



# **Call for a Medium-size mission opportunity in ESA’s Science Programme (M5)**

## **1 INTRODUCTION**

The ESA Science Programme is based on long-term planning of scientific goals. The Cosmic Vision plan (available as ESA BR-247) was established in 2005 on the basis of a bottom-up process that started with a consultation of the broad scientific community and contains the wide-ranging and ambitious scientific questions to be addressed by missions in the ESA Science Programme.

The definition of the actual space missions that will address the science themes in question is based on the competitive, peer-reviewed selection of Large (L) and Medium (M) missions.

Through the present Call for Missions the Director of Science solicits from the broad scientific community proposals for the competitive selection of mission concepts to be candidate for the implementation of the “M5” Medium mission. The present Call is open to missions in all areas of Space Science.

## **2 BOUNDARY CONDITIONS**

The proposals submitted in response to the present “M5 Call” for mission concepts must be compatible with the boundary conditions spelled out in the present section.

### **2.1 Cost and schedule**

The present “M5 Call” solicits proposals for a mission with a cap to the ESA Cost at Completion (CaC) of 550 M€. Proposals with a cost below this cap would be considered with no prejudice, both for stand-alone missions and for contributions to partner-led missions. Proposals with a cost to ESA exceeding the cap would be considered as non-feasible.

The CaC cap includes the cost of the mission’s nominal operations and can include a contribution to the payload, including the case of a mission with payload fully funded by ESA (à la Gaia).

The development schedule and therefore the launch date will be driven by the mission's complexity (and, in case of international partnerships, by the partner's schedule). It is

foreseen that a mission of typical complexity making full use of the available ESA CaC allocation (plus nationally provided payload) would require a development schedule of some 8 years from mission adoption to launch (about 7 months for the Prime Contractor selection plus 7 to 7.5 years development). Assuming a mission adoption in 2021, the M5 launch would take place in 2029.

## **2.2 *Technology Readiness Level***

Regardless of the type of proposal, its implementation timescale and financial envelope, proposed missions must rely on technologies that will reach TRL 5-6 (ISO scale) by the end of the definition phase and before the mission adoption. Considering the limited time available between the selection of the mission candidate following this Call and its adoption, the mission must rely on available technologies already at the time of the proposal, although mission-specific technology verifications can be foreseen during the preparation phase as long as feasible within 2-2.5 years. The specific technical requirements for the proposals are described in detail in the Annex.

## **2.3 *Mission profiles***

Any mission profile can be proposed in response to the present Call as long as it fits the boundary conditions indicated above. Examples of mission profiles that can fit these boundary conditions are described in some detail in the Annex to the present Call. However, they are in no way meant to be prescriptive. Proposers are free to propose different mission profiles, conditional to their being compatible with the conditions of this Call.

Use of launch vehicles will be consistent with ESA's policy on the use of European launch vehicles, unless an international partner provides the launch vehicle on a no exchange of funds basis.

## **2.4 *International collaborations***

M missions are a key vehicle for pursuing collaboration opportunities between the ESA Science Programme and other space agencies. As such, any international collaboration scheme can be considered for the implementation of M missions: an M mission can be entirely European, or it can be European-led with junior participation by international partners, or (part of) the budget allocation of an M mission can be used to implement a junior European contribution to a mission led by a partner agency. All these scenarios have been implemented in the Programme's history.

The present Call is open to all possible international collaboration schemes, i.e., proposals are allowed for both European-only missions as well as for missions in collaboration with international partners. In case an international collaboration is proposed, the proposal must clearly identify whether the mission is proposed as European-led or as a contribution to a partner-led mission, with a clear management scheme proposed in either case.

Any international partnership scheme will be contingent to the availability of partner agencies willing to pursue the scheme.

### **3 PROPOSAL ENDORSEMENT BY NATIONAL FUNDING AGENCIES**

ESA Science missions are, in general, collaborative undertakings between ESA and its Member States (as well as, in a number of cases, international partners). For the majority of missions, the relative share of responsibilities between ESA and the Member States is based on ESA procuring the spacecraft and the launch vehicle, and being also responsible for the launch services and for the operations.

