



Annual Report 2011
of the
International Space Exploration Coordination Group





INTERNATIONAL SPACE EXPLORATION COORDINATION GROUP

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1 Introduction

The 2011 Annual Report of the International Space Exploration Coordination Group (ISECG) provides an overview of ISECG activities, products and accomplishments in 2011. It also highlights the national exploration activities of many of the ISECG participating agencies over the past year.

2 Executive Summary

In May 2007, 14 space agencies¹ jointly released “[The Global Exploration Strategy: The Framework for Coordination](#)” (GES). It describes a shared vision of coordinated human and robotic space exploration focused on solar system destinations where humans may one day live and work.

One of the many Framework Document findings was the need to facilitate information exchange among individual agencies regarding their activities in space exploration.

Therefore, the GES called for a voluntary, non-binding coordination mechanism among interested space agencies. This call led to the establishment of the **International Space Exploration Coordination Group** (ISECG) by the participating agencies. ISECG serves as the forum to advance the GES through the coordination of participating agencies’ mutual efforts in space exploration. The scope of ISECG is broad and strategic. Its activities are based on the principles of being open and inclusive, flexible and evolutionary, effective and of mutual interest.

The work of the ISECG is focused on products, findings and recommendations that are critical in informing individual agency decision-making.

The year 2011 is marked by important milestones in the process of implementing the GES. During their meeting in Kyoto (Japan) in August, senior agency managers from 10 agencies met to discuss exploration plans and agreed to release the first iteration of the ISECG [Global Exploration Roadmap](#) (GER). They also shared thoughts on joint work which would be timely to inform near term decisions and these priorities have guided the work of ISECG going forward.

The GER was presented to exploration stakeholders by a large number of technical papers on the work status and a dedicated “Late Breaking News” at the International Astronautical Congress in Capetown (South Africa) in September. In November, the GER was acknowledged in the declaration (see Annex II, p.27) of the first High-level International Space Exploration Platform meeting in Lucca (Italy).

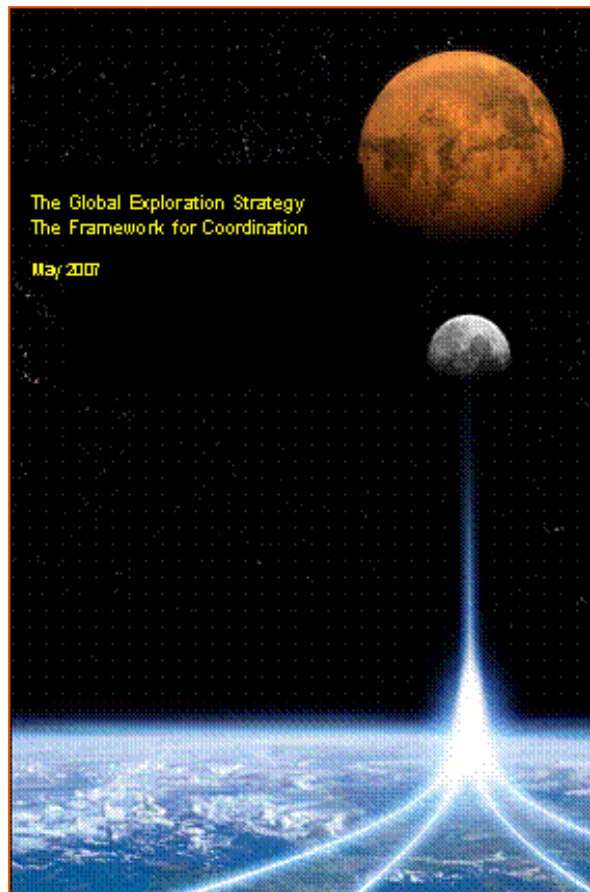
In summary, ISECG continued to advance the implementation of the GES in 2011 by serving as the international forum where interested agencies continued to share their objectives and plans for human and robotic space exploration. In addition, ISECG products contributed to the individual agency decision-making process to take concrete steps towards an internationally coordinated approach to space exploration.

¹ In alphabetical order: ASI (Italy), CNES (France), CNSA (China), CSA (Canada), CSIRO (Australia), DLR (Germany), ESA (European Space Agency), ISRO (India), JAXA (Japan), KARI (Republic of Korea), NASA (United States of America), NSAU (Ukraine), Roscosmos (Russia), UKSA (United Kingdom),. “Space Agencies” refers to government organizations responsible for space activities.

3 ISECG Background

3.1 Global Exploration Strategy and Terms of Reference

ISECG was established in response to the “The Global Exploration Strategy: The Framework for Coordination” developed by 14 space agencies¹ and released in May 2007.



This GES Framework Document articulated a shared vision of coordinated human and robotic space exploration focused on solar system destinations where humans may one day live and work.

The GES identifies a common set of exploration themes and benefits:

- New knowledge in science and technology
- A sustained presence – extending human frontiers
- Economic expansion
- A global partnership
- Inspiration and education

Among the many Framework Document findings was the need to establish a voluntary, non-binding international coordination mechanism through which individual agencies may exchange information regarding their interests, plans and activities in space exploration, and to work together on means of



strengthening both individual exploration programmes as well as collective coordinated efforts. The [Terms of Reference](#) (ToR) for ISECG were formally adopted at the first meeting of the group in Berlin in November 2007.

The purpose of ISECG is to work collectively towards the further development and implementation of the GES and to facilitate collaborations. ISECG provides a forum to discuss interests, objectives and plans in space exploration and supports promoting interest and engagement in space exploration activities throughout society.

The scope of ISECG is broad and strategic. Its activities are based on the following principles:

- Open and inclusive
 - o ISECG receives inputs from all interested agencies that invest in and perform space exploration activities
 - o ISECG provides for consultations among all agencies with a vested interest in space exploration
- Flexible and evolutionary
 - o Existing consultation and coordination mechanisms are taken into account
- Effective
 - o ISECG encourages participating agencies to accept the role of the coordination process
 - o ISECG encourages participating agencies to act upon the anticipated results of the coordination mechanism
- Of mutual interest
 - o ISECG activities benefit all participants and respect national prerogatives
 - o ISECG activities allow for optional participation based on the level of interest

ISECG participants focus on developing non-binding products - findings, recommendations and other outputs as necessary – based on consensus.

3.2 Senior Agency Management Meetings

Given that the scope of ISECG is “broad and strategic”, ISECG meetings at the Senior Agency Management (SAM) level are crucial for the advancement of the global space exploration effort. Initiated in 2010, those periodic meetings allow senior agency managers to share common perspectives and increase understanding of ISECG strategic issues at the corporate level.

In 2011, the progress of ISECG work was reviewed by the senior agency managers and they provided guidance for the future work priorities.

Future SAM meetings are planned to ensure timely and effective alignment between ISECG activities and strategic considerations of ISECG members.



Press Release:

August 30, 2011 - SPACE AGENCY SENIOR MANAGERS MEET TO DISCUSS A GLOBAL EXPLORATION ROADMAP

Senior managers representing 10 space agencies* from around the world met in Kyoto, Japan today to advance a Global Exploration Roadmap for coordinated space exploration.

Over the past year, the International Space Exploration Coordination Group (ISECG) has developed a long-range exploration strategy that begins with the International Space Station (ISS) and expands human presence in the solar system, leading ultimately to human missions to explore the surface of Mars. The roadmap flows from this strategy and identifies two potential pathways: “Asteroid Next” and “Moon Next.” Each pathway represents a notional mission scenario over a 25 year period describing a logical sequence of robotic and human missions. Both pathways were deemed to be practical approaches capable of addressing common high-level exploration goals developed by the participating agencies, recognizing that individual preferences among participating space agencies may vary regarding these pathways.

The first iteration of the Global Exploration Roadmap will inform and help focus the planning currently underway in each of the partner agencies in the areas of planetary robotic exploration, advanced technology development and use of the ISS in preparation for exploration. It was agreed that over the next few weeks, this initial version of the Global Exploration Roadmap would be finalized and released to the public.

Mr. Yoshiyuki Hasegawa of JAXA, in his capacity as chairman of the International Space Exploration Coordination Group, noted “We are very happy with the progress of the Global Exploration Roadmap to technically coordinate both near and long term space exploration planning, with world space agencies.” Outgoing ISECG chair Bill Gerstenmaier said “NASA is confident that the release of this product, and subsequent refinements as circumstances within each space agency evolve, will facilitate the ability of space agencies to form the partnerships that will ensure robust and sustainable human exploration.” During the meeting, the senior agency managers also reaffirmed the role of the ISECG to facilitate the ability of space agencies to take concrete steps towards partnerships that reflect a globally coordinated exploration effort, consistent with their respective agency priorities and mission objectives.

