



AMADEE-24

Announcement of Opportunity



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Public



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Between 15Apr-15May2024 (tbd), the Austrian Space Forum will conduct its next major international analog mission in a Mars-like desert, eg in the Northern Sahara (to be confirmed). The expedition will be carried out in a Martian terrestrial analog and directed by a dedicated Mission Support Center in Austria. A small field crew of highly trained analog astronauts with spacesuit simulators will conduct experiments preparing for future human and robotic Mars exploration missions.

The Austrian Space Forum invites the scientific community to submit experiment proposals in the fields of geosciences, engineering & robotics, planetary surface operations, and life sciences including astrobiology, human factors in a 2-stage call.

Submission deadline stage 1	Draft summary proposal 30Oct2022, 23:59 CEST , sent via email to the Austrian Space Forum via Email
	The experiment selection team will decide upon the first submissions and notify all applicants until 06Nov2022
Submission deadline stage 2	Full proposal to be submitted no later than: 06Dec2022, 23:59 CET to the Austrian Space Forum
	Final selected/not selected decision communicated until 30Dec2022

This AO contains the following sections:

1. AMADEE-24 Aims
2. Mission Architecture
3. Exploration Cascade
4. Administrative Aspects
5. Format for Experiment Proposals
6. A-24 Compliance Form



AMADEE-24 aims

Simulating Mars Human-robotic surface activities in terrestrial analogs has evolved into an efficient tool for developing exploration mission architectures. They facilitate to understand the advantages and limitations of future Human planetary missions, becoming an added value for the development of remote science operations, helping to understand the constraints and opportunities of the technology and workflows.

The test sites will be selected for their geological and topographic similarity to Mars. The AMADEE-24 mission presents an excellent opportunity to:

- Study equipment behaviour involving the simultaneous usage of instruments with the option of humans-in-the-loop (via two high-fidelity spacesuit simulators, portable system, etc.)
- The development of platforms for testing life-detection or geoscience techniques, robotic support tools for human missions and concepts for high situational awareness of remote support teams.
- Studying the analog as a model region for their Martian counterparts.
- Serving as a catalyst to increase the visibility of planetary sciences and human exploration.
- Evolving the know-how of managing human mission to Mars deploying a realistic model for Mission Support center – Astronaut actions and the encompassing decision making framework.

The AMADEE-24 mission architecture

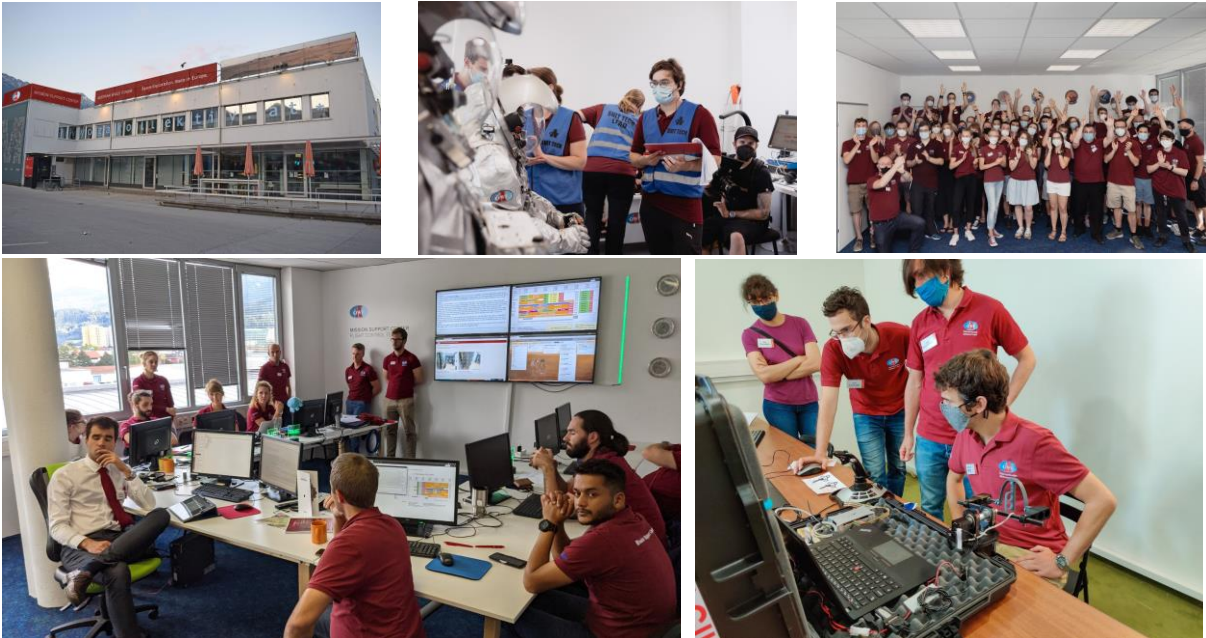
The location of the AMADEE-24 field segment is yet under negotiation. Current candidate countries include Egypt and other countries with desert systems relevant to future human-robotic Mars missions. The site selection will be based upon a thorough site assessment, including logistics and safety parameters, a regional geographical analysis as well as soil/sand sampling.