Payload elements are in most cases procured under the responsibility of scientific consortia funded by Member State agencies, with a varying degree of ESA involvement, with some missions featuring payloads which are funded entirely by the Member States (and in some cases with the contribution of international partners, e.g., JUICE or Euclid) and other missions featuring payload for which the procurement is shared between ESA and the nationally funded consortia. For example, ESA is procuring the telescope assembly and the optical detectors for the Euclid mission, and the complete suite of focal plane detectors for the PLATO mission. For some missions (e.g., Gaia) the payload was entirely ESA-procured.

The science ground segment of the missions is in most cases procured under the shared responsibility of ESA and of the Member States, with ESA normally being responsible for the science operations and nationally funded consortia contributing to instrument-specific data processing and calibration activities. In some cases the scientific data processing is almost entirely performed by nationally funded consortia (e.g., Gaia through the Data Processing and Analysis Consortium).

Any of the above schemes can be proposed in response to the present Call. Proposers will have to clearly indicate the proposed share of responsibilities between ESA and the Member States (and eventual international partners), by indicating which mission elements they propose to be procured under their responsibility with funding from the Member States and which elements they propose to be ESA-procured. The proposal must therefore define a Lead Proposer (who shall be the formal point of contact between the Agency and the proposing team during the study phase for selected proposals), include a definition of the payload consortium or consortia (or core consortium) and provide the foreseen distribution of tasks and responsibilities within the consortium (in the “Management” section of the proposal).

Note that it is not planned to issue an “Announcement of Opportunity” for the payload of the missions selected for study. Hence (while susceptible of evolution if necessary) the consortium or consortia defined in the “Management” section of the proposal will be tasked with carrying out the study activities for selected proposals.

ESA intends to implement an enhanced consultation phase with Member State agencies (and if applicable, with international partners) after Proposals submission and prior to their evaluation. Letters of Endorsement from Member State agencies (and international partners, if applicable) will be required after the Proposals submission, according to the deadline indicated in Section 8.

Proposers are of course strongly recommended to interact with their funding agencies already at the beginning of the proposal phase to verify their readiness to support the

proposal.

The Letters of Endorsement will have to state the readiness of Member State agencies to undertake the necessary action to secure funding for the study (Phase B1, subject to the mission selection) and implementation (Phases B2/C/D/E/F, subject to the mission adoption) of the nationally provided mission elements falling under their responsibility, contingent on the consolidation of the cost figures for all nationally funded mission elements.

The Letters of Endorsement will have to be addressed to the ESA Director of Science, and sent directly by the Member State agencies by email to the address [endorsement-M5@cosmos.esa.int](mailto:endorsement-M5@cosmos.esa.int).

It is understood that commitments by funding agencies of the complete set of mission elements proposed to be nationally funded may not be achievable already at the time of the submission of the Letters of Endorsement. However, proposers must strive to demonstrate the funding and feasibility of the proposed payload complement by showing the presence of at least a “core consortium” (e.g., for astronomical telescopes with an integrated payload complement) or a “core payload complement” (e.g., for solar system missions featuring several individual instruments). It is understood that the funding scheme of the nationally provided mission elements may require consolidation during the study phase prior to the mission selection.

Assessment of the adequacy of the proposed consortium as demonstrated by its preliminary definition, including a distribution of tasks and responsibilities within the consortium supported by the submitted Letters of Endorsement will form an important part of the proposal’s technical and programmatic evaluation.

## **4 SCIENCE MANAGEMENT**

Proposers must clearly explain their science management concepts, including their proposed approach to data ownership, broad community involvement, and division of mission responsibilities between ESA, the Member States and the international partners (if applicable). Acceptance of a proposal does not constrain ESA to adhere to the proposed scheme, which will however constitute a starting point for the selected mission. For the selected mission a Science Management Plan will be prepared by ESA in coordination with a Science Study Team; this plan will undergo revision by the Science Advisory Structure of the ESA Science Programme and approval by the Science Programme Committee (SPC).

