Joint DLR / ESA

Focussed Research Announcement for ISS Flight Experiments

Soliciting for proposals for

Research under spaceflight conditions utilising live fluorescent microscopic imaging (ISS FLUMIAS Microscope)

ISS-FLUMIAS- 2020

Issued - 4th February 2020

(updated 20th April for extension of deadline)

Deadline for submission of Letter of Intent (non-binding) – 3rd March 2020

Proposer workshop at ESA-ESTEC – 18th March 2020

Deadline for submission of Proposals – 20th May 2020
1 INTRODUCTION AND BACKGROUND

The European Space Agency (ESA) “Science in Space Environment” (SciSpacE) element, part of ESA’s overall European Exploration Envelope (E3P) programme, includes scientific activities on research platforms such as ground-based space analogues (e.g. bedrest studies, research on Antarctic stations, radiation facilities, drop tower, sounding rockets, parabolic flights), as well as an ambitious research programme on-board the International Space Station (ISS).

The SciSpacE programme activities cover science in the domains of Human Research, Biology (including Astrobiology) and Physical Sciences, with an emphasis on scientific excellence, space research- and exploration-relevance, innovation and timely delivery. Its research results will advance Europe’s knowledge base, support its economy and help prepare future human and robotic space exploration. In addition to gaining fundamental knowledge, the research carried out within ESA’s SciSpacE programme is helping to deliver solutions to problems back on Earth, e.g. developing innovative materials to manufacture products, removing pollutants from water, improving engine efficiency, testing new medical techniques and support equipment for the elderly and disabled.

In addition to the Continuously Open Research Announcements (CORA) for ground and selected flight platforms, ESA periodically issues Research Announcements which address specific topics of high scientific and programme priority and/or specific flight opportunities.

The Deutsches Zentrum für Luft- und Raumfahrt (DLR, German Aerospace Centre) supports life and physical sciences research by German led science teams using platforms available through national ground and flight platforms as well as ESA’s E3P / SciSpacE programme. The research topics of the DLR life and physical sciences programme are similar to those of ESA’s SciSpacE programme. In life sciences this includes fundamental biology, biotechnology, health research and enabling exploration.

This document provides an overview on the joint DLR/ESA research opportunity offered within this Focussed Research Announcement as well as on the sequence of events starting from submission of the research proposal to selection and implementation of successful proposals.

2 OBJECTIVE OF THIS OPPORTUNITY

The objective of this Research Announcement is to solicit for experiment proposals making use of live fluorescent microscopic imaging, using the ISS FLUMIAS microscope system. Research topics should address one or more of the SciSpacE element roadmap objectives (see below) and have a clear need for the spaceflight environment provided by the ISS.
The overall goals of the SciSpacE Programme until 2024 are defined in scientific roadmaps which were elaborated with the research community. The roadmaps are described in detail in a document which can be found at the following link:

http://esamultimedia.esa.int/docs/HRE/SciSpacE_Roadmaps.pdf

An overview of the SciSpacE Roadmap themes are given in the figure below;

In Biology research there are three roadmaps, which have several specific themes and objectives;

- **Astrobiology**
  - Understanding the origins of life
  - Understanding habitability and the limits of life
  - Understanding the signs of life
- **Biology in altered gravity environments**
  - How are cell structure and function influenced by the gravity perception mechanisms?
  - How do gravity alterations affect animal and human systems at a cellular tissue level?
  - How are plants affected by altered gravity, either as a stand-alone factor or in combination with other factors within the space environment?
  - Microbiology and Microbiome
How to obtain an integrated picture of the molecular networks involved in adaptation to microgravity in different biological systems?

- Life Support
  - Understanding the effects of cultivation, environmental and spaceflight factors on fundamental micro-organisms and higher plant processes
  - Studying and optimising each module of closed ecological life support system (CELSS)
  - Integration of all sub-systems of the CELSS

The detailed objectives for each roadmap theme are described in the SciSpacE Roadmap document. In addition the cosmic radiation risks roadmap has a number of topics which can be addressed by biological experiments. Furthermore, some aspects of the human research roadmaps may be addressed with biological studies (cell or organ cultures, animal models).

It is anticipated that this Announcement of Opportunity would primarily be of interest for biological research, although other research domains identified (e.g. complex fluids) will be considered in scope if compatible with the capabilities of the instrument.

