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ASTROMAP , A EUROPEAN ROAD MAPPING PROJECT IN SUPPORT OF A EUROPEAN RESEARCH  
FRAMEWORK PROGRAMME IN ASTROBIOLOGY AND SPACE EXPLORATION

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Astrobiology and space exploration are among the areas that are receiving an increasing attention within the European Commission (EC) Research and Technology Development agenda. To prepare a European vision for astrobiology and space exploration, the AstRoMap (Astrobiology and Planetary Exploration Road Mapping) project has been funded within EC Seventh Framework Programme (FP7).

AstRoMap is a foresight initiative that intends to identify research priorities for Europe and articulate them around a roadmap but it is also a networking and mapping initiative.

AstRoMap gathers six partners from five European countries; the project was kicked-off in October 2012 for a period of three years.

## I. BACKGROUND

Relevant European participations in space missions are currently in progress with a major support of investment in the European Southern Observatory (ESO), through use of the Very Large Telescope (VLT) and the approaching use of the Atacama Large Millimeter Array (ALMA). European leadership in the search for extra-terrestrial systems indicates the breadth and innovation of the planetary scientific community.

The European ExoMars mission that intends to send a rover to Mars in 2018 with the objective to search for evidence of past or present biological activity is included into the Exploration programmes for planetary and space exploration in the coming years.

Beyond Mars, the Jupiter Icy Moon Explorer (JUICE) mission is integrated in ESA's Cosmic Vision programme. JUICE is expected to perform detailed investigations on Ganymede as a planetary body and evaluate its potential to support life. Investigations of Europa and Callisto would complete a comparative

picture of these Jovian moons. The three moons are believed to harbour internal liquid water oceans, and so are central to understanding the habitability of icy worlds.

Future developments should follow the intention of providing a stimulus to innovation and growth in the European economy with important contribution to European 2020 priorities, especially with regard to Smart and Sustainable growth and Innovation aspects of the future.

Over the past couple of years, the term *astrobiology* has appeared in the European Commission Seventh Framework Programme' (FP7) jargon, showing an increasing interest of in the matter. The AstRoMap project intends to provide integrated expert advice to support the planning of European astrobiology research in the decades to come.

The main objectives of AstRoMap project are to:

- Identify the main astrobiology issues to be addressed by Europe in the next decades in relation with space exploration
- Identify potential mission concept that would allow addressing these issues
- Identify the technology developments required to enable these missions
- Provide a prioritised roadmap integrating science and technology activities as well as ground- based approach
- Mapping scientific knowledge related to astrobiology in Europe

## II. FORESIGHT AND ROADMAPPING

AstRoMap has structured its foresight effort around four basic issues, each being addressed through a dedicated expert workshop:

- Origin of organic compounds, steps to life
- Physico-chemical boundary conditions for habitability
- Biosignatures as facilitating life detection
- Origin of Solar system

These workshops are intended to address the following questions: i) identify the main astrobiology challenges to be addressed (by Europe) in the next decades in relation with space exploration, ii) identify the main scientific and technological knowledge gaps related to these issues, iii) consider the International environment and potential for collaboration and, iv) also consider the education and training landscape. In

advance of the workshop, the scientific community had the opportunity to provide inputs and ideas via an online consultation. The contributions received were made available to the workshop participants and fuelled the discussions.

Two cross-cutting subjects are also considered through the project:

- Earth analogues: How Earth analogues can contribute to identify putative extra-terrestrial habitats and technology test?
- Planetary protection: What are the conditions and requirements for planetary protection and planetary ethics?

The first three workshops were held between October 2013 and May 2014, the final workshop will be held in November 2014.

The outputs, findings and recommendations from the four workshops will be integrated into one scientific roadmap that will be available by the summer 2015.

## II. MAPPING

Besides roadmapping and foresight AstRoMap also intends to draw the picture of the astrobiology research landscape in Europe. This is achieved through the analysis of the inputs provided to an online questionnaire addressed to the community. This questionnaire was structured around the following elements:

- Demography of the astrobiology community
- Research activities and interests
- Applications and cross-cutting societal interest
- Professional profile
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While the number of answers received was pretty low (105), the project could however depict some of the main trends and features of European astrobiology landscape, a dedicated paper (IAC-14.A1.5.8) addresses these issues.

## III. NETWORKING

The AstRoMap project also intends to provide a networking and exchange of information platform aimed at facilitating research collaboration in Europe and beyond. In order to achieve this objective, the project has designed and implemented a database of individual scientists who has some interest in astrobiology. This platform is open and public and

allows to i) provide one's profile in terms of research interest together with his/her contact details and ii) to search for specific expertise through an embedded search engine that discriminates across the various dimensions of the database.

The structure of the database allows providing a detailed profile for each investigator registered; this 'scientific fingerprint' made possible through tick-boxes is structured around the following areas:

- Astrobiology research topic (e.g. planetology, prebiotic chemistry, habitability)
- Celestial target of research (e.g. interstellar medium, solar system planets, Earth extreme environments, small bodies)
- Environment of interest (e.g. planetary surface, subsurface, atmosphere)
- Time scale of interest (e.g. pre-biotic chemistry, early life on Earth, Putative extant life on planetary bodies)
- Physico-chemical conditions of interest (e.g. radiation, extreme pH)
- Test system (e.g. viruses, eukaryotes)
- Methodology (e.g. field studies, space experiments)
- Measurement tools and techniques (techniques and instruments)
- Applications and cross-cutting societal interest (e.g. global change, biotechnology, humanties)

In addition, and besides full contact details, a list of publications can also be provided. This database currently gathers 122 research profiles and is available at <http://www.AstRoMap.eu/database.html>

The AstRoMap project will also organise an 'Astrobiology day' in 2015, this event will be primarily targeted to European policy makers and will promote astrobiology, demonstrating its relevance to the *Europe 2020* strategy.

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