This entails a preliminary pilot analysis comparable to what can be expected from precursor missions pertinent to future crewed expeditions, including remote sensing data (and derived GIS data products) and environmental conditions.



Mission Support Center (MSC)

The A-24 expedition is comprised of the “ground segment”, a Mission Support Center, operated by flight controllers, healthcare professionals, engineers and a ground support team, as well as the “space segment”, operated by a six-person “flight crew”. The flight crew is supported by the “Ground Operations and Support Team” (GOST), responsible for safety and security, as well as technical/logistical support.



Impressions from the Mission Support Center in Innsbruck/Austria, during a prior crew training and 2020 Dress Rehearsals

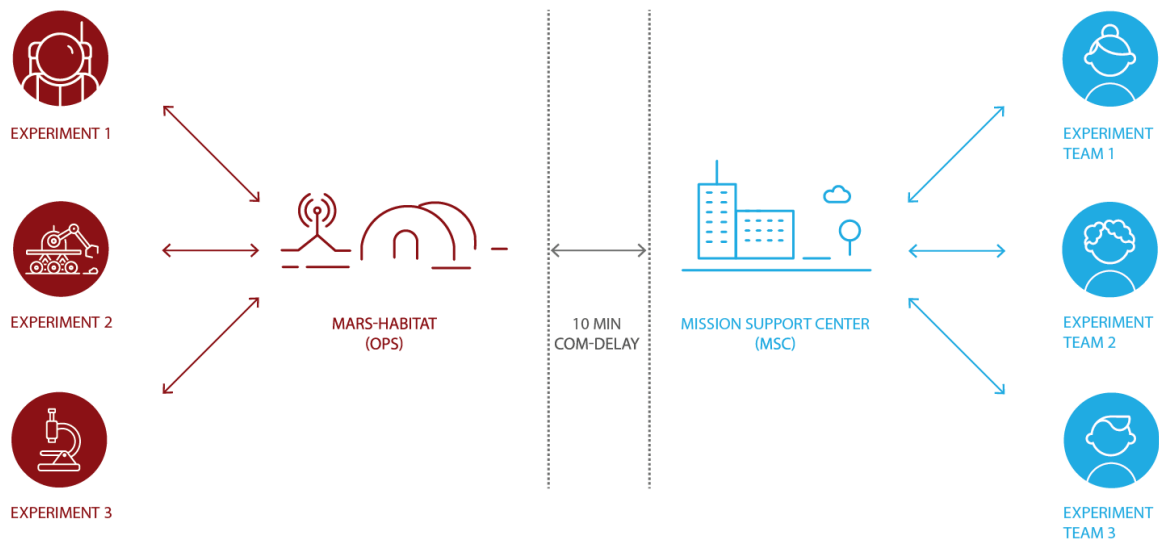
Field habitat

In the Northern Sahara itself, the host country will provide a habitat to accommodate a six-person crew for the duration of one month. The crew will follow a carefully designed Flight Plan, monitored by a dedicated Flight Control Team at the MSC. They will live in the habitat in isolation and conduct suited extra-vehicular activities (EVA). The habitat will host the experiment hardware, living quarters, power, limited electronics and mechanical workshop capabilities.