The ISECG was established as a voluntary, non-binding international coordination forum, where the partner agencies who contributed to the Global Exploration Strategy (GES) can exchange information regarding interests, plans and activities in space exploration. The GES set forth a shared vision for concerted human and robotic space exploration missions focused on solar system destinations where humans may one day live and work. Another stated goal is to encourage the partners to work together on strengthening both individual exploration programs and collective efforts. The development of the Global Exploration Roadmap is the second step toward achieving this goal, following the development of the ISECG Reference Architecture for Human Lunar Exploration.

* In alphabetical order: ASI (Italy), CNES (France), CSA (Canada), DLR (Germany), ESA (European Space Agency), JAXA (Japan), KARI (Republic of Korea), NASA (United States of America), Roscosmos (Russia), UKSA (United Kingdom)



4 Activities

4.1 Overview

ISECG products are developed by working groups (WG). The work is guided by regular plenary meetings and monthly plenary ISECG teleconferences. The degree of participation in ISECG working groups varies by agency and by product. Throughout the development process, products are shared with ISECG members reflecting the open and inclusive approach of ISECG activities – one of the key principles established in the GES. As ISECG work is based on consensus among the members, all products developed at the WG level need approval by the ISECG plenary.

ISECG members participating in the production of specific ISECG products (referred to as “participating agencies” of that product) demonstrate the flexible and evolutionary nature of ISECG to serve as a forum for interested agencies to advance a variety of initiatives of interest to their respective programmes and plans. Overall, ISECG continues to focus on the development of products that are both effective and of mutual interest to address the needs of the participating agencies. The work is performed through the [ISECG Workplan](#) which is updated periodically as required by the evolving needs of the participating agencies and the status of the products.

ISECG and supporting WG are supported by a permanent secretariat, provided by ESA. In addition, the ISECG secretariat provides generic information about ISECG and its products, hosts and maintains the ISECG website and supports space agencies that request ISECG membership.

4.2 Activities on ISECG Level

ISECG chairmanship rotates and effective as of August 30, 2011, JAXA assumed chairmanship from NASA.

Further discussions took place in 2011 to improve ISECG business practices and to define [Interim Guidelines for Non-Agency Participation in ISECG Meetings](#) (see Annex I).

4.3 Activities on Working Group Level

4.3.1 International Architecture Working Group (IAWG)

4.3.1.1 Accomplishments

The primary focus of the International Architecture Working Group (IAWG) during 2011 was to develop and refine the ISECG mission scenarios. Initially, the IAWG developed six notional mission scenarios to reflect the “capability-driven/objectives based” framework embraced by the ISECG. Of these six mission scenarios, three were eliminated due to high technological challenges, constrained budgets, high risk, and insufficient mission opportunities. The remaining three scenarios were further developed and refined through the creation of Design Reference Missions (DRMs), which capture the notional mission concept that includes the capabilities required and the basic operational concept.



The Exploration Roadmap Working Group (ERWG), the International Objectives Working Group (IOWG) and the IAWG considered the benefits of conducting a systematic assessment of the mission scenarios against the common goals, objectives and strategic principles of the GER. It was agreed that performing such an assessment would yield insights which would help agencies better understand each other's preferences, as well as help agencies obtain a common understanding of how various scenarios were responsive to the goals, objectives and principles of the GER.

The three remaining scenarios were evaluated by the IAWG. After further consideration, the ERWG reduced the number of scenarios from three to the following two: "Asteroid Next" and "Moon Next". The IAWG then focused its efforts on concepts for displaying the key features of the two remaining scenarios to effectively communicate each strategy at a summary level.

In addition, the IAWG contributed to the GER document and took the leadership for to the GER Coordination document.

A paper titled "ISECG Mission Scenarios and Their Role in Informing Next Steps for Human Exploration Beyond Low Earth Orbit" was presented at the 62nd IAC in 2011.

4.3.1.2 Future Work

The IAWG has several ongoing activities that will contribute to the second version of the GER. The primary focus of its activities will be to better define the early DRM phase, which is targeted for the 2020 timeframe, leading up to human exploration of an asteroid or the Moon. This will inform other activities, including those conducted by the IOWG, the Strategic Knowledge Gaps Assessment Team, and the Technology Assessment Team.

In addition, members of the IAWG formed a Robotics Servicing Working Group (RSWG), whose goal is to assess the value of the human-robotic partnership for the mission scenarios. The IAWG will support the Technology Assessment Team (TAT) in reviewing technology needs and priority areas.

In 2012, the IAWG will continue to update the mission scenarios and contribute to the second version of the GER.

4.3.1 International Objectives Working Group (IOWG)

4.3.1.1 Accomplishments

In 2011, the IOWG collected space exploration goals and objectives from ISECG participating agencies and used these as a basis to establish the following set of eight common goals: Search for Life; Extend Human Presence; Develop Exploration Technologies and Capabilities; Perform Science to Support Human Exploration; Stimulate Economic Expansion; Perform Space, Earth, and Applied Science; Engage the Public in Exploration; and Enhance Earth Safety. Each of these common goals is supported by a set of consolidated objectives for exploration that collectively reflect agencies priorities.

The common goals and objectives guided development of the GER mission scenarios and were published in the GER document. They were established as the result of an iterative process and will continue to be refined as agencies priorities evolve. The IOWG's work on goals and objectives was documented in a paper published for the IAC in 2011, and made available on the ISECG website. While the common goals and objectives describe what agencies want to accomplish in the long term



as they conduct space exploration, the overarching value of space exploration will be measured in terms of the resulting outcomes and benefits imparted to society.

In response to a request from senior managers of ISECG agencies, the IOWG initiated work to collect information on and improve understanding of the societal benefits of space exploration.

4.3.1.2 Future Work

In 2012, the IOWG continues its work on understanding the societal benefits of space exploration and plans to develop a white paper to document its findings. Also, the IOWG will continue to monitor the evolution of agency priorities, refine the common space exploration goals and objectives as necessary, and ensure that the GER continues to reflect this commonality.

4.3.2 International Space Exploration Coordination Tool (INTERSECT)

4.3.2.1 Accomplishments

The INTERSECT Working Group focused on the development of a data repository to provide a single reference source for ISECG members and working groups on the type and status of exploration-related missions, payloads, capabilities, systems and technologies.

During 2011, the Working Group activity consisted mainly of data collection and validation using templates previously developed for data entry after an iterative review process with ERWG. The data was made available on the ISECG website and used by an ERWG Team reviewing Agency's plans to elaborate on the first release of the Global Exploration Roadmap.

4.3.2.2 Future Work

For the time being, the activities related to the web-based repository have been put on hold following a decision made at the SAM meeting held in Kyoto in August 2011. Future work will be folded into the process for maintaining and updating the GER.

4.3.3 Exploration Roadmap Working Group (ERWG)

4.3.3.1 Accomplishments

In 2011, the Exploration Roadmap Working Group (ERWG) provided the opportunity for participating agencies to discuss the next step in human space exploration and published the results of their work in the ISECG Global Exploration Roadmap. Participating agencies shared plans and interests, resulting in development of a common long-range strategy that builds on the International Space Station (ISS) to achieve sustainable, affordable human exploration of Mars. They affirmed their desire to follow this strategy through collaboration and cooperation.

Participating agencies divided their work into three main activities, creating a framework for discussion which is reflected in the GER. A description of the framework and specific achievements are listed below:



1. Common goals of ISECG participating agencies for space exploration
 - Within the IOWG, agencies shared the current status of their goals and objectives associated with each destination (Moon, asteroids, Mars) and looked for commonality.
2. Notional mission scenarios that are technically feasible and programmatically implementable. These respond to common set of agency needs or drivers, such as affordability, and can be used to inform near-term studies or technology prioritisation within individual agencies. The scenarios were developed together with the IAWG.
 - Two mission scenarios were seen as responding to the strategic guidelines of the long-range strategy: the “Asteroid Next and the “Moon Next” mission scenarios.
3. Identification of near-term opportunities for coordination and cooperation related to
 - The development of technologies enabling the implementation of the near-term DRMs included in the optional mission scenarios.
 - The implementation of robotic missions to destinations of interest for closing strategic knowledge gaps which need to be addressed prior to human missions.
 - The utilisation of the ISS for demonstration of exploration enabling capabilities.
 - The implementation of analogue campaigns to demonstrate exploration technologies, operations scenarios and interoperability concepts.
 - Enabling capabilities for beyond Low Earth Orbit (LEO) exploration which build on expertise and capabilities in use today.

The September 2011 release of the GER represents the first iteration. It will be updated as necessary to reflect the current status of agencies discussions related to the definition of technically feasible exploration roadmaps. In addition, the GER is intended to generate ideas and solutions from the broader community for meeting the challenges represented in the mission scenarios.