## **5 LETTERS OF INTENT AND BRIEFING TO PROPOSERS**

Prospective proposers must submit a mandatory Letter of Intent (LoI) by the deadline stated in Section 8. Proposals not preceded by a corresponding Letter of Intent will not be considered. LoIs are accepted exclusively in electronic form, in PDF format, using the interface available at <http://www.cosmos.esa.int/web/call-for-m5-missions>. LoIs will allow ESA to perform an initial assessment of the range of science themes that will be proposed, and to prepare for the evaluation process.

LoIs are limited in length to 4 A4 pages (minimum font size 11 pt), and must be structured to contain the following information:

- Proposal title;
- Name and contact information of Lead Proposer;
- Core team members (names and institutions) insofar as known/available;
- Scientific goals of mission;
- Possible mission configuration (including mission profile, payload/instrument configuration, technology, etc.);
- Potential payload consortium/consortia composition, and expected main funding agencies involved in the payload provision;
- Eventual (if applicable) proposed international collaboration elements for the mission.

LoIs may contain in attachment a list of supporters of the proposal; this attachment should be clearly marked as such, and will not be counted against the page limit.

It is understood that the proposal’s structure and content may evolve between submission of the LoI and submission of the actual proposal, e.g., in terms of technical configuration, payload consortia composition, or presence of possible international partners. The Lead Proposer and the proposal’s title identified in the LoI, however, must remain the same throughout the process.

LoIs will be made available by ESA to Member State agencies, SPC delegations and international partners (if applicable); hence ESA cannot guarantee their confidential treatment.

Any further communication between ESA and the proposing team will only take place through the Lead Proposer.

Failure to submit a LoI by the deadline stated in Section 8 will prevent teams/proposers from the possibility of submitting a proposal.

### **5.1 Briefing meeting**

Following the submission of LoIs, proposers will be invited to a briefing meeting, currently planned for the date and location stated in Section 8 (date and place may be subject to change). Confirmation of the date and of the logistic details for the briefing meeting will be communicated to the Lead Proposers indicated in the LoI.

## **6 PROPOSAL STRUCTURE, PAGE LIMITS AND SUBMISSION**

The deadline for submission of proposals in response to the present Call for missions is stated in Section 8. Late submissions will not be considered. Submission of proposals is accepted exclusively in electronic form, in PDF format, using the interface available at <http://www.cosmos.esa.int/web/call-for-m5-missions>. Proposals will be limited in length to 51 A4 pages (not including annexes), with a minimum font size of 11 pt, and a maximum file size of 100 Mbytes. Proposals with file size in excess of this limit will be rejected by the submission system.

The submission deadline will be implemented strictly. Proposers are invited to submit their proposals well in advance of the deadline.

Proposals must contain all the information indicated in Section 6.1. Proposals missing one or more of the indicated elements may fail the initial technical and programmatic screening. The suggested number of pages for each topic is indicative, unless otherwise stated. Proposers are thus free to give more relevance to one topic with respect to other ones. However, the total number of pages in the proposal is a hard limit; proposals exceeding the total page limit will not be considered for evaluation.

### **6.1 Topics to be covered in the proposal and page limits**

- Cover page (1 page, mandatory limit): must clearly indicate the proposal name and the name of the Lead Proposer. Any other information is optional;
- Contact information page (1 page, mandatory limit): must clearly indicate the contact information for the Lead Proposer. The proposal must explicitly state the availability of the Lead Proposer to support the study activities by making available at least 20% of his/her time throughout the study period. Note that the Lead Proposer will be the formal point of contact between the Agency and the proposing team throughout the study phase;
- Executive summary (2 pages, mandatory limit): should contain a summary of the proposal, allowing the reader to gain a preliminary understanding of the proposal’s content upon reading;
- Science case (10 pages, suggested length): should clearly address the scientific rationale for the proposed mission, explaining the broad context, the progress in the relevant field that the proposed mission will achieve, the need to perform the relevant measurements from space, the eventual synergy with other facilities (ground- and space-based), etc. It is suggested to assume that the relevant readers will be scientists from other fields of space science, hence not necessarily experts in the field;
- Scientific requirements (5 pages, suggested length): should explain how mission science objectives flow into scientific requirements, what are the required measurements, and how these translate into instrument requirements. For the selected mission the information provided in this section will constitute the starting point for producing the Science Requirements Document, the Mission Requirements Document and the Payload Definition Document. Content of this section should be understandable by both scientists and engineers;
- Proposed scientific instruments (15 pages, suggested length): should explain, following on the definition of scientific requirements, what instrument(s) will be needed to achieve the required measurements. While the proposal is not intended to contain engineering blueprints, the information provided should allow readers to assess feasibility and maturity level of the proposed instruments. Relevant information about, e.g., TRL, heritage, etc. needs to be provided. To allow a proper technical evaluation of the proposal the following information needs to be provided:
  - Measurement principle/detection concept;
  - Block diagram: main building-blocks and subsystems, including software;
  - Design description (down to major subsystems) and operating principle;
  - Performance budgets;
  - Required resources: volume, mass, power, data transmission;