3 RESEARCH PLATFORMS AND FACILITIES TARGETED WITH THIS OPPORTUNITY

A significant limitation for biological research on-board ISS up to now has been the lack of a readily available fluorescence microscopy for live cell imaging in combination with artificial gravity (centrifuge). Therefore, the availability of the ISS FLUMIAS microscope on board will enable studies of biological processes in live cell systems under altered gravity environments.

It is currently anticipated that ISS FLUMIAS will be available as of 2022. ISS FLUMIAS is developed by DLR and will be jointly utilised by ESA and DLR.

This Announcement of Opportunity (AO) specifically addresses research using the ISS FLUMIAS microscope. Therefore, proposed experiments submitted to this AO should have requirements and protocols which are compatible with the ISS FLUMIAS instrument and the operating concept within the constraints of the ISS platform. The specific characteristics of the ISS FLUMIAS microscope are described in detail below.

Note: Proposals for other research topics and facilities are considered out of scope for this announcement and should be directed to other appropriate research announcements on the ESA Human Spaceflight research portal.
3.1 ISS FLUMIAS Microscope Overview

ISS FLUMIAS is a German Aerospace Center (DLR) developed 3-D structured illumination fluorescence microscope which can be used for live cell imaging aboard the ISS at g-levels varying between microgravity and 1g through use of an integrated centrifuge. Structured illumination fluorescence microscopy provides equivalent capabilities to fluorescence confocal microscopy. Therefore, this imaging technique can be used for live cell imaging of cells, cellular components, tissue segments (e.g. seedling roots) and small organisms with associated fluorescence techniques (e.g. Green Fluorescent Protein, chemical fluorescent probes, Fluorescence Resonance Energy Transfer for protein-protein interactions etc). Furthermore, optical sections can be used to reconstruct 3D structure. The imaging technique and specific details are described in further detail below.

ISS FLUMIAS is a direct successor of previous DLR flight instrument developments. These include a parabolic flight instrument flown in 2014, 2016 and 2018, a sounding rocket instrument flown in 2015 and 2018 employing the Nipkow spinning-disk technique and an extremely compact technology demonstrator flown on board ISS in 2018 using the structural illumination technique. Results from studies with these instruments can be found in the publication list below.

3.2. ISS FLUMIAS microscope capabilities

The ISS FLUMIAS microscope imaging system uses 3D Structured Illumination Microscopy (3D-Sim). Confocal-like and potentially resolution-enhanced images are obtained by recording a set of phase images acquired at different grid-positions projected onto the sample. ISS FLUMIAS uses a hexagonal grid pattern, which is applied in a slit-confocal manner, thus suppressing out-of-focus light and, in turn, increasing tissue penetration and increasing signal to noise performance. In contrast to previous SIM-concepts, the hexagonal pattern is shifted in a single direction only, thus, making grid-rotation obsolete and allowing a very compact microscope design. The basic optical design of 3D-Sim microscopy is described in the Figure 3-1 below;
The specific capabilities of the ISS FLUMIAs microscope are the following:

- **Lateral resolution**: 350 nm (for a 40x 0.95 NA objective and an excitation wavelength of 488 nm)
- **Axial resolution**: <1.5 μm
- **Z-Stack acquisition for 3D-image reconstruction**
  - Imaging area 330 x 330 μm
  - Imaging depth +/-10 μm
- **Four excitation wavelengths**: 405 / 488 / 561 / 640 nm
- **Emission wavelength bands** are fixed by a multiband filter cutting off the excitation wavelengths
- **Temporal resolution for image recording**: 24 fps (raw images).
- **Sectioned image**: 300 ms/full frame @ 14 bit, higher frame rates possible at reduced field of view or resolution.

The microscope is mounted on a centrifuge platform which will provide accelerations at the level of the sample between microgravity and 1.0 g depending on the rotational speed. The outer diameter of the centrifuge is 520 mm and the experiment samples are positioned at a radius of approximately 151 mm. Therefore, a rotational speed of 77 rpm will yield 1 g acceleration. The rotation rate can be set in 0.01 increments of g-level (See Figure 3-2)
3.3. ISS FLUMIAS Experiment Blocks

Experiment blocks (EBs) will contain a dedicated life support system for the biological sample, including temperature control, a medium resupply volume and an internal gas volume (see Figure 3-5). In addition, each EB will include a microscope front-end consisting of an objective lens interfacing with the rest of the microscope optical chain. An integrated x-y-z-stage will allow the selection of the field of view (scan range: x: 32 mm, y: 8 mm) and a focusing-exursion $\partial z = 200 \mu m$ (x-y-z stage is visible in Figure 3-6).