Impressions from the Habitats of two prior missions, at the Dhofar Desert/Sultanate of Oman (2018, above) as well as the Negev Desert/Israel in 2020 (below).





Conceptual architecture of the AMADEE-24 expedition: A 10min time delay reflects the signal travel time between Earth and Mars. The Mission Support Center in Austria is the single-line-of-contact between “Earth” and “Mars”.

Bridgehead phase (days 01-05)

During the initial preparatory activities and the establishment of an operational base camp as well the local infrastructure in-situ, this period offers an opportunity for guest researchers to be present on site on a case-to-case base. Instruments which cannot be operated by the OeWF field crew (e.g. due to the experiment sensitivity, operator training requirements etc.) may be operated by the researchers in the field. Selected pilot & calibration measurements may be conducted.

Media & Access phase (days 06-09)

Experiment teams can continue to work in the field, however, with media interactions – there is a significant media echo to be expected.

Isolation phase (days 10-25)

After the preparatory phase, research teams leave the site, the Mission Support Center (MSC) in Austria will now direct the crew limited to six crewmembers who will conduct experiments according to a flight plan. The analog astronauts are supported by the GOST team, performing activities necessary for the simulation, but not available on Mars (e.g. Safety, managing local W-LAN infrastructure etc). GOST will not directly interact with the analog astronauts. A 10 minutes time-delay between “Earth” and “Mars” mimics the signal travel time between Earth and Mars.

The following infrastructure will be available:

- General logistics (housing @ GOST station, water/food/medical care, basic hygiene, security)
- Broadband internet access and 230V/50Hz electrical power
- A basic mechanical and electrical workshop (including 3d-printer) & basic mobility (tbc)
- Remote Science Support team (Mission Support Center, Austria)

Timeline & Selection process

Oct2022	Original Announcement of Opportunity released
Feb2023	AMADEE-24 Science Definition Workshop
May2023	Experiment interactions defined & preliminary mission definition
31Aug-03Sep2023	A-24 Dress Rehearsal I (in Peuerbach near Linz, Austria)
08-10Dec2023	A-24 Dress Rehearsal II (in Vienna/Austria, tbd) & Experiment readiness review
09-11Feb2024	A-24 Dress Rehearsal III (in Vienna/Austria, tbd), followed by a hardware freeze
Mar2024	Shipment to Test site
15Apr-15May2024	Field Mission
Jun2024	Return of hardware to Austria, shipping back to home institutions
Sep2024 (tbd)	AMADEE-24 Science Workshop (location tbd)

Experiment selection process

The Austrian Space Forum encourages potential Principal Investigators to contact the AMADEE-24 leadership before submitting a proposal to discuss opportunities and challenges to the experiment.