- Specific/critical interface requirements to the spacecraft and environment constraints, e.g. accommodation, integration, cooling, pointing, contamination and cleanliness, radiations, magnetic cleanliness, etc.
  - Specific calibration needs (on ground and in orbit);
  - TRL assessment per unit and relevant heritage;
- Proposed mission configuration and profile (10 pages, suggested length): it should contain a description of the proposed mission needs, including the orbit, launch, etc., together with the system level requirements imposed by the mission concept (e.g., pointing requirements, sun aspect angle constraints, specific observing modes, etc.). Relevant options and trade-offs should be identified. A concept for the operations should be provided, describing the mission phases from launch to end of life (e.g., as relevant: observing strategy, measurement sequence, specific modes for science or calibration aspects, spacecraft disposal at end of life, etc.). Details of the spacecraft should be provided as far as available, including possible spacecraft design, requirements/description of major sub-systems and estimation of spacecraft key budgets (possibly by benchmarking with previous missions). Proposers may make reference to the mission profiles described in the Annex to the present Call or deviate from them, by providing necessary elements for enabling the proposal assessment;
  - Management scheme (5 pages, suggested length): proposers should spell out the proposed procurement scheme for all mission elements, indicating which elements are proposed to be ESA-procured and which procured by nationally funded consortia or international partners (if applicable). The consortia organisation and the distribution of tasks and responsibilities (work breakdown structure for the core team with key persons) should be detailed, for both the Phase A and subsequent phases. The proposers are also invited to detail where relevant any specific task they believe should be achieved during the Phase A, in addition to the regular Phase A study activities, for the purpose of the mission selection. Should the mission be proposed as an international collaboration, the proposed collaboration scheme should be described in this section. Proposers should describe the proposed science management plan (data policy, community involvement, etc.) – see Section 4;
  - Costing (2 pages, suggested length): while proposers are not expected to provide detailed costing information about the proposed mission, they should argue convincingly that it can be implemented within the M5 ESA CaC ceiling (see Section 2.1), in particular if the proposed mission is deviating from the guidelines provided in the Annex to the present Call;
  - Bibliography: not required but encouraged. The list of references can be included as an Annex; it will not count against the page limits.

An eventual list of supporters should be clearly marked as proposal Annex, and will not count against the proposal page limits.

As mentioned above, Letters of Endorsement from Member State agencies or from eventual international partner agencies are not required at the time of the submission of the Proposal. They are mandatory by the deadline stated in Section 8.

ESA will share the proposals with Member State agencies and with SPC delegations, e.g., for the purpose of discussing their commitment, as well as, when applicable, with the proposed international partners. ESA cannot therefore ensure the confidentiality of the

submitted material.

## **7 PROPOSAL EVALUATION AND FURTHER STEPS**

Valid proposals (i.e., received by the deadline indicated in Section 8 and supported by Letters of Endorsement from Member State agencies as indicated in Section 3) will be subject to a strict technical and programmatic screening by ESA, aiming at ascertaining the compatibility of the proposed mission with the Call’s boundary conditions.

Proposals which will be found to be incompatible with the Call’s programmatic boundaries (i.e., within the budget ceiling indicated in Section 2.1, or within the planned schedule), or which do not provide the required endorsement for the mission elements proposed to be nationally provided (or provided by international partners) will be marked as “unfeasible” and will not be subject to the scientific peer review.