Up to six EBs will be housed in the magazine (see Figure 3-2). The pre-programmed experiment run will be started by transferring one EB at a time from the magazine to the centrifuge rotor. Only after the EB has been returned to the magazine, another EB can be transferred via the transfer mechanism to the microscope on the centrifuge rotor.

Currently two multi-user EB block designs are in development, one for mammalian cell cultures (EB-C) and one for small plant seedlings (EB-P).

The mammalian cell culture EB (EB-C) will contain a micro-channel slide (Figure 3-3) connected to a fluidic system with 4 separate tanks (illustrated in Figure 3-4). During centrifugation, the acceleration force will press the cells onto the cover slip facing the objective like in an inverted microscope. One tank will provide up to 100ml of fluid (e.g. culture medium); the other three will provide 5ml (e.g. for growth factors, activators or dyes).

The plant EB-P will consist of a cultivation chamber providing atmosphere, light, humidity and substrate for growing small plants. The chamber is positioned such that roots and shoots grow in parallel or can be observed perpendicular to the direction of acceleration upon centrifugation (see Figure 3-8).

All EBs will be prepared and loaded pre-flight and remain sealed throughout the mission. While these two EB types are expected to be used for initial ISS FLUMIAS campaigns, dedicated EBs may be developed based on specific experiment requirements with the caveat that these need to be compatible with the ISS FLUMIAS interface and operational concept.

Details of the current EB designs as well as the overall instrument design can be found in the following diagrams.
Figure 3-2: View on the Facility with removed Front Panel and Side Wall; left: magazine for up to 6 EBs; center and right: rotating platform with one transferred EB (not visible), microscope and motor drive
Figure 3-3: One-channel slide with modified connectors (not shown in the picture) for the mammalian cell culture EB-C; channel dimensions: 32 mm useful length, 5 mm width and 0.8 mm depth.

Figure 3-4: Schematic of the Life Support System including media resupply and staining capability for the mammalian cell culture EB-C.
Figure 3-5: The Experiment Block (EB) fully integrated and double sealed closed (both types of EB)

Figure 3-6: Removed Cover of the mammalian cell culture EB showing the slide holder with the x-y stage; the blue colored components are parts of the LSS
Figure 3-7: Scheme of the EB showing possible objective configurations

Figure 3-8: Scheme of the Plant Experiment Block (EB-P)
3.4. ISS FLUMIAS Operating Concept and anticipated constraints for this AO

Note: The operational scenario for an ISS FLUMIAS experiment is dependent on ISS transportation logistics and operational constraints at the time of the mission which may change as the overall ISS programme evolves. In particular new or updated resupply vehicles may become available in the future which have different characteristics to current vehicles and also the on orbit operational concept may change. Therefore, the scenario presented here is only indicative of the current boundary conditions.

The expected steps and timeline for pre-flight, inflight and post flight operation of ISS FLUMIAS experiments (based on a SpaceX resupply vehicle configuration) are the following:

- **Pre-flight preparation of experiment samples and integration into experiment hardware.**
  - Depending on the time constraints from sample preparation to start of the experiment on orbit, the sample preparation may be performed in the home laboratory or at the launch site laboratory. If the experiment samples can be stored for several weeks, preparation of experiments may be performed at the science team’s home laboratory. For samples with shorter lifetimes, experiment preparation will be done at the launch site.
  - Experiment samples and reagents will be loaded into the ISS FLUMIAS Experiment Blocks (EBs) on ground before launch. The EBs will remain double-sealed throughout the duration of the mission to satisfy the safety requirements of Tox-level (THL-1) as well as Bio-Safety Level (BSL 2M). A total of 6 EBs can be loaded into one or two Cargo Transfer Bags (CTBs) together with a certain quantity of bricks containing phase change material (PCM).
  - As a current baseline it is assumed that the experiment will be launched on a commercial resupply vehicle (e.g. SpaceX CRS Dragon) from Kennedy Space Center (Florida, US), where basic laboratory facilities can be provided. Typically, the integrated EBs are handed over for integration in the launch vehicle 24-36h before launch.