1. The submissions of stage-1 proposals **MUST** reach the Austrian Space Forum no later than **30Oct2022, 23:59 CET** in electronic form. This draft submission serves as the baseline for a preliminary selection or de-selection.
 - a. This stage-1 proposal shall contain
 - i. Name, affiliation and contact coordinates of the principal investigator
 - ii. a <500 word description of the scientific or engineering proposal
 - b. Applicants will be informed no later than 06Nov2022 on the selection results. If successful, they will have one month writing time for the main (stage-2) proposal.
2. **The main stage-2 proposal must reach the OeWF 06Dec2022, 23:59 CET. There will be no exceptions.**
3. All stage-2 proposals will undergo a peer-review process following these criteria:
 - Scientific, technical or operational merits. The experiment selection committee may contact PI's for a clarification teleconference during stage-2 selection.
 - Detailed plan of the research that clearly states that:
 - Feasibility of the proposed project, including the potential for data fusion with other experiments and alignment with the aims of the OeWF research program.
 - Experiment needs versus resources available, ability to assess and mitigate programmatic, engineering and safety risks (“*Can it work reliably and safe?*”)
 - Ability to process, analyze, share and publish the experiment data in a timely manner, as indicated in the project timeline.
4. The experiments will have to be self-funded, but the scientific and logistics infrastructure will be provided by the Austrian Space Forum. Also, the option for tele-operated experiments is available. Based upon the joint decision of the AMADEE-20 Science Workshop in 2022, the Austrian Space Forum will be invoicing every experiment a charge of EUR 1.100,00 EUR (incl. VAT) to be payed after the selection of the experiment no later than 15Feb2023. (This fee has been introduced to corroborate the PI's commitment to his/her proposal. The OeWF reserves that sum to support the experiment inclusion and PI team onboarding. If the experiment should drop out of the A-24 manifest, the fee is non-reimbursable.)

5. Depending on the outcome of the selection board's recommendations (expected: 30Dec2022), experiments will either be selected "as is", "with a request for modifications" (where the Principal Investigator has still the option to decline), or "not selected".

Acknowledging the short timeframe for submitting and processing proposals to national funding institutions, experiments can also be submitted as "subject to funding decisions". In this case, the OeWF and the principal investigator will agree on a deadline (ca July 2023) at which the funding decision will have to be consolidated to continue the experiment in the AMADEE-24 framework.

Exploration Cascade

The AMADEE-24 expedition will focus on the interplay of the respective instruments and experiments relevant for human-robotic Mars missions. Based upon the research question of how to identify biomarkers, which in turn is traditionally based upon the characterization of the (paleo-)geoscientific environment, the experiments will be selected to reflect a realistic sequence of activities.

This strategy is based upon the "exploration cascade", an algorithm defining an efficient deployment sequence, providing the framework for the question: *"which instrument needs to be active where and when, leading to what kind of data sets, leading to what kind of knowledge, leading to which type of input for the tactical flight planning"*

As suggested by Neveu et al. (2018) life-detection measurements must be sensitive, contamination-free regarding the absence of interfering signals, and reproducible; one or more features must be detectable, preserved, reliable, and compatible with life on Earth. Experiments will be scheduled according to a flight plan defining the resources, location and timing as well as considering the processing pipeline between data acquisition in the field, data transfer and integrity checks and the subsequent near-real time interpretation to formulate a hypothesis. This then translates into a scientific input into the tactical flight planning for the field crew.



For details we refer to the academic thesis of Stefanie Garnitschnig from 2018 on the Exploration Cascade (available via www.oewf.org → Research → Academic theses).

Engineering experiments: Robotics, operations research and material science

Besides the search for life and the preceding characterization of the (sub)surface and aeolian environment, robotic elements such as copters, rovers or human-operated tools are considered as an enabler to perform the science. Therefore, robotic experiments are selected according to their enabling potential (such as mapping, carrying an instrument or rock sample), and not on their engineering maturity or engineering demonstration alone.

Hence, proposals capable of demonstrating the following are preferred:

- **Fast turn-around times for a first data processing** leading to hypothesis building (Good example: In-situ Raman spectroscopy vs (Bad:) multi-month laboratory analysis back on “Earth”; or (Good:) near-real time robotic terrain mapping vs (Bad:) post-mission 3d-data generation).
- **Ability to provide input into hypothesis forming** (Good example: identifying water layers within 48 hrs of receiving georadar data triggering a subsurface sampling experiment vs (Bad:) stand-alone tech-demonstration of a new instrument measuring local UV-radiation).
- **Experiments that cooperate with other experiments**, where data synergies allow for additional research questions to be addressed, or to cross-validate a hypothesis. (Good example: mineralogical spectrometry verifying hydrated minerals previously identified by orbital hyperspectral imaging vs. (Bad:) isolated measurement of a rock weathering).