By reflecting the status of agencies discussions on exploration, the first iteration of the GER has informed preparation of an international political dialog on exploration. It was referred to in the Lucca Declaration from the first High-level International Space Exploration Platform meeting and recognised as a valuable tool by other international fora and working groups. At the end of 2011, over 40,000 copies of the GER have either been downloaded from individual agency and ISECG websites or distributed at conferences/workshops.

Members of the ERWG collaborated on various papers related to the GER, which were presented at the 62nd International Astronautical Congress (IAC) in 2011, to introduce the GER framework and address insights gained from the development of the GER as well as the role of the ISS lessons learned for the GER development.

4.3.3.2 Future Work

With the budget challenges faced by all ISECG agencies, human exploration road-mapping work in 2012 is concentrated on enabling collaboration and cooperation opportunities related to exploration preparatory activities. Work in the area of needed technologies will concentrate on sharing priorities and looking for opportunities to collaborate in technology demonstration activities.

Agencies are also looking at ways to increase the partnership between human and robotic science exploration programmes, recognising the synergies between the two and looking for ways to exploit them.



Lastly, agencies are looking at the early design reference missions within the two mission scenarios in more detail in order to inform requirements definition of near term exploration capabilities.

The highlights of this work will be published in the second iteration of the GER in spring 2013. The second iteration will also reflect any updates in policies and plans of participating agencies.

4.3.4 Strategic Communications Working Group (SCWG)

4.3.4.1 Accomplishments

The SCWG continued to work on intensifying target-group oriented communication with the ISECG stakeholders which are the member agencies and with further exploration stakeholders in science, industry, politics and society. The group continued to implement coordinated actions to further increase the visibility of ISECG. Also, the SCWG started activities to ensure that relevant existing multilateral WG are informed regarding the existence of ISECG, its mandate and products.

A focus of the work in 2011 was to start establishing relations with one of the relevant existing multilateral working groups, namely the International Space Life Sciences Working Group (ISLSWG). An ISECG representative delivered a presentation on ISECG mandate and products to inform the ISLSWG delegates at their 40th meeting in June 2011. It was agreed that the dialogue shall be continued at future ISLSWG meetings. In particular, all ISLSWG members took the action to review and discuss the first iteration of the GER and prepare a joint ISLSWG response to ISECG.

Following a proposal initiated by the SCWG in 2010 and approved at the SAM meeting in Kyoto in August 2011, ISECG was invited to co-chair the International Programme Committee for the “Global Exploration Conference “ to be held in May 2012 in Washington, DC. Participation in the conference would provide an opportunity to brief exploration stakeholders and discuss the GER plans for space exploration.

In a joint effort of all WG the visibility of ISECG was enhanced at the 62nd International Astronautical Congress in Cape Town, South Africa, by technical papers on the work status and a “Late Breaking News” on the GER.

November 2011 offered another important outreach opportunity to ISECG: embedded in the “Third International Conference on Space Exploration” in Lucca, Italy, was the first meeting of the High-level International Space Exploration Platform. One of the keynotes was given by the ISECG Chair and the Representatives took note of the GER (see Annex II, p. 27 for the Lucca Declaration).

4.3.4.2 Future Work

In 2012, the SCWG will continue to support, by consensus of all ISECG members, all communication-related activities of ISECG including outreach opportunities for consideration by the ISECG plenary.

Discussions on a set of strategic communications guidelines will be initiated.

The Group will also continue to analyze existing multilateral WG related to space exploration and will provide a list of relevant WG to ISECG. This list shall be a tool to inform decisions of ISECG members when contacted by other groups.

Renewal of the public part of the website will be discussed and initiated depending on the available resources.



Annex I

Interim Guidelines for Non-Agency Participation in ISECG Meetings

ISECG Participating Agencies recognize that participation in certain elements of the ISECG Work Plan by non-agency participants (that is, the involvement in ISECG activities of individuals from entities other than Participating Agencies) could be valuable to provide advice and guidance, or to help resolve a particular issue. Non-agency participants include:

- (a) department, ministry or other type of government entity, referred to below as government participants; and
- (b) all other entities.

ISECG Participating Agencies also recognize that it is desirable, when envisaging non-agency participation, to avoid generating both real and perceived conflicts of interest which, among other issues, could have an impact on future procurement actions.

These guidelines will be adopted for an interim period to assess their suitability. In particular, the Participating Agencies will evaluate (a) the benefits entailed by different types of non-agency participation; (b) potential problems that could be caused by non-agency participation in ISECG activities, particularly those problems related to future procurement actions; and (c) how such non-agency participation can be addressed in a satisfactory manner.

It is the intention of the Participating Agencies to adapt and modify as required the following interim guidelines and procedures by August 31, 2012.

The ISECG Terms of Reference (TOR) provide as follows:

III.2.1. ISECG Composition

Each Participating Agency will designate authorised representatives to the ISECG. These representatives are expected to be staff of the designating Participating Agency. In all cases, conflicts of interests will be avoided.

Any ISECG Participating Agency may request by invitation the presence at an ISECG meeting of appropriate experts to provide advice and guidance, or to help resolve a particular issue. In all cases such advisors will be considered part of the delegation that issued the invitation, for the duration of the meeting. Delegations intending to invite an advisor will notify the ISECG Secretariat in a timely fashion.

The TOR also provide as follows:

III.2.2. ISECG Operating Procedures

...

ISECG operates by consensus among Participating Agencies

...

The interim guidelines are as follows:

1. It is expected that government participants, as defined in introductory paragraph 1(a), will be allowed to participate in all ISECG activities, subject to guidelines (3) – (9) below.
2. Other entities' participation will generally be limited to working groups and working-level workshops, subject to the interim guidelines (3) to (9) below. While a Participating Agency should not unreasonably object to such participation, such participation is expected to be on an exceptional basis.
3. A notification from a Participating Agency of its intention to include non-agency participants in its delegation to provide advice and guidance will be considered by the ISECG Participating Agencies on a case-by-case basis.
4. Such a notification will (a) contain sufficient details about the proposed non-agency participants and (b) be sent to the ISECG Secretariat in writing at least three weeks in advance of the date of the first meeting for which such participation is envisaged.
5. Upon receipt of the notification, the ISECG Secretariat will distribute it to all the Participating Agencies. This will provide sufficient time for any of the other Participating Agencies to express, through the ISECG Secretariat, the concerns it may have, with a view to having these concerns addressed by the originator of the notification in a timely manner.
6. Failing consensus, such participation will not be allowed.
7. Absent objection in writing within a week of the Secretariat's distribution, the participation as proposed will be considered agreed by consensus.
8. Each Participating Agency will take the necessary steps to ensure that information and data communicated through whatever means to non-agency participants in its delegation in the frame of the execution of ISECG activities will not be divulged to third parties (including persons in its own entity) without the authorization of that Participating Agency.
9. These Interim Guidelines will be posted on the public section of the ISECG website and a Participating Agency whose delegation includes non-agency representatives will inform its non-agency representatives of these guidelines.



Annex II

Space Exploration Highlights of ISECG Member Agencies

(in alphabetical order)

1. Agenzia Spaziale Italiana (Italian Space Agency ASI), Italy

Introduction

The year 2011 has been characterized, by the continuation of the programmes approved during the last ESA Ministerial Council, held in 2008, mainly the robotic mission ExoMars, for which Italy confirms its leadership, and the participation to the European Exploitation of the International Space Station ISS, through the Intergovernmental Agreement, IGA, between ESA and NASA and the MPLM, Multipurpose Logistics Modules, MOU between NASA and ASI.

Past significant events and missions

Hereafter are reported the significant events related to exploration during the past year:

- Human exploration
 - o The activities within the Permanent Multipurpose Module, PMM, derived from the MPLM FM1 Leonardo, developed by the Italian Space Agency, through Thales Alenia Space Italia, for NASA, and docked last year to the ISS, are on-going as planned.
 - o The ESA astronaut of Italian nationality Luca Parmitano is being trained for his long term mission to ISS planned for March-September 2013 period. 25 experiments are currently planned to be performed during this mission.
 - o The other ESA astronaut of Italian nationality Samantha Cristoforetti is also performing training activities for a long term mission to ISS in 2015.
- Robotics for exploration
 - o Together with European partners, the activities of ExoMars (Italian Prime Contractorship) are on-going.
 - o Continuation of the operations, data acquisition and analysis of Italian instruments on-board Mars Express (MARSIS and PFS) and NASA MRO mission (SHARAD).

Upcoming events

Italy foresees to follow both the human and robotic exploration. Attendance and active participation to the major events like IAF, COSPAR, etc. are confirmed. Involvement in ISECG activities will mostly focus on the robotic support activities including scientific aspects and in situ resource utilization.

