

1. INTRODUCTION

1.1 Europe's role in the Exploration of the Solar System

From the dawn of humankind the need to explore has driven the expansion across our planet. Today this expansion continues towards other planets in the Solar System by means of robotic spacecraft – virtual explorers. But will human expansion continue? In the public consciousness, this is only a matter of time.

By 2025 an international human mission to Mars may be a reality. It may use the Moon as a way station and to prepare for the great leap. The feasibility of such a mission is being assessed; however, the necessary technologies and capabilities still need to be developed. Having reached maturity in human spaceflight thanks to its developments in the ISS frame, Europe will have to decide whether to play a key role in the next step or whether to join later as a junior partner. Given the time-span of such a human mission, Europe faces also the issue of how to exploit the industrial know-how developed in the ISS frame and to orient it toward the new mission. Deciding which areas of expertise Europe wants to lead in the future is a step that cannot be left to the future partners, and has to be taken soon.

With this objective in mind, ESA has recently issued a call for ideas. With more than 300 responses this call has clearly demonstrated the interest as well as the potentialities of undertaking a programme for Exploration.

Over the next 20 years robotic missions will prepare the human missions, by collecting as much scientific and engineering data as possible without human scientists in situ. These robotic missions will contribute and demonstrate the technologies needed to put humans on Mars and return them safely on our planet. Some of the key technologies for a human mission are also very important for the search for life in situ on the red planet and on other Solar System's planets and moons. Soft and precision landing, drilling and sample return, will not just be demonstrated for the sake of technology. These missions will carry sophisticated exobiology payloads and will allow us to answer some key questions on the origins of life in the Solar System, and possible causes for its extinction.

These “precursor missions” will also greatly advance our technology capability making Aurora a genuine programme for innovation. Spin-offs are expected in sensor technology; Information Technology, in particular spacecraft autonomy (signal return delay from Mars); biochemical technology (searching life means understanding what life is on our planet and what different forms it may take, how it can be identified, not contaminated and viceversa); navigation and communication technology (precision landing and large volume of data transmission); propulsion; power generation, conversion, transmission, conditioning and storage; thermal control; extreme temperature and radiation hardened electronics; in-situ resources utilisation; aerothermodynamics; etc

By its very nature the Programme is therefore multidisciplinary, crossing many sectors of science, technology and space activities. Thus the Aurora Programme can be seen as a road- map for manned exploration from where a large number of scientific as well as technology spin-offs will emerge, which the Exploration goal is driving.

Most of all, by federating the efforts of all Member States toward a common objective, Europe will reaffirm its new role on the world stage, through one of the most visible activities, and give an exciting goal to its young minds. Aurora will indeed attract many young talents in Science and Engineering, those who will build the Europe of the 21st Century. A number of key decisions will be taken in the next 30 years. However, by deciding on the Aurora programme, Member States will have taken a first, very important step. While integrating so many disciplines and federating all European efforts in Exploration, through the conduct of advanced studies and the development of its missions the programme should have the way to putting a European on the surface of Mars before 2025.

1.2 Towards a European Framework for Exploration

The objective of the Aurora Programme is to formulate first, and then implement, a European long-term plan for the robotic and human exploration of the Solar System bodies holding promise for traces of life.

The programme shall also provide for the necessary missions and technologies to complement those planned in the existing ESA and national programmes, in order to bring about a coherent European Framework for Exploration and to progressively develop a unified European approach.

Mission opportunities or co-operation with non-European partners will be sought whenever functional to the achievement of the Programme's goals.

The final goal of Exploration in this context is to expand the sphere of influence of humankind further into the Solar System and to prepare the utilisation of space. In order to achieve this goal it will be necessary to:

- improve our knowledge of the planetary environments,
- advance technology to cope with severe requirements,
- ensure the health, safety, and performance of humans living and working in space.

The necessary technologies to enable such capabilities need to be developed and demonstrated. The Executive proposes to exploit the synergy between the needs of technology demonstration for the future human exploration missions and those of in-situ astro/exobiology.

1.3 The Initial Objective of the Aurora Programme

The goal of the present preparation period is to strengthen and implement a European consensus on the future for exploration of space by humans. Other imperatives will contribute to this aim: the quest for knowledge of the origin of the solar system, the quest for evidence of life elsewhere than Earth, and the need to guard against threats to human life from space (on Earth or in space).

Aurora will bring together the diverse elements already existing in Europe, both within and out of the present ESA programmes. Particular attention will be paid to obtaining cohesion with existing national programmes. Not only does this mean achieving coherence with nationally led solar system exploration programmes but also bringing together the many laboratories in Europe where knowledge resides on working in extreme environments. Similarly, being European, the

programme also rests on and uses the capabilities of other European organisations such as EMBL, CERN, ESO, etc.

The Aurora Programme is conceived to proceed in this sense by first defining the overall necessary activities and then implementing only those that are not covered by other national or Agency programmes. By continuous co-ordination the potential synergy effects between Aurora and these other programmes will be activated so that the programmes will reciprocally benefit from each other.

There will be a strong emphasis on early technology preparation. A central aim will be to give a plan for a sequence of missions as well as a long-term plan for technology development by the end of the preparatory programme. These two plans will provide the basis also for a description of the long-term funding needed overall in Europe. This is a prerequisite if Europe is to achieve a programme where it may independently plan its way ahead.

Nonetheless, the existence of this initiative does not mean that Europe is going to reject international cooperation. The aspirations of the Aurora initiative will form an element of all discussions of strategic goals in cooperative exploration with the USA, Russia, Japan and other potential partners. Mission opportunities or co-operation with non-European partners should be sought whenever functional to the achievement of the Programme's goals. However the aim is to raise Europe's status as a partner to a new level and to ensure European perspectives are brought to bear on the world-wide efforts in space exploration.

The expected results should put Europe in a position within the next two/three decades to take a prominent role in an international scenario for the human exploration of Moon and Mars. Such aims are consistent with Europe's economic strength as well as its traditions and ambitions.

By setting up this new programme between the present Science and the Manned Space Programmes, the Executive proposes to exploit several synergies. There is a strong synergy between the needs of technology demonstration for the future human exploration missions and those of in-situ astro/exobiology. Many technologies developed already planned for use in the Science Programme, such as soft and hard landing techniques, novel propulsion techniques, autonomous operation, etc. can similarly contribute to Aurora.

The main priorities for the Preparatory Period are to:

- bring together current European efforts and aspirations in exploration;
- use the weight and reach of the total European effort to produce a European perspective on Solar System exploration, with emphasis on Mars, the Moon and NEO's;
- establish a European Exploration Framework including a list of near and long-term priorities to be pursued;
- start implementation for technology development, mission scenarii and scientific exploitation, building on national capabilities within Europe and including International co-operation;
- propose a long-term cost plan for the level of investment needed by Programme Participants.