Proposals that are considered feasible will be submitted to a scientific peer review process conducted under the responsibility of the Science Advisory Structure to the Science Programme. Based on this evaluation, the ESA Director of Science plans to select up to three proposals for a study phase.

A written debriefing will be provided to all proposers, comprising in all cases a short technical and programmatic assessment of the proposal, as well as, for the proposals which were submitted to the scientific peer review, a scientific evaluation. No face-to-face debriefing meetings are planned.

The proposals selected for a study phase will be first subject to a Phase 0 study (as done for previous Calls and using ESA Concurrent Design Facilities) by involving the payload consortia in the preliminary definition of the mission concept and requirements. Following the Phase 0, and assuming no showstopper is identified, Phase A studies will be initiated for the mission candidates, at the end of which each mission candidate will undergo a dedicated independent “Mission Selection Review”, for evaluating the technical and programmatic status of the mission (including the science payload). Following this review, the candidate missions that are compatible with the Agency requirements for the M5 mission will be subject to a peer scientific review involving the ESA Science Advisory Structure. Based on the recommendations from the Science Advisory Structure, the Director of Science will propose to the SPC to select one mission candidate for the Definition Phase (Phase B1). Activities for the non-selected mission candidates will be terminated.

To ensure a definition of the payload at the same level with the definition of the rest of the space segment, enabling a solid and well-informed decision at the end of the Phase A, the Agency is ready to fund the study of nationally-provided mission elements (e.g., scientific instruments) for the mission candidates that will be selected through the present M5 call, in close cooperation and in coordination with the Member States that will fund the same mission elements for the next phases (Phase B and following), should the mission be selected for the M5 opportunity. The Phase A study approach will be discussed with the consortia during the Phase 0 (once the payload preliminary concept is sufficiently well established for the selected proposals) with the details possibly depending on the characteristics of the proposal.



## 8 DEADLINES AND SCHEDULE

Activity	Date
Release of Call for M5 mission	April 29, 2016
Letter of Intent submission deadline	June 6, 2016, 12:00 (noon) CEST
Briefing meeting (ESTEC)	June 24, 2016 (TBC)
Proposal submission deadline	October 5, 2016, 12:00 (noon) CEST
Letters of Endorsement deadline	February 8, 2017, 12:00 (noon) CET
Selection of missions for study	June 2017
Phase 0 completed	November 2017
Phase A kick-off	January 2018
Mission selection	November 2019
Mission adoption	November 2021

## 9 BACKGROUND INFORMATION

The definition of the space missions in the Science Programme is based on competitive “Calls for Missions”. Through this approach, Solar Orbiter and Euclid were selected in 2011 as the first and second Medium missions (M1 and M2), followed by JUICE, selected in 2012 as the first Large mission (L1) in the Cosmic Vision plan. CHEOPS was selected in 2012 as the first Small mission (S1) and PLATO in 2014 for the M3 opportunity. Through a “Call for White Papers” the science themes for the L2 and L3 launch opportunities were selected in 2013: “The hot and energetic Universe” science theme, to be pursued by implementing a large collecting area X-ray observatory, and “The gravitational Universe” science theme, to be pursued by implementing a gravitational wave observatory, with planned launch dates of 2028 and 2034, respectively. The ATHENA mission was then selected in 2014 for the L2 mission opportunity. The call for the implementation of the “M4” Medium mission resulted in 2015 in the selection of ARIEL, THOR and XIPE mission concepts for study, with a planned down selection for the M4 opportunity in 2017. Finally, SMILE was selected in 2015 as a joint science mission between ESA and the Chinese Academy of Science.

In February 2016 a Call was issued to solicit from the broad scientific community proposals for the competitive selection of new “Science Ideas”, to be investigated in terms of feasibility and needed technology developments. The Call is not intended to replace future Calls for M or L missions, but aims at stimulating the emergence of new and innovative science ideas based on technologies not yet sufficiently mature, possibly to become potential candidates for future M or L mission Calls in the ESA Science Programme.