In this context Italy will focus its attention on the following programmes:

2011 will be characterized by a relevant involvement of Italy in the exploitation of the ISS, thus confirming its relevant role in this endeavour:

- o The Elite-S2 activities continued nominally through 2012.
- o An ASI-led Combustion Experiment for Green Air, ICE-GA, is being planned in cooperation with NASA, and will use the NASA Combustion Integrated Rack on the ISS. Another combustion experiment to be flown on ISS, the DIAPASON Particle Detection unit, is also being planned in cooperation with NASA.



Conclusion

Italy is still strongly involved in Exploration, both robotics and with the astronauts. Currently the main objective is the Mars Robotic Exploration, mainly ExoMars. At the same time, Italy is also aiming at enhancing the Italian expertise in exploration related fields like robotics systems, pressurized modules and the relevant life support systems, aiming to acquire new technologies for the future space exploration.



2. Centre National d'Etudes Spatiales (CNES), France

In 2011 CNES started to apply the 'Contract between the state and CNES for the period 2011-2015' signed in October 2010. In this document, it is stated that CNES shall 'make proposals to promote an international exploration program of the Solar System in a renewed governance'. In particular, an increased role for the European Union in exploration matters is foreseen.

Furthermore, CNES took an active part in the writing of the ISECG Global Exploration Roadmap which was eventually released in September 2011.

CNES was also active in the preparation of the high-level international conference on exploration which took place in Lucca (Italy) in November 2011.

For France, recent significant exploration-related activities are:

- the participation to the development of ExoMars (in an ESA/ROSCOSMOS context):
 - o Contribution to the payload
 - o Rover vision/navigation algorithms
 - o Support on EDLS
- the exploitation and utilisation of the ISS:
 - o ATV Control Center in Toulouse
 - o French participation in the ESA/ELIPS program
 - o CADMOS: French part of the ISS ground segment
 - o Physiology/space medicine: CARDIOLAB with DLR, CARDIOMED with ROSCOSMOS
 - o Fluid physics: DECLIC in cooperation with NASA

Other missions with a significant CNES involvement are worth being mentioned:

- Robotic missions to Mars: MSL (NASA), Maven (NASA), studies on a Mars geophysical network (ESA) and Insight (NASA)
- Robotic missions to other destinations: Rosetta (asteroid - ESA), Bepi-Colombo (Mercury - ESA), Hayabusa 2 (asteroid - JAXA; in particular MASCOT with DLR) and Juice (moons of Jupiter - ESA)
- Human spaceflight: cooperation with China on cardiovascular monitoring (CARDIOSPACE)



3. Canadian Space Agency (CSA), Canada

CSA 2011 Exploration Highlights

Summary

Space exploration provides valuable Canadian science, signature technologies and qualified astronauts to international space exploration endeavours. It contributes to the Government of Canada's Science and Technology Strategy. It could also generate spin-offs that contribute to a higher quality of life for Canadians and could foster nation-building. Space Exploration appeals to the science and technology communities and generates excitement within the population in general. It is targeted mostly towards Canadian academia, industry and international space exploration partnerships.

Space Exploration Organization

A Space Exploration branch, under a Director General, was created following a re-organization of the CSA on April 1, 2010. Directorates within Space Exploration are responsible for the following program areas:

- The International Space Station
- Astronauts, Life Sciences & Space Medicine
- Planetary Exploration
- Space Astronomy Missions
- Exploration Technology R&D

The International Space Station (ISS)

The CSA continued to operate the Mobile Servicing System (MSS) to carry out robotic maintenance and resupply operations on the ISS. The CSA supported the final two Space Shuttle missions, Russian cosmonaut spacewalks, and accomplished the transfer of cargo from the Japanese HTV vehicle using Canadarm2 and Dextre. Canadian robotics successfully replaced critical equipment on the station and performed flawlessly during a robotic refueling demonstration in cooperation with NASA. These activities resulted in the development and certification of new flight products and procedures to support MSS operations. The CSA also continued the upgrade of its ground control operations for Canadarm2 to enable the handling of heavy payloads as scheduled. The CSA also completed the technical activities required to assess the feasibility of extending the operating life of the MSS.

Astronauts, Life Sciences & Space Medicine

Veteran Canadian astronaut Chris Hadfield continues his training and preparation for ISS Expedition 34/35 mission. This will be Hadfield's third space mission and second trip to the ISS. He will be on-orbit for about five months with a planned launch date in December 2012. After four months working as a Flight Engineer during Expedition 34, Hadfield will assume command of the ISS and its crew in March 2013—a significant first for Canada.



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Canada's two newest astronauts, Major Jeremy Hansen and Dr. David Saint-Jacques, have successfully completed their Basic Training course requirements and are now eligible for long-duration flight assignment on the ISS.

In Advanced Astronaut Medical Support, work was initiated in the development of a physician web interface, medical ultrasound remote control interface, astronaut health monitoring system and concept for a space medicine medical decision support capability.

The mandate of the CSA's Space Health and Life Sciences group is to identify, characterize and mitigate risks to humans during extended space travel. Three subjects completed the VASCULAR protocol on ISS to examine the effects of long duration exposure to weightlessness on the structure and function of the cardiovascular system. Hypersole, completed on the last two shuttle missions, examined the effects of weightlessness on the function of cells in the sole of the foot that detect contact with surfaces. Finally, three life science activities began development for execution on ISS: Microflow, a technology demonstration of a flow cytometer for space, See Jitter, an experiment determining the effects of a vibrating field of view on perception; and BP Reg, a cardiovascular experiment aiming to validate techniques for monitoring cardiovascular.

Planetary Exploration

The CSA continues to provide instruments for Mars robotics missions and has the Alpha Particle X-ray Spectrometer, to measure the composition of Mars rocks and soil, on NASA's Mars Science Laboratory rover. We are making contributions to upcoming Mars missions namely ExoMars 2016, ExoMars 2018 with the goal to contribute to an eventual Mars Sample Return mission.

We are also supporting Canadian participation in NASA's OSIRIS-REX asteroid sample return mission, scheduled for launch in September 2016. The University of Calgary and MacDonal Dettwiler and Associates (MDA) are designing a science lidar instrument for the spacecraft (based in part on the Canadian-built laser on the Phoenix Mars Lander mission).

Astronomy

Work continues in astronomy on Canada's contribution to the James Webb Space Telescope, the telescope's pointing system (known as the Fine Guidance Sensor). Canadian technology that provides the essential reference signal for the Heterodyne Instrument for the Far Infrared (HIFI) was provided for ESA's Herschel spacecraft. Canada's "humble" telescope, the Microvariability and Oscillation of STars (MOST), continues to make valuable contributions to the field of astronomy. In 2012, Canada's Near-Earth Object Surveillance Satellite will be launched. It is unique in that it has the capability (technology) to be able to look towards the Sun and detect for the first time objects directly between the Earth and the Sun.

In 2011, the Canadian astronomy community released their Astronomy Long Range Plan. It is a decadal plan similar to (and aligned with) the plan released by the United States—Astro2010—and Europe's Cosmic Visions.

Exploration Signature Technology R&D

Created in 2007, the CSA's Exploration Core program funds advanced exploration technology development. The Exploration Core program continues at an impressive pace, due to additional funding through Canada's Economic Action Plan (stimulus budget). The program's goal is to ensure



Canada's readiness to participate in future human and robotic exploration missions. Signature technologies include technologies related to: optics; radiation mitigation; robotic servicing; spectrometers; advanced crew medical systems; drilling and sample extraction; and rovers.

In 2011-2012, the CSA continued to work with its industrial contractors to deliver a series of projects under a stimulus initiative on space robotics announced as part of Canada's Economic Action Plan. This work has enabled the development of terrestrial prototypes of the Next-Generation Canadarm, as well as prototypes of different rovers and their associated technologies for future Moon and Mars exploration. Using the Exploration Core funding, the TriDAR vision system from the Ottawa-based Neptec Design Group flew for a third flight on the last space shuttle flight in July 2011. The CSA also issued contracts for the development of science instruments and to support analogue mission deployments. Moreover, the CSA completed the upgrade of its analogue terrain and exploration operation center.

In 2011, space exploration missions and programs generated a number of signature technologies that found their way into terrestrial applications and commercial markets. For example, in July 2011, the US-based Orbital Sciences announced the selection of the TriDAR system developed by Neptec for approach and rendez-vous of their Cygnus commercial spacecraft with the ISS. The CSA has invested in the R&D and in-orbit demonstrations of the TriDAR technology since 2007.

Analogue Activities

In 2011, the CSA conducted a series of science-driven analogue deployments looking at the geology of impact craters in Labrador; the detection of methane in an operational asbestos mine near the town of Thedford Mines, Quebec; and the detection of signatures of life for future Mars missions as part of the Pavilion Lake Research Program performed in collaboration with NASA. The CSA was also preparing its third in-situ resource utilisation (ISRU) deployment in Hawaii in collaboration with NASA. The CSA contributed the ISRU rover, a drill, a science rover and access to its space exploration operation center for a deployment in July 2012.