Human factors: Medical & Psychological Research

AMADEE-24 also allows for human factors experiments utilizing the crew (and potentially also the GOST and MSC team members as comparison group). However, ethics commission approval must be obtained before a final acceptance can be provided, by no later than July 2023. As astronaut time is a very limited resource during missions, there needs to be a careful balance between crew time usage and expected scientific output.

This does not apply to man-in-the-loop experiments where the focus is purely engineering-oriented. The Medical Team of the Austrian Space Forum might require ethics commission approval.

If you are unsure, if your experiment might fit into the exploration cascade or has a high potential w.r.t. human factors research, feel free to contact the Austrian Space Forum.

Useful references

- Groemer, G. et al. (2016): The AMADEE-15 Mars Simulation, Acta Astronautica, Vol 129, pp 277–290
- Zanardini, L. et al. (2018): Training for Analog Mars Simulations, Proc. of the 2018 SpaceOps Conference, 28 May - 1 June 2018, 2018, Marseille, France. 10.2514/6.2018-2449
- Neveu, M. et al. (2018): The Ladder of Life Detection. In: Astrobiology. DOI: 10.1089/ast.2017.1773
- Garnitschnig, S. (2018): Development of a supportive method for the detection of biomarkers during future human-robotic Mars missions, BSc thesis, University of Innsbruck.
- Sejkora, N., et al. (2018): Geodata workflow for the AMADEE-18 Mars analog mission, In EPSC Abstracts Vol. 12, EPSC2018-442, European Planetary Science Congress 2018
- Groemer, G. et al. (2018): AMADEE-18 Mission Report, online at: <https://oewf.org/en/download/14445/>

Administrative aspects

Media activities

A major global media attention is expected for the mission, as it was the case in previous simulations. The Austrian Space Forum as project owner will coordinate and manage all media activities to ensure a professional media campaign.



Experiment funding

Experiments must be self-funded, including the development of the hardware, documentation, transport of hardware and personnel to and from Austria. The hardware transfer between Innsbruck to the test site and back to Austria will be organized and funded by the OeWF. For experiment-specific personnel participating in the field, the expenses for infrastructure and consumables will be distributed amongst the experiments. (Ca. € 300-500 /field person-week, tbd).



Legal Disclaimer

Although very unlikely, the Austrian Space Forum reserves the right to cancel the field mission. Hence, teams submitting a research proposal do so at their own discretion, expenses, and risks without guarantee of success.

Next steps after selection

Upon selection, representatives of the OeWF Remote Science Support and the Flight Planning team will get in touch with the experiments' Principal Investigators, discussing the experiment implementation, training requirements for the field crews, logistics, bandwidth and power topics, as well as experiment specific hazards and risks. These deliberations lead to the creation of the Standard Experiment Information Form (to be compiled by the PI) which is the basis for the operational and contingency procedures.



Format for stage-1 experiment proposals

Title, Summary & Contact details	An informative title such that by reading the title a person can understand the goal of the proposed investigation; plus a one-word name or acronym for the proposal and your contact details	Cover page
Scientific and/or technical description	<p>A description of the experiment should follow the standard outline of a scientific proposal:</p> <ul style="list-style-type: none"> • Research rationale for your experiment. • Scientific, engineering, or operational hypothesis (articulate a testable statement, hypothesis or research question), including a suggested methodology and expected results • Supporting photos/graphics/sketches at your discretion 	≤ 500 words

The stage-1 proposal shall be sent as a pdf-file Austrian Space Forum (amadee24@oewf.org) no later than **30Oct2022, 23:59 CET**. A confirmation will be sent, triggering the review process.

