



*Public consultation on the next EU
Research and Innovation Programme*

European Space Sciences Committee Contribution

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SPACE AND SPACE RESEARCH FOR THE BENEFITS OF EUROPEAN CITIZENS

The space sector offers several key solutions to challenges that our modern society is facing. Fundamental space research delivers answers to the most important questions of mankind: In what environment do we live? Why do we live here? How did the universe and our (and other) solar system(s) develop and how will it (they) evolve. Additionally, fundamental science brings surprises. It is not straightforward to plan exactly how it will benefit society, but experience shows that it always does. For example, the need at CERN to coordinate between many, many different machines and experiments, hardware and software, support systems and beam lines, led to the development of HTML. This enabled the World Wide Web, an essential part of our modern society. Another example concerns the development of the theory of general relativity by Albert Einstein in 1915, which later (80 years later) enabled the performance of GPS systems, a key component in services routinely delivered and used by citizens.

Space activities such as telecommunication and navigation, operational Earth observation services and security, space engineering and space technology are deeply rooted in European citizens' lifestyle. In return, European societies and economic welfare are increasingly dependent on these services and activities. This intertwining of space activities with our technology-driven societies and economies can also be transposed to research performed in space. Space sciences (also considering research done in space) cover an extremely wide range of sciences, they are everywhere and have relevance and impact on many scientific disciplines: health research (i.e. ageing, immunity, stress related responses and cardiovascular diseases), life and environmental sciences, physical and material sciences, to name a few in addition to astronomy and planetary science.

Looking downstream, numerous space-based investigations have direct relevance for technology development (e.g. telemedicine, biomedical research, material engineering, energy production, communications, information technology, robotics, sensors and automation). Acknowledging and catalysing the role and potential of space science has for innovation in Europe would strengthen these links between research and application and facilitate industry uptake and appropriation of investigations performed in and from space.

As science progresses and tackles more and more difficult and increasingly complex problems, it is vital to follow a 'System Approach' to answer scientific questions, i.e. to study interactions (as for example the sun-planetary interactions) as a coupled system with all available data, not just from one instrument on one satellite. This is particularly true in areas where there are multiple, complimentary assets available to the communities, both in space and on ground (free flying and Earth-based observatories). An integrated approach between ground and space research on selected topics across the full space sciences arena has high potential for progress.

There is a need for improved coherence between all European space players' strategies that would allow an ambitious, efficient and optimised European long-term strategy. Such an overarching 'trans-institutional' (and particularly trans-national) approach on issues of common (European) relevance would strengthen the European space sector and avoid redundant developments driven simply by individual geo-return considerations and/or parallel developments within different (sets of) bodies.

Such a coherent vision should translate to 'strategic', i.e. top-down, areas with dedicated budgets. It is important to stress that fundamental and curiosity-driven research should be included in these strategic areas, to ensure optimal long-term scientific developments without immediate short-term technological applications. Such an approach has been taken to some extent with the Horizon 2020 programme Strategic Research Clusters (SRCs) and should be continued in the next Framework Programme, e.g. through the development of virtual institutes for domains of strategic relevance and/or that would most benefit from increased European coordination. Building up critical masses, these institutes or initiatives would strengthen the European space research landscape and demonstrate flexibility and adaptability.

Beyond Europe, the international space sciences landscape is evolving at a rapid pace, new capacities are appearing and scientific and technological milestones are being completed in non-European countries. Besides USA and Russia, this is particularly the case in Japan, China and India and Europe is in a unique position to exploit partnership with all space powers. Although at the scientists' level, cooperation is a success and progresses internationally, several collaborative projects are hindered by lack of willingness or of capacity to achieve an agreement at a sufficiently high level in space agencies (and/or the overlaying governmental bodies) for political and/or export regulation reasons. An improved European coordination mechanism could also allow the emergence of a European anchor for international cooperation.

RECOMMENDATION: The next Framework Programme should initiate a new large scale and long term SPACE topical area, as a visible and distinct component within the Programme. It should be focussed on key scientific and societal challenges and feature improved coordination between the various relevant actors, which could be defined and implemented through the work of a reinforced EU/ESA mechanism. Similarly stronger links between national (space) agencies and the EU Framework Programme would be beneficial. In cases where the scientific purpose comes after other considerations, the scientific community should nevertheless be involved in the programme definition as early as possible, in order to maximise the corresponding scientific return and optimise the benefits for the EU citizens that could stem from this investment.

A NEW SPACE FLAGSHIP FOR THE EUROPEAN UNION

As recently emphasised by EC Vice-President Federica Mogherini, Copernicus and Galileo have represented over the past years the biggest and most stable space programmes the European Union has initiated, together with ESA. They are key milestones for the European space sector, both from a programmatic and technological point of view, providing real benefits to society at large, but also because of the important scientific data return to the community. A new 'Flagship' undertaking by the European Union would be an opportunity to continue the tradition of excellence established with these programmes.