Space Exploration Plan

The CSA has made major progress towards completing our updated Canadian Space Exploration Plan, including consultations with Canadian stakeholders. The plan defines Canada's vision for space exploration. It outlines exploration goals to bring that vision to fruition, and identifies principles to guide the prioritization and decision-making process for Canada's space exploration activities.

The plan highlights the priorities for the next three to ten years, which are supported by mission roadmaps. Exploration goal-driven priorities include the International Space Station, Planetary Exploration, and Astronomy. The plan also highlights Exploration Signature Technologies, which are critical to enabling missions.

The plan emphasizes Canada's commitment to the continued operation of the MSS and preparation for the ISS extension to 2020, as well as to robotic servicing. The latter is the genesis of the CSA's Exploration Signature Technologies, and a major part of Canada's current role in space exploration. Canada sees its robotic contributions as essential to the success of the ISS.



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Among the plan's guiding principles are: focus and build on Canadian strengths and space heritage; participate in international missions with contributions that add value (welcomed) and are visible and resonate with Canadians; ensure a robust and sustainable program; provide a balanced portfolio between destinations. Public engagement and participatory exploration are also included in our plan. Furthermore, the Plan is aligned with the Global Exploration Strategy and the Global exploration Roadmap.

4. Deutsches Zentrum für Luft- und Raumfahrt (DLR) – German Space Agency, Germany

Highlights of the DLR manned Space Program in 2011

In 2011, there were several events suitable for citation, related to manned Space Flight Activities and Space Exploration. With respect to manned Space, DLR continues to play a major role within the European space sector, particularly in the European Space Agency (ESA).

MARS 500

With great interest, scientists from Sporthochschule Köln, Charité Berlin and Technical University of Munich observed the performance of 11 experiments supported by DLR in the course of the virtual flight to Mars dubbed the Mars500 Project. The virtual Mars journey started 3rd of June 2010 and ended 4th of November 2011. The experiments give insight on the impact of lowered salt diet levels and respective blood pressure correlation. Additionally, the stress syndrome and influence on brain/immune system and possible deterioration of resistivity against infectious diseases have been monitored. The campaign in Moscow received great attention from the German press and the public. Even after the mission, subjects were examined at the University of Munich by magnetic resonance tomography for effects of stress on brain tissue. Mars-500 holds a record, never before have humans been so thoroughly and continuously examined (medically and physiologically) for such a long period.

ATV-2

ATV-2, Johannes Kepler, flew successfully on 16th of February 2011 to the ISS and performed an automated docking. EADS, Bremen, had the industrial lead in this ESA-Project. ATV carried 7 tons of payload. Only the fuel, which is partially used to reboost the ISS, had a mass of 5.4 tons. ATV-2 has been undocked on 20th of June 2011 and burned up in the atmosphere on 21st of June 2011.

Geoflow II

Geoflow II has been transported to the ISS onboard ATV-2. Geoflow is an important experiment from Principal Investigator, Prof. Egbers, BTU, Cottbus. Geoflow is a miniaturized model of the earth that simulates the inner liquid spheres of our planet. It helps to understand the processes in the Earth's mantle that lead to volcanism, plate tectonics, earth's magnetic field and also earthquakes.

Geoflow II has been installed in the Fluid Science Lab of the Columbus module. The science programme for Geoflow II has been resumed in November 2011 and is doing well.

Thomas Reiter

On 17th of March 2011, Thomas Reiter, Astronaut, Brigadier General, Head of DLR's Space Science and Technology Department, has been appointed Head of the ESA Directorate for Manned Spaceflight and Operations. While DLR regrets to lose Mr. Reiter's direct expertise, his appointment has been sincerely welcomed. Germany is engaged in Manned Space activities for a long time. DLR is convinced that Mr. Reiter's experience and expertise will be beneficial for the future of manned space missions and operational tasks thereof.

CCF

The Capillary Channel Flow Experiment of Prof. Dreyer, ZARM, Bremen, collected more than 900 Data Sets with telemetric measurements and recordings by a High Speed Camera. The behaviour of liquids (fuels) under reduced gravity still leave many questions open, e.g. how liquids can be transported free of bubbles, or when ruptures in turbulent or laminar flowing liquids occur. First results on board the ISS give new insight in the behavior of liquids under extreme conditions of space. First results indicate that data received from the Fluid Science Lab, confirm the mathematical model calculations for laminar flows under reduced gravity.

MASCOT

In September 2011, DLR welcomed a JAXA delegation around Prof. Kamaguchi to discuss the German participation to the planned Japanese Hayabusa-2 mission. After successful Phase A/B activities in the last year, DLR and JAXA agreed on the inclusion of the German small surface lander science package MASCOT in the mission. The system is developed in Germany with a strong participation from CNES on the science instrumentation.

Space Day, DLR

On September 18, 2011 the German “Space Day” attracted more than 85.000 visitors. Various events and exhibitions had been prepared for the guests at the European Astronaut Centre and on the premises of the DLR. The public had the opportunity to inform themselves about DLR activities as well as ESA’s ISS programme. European and American Astronauts were also present. DLR’s Institute for Air and Space Medicine presented a special exhibition: “Mobility and Health”. The User Centre for Space Experiments and the Centre for Material Sciences in Space opened their doors and presented techniques and space H/W to the visitors.

The DLR School Lab invited young visitors to perform interesting and surprising experiments.

Alexander Gerst

The German ESA-Astronaut Alexander Gerst has been nominated for his first Mission to the ISS. Dr. Gerst will stay onboard the ISS from May to November 2014. This decision has been announced by the Minister for Economics and Technologies, Dr. Philip Rössler, on the occasion of the “German Space Day” at DLR, September 18, 2011.

IAC 2011

DLR took benefit of the International Astronautical Congress 2011 in Cape Town, South Africa, to reach out to a large number of schools, educational institutions and supporting space actors in Africa. The DLR_School_Lab’s capabilities to inform about and to teach science, technology, engineering and math subjects particularly related to space activities were demonstrated and warmly embraced by hundreds of students, educators and officials throughout the congress.



SIMBOX

SIMBOX is the first non-Chinese experimental facility onboard a Chinese space vehicle. SIMBOX contained 17 biological and medical experiments. Scientists from Erlangen, Hohenheim, Magdeburg, Tübingen, Hamburg, Freiburg and Berlin were involved. SIMBOX experienced a 17 days space mission on board the unmanned Shenzhou-8 space capsule. The experiments were retrieved on 17th of November from the landing site in the Gobi desert. Dr. Markus Braun, SIMBOX Manager at DLR, was very satisfied with the condition of the samples after retrieval. Plants, worms, bacteria and human cancer cells were exposed to low gravity and space conditions for more than 2 weeks. DLR organized and realized this campaign on behalf of the German Ministry of Economics and Technologies (BMWi).

SEMS

On December 6th, 2011, DLR's Institute of Space Systems hosted an international Systems Engineering Mini Symposium (SEMS) in Bremen, Germany. Participants from European industries and academia as well as international experts presented and discussed capabilities and technologies related to space exploration particularly in the fields of planetary landing, mobility and architectures.

5. European Space Agency (ESA)

Exploration Highlights

European ministers, heads of space agencies, representatives from European Member States and international delegations gathered for the third High-Level Conference/first High-Level International Space Exploration Platform in Lucca (Italy) on 10 November. The event was co-organised by the European Commission, ESA and Italy (as host country and chair of the ESA Council at Ministerial Level). The 110 delegates from 28 countries attending (plus ESA and the European Commission) agreed on the establishment of an open structured high-level policy dialogue on space exploration at government-level. International partners were present, with representatives from Canada, China, Japan, Russia, South Africa, Ukraine and the USA. A Declaration (see annex) was issued and the participants welcomed an offer from the United States to host the next dialogue.

In the frame of the implementation of the Resolution of the 7th Space Council and of the work of the ESA Exploration Scenarios Working Group (ESWG), draft roadmaps on four technological domains for exploration (life support, automation and robotics, advanced propulsion, novel energy sources) have been prepared and presented to industry and Member States representatives in a workshop held in May. Discussions will help refine the roadmaps and prepare the identification of studies and technological activities preparing the elaboration of the European position on global exploration.

In addition to the on-going activities with the partners, bilateral relationships have been enhanced with Russia and China in the area of exploration. ESA and Roscosmos are discussing potential cooperation with Russia's lunar sample return mission. For what concerns China, the second meeting of the China - ESA Joint Committee on Space Cooperation under the ESA-China Framework Agreement was held in Tianjin on 21 September. Most promising areas for future cooperation activities are in the field of space science and exploration, China having notably offered ESA an opportunity to fly a scientific instrument on board a future Chinese lunar lander.

