

EUROPEAN SPACE AGENCY

SENIOR SCIENCE COMMITTEE FOR M4 (SSC-M4)

**Recommendation on the selection of mission concepts to be candidates
for the implementation of a medium-size, or M-class, mission (M4)**

The Senior Science Committee for the M4 mission selection (hereafter SSC-M4) was appointed by the Director of Science and Robotic Exploration of ESA and was requested to issue a recommendation about which mission concepts to select for study in view of the implementation of the “M4” Medium mission.

The SSC-M4 had its final meeting in ESA-HQ, Paris on 11-12 May 2015 to issue its recommendation, following the process described in Annexe 1.

Ten proposals were submitted by the Executive to the SSC-M4, i.e., (in alphabetic order) Alfvén⁺, ARIEL, ASTROGAM, EPIC, Galileo Galilei, LOFT, NITRO, Ravens, THOR, and XIPE.

The SSC-M4 evaluated both the scientific and programmatic aspects of the ten candidate missions, including scientific value, timeliness, and potential impact. Summary evaluations for the candidate missions are reported in Annexe 2.

Following the evaluation, the SSC-M4 recommends to the Director of Science and Robotic Exploration three mission concepts, i.e., (in alphabetic order) ARIEL, THOR, and XIPE for a study phase.

The SSC-M4 considers that the ARIEL mission can be the first dedicated mission to make IR spectroscopic observations of atmospheres of hot exoplanets, thus giving the chemical composition and insight into their formation. The proposed mission is mature, well developed and timely. The science it offers to do is comprehensive, systematic and should have field-changing impact.

The SSC-M4 considers that the THOR mission can address a fundamental problem of plasma physics, the energy dissipation of turbulent fluctuations and the corresponding transfer of energy to kinetic energy of electrons and ions, relevant in many astrophysical areas. The technological readiness of the proposed instrumentation is very high and this dedicated mission shows the potential to make a lasting contribution to the understanding of turbulence on the small scale.

The SSC-M4 considers that the XIPE mission can open an unexplored domain by measuring at high sensitivity the polarization (percentage and direction) in the X-ray spectral range. The mission can probe an array of objects from supernova remnants and wind nebulae, magnetized white dwarfs, neutron stars and microquasars, to active galactic nuclei and their jets, and perform more speculative studies relevant for fundamental physics, such as the measurement of black-hole spin and the search for dark-matter candidates.

Annexe 1 – SSC-M4 Evaluation process

The Director of Science and Robotic Exploration of ESA issued on 19 August 2014 a Call for Missions soliciting from the broad scientific community proposals for the competitive selection of mission concepts to be candidates for the implementation of the “M4” Medium mission. The proposal submission deadline was 15 January 2015 with the aim of selecting missions for a study phase by mid-2015.

Proposals were first screened by the Executive for technical and programmatic feasibility. The Executive requested the SSC-M4 to recommend proposals for a study phase among the ones that were deemed to fit within the M4 constraints following this screening. These were (in alphabetic order) Alfvén⁺, ARIEL, ASTROGAM, EPIC, Galileo Galilei, LOFT, NITRO, Ravens, THOR, and XIPE.

A Science Assessment Review Panel (hereafter SARP) was convened to perform a scientific evaluation of these proposals according to a number of pre-defined criteria. The SARP performed its activities between March and April 2015.

The SSC-M4 received these proposals at the same time as the SARP, attended the proceedings of the SARP, was involved in the preparation of questions provided in written form to the competing teams on 10 April 2015 (answers in written form were received on 15 April 2015) and took an active part in the interview session with the proposing teams (ESTEC, 20-21 April 2015) and in the following SARP discussion (ESTEC, 22 April 2015). The SSC-M4 received the SARP’s evaluations on 27 April 2015.

The members of the SSC-M4 are:

| <i>Name</i> | <i>Affiliation</i> |
|------------------------------|--|
| Catherine Cesarsky | CEA Saclay, France |
| Jørgen Christensen-Dalsgaard | Stellar Astrophysics Centre, Aarhus University, Denmark |
| Ewine van Dishoeck | Leiden Observatory, The Netherlands |
| Karl-Heinz Glassmeier | Institut für Geophysik und extraterrestrische Physik - Technische Universität Braunschweig, Germany |
| Rickard Lundin | Institutet för Rymdfysik, Swedish Institute of Space Physics, Sweden |
| Philippe Masson | Faculté des Sciences d'Orsay, Université Paris-Sud, France |
| Birgitta Nordström | Niels Bohr Institute, Copenhagen University, Denmark |
| Stefano Vitale | Department of Physics, University of Trento, Italy |
| Diana Worrall | University of Bristol, U.K. |
| John Zarnecki (Chair) | International Space Science Institute, Bern, Switzerland |

The SSC-M4 had a kick-off teleconference on 28 April 2015 and a final meeting on 11-12 May 2015, where the present recommendation was issued.

Members of SSC-M4 were selected in order to avoid “strong” conflicts of interest. The SSC-M4 members were required at the beginning of the process to sign a "conflict of interest statement" indicating any weak conflicts (i.e., presence in their same institutions of colleagues involved in a

proposal). Members of the SSC-M4 that are affected by weak conflicts of interest with a given proposal were not involved in the discussion of the relevant proposal. The weak conflicts identified are:

| <i>Name</i> | <i>Mission</i> |
|--------------------|-----------------------|
| Catherine Cesarsky | ARIEL, ASTROGAM, LOFT |
| Ewine van Dishoeck | ARIEL, EPIC |
| Rickard Lundin | NITRO |
| Stefano Vitale | LOFT |

As Catherine Cesarsky, who was originally appointed as Chairperson of the SSC-M4, has weak conflicts with three candidate missions, in consultation with the ESA Executive, it was agreed to ask John Zarnecki to chair the SSC-M4.