Space sciences in Europe have been a fundamental factor of success, whether in observations of the Earth, exploration of the Solar system or discoveries in the Universe. Balancing the operational nature of Copernicus and Galileo, the ESSC strongly recommends that a new Flagship undertaking by the European Union, if implemented, focusses on space sciences. The selection of topics to be addressed should be performed with direct involvement of, and input from, the European scientific community, following the model of calls for proposals of the European Space Agency. Indeed, the current scientific themes considered by ESA in selected mission studies ranging from life and physical sciences to Earth observations and astronomical aspects, should also be taken into account.

RECOMMENDATION: The next Framework Programme should acknowledge the transversal nature of space sciences and develop a cross-cutting flagship initiative that would unite and support research and innovation activities from various space science and technology development areas. Additionally, such flagship initiative should foster and catalyse a Systems Approach that would allow all actors and capabilities to be mobilised around a common set of strategic and ambitious objectives.

INNOVATION FOR SPACE – INNOVATIONS FOR EUROPEAN ECONOMY

Space is quickly becoming a dynamic field where private companies, different in nature from the traditional space companies of old, compete to offer new services in the fields of research, Earth observation, transportation and even exploration. It is thus paramount that Europe remains at the forefront of space development and maintains and strengthens its position as a major space power and a key international partner in all space matters.

The scientific and technical challenges posed by space represent a great opportunity for European industry and the European citizens. Technologies related to reduction of mass, resilience of space infrastructures, deployment and operation of large scale orbital infrastructure, robotics and autonomous systems (including human-robotic partnership), life support systems, telemedicine, telecommunication, human-machine interfaces, in-orbit servicing, space debris reduction as well as power generation are key enablers of future world class scientific achievements. More specifically, and considering the current challenges in planetary sciences, propulsion, new material for heat shields, new energy sources, and sample return technologies (to name a few) represent contemporary challenges that should be tackled by Europe in a coherent manner.

While they allow scientific progress, all the technologies listed above are fully relevant for the development of innovative products and techniques on Earth. Therefore, it is important to facilitate spin off to the consumers and B2B market. This could be performed not only through direct financial support but also 'in nature' through enabling effective transfer of knowledge from programme-managing institutions to the private sector and in particular SMEs. Alternative ways to the traditional method of direct funding can be exploited, for example access for non-space researchers to space facilities and experts. This would, promote cross-fertilisation and leverage key enabling technologies.

In this context, it is also important to foster the development of critical technologies for European non-dependence in order to ensure that the European industry is capable of offering needed (scientific) capabilities without undue influence of externalities.

A report from an ESA-commissioned 2014 foresight exercise (TECHBREAK Study) provided clues to flag up main developments in various non-space technological areas. The identification of the level of granularity at which the availability of these technologies could be assessed for potential spin-in led to the choice of the EC-defined "Key Enabling Technologies" (KETs) as references, in order to maximise commonalities and synergies with efforts led by the EU. The KET-related activities address the whole innovation chain and related support by the EC encompasses means to facilitate industrial uptake and commercialisation. Identifying commonalities would be a good way to circumvent the (traditionally) conservative approach to technology development of the space sector and exploit synergic funding. A challenge for the European Space Strategy would therefore be to help support such commonalities and synergies, and thereby the necessary technology pull to Europe's space programmes.

RECOMMENDATION: The next Framework Programme should allow for the development and implementation of proper spin-off mechanisms that would optimise the impact of space-research related technologies on European innovation landscape and industrial capacity. Innovative supports schemes such as efficient transfer of knowledge to the SMEs should be defined. Commonalities and synergies with efforts led by the EU in other areas than space should be maximised. A challenge for Europe would therefore be to help support such commonalities and synergies, and thereby the necessary technology pull to Europe's space programmes.

THE NEED FOR AN EMPOWERED ADVISORY BODY FOR SPACE

There is a basic need to create a really independent advisory body for space matters, in order to offer direct and unbiased advice to the EU regarding space strategy and programme implementation. This emerges naturally from the need for pan-European coordination in space matters.

Given the increased importance of the EU in space matters, a trend projected to increase in the next decades, it is essential that the EU receives authoritative independent advice on scientific and technological matters, from a body that can articulate and organise the needs of the wider space community, in a fully transparent way, and independently from national, EU or ESA considerations. It is also necessary to fight the unnecessary fragmentation and duplication of efforts at European level, to carry out regular surveys to assess the status and perspectives of European space activities, and to establish roadmaps and strategic plans that are widely accepted by the community.

The creation of such a pan-European expert body, empowered by the EU, ESA and their Member States, would allow the above needs to be fulfilled and contribute to the effective implementation of a true European space strategy. Such a body could express the collective voice and vision of the broader European space community, on current and future space research matters. At international level, it could promote synergies between programmes and organisations, by identifying potential opportunities for shared development. Such a body could also offer a 'systemic view' to space research as it would draw its members from the large European pool of established researchers (and not only space scientists) that are vital, active and expert members of the scientific fields at hand.