In the area of human spaceflight, a visit of a CMSEO (Chinese Manned Space Engineering Office) delegation to Europe in August, followed by a meeting between the ESA and CMSEO Director Generals in Beijing in September have led to the setting up of joint working groups to discuss astronaut training, life support systems, rendezvous and docking, as well as scientific experimentation. Meetings will take place in Europe in 2012 to elaborate in more detail common interests in the four areas mentioned above, and to evaluate possible future cooperation opportunities, including possible involvement of ESA in the planned Chinese Space Station.

ESA Member States participating in the International Space Station (ISS) Exploitation Programme have decided at ESA's Council meeting in March to concur with the ISS partners' objective to extend the duration of their involvement in ISS cooperation until the end of 2020.

Main event has been the successful launch and flawless rendezvous/docking in February of ESA's second Automated Transfer Vehicle (ATV-2) Johannes Kepler with the ISS. Besides bringing essential supplies to the ISS, ATV-2 performed several minor ISS re-boosts, important ISS attitude control manoeuvres and the biggest raise (40 km in 3 steps) of the ISS orbit ever performed by a single space vehicle. ATV-3 Edoardo Amaldi is scheduled to be launched on 9 March 2012.



ATV-4 is scheduled for launch no earlier than end of February 2013. ATV-5 production is on schedule for a launch in 2014. The launch of the European Robotic Arm on a Russian Proton launcher is scheduled for June 2013.

2011 has been a very active year for European astronauts starting from Paolo Nespoli long-duration mission aboard the ISS initiated in December 2010, followed by Shuttle Endeavour STS-134 flight in May with Roberto Vittori and concluded with André Kuipers launch from Baikonour on 21 December. ESA astronauts Luca Parmitano and Alexander Gerst have been assigned to fly to the ISS in 2013 and 2014 respectively. Flight opportunities for R. Vittori in 2011 and L. Parmitano in 2013 have been provided by ASI in agreement with NASA.

In the framework of the European Life and Physical Sciences Programme, it is worth to mention the experiments with a direct link to exploration that have been carried out on board the ISS. This concerns the experiments focussing on radiation like Matroshka (study of radiation absorption in the Japanese Kibo Laboratory), DOSIS (mapping of the nature and distribution of the radiation field inside) and ALTEA-Shield (ALTEA-SHIELD aims at obtaining a better understanding of the light flash phenomenon, as well as testing different types of shielding material). Also of interest is the CFS-A Coloured Fungi in Space experiment relevant to spacecraft contamination, panspermia and planetary protection issues.

As ESA astronauts continued to work on the ISS, on the ground, preparations for destinations beyond were proceeding. The 520-day Mars500 isolation study initiated on 3 June 2010 in Moscow with an international crew of 6 (2 participants from ESA, Romain Charles and Diego Urbina, 3 from Russia and 1 from China) performed the Mars “landing and surface” phase in February and “landed back on Earth” on 4 November. The mission generated excellent scientific results, which are important for operations and psychological management on long-duration missions with an international crew in confined conditions.

The second campaign of short-term bed rest at the DLR Institute has been successfully concluded.

Looking at preparatory activities for future human exploration, the Micro-Ecological Life Support System Alternative (MELiSSA) continued to progress as planned. The industrial activities for the Advanced Closed-Loop System (ACLS) service, which focuses on air revitalisation have started. ESA has reviewed the 181 proposals received from 19 countries in response to the ‘Call for Ideas: ISS for Exploration’ published in October 2010. The recommendations of the review panel tasked to analyse the ideas covering a broad spectrum of areas of interest such as life support systems, crew assistants, monitoring of astronauts’ health, robotics, maintenance, failure management, tele-operations as well as other topics, will be taken into account for the preparation of the programme proposals to be presented at the next Council at Ministerial Level in November 2012.

The study and development of future exploration capabilities and precursor missions continued, including the Advanced Re-entry Vehicle (ARV), EXPERimental Re-entry Testbed (EXPERT), the International Berthing/Docking Mechanism (IBDM) and the Lunar Lander. The ARV Phase-A activities made progress on a 3-module configuration providing added flexibility and operational capability leading to successful System Requirement Review in July. The EXPERT vehicle and payload integration and testing have been completed during summer and the Qualification and Acceptance Review concluded successfully. Permission for the launch to be provided by the Russian authorities has not yet been confirmed and launch alternatives are being investigated. While awaiting



the final planning for the launch campaign, EXPERT will be kept in storage in a controlled environment. The industrial activities for the IBDM development have been progressing well including successful IBDM contact and capture testing. Discussions were started between ESA and NASA on how to verify IBDM common interfaces and identify areas of common development, in line with new International Docking System Standard (IDSS).

Work on the Lunar Lander Phase-B1 mission definition and spacecraft design has made steady progress in several areas including work with Arianespace on the Soyuz launcher performance, analysis and bread-boarding activities in the areas of propulsion (firing test of the 220N ATV's thruster) and navigation (LIDAR bread-boarding). The Polar Landing Review (PLR) was completed on 1 June. Forward work will consolidate the results on the landing site characterisation, and demonstrate the accuracy of the descent and landing system. The Lunar Lander Phase B1 activities will be completed by mid-2012 with a preliminary System Requirement Review. The payload definition studies have also made good progress.

In April an ESA team participated in an analogue campaign in Rio Tinto (Andalusia, Spain) organised by the Austrian Space Forum. This field test supported objectives related to future exploration scenarios, as well as testing of specific technologies under development. In September, ESA hosted in ESTEC one of the two science backrooms supporting the space exploration vehicles deployed in the field in Arizona in the framework of the NASA DRATS 2011 campaign.

Looking at Mars exploration, the ExoMars programme continues its progress. The ExoMars EDM (Entry Descent and landing Module) Payload has been selected. A revision of the ExoMars Programme took place in spring driven by a number of factors, including NASA's planning and negotiations with European industry. Decision was taken to proceed with the implementation of the two ExoMars missions, including the development of the 2016 mission, the development of significant parts of the 2018 mission and the consolidation with NASA of the design of a single, joint Mars rover for the ExoMars 2018 mission. Last, facing the uncertainties of NASA budget and following a positive expression of interest from Roscosmos at ESA and NASA invitation concerning a possible Russian contribution to the ExoMars mission, a tri-partite meeting between ESA, NASA and Roscosmos took place in Paris in December to discuss a possible collaboration among the three agencies.

In the context of the Mars Robotic Exploration Preparation (MREP) Programme, a number of candidate missions have been identified for post-ExoMars launch opportunities to Mars in 2020 and/or 2022. In MREP, several technologies are developed which are relevant to these candidate missions, and at the same time prepare for a future potential European participation to Mars Sample Return. Moreover, long-term technology developments, which are defined as strategic and enabling technology developments for European robotic exploration, are also developed (e.g. Novel Power Sources using radioisotope heat generation).

On Tuesday 22 November, ESA's tracking station at Perth (Australia), established contact with Russia's Phobos-Grunt spacecraft. Contact with the Mars mission was lost shortly after separation from the launch vehicle was confirmed on 8 November. On 23 November, two-way communication was established again. The data received from the spacecraft have been sent to the Russian mission control centre for analysis.



Regarding the Exploration Scenario Studies awarded to European industries in 2010 to inform the development of a Strategic Plan for Human Spaceflight and Exploration by mid-2012, significant progress has been made with the identification and definition of optional building blocks elements and their integration into seven optional roadmaps.

The ESA's Council approved with effect from 1st April the proposal by ESA Director General, Jean-Jacques Dordain, of a new team of Directors including Alvaro Gimenez-Canete as Director of Science and Robotic Exploration, Thomas Reiter as Director of Human Spaceflight and Operations, Franco Ongaro as Director of Technical and Quality Management and Giuseppe Morsillo as Director of ESA Policies, Planning and Control.

A Directors Committee for Exploration (DC-E) chaired by the ESA Director General, involving the Directors of Human Spaceflight, Science and Robotic Exploration, Technology and Policy Directors, as well as the Head of the Director General's Cabinet and the Head of the Director General's Office for relations with the EU has been established. This Committee shall guide and monitor the position of ESA on space exploration activities and being the highest-level exploration coordination committee in ESA, will establish the common policies and content of the programmes, fostering synergies and conveying a common ESA position to International Partners and Member States. Reporting to the DC-E, an Exploration Coordination Committee (ECC) has been formed with members appointed by participants to the DC-E. ECC discusses the coordination in the implementation of the different programmes and prepare the participation of ESA to international committees and fora related to space exploration.

ESA is supporting the activities of ISECG through its participation in all the Working Groups and continues to host the Secretariat.