Format for stage-2 experiment proposals

Title, Summary & Contact details	An informative title such that by reading the title a person can understand the goal of the proposed investigation; plus a one-word name or acronym for the proposal.	Cover page ≤ 1 page
	The full contact coordinates of the proposing team (name, affiliation, postal address, email, telephone).	
Expertise	A brief outline of the expertise that each investigator will contribute to the proposed investigation.	one paragraph per person
A-24 Compliance form	Signed checklist for experiment submissions, stating your ability and willingness to comply with mission requirements	1-page form, signed
Scientific description	<p>A detailed description of the experiment should follow the standard outline of a scientific proposal:</p> <ul style="list-style-type: none"> • Research rationale: why it is important to perform your experiment, including a brief literature review. • Scientific, engineering or operational hypothesis (articulate a testable statement, hypothesis or research question), including a suggested methodology and expected results • What kind of experiment hypothesis can be expected in near real-time (<24h) to be used by the flight planning team? • A publication plan (likely choice of journals or conferences) 	≤3 pages

This part of the proposal is to demonstrate that the proposed work is scientifically/technically sound and feasible.

<p>Technical and logistics description</p>	<p>The scientific, technical and management implementation description, including instrument heritage and maturity, where applicable. This section should include:</p> <ul style="list-style-type: none"> • Duration of experiment in the field (e.g. 10 x 2 hrs total), analog astronaut time requested (projected training and actual test time) • Power requirements (if >100 W: e.g. 1500 W, 4 hrs per day) Communication (if >500 kB/s: for how long/day?) • Do you have any other special needs? (e.g. legal/IPR issues, ITAR-restrictions, ethics approval required, special frequency licenses needed, safety-relevant information (eg such as explosives or hazardous chemicals), etc.) 	<p>≤ 3 pages</p>
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The stage-2 proposal shall be sent as a pdf-file to amadee24@oewf.org no later **06Dec2022, 23:59 CET**. A confirmation will be sent, triggering the review process.

Once selected, each experiment will receive a formal confirmation (eg for submitting project funding proposals). In parallel the PI will receive a EUR 1.100,00 invoice payable until 15Feb2023. Only if the charge is paid, the experiment will continue to be on the experiment manifest.

Contact

Austrian Space Forum / Spacesuit Laboratory

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(Photo credits for this AO: Florian Voggeneder, Paul Santek, Gernot Groemer)



A-24 Stage-2 proposals compliance form

We kindly ask you to carefully check each item before submission and then confirm by signature. You can copy-paste this form and include it in the proposal-pdf.

	Compliance item	Signature of PI
1	Our research team is able fulfill the requirements put forward in this Announcement of Opportunity, including a strict commitment to deadlines and required documentation. We are aware, that failure to do so (including no payment of the experiment charge), might result in a removal from the list of experiments for the AMADEE-24 expedition.	SIGNATURE
2	We are committed to have at least one team member physically present at the Mission Support Center Austria for the duration of the mission.	SIGNATURE
3	We are open to sharing data for data fusion and joint experiments on a case-to-case basis. We do understand the importance of the Exploration Cascade as a tool to synergize between experiments and the operational workflows and agree for our data to be used in this context.	SIGNATURE
4	We can cover the funding for our experiment (including the experiment charge), to deliver the experiment hardware in time to and from Austria, including documentation and customs clearances. We can also cover the travel and accommodation costs for our team members to be present in Austria. If we rely on an external funding agency, we shall commit to a deadline, at which the experiment funding is secured, or the experiment will automatically be withdrawn.	SIGNATURE
5	We are committed to participate in the preparatory teleconferences and training workshops as well as at least 2 out of 3 Dress Rehearsals. Also, we are committed to participate in the post-mission science workshop in 2024.	SIGNATURE
6	Our research team is willing and able to process, analyze and publish the results of our experiment within six months after the end of the field campaign.	SIGNATURE
7	Our team is willing to proactively participate in the media activities of the AMADEE-24 mission, adhere to the mission-wide media rules and milestones, including social media.	SIGNATURE