Examples of such bodies abroad are the Space Studies Board and the Aeronautics and Space Engineering Board of the U.S. National Academy of Sciences, Engineering, and Medicine. In Europe, the European Space Sciences Committee of the European Science Foundation already provide independent scientific advice and recommendations and has a recognised role in the EU scientific community. With careful planning and stakeholder engagement, this body could evolve its mandate and constituency to serve an integrated European space strategy.

RECOMMENDATION: The European Union should equip itself with an independent advisory body, empowered to advise the EU (the European Commission and the European Parliament) and other European and national institutions on space matters. This body should be tasked by EU institutions, ESA and the member states and its structure and mandate should encompass the whole scope of space science and technology, from a pan-European and international perspective.

The European Space Sciences Committee (ESSC)

The European Space Sciences Committee (www.essc.esf.org) hosted by the European Science Foundation (ESF – www.esf.org) is an independent body that regularly provides expert advice to European and National research funding and research performing organisations that support space sciences in Europe. ESSC members are drawn from experts active in all fields of space research on the basis of scientific expertise and recognition within the community, they are nominated *ad-personam* and therefore do not represent any organisation or country.

The ESSC covers the whole spectrum of space-related sciences and is structured around four panels (Astronomy and Fundamental Physics, Earth Sciences, Life and Physical Sciences, Solar System and Exploration).

The mission of the ESSC is to facilitate, support and foster space sciences at the European level by providing unbiased, expert advice on European space research and policy via recommendations or reports directly to decision makers, stakeholders and all interested parties at a national and international level. Furthermore, ESSC provides a unique focal point to assist European national councils and agencies to achieve optimal science return and harmonise strategic priorities in space activities.

The following sections highlight the recommendations and input of the ESSC to the EC space policy consultation on the policy priorities, challenges and opportunities that could shape a future Space Strategy for Europe, from the perspective of the European Space sciences community.

European Space Sciences Committee – Membership as of 8 March 2018

Title	Firstname	Surname	Affiliation	Town	Country
<u>Chair</u>					
Dr.	Athena	Coustenis	Observatoire de Paris-Meudon, PSL	Meudon	France
<u>Members</u>					
Prof.	Conny	Aerts	Katholieke Universiteit Leuven	Leuven	Belgium
Dr.	Nabila	Aghanim	IAS-CNRS	Paris	France
Dr.	Mahesh	Anand	The Open University	Milton Keynes	United Kingdom
Prof.	Ester	Antonucci	Torino Observatory of Astronomy	Torino	Italy
Dr.	Sarah	Baatout	Belgian Nuclear Research Centre (SCK-CEN)	Mol	Belgium
Dr.	Ian	Brown	Stockholm University	Stockholm	Sweden
Prof.	Alexander	Choukèr	Hospital of the Ludwig-Maximilian University	Munich	Germany
Prof.	Paolo	De Bernardis	Rome "La Sapienza" University	Rome	Italy
Dr.	Laurence	Eymard	Université Pierre et Marie Curie	Paris	France
Prof.	Berndt	Feuerbacher	DLR	Köln	Germany
Dr.	Helen	Fraser	The Open University	Milton Keynes	United Kingdom
Prof.	Andreas	Kääb	University of Oslo	Oslo	Norway
Prof.	Maarten	Krol	University of Wageningen	Wageningen	Netherlands
Dr.	Dominique	Langevin	Université de Paris-Sud	Orsay	France
Dr.	Luisa M.	Lara Lopez	Instituto de Astrofísica de Andalucía -CSIC	Granada	Spain
Dr.	Rosemary	Morrow	LEGOS-OMP	Toulouse	France
Dr.	Franck	Montmessin	CNRS	Guyancourt	France
Dr.	Karri	Muinonen	University of Helsinki and National Land Survey	Helsinki	Finland
Prof.	Hermann J.	Opgenoorth	Swedish Institute of Space Physics	Uppsala	Sweden
Mr.	Gerhard	Paar	JOANNEUM RESEARCH	Graz	Austria
Dr.	Anne	Pavy Le Traon	University Hospital of Toulouse	Toulouse	France
Prof.	Michael	Perryman	North University College	Dublin	United Kingdom
Prof.	Roberto	Piazza	Milano Politecnico	Milano	Italy
Prof.	Manolis	Plionis	National Observatory of Athens	Athens	Greece
Dr.	Peter	Preu	DLR	Rheinbreitbach	Germany
Dr.	Sindy	Sterckx	VITO	Mol	Belgium
Dr.	Petra	Rettberg	DLR	Köln	Germany

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Prof.	Alexander	Tielens	Leiden Observatory	Leiden	NL
Dr.	Hubertus	Thomas	DLR	Wessling	Germany
Dr.	Jordi	Torra	Universitat de Barcelona	Barcelona	Spain
Prof.	Stephane	Udry	Université de Genève	Sauverny	Switzerland
Dr.	Pepijn	Veefkind	Royal Netherlands Meteorological Institute	De Bilt	Netherlands
Prof.	Robert	Wimmer Schweingruber	University of Kiel	Kiel	Germany