Annex

Third International Conference on Exploration

First meeting of the High-level International Space Exploration Platform

Declaration

Foreword

Humanity's quest to explore has existed for as long as history has been recorded. This desire to go further, to explore new frontiers, to make new discoveries, is never ending. It is part of the essence of being human. Only the pace and actors have changed over time. We have gone from exploring the oceans and to finding new lands to breaking free of the Earth's atmosphere. After more than 50 years since humans ventured into space, space exploration has evolved in terms of destinations, duration, objectives, partnerships, and complexity. Sustainable space exploration is beyond the capabilities of a single country.



“Space exploration” consists of multiple missions and projects, large and small, to several destinations, including the Moon, Mars, and asteroids, which all have their own merits, and can be explored with a variety of technologies. These on-going and potential activities can have robotic and human components, in sequence or in parallel, and can also involve many established and emerging actors.

The importance of high-level structured policy dialogue

Representatives from around the world met in Lucca, Italy, on 10 November 2011, to highlight the importance of future space exploration and its direct benefit to humankind. Representatives took note of the scenarios elaborated by the International Space Exploration Coordination Group in the recent 'Global Exploration Roadmap' document. These leaders affirmed that space exploration can profit from an international high-level dialogue. In addition to advancing the state of the art in science, technology and engineering, there are unprecedented opportunities to deliver benefits to humanity on Earth while paving the way for future space exploration activities. These benefits include fuelling future discoveries; addressing global challenges in space and on Earth through the use of innovative technology; creating global partnerships by sharing challenging and peaceful goals; inspiring society and especially the younger generations through collective and individual efforts; and enabling economic expansion and new business opportunities. The international high-level policy dialogue initiated in Lucca contributes to delivering these benefits.

Next steps

Representatives at the Lucca Conference recognised the benefit from a continued, and structured high-level policy dialogue on future space exploration that can help identify potential areas for international cooperation, and took note of the European concept paper which helped prepare for the Conference. In addition, this high-level structured policy dialogue will provide inspiration to the already existing multilateral fora and bilateral technical, programmatic and scientific venues.

It is expected that further discussions will allow exchange of views that could include joint missions, research collaboration, and could lead to greater cooperation in areas such as access to space, innovation and space technologies, the utilisation of the current and possible future Low Earth Orbit (LEO) infrastructures, and future human and robotic presence beyond LEO. The participants welcomed an offer from the United States to host the next dialogue.

The government representatives in Lucca committed to begin the open structured high-level policy dialogue on space exploration at the government-level for the benefit of humankind.

Lucca, Italy, 10 November 2011

6. Japan Aerospace Exploration Agency (JAXA), Japan

General

On May 27, 2009, the Cabinet Office for Space Strategy (SSHQ) released a “Basic Space Policy Plan” for the Government of Japan in accordance with “Basic Space Law” legislated in 2008. This policy was quite broad and expressed five-year initiatives including contribution to the national security, promoting R&A etc. As one of the pillars in this plan, it was facilitated to create to an energetic future by promoting R&D of the forefront such as space exploration.

In August 2010, SSHQ released another document which is called as “the Immediate Priority for Space Policy”. This policy described with 3 basic pillars; (1) Realization of growth driven by the utilization of space, (2)Promotion of space diplomacy, (3)Reinforcement of cutting-edge science and technical capabilities. Participation in the International Space Station program is included in the second pillar and space exploration is included in the third pillar. In this policy, with regard to asteroid exploration, it is encouraged to develop the sample return technology. Therefore, the follow-on mission of HAYABUSA brought back samples of the asteroid to the earth which was the world 1st achievement has just developed.

JAXA’s products for space exploration in 2011 are three major events, those are the accomplishment of the world first solar sail satellite IKAROS, the analysis of samples of asteroid brought back by HAYABUSA and the start of HAYABUSA2.

IKAROS: The world first solar sail satellite

A Solar Sail is a space yacht that gathers energy for propulsion from sunlight pressure by means of a membrane. A solar sail can move forward without consuming propellant as long as it can generate enough energy from sunlight.

A Solar Power Sail is a Japanese original concept that gets electricity from thin film solar cells on the membrane in addition to acceleration by solar radiation. A solar power sail craft can save the fuel using a solar sail and it can also gain the necessary electric power using a vast area of thin film solar cells on the membrane even when it is away from the sun. If ion-propulsion engines are driven by such solar cells, it can become a hybrid engine that is combined with photon acceleration to realize fuel-effective and flexible missions.

JAXA performed a mission to evaluate the performance of the solar power sails. The project name is IKAROS (Interplanetary Kite-craft Accelerated by Radiation Of the Sun). This craft was launched on May 21, 2010 together with the Venus Climate Orbiter, AKATSUKI. This is the world’s first solar powered sail craft employing both photon propulsion and thin film solar power generation during its interplanetary cruise. IKAROS deployed successfully a square membrane whose tip-to-tip length is 20m, and generated solar power by means of thin film solar cells (minimum success level) within a few weeks. Two separation cameras took images of the deployed solar sail of IKAROS. Acceleration and navigation using the solar sail was demonstrated (full success level) within half a year for the first time in the world. IKAROS flied by Venus on December 8, 2010. IKAROS finished all experiments planned and still continues to sail in order to enhance the skill of controlling solar sail.



JAXA is studying the next solar power sail mission which will take place in the late 2010s. It involves a large sized solar power sail with a diameter of 50m, and is integrated ion-propulsion engines with high specific impulse. The destinations of the spacecraft are Jupiter and the Trojan asteroids. JAXA will lead future solar system exploration using solar power sails.

Analysis of samples brought back by HAYABUSA

The Asteroid Explorer HAYABUSA, launched in May 2003, arrived at asteroid Itokawa in September 2005. HAYABUSA successfully touched down Itokawa that November, but then a series of problems developed, including a fuel leakage, engine malfunctions and the loss of communication. HAYABUSA's return to Earth was threatened many times, but the space probe managed to overcome these problems. It re-entered the atmosphere above the southern Australia sky on June 13, 2010, returning to Earth after traveling about 6 billion kilometers over seven years. The HAYABUSA sample capsule landed in the Woomera Test Range in South Australia. And its all parts such as ablative heat-shields were retrieved successfully. It was the first time ever that a space probe landed on a celestial body other than the Moon and returned to Earth. The navigation for the return of the HAYABUSA was conducted with large cooperation of JPL/NASA. And the retrieval of the sample capsule was completed with large cooperation of Australian government and army.

JAXA has been engaged in collecting and categorizing particles in the sampler container that were brought back by the HAYABUSA.

As a result of the scanning electron microscope (SEM) observations and analyses of the samples, about 1,500 grains were identified as rocky particles, and most of them were judged to be of extraterrestrial origin, and definitely from Asteroid Itokawa, after further study of the analysis results and comparison of mineral compositions.

Their size is mostly less than 10 micrometers, and handling these grains requires very special skills and techniques.

JAXA and scientists commenced initial analysis for these ultra-minute particles and identified a lot of scientific discoveries about the origin of comets. Furthermore, international Announce of Opportunity for the sample analysis is to be planned in 2012. The analysis by leading experts is expected that the samples will contribute to the further development of planetary physics globally.

HAYABUSA2

In April 2011, JAXA started HAYABUSA2 mission. HAYABUSA2 is a mission to retrieve samples from an asteroid to the earth. This is a similar mission to HAYABUSA's one, However, target asteroid is different from HAYABUSA's. The Asteroid Itokawa explored by HAYABUSA is rock-rich S-type one. HAYABUSA2 will visit a C-type asteroid. C-type asteroids are also rock quality but it is thought that their rocks contain much more organic matters and water. HAYABUSA2 will challenge very interesting objectives: what are original organic matters and water existed in the solar system? how are they related to life and ocean water? In addition, HAYABUSA2 will challenge new technologies as well as improving the technologies of HAYABUSA.

An asteroid currently considered as a target of HAYABUSA2 is temporally called 1999 JU3. Observation of spectrum of sunlight reflected by the asteroid shows that it has features of C-type. That is exactly suitable for HAYABUSA2.



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Asteroid 1999 JU3 has a similar orbit as that of Itokawa and it is in the orbit that occasionally comes close to the earth orbit. Past observations show that, the size is approximately 920m and relatively it looks like a sphere. The rotation period is approximately 7.6 hours. The albedo on the surface is tiny, estimated about 0.06.

Like HAYABUSA, HAYABUSA2 will use an ion engine to access the destination asteroid. HAYABUSA2's spacecraft is almost same as HAYABUSA's one, but, we will improve the problem identified at HAYABUSA and aggressively adopt new technology. And HAYABUSA2 will observe and collect the sample, based on the C type of Asteroid

Best timing to launch to the asteroid for this sample return mission is 2014. HAYABUSA2 is supposed to reach the asteroid in the middle of 2018, stay there about one and half years, depart from the asteroid to return to the earth at the end of 2019, and come back to the earth at the end of 2020.

