. By 2030, Europe should be able to fully benefit from its space solutions to implement its policies, to strengthen European values and security, improve knowledge and foster prosperity.
- We [...] envisage to:
 - foster a globally competitive European space sector, by supporting research, innovation, entrepreneurship for growth and jobs across all Member States, and seizing larger shares of global markets;
 - ensure European autonomy in accessing and using space in a safe and secure environment, and in particular consolidate and protect its infrastructures, including against cyber threats.
- [Resting] on a solid foundation of excellence in science, technology and applications, expressed through an environment of outstanding education and skills and a thorough knowledge base.

ESSC and International partners



Interactions with European Union and Commission

- COSPAR CSAC (CNES, Paris)
- Interactions with CAS, IKI and JAXA
- NAS SSB



- Long-term constructive interactions and international exchanges/information
- Mutual Ex-Officio representation
- Joint reports and activities
- Current projects
 - Phobos Planetary Protection Study
- ESSC participating in SSB committees at the Space Science Week (28-30 March 2017)

SSW: Participation and contribution in the Plenary Session and in CAPS, CBPSS, CESAS



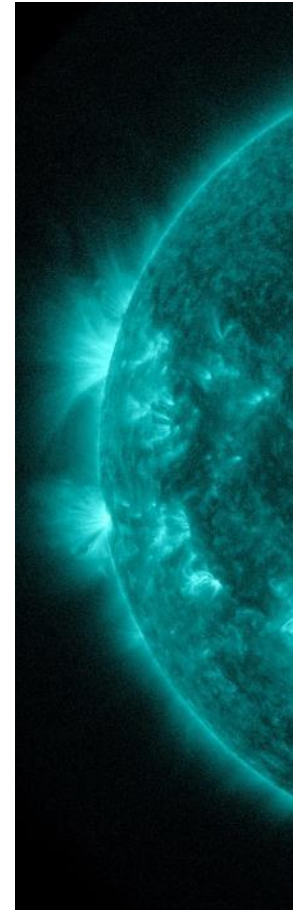
ESSC Future activities

Studying the worlds in the outer solar system with possible subsurface liquid water oceans

- Concept for a joint working group between ESSC and the European Marine Board
- Would involve marine scientists (geo/bio), planetary scientists and astrobiologists.
- Objectives: provide recommendations on issues of common scientific interest and opportunity to foster collaborations between programmes
- Already on board ISSI, NAS, PSL IRIS-OCAV,

Working Group, composed of 10-12 members:

- explore the challenges and monitor the approaches being taken around the globe, in order to carry out a gap and requirement analysis with special consideration of potential European strengths and weaknesses (vulnerabilities) to meet the global SW challenge in true global partnership for mutual benefits,
- investigate a possible consolidation of user needs and produce a map of competencies needed for taking the next steps in implementing Space Weather services for Europe,
- propose ways to raise the awareness for potential space weather threats and necessary mitigation activity amongst the European public and decision makers



Study on microgravity user community

- ESA recently announced the award of an ESA ITT to Telespazio UK to study (in only 6 months) the scope and depth of the current microgravity user community, the providers in the landscape and how ESA provision of microgravity should evolve beyond 2020 and particularly post-ISS (2024).
- ESSC Contribution to be considered

- Strong Interest from the Earth Sciences Panel to discuss and make recommendation on the quality (control) of Copernicus data
- Will be further addressed in June Athens meeting

- 53d plenary meeting in Athens, 1-2 June 2017
- 54th plenary meeting in DLR Munich on 21-24 Nov. 2017,
- ESA upcoming SSAC, HESAC meetings with decisions on mission selections and development, as well as continuing discussions and consultations on the way forward after the Ministerial...
- ...



<http://essc.esf.org>