As a new challenge, it is considered to carry "Crackup installation" on HAYABUSA-2 that HAYABUSA didn't have. It will be separated above 1999 JU3 and explode there after HAYABUSA-2 hides behind the asteroid. Then an impactor of approximately 2 kg hits the surface of the asteroid and it will make a crater of several meters in diameter. After that, it tries to collect materials inside of the crater. In other words, HAYABUSA-2 will collect materials of underground not only the ones on the surface. By doing that, we try to collect less altered materials.



7. Korea Aerospace Research Institute (KARI), Republic of Korea

Exploration Highlights

Dr. Seung Jo Kim was appointed as the new president of KARI in June 2011, where after KARI underwent a structural reorganization to increase institutional efficiency, enhance internal communications and strengthen research capability. The new organization emphasizes the development of future converging core technologies, the reinforcement of international cooperation and closer communications with industry.

KARI has been preparing and developing a number of satellite programs including KOMPSAT-3(Korea Multi-Purpose Satellite), KOMPSAT-5 and STSAT-3(Science and Technology Satellite) which are all scheduled for launch in 2012. KARI has also been conducting a series of tests and investigations to clarify the possible cause(s) for the failure of the 2nd launch attempt of KSLV-I (Korea Space Launch Vehicle I) with the 3rd launch scheduled for October, 2012 from the Naro Space Center in Korea.

In order to prepare for future space exploration missions, KARI has been conducting basic research in various related areas such as orbiter/lander systems for lunar exploration, science payload systems for planetary exploration, as well as microgravity experiments for ISS utilization. KARI will continue to expand its research to include planetary rover development and planetary science to support future manned space exploration.

With regards to ISS utilization, KARI and JAXA have been evaluating the feasibility of a joint experiment onboard the Japanese Experiment Module (JEM) and hope to implement the experiment onboard the JEM around 2015 after the two agencies affirm their mutual interests through a feasibility evaluation process. In addition to collaboration with JAXA, KARI has also been reviewing joint projects with NASA to utilize the resources of the ISS.

Most recently, the Korean government revised the national space development plan, Basic Space Development Promotion Plan (2012~2016), to broaden the scope of future national space programs. Korea continues to expand its space programs further into outer space and strives to become a major player in the future global exploration of space.



8. National Aeronautics and Space Administration (NASA), USA

Exploration Highlights

2011 marked the completion and full utilization of the U.S. On-orbit Segment of the International Space Station, and the conclusion of the Space Shuttle Program, among other notable accomplishments. NASA reached several key milestones in developing a new U.S. space transportation system that will serve as the cornerstone for America's future human space exploration efforts. In May, NASA selected the Orion Crew Exploration Vehicle as the spacecraft that would take astronauts beyond low Earth orbit. Shortly following this selection, NASA announced in September the design of the Space Launch System – a heavy-lift rocket that will take astronauts further into space than ever before.

As NASA looks to the future of exploration, it continues to make progress in scientific research and technology development by fully utilizing the recently completed U.S. On-orbit Segment of the International Space Station. To date, more than 1,400 research and technology development activities have been conducted aboard the orbiting lab, many of which are producing advances in medicine, environmental systems and our understanding of the universe. In addition, NASA selected an independent non-profit organization, the Center for the Advancement of Science in Space (CASIS), to manage and develop the part of station that is a National Laboratory.

NASA is preparing for the first U.S. commercial resupply missions to the International Space Station in 2012. SpaceX and Orbital Science Corp. are progressing with Dragon and Cygnus cargo vehicles' preparations for launch to the station. Other commercial space ventures have begun to accelerate, as NASA awarded four Space Act Agreements in April for the agency's Commercial Crew Development effort. The four companies are working to advance the availability of U.S. commercial crew transportation to space station and reduce the gap in American human spaceflight capability.

To improve NASA's capabilities, while reducing cost and expanding the reach of future exploration missions, NASA and its Office of the Chief Technologist implemented the agency's new Space Technology Program. The program has more than 1,000 projects underway.

NASA's Year of the Solar System resulted in three planetary launches, major science observations, an asteroid rendezvous, and a comet flyby, including missions which had international participation. In February, Stardust-NExT provided the first-ever opportunity to compare observations of a single comet, Tempel 1, made at close range during two successive passages. In March, the Mercury Surface, Space Environment, Geochemistry, and Ranging, or MESSENGER, spacecraft became the first spacecraft inserted into orbit around Mercury, our solar system's innermost planet. In July, the Dawn spacecraft began orbiting the asteroid Vesta and obtained never-before-seen close-up observations of the second largest asteroid in our asteroid belt. In August, the Juno spacecraft was launched on a mission to Jupiter to map the depths of the planet's interior and learn how the gas giant was formed. It will reach Jupiter in 2016. The Gravity Recovery and Interior Laboratory, or GRAIL, lifted off in September to study the moon from crust to core, and the first of 2 spacecraft arrived at the Moon just before the end of the year.



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The Mars Science Laboratory (MSL), NASA's newest Mars Explorer, launched in November, and includes the car-sized Curiosity rover that will search for signs that the planet could ever have been hospitable to life. MSL also included the first Technology Development Mission, the Mars Science Laboratory Entry, Descent, and Landing Instrument (MEDLI) Suite.

NASA's Kepler mission confirmed its first planet in the habitable zone, the region where liquid water could exist on a planet's surface. Kepler also discovered more than 1,000 new planet candidates, nearly doubling its previously known count to 2,326. Ten of these candidates are near-Earth-size and orbit in the habitable zone of their host star.

NASA's Lunar Reconnaissance Orbiter (LRO) has brought the moon into sharper focus and has showed the whole globe in unprecedented detail. This rich new portrait has been rendered by LRO's seven onboard instruments, which together have delivered more than 192 terabytes of data, images and maps -- the equivalent of nearly 41,000 typical DVDs.

The astronaut class of 2009 graduated, and NASA began recruiting its next astronaut class in November. These new astronauts will advance research aboard the space station to benefit life on Earth and develop the knowledge and skills needed for longer flights to explore the solar system. Those selected also will be among the first to pioneer a new generation of commercial launch vehicles and travel aboard a new heavy-lift rocket to distant destinations in deep space.

To train and inspire the next generation of highly skilled engineers, scientists, and astronauts, NASA's Office of Education developed a variety of new partnerships and engaged in activities to promote science, technology, engineering and math education. NASA Education's 2011 Summer of Innovation program reached more than 46,000 middle school students throughout the U.S. In addition, NASA's Office of the Chief Technologist selected the inaugural class of 80 highly qualified and talented graduate students from 37 universities and colleges during the summer to receive fellowships. The students will pursue master's or doctoral degrees in relevant space technology disciplines at their respective institutions.



9. State Space Agency of Ukraine (SSAU), Ukraine

Ukrainian Space Strategy

The Cabinet of Ministers of Ukraine in April, 2011 adopted a new Space Strategy – “Concept of the National Space Policy Realization for the period to 2032”. The document envisages SSAU to explore the lunar surface and the near lunar plasma environment using Ukrainian “Dnepr” and “Mayak” launch vehicles and domestic spacecrafts, as well as provides for participation in international space projects. The State Space Agency of Ukraine is to continue preparation of experiments in space physics, biology and material sciences with mandatory specialists’ participation onboard international space stations, including national mission specialists’ engagement as part of international crews.

The document is available at: <http://www.nkau.gov.ua/>

As a first step, SSAU and Roscosmos concluded an agreement on cooperation in the framework of Russian “Luna-Glob” mission. The partners have agreed to put Ukrainian Electromagnetic Sensors for lunar environment research onboard “Luna-Glob” spacecraft.

Radio Astronomy

The Ukrainian RT-70 Radio Telescope of the National Space Facilities Control and Test Center (Yevpatoriya, Crimea) is our principal contribution to the Russian “RadioAstron” mission.

“Spektr-R” space observatory launched on July 18, 2011 by “[Zenit-3M](#)” launch vehicle is operated by an international network of ground-based radio telescopes (three ones in Russia, two in Ukraine and Effelsberg Radio Telescope in Germany). This ground- and space-based telescope system, also called as interferometer, will provide the finest angular resolution and appears to become the most sensitive telescope ever created by humanity.

International Space Station

Implementation of two scientific experiments of “Obstanovka-1” and “Microsatellite” is planned to start in January 2012 through Ukrainian involvement. These are the first two experiments being prepared in the framework of “Long-duration Russian-Ukrainian program of scientific research onboard Russian Module of ISS”.

Exploration Technologies

SSAU also aims at development and improvement of new technologies for Ukrainian launch vehicles’ and spacecrafts’ manufacturing.

Space industry enterprises continue development of advanced technologies as part of the international teams, namely:

- 1) lightweight multifunctional composite panels for exploration rovers for missions to Mars; and
- 2) radiation shielding of composite space enclosures.

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