- **Handover, launch, flight in the transfer vehicle to ISS until installation in ISS FLUMIAS (upload).**
  - Following handover of the EBs, the experiment package is installed in the launch vehicle. From this point until installation of the experiment in ISS FLUMIAS onboard ISS, there is no electrical power available to the experiment. In soft stowage the experiment samples are exposed to the ambient temperature which can vary between +16°C to +30°C. Passive conditioned temperature stowage (e.g. with phase change materials) can provide a more constrained range of temperatures including refrigerated.
stowage (e.g. +4°C to +8°C), as well as intermediate temperatures (e.g. ~12°C) or ensure minimum temperatures (e.g. >+23°C, or up to +37°C) for a limited period of time.

- The duration from handover to installation in ISS FLUMIAS is expected to not exceed 7 days, therefore the experiment samples need to be capable of withstanding the conditions described above for this period. It shall be noted that initial launch attempts may be scrubbed due to weather or technical issues and several attempts may be made before finally launching. In this case it may be possible to exchange experiment containers.

- **Installation & operation in ISS FLUMIAS**
  - The CTB, containing up to 6 EBs will be unloaded from the cargo vehicle and installed in ISS FLUMIAS by a crew member. After installation into the magazine (visible in Figure 3-2) and insertion of the magazine in ISS FLUMIAS, the EBs will be supplied with power and data link, thus life support will be provided by temperature control and medium exchange at periodic intervals.
  - All subsequent experiment operations will be performed automatically by the ISS FLUMIAS instrument, including EB transfer to/from the microscope rotor, imaging operations and fluidics commanding. Operations may be performed either from a pre-programmed script or by ground commanding.
  - Science imaging data will be recorded onto a dedicated memory chip in the EB, which will be available upon return of the EBs. Due to the large data volume generated by the imaging processes it is currently not possible to downlink the complete set of science images to ground in real-time. Low resolution images may be transmitted within the housekeeping data stream from ISS FLUMIAS to ground for a quick verification of the image parameters during an experiment run.
  - As a baseline chemical fixation of experiment samples is not foreseen due to safety constraints with operation of the experiment cassettes. Therefore, in this case the experiment will generally conclude at the end of the imaging run.

- **On-orbit stowage and return (download)**
  - In general, it is anticipated that the experiments focus on analysing the imaging-data, rather than on analysing the actual experiment samples. In this case there are no special constraints for return of the EBs as the science data is electronic. However, in case there is the need to do further analyses off the physical experiment samples, several options exist for condition temperature stowage on board ISS and during download. These include following options:
    - Ambient temperature (+18°C to +30°C).
Conditioned temperature stowage includes refrigerated (e.g. \(\sim +4^\circ C\)), frozen \((-20^\circ C, -80^\circ C\)) in separate on-orbit actively powered facility. Note; very low temperatures may not be compatible with the EB electronics and hardware.

Ambient, passive and active conditioned temperature (including refrigerated \(+2^\circ C\) to \(+10^\circ C\), frozen \(-15^\circ C, -20^\circ C, -32^\circ C\) and \(-80^\circ C\)) are available during the download phase from the ISS until post flight recovery. No power is available to the experiment samples during this phase. (See above bullet)

As a baseline it is assumed that the SpaceX CRS Dragon capsule would be used for post flight return of experiment samples. Typically the time between transfer of the experiment units from ISS stowage until handover of the samples at a NASA facility (usually NASA Johnson Space Center) would be 5-7 days.

Depending on the experiment run duration and operational constraints the experiment may be launched and returned on the same vehicle (e.g. typically under 4 weeks with the Space-X Dragon) or returned on a different vehicle. In the latter case the total on-orbit time may be several months, with the possibility of delays in the schedule.

3.5. Literature on ISS FLUMIAS

For reference, the following publications provide details of results from previous flight experiments using the various ISS FLUMIAS microscope systems including 3D Structured Illumination Microscopy.

4 SCOPE OF THIS RESEARCH ANNOUNCEMENT AND BOUNDARY CONDITIONS

Proposals considered in scope of the research announcement must satisfy all of the following criteria:

- Clearly address one or more of the specific research topics identified in the SciSpacE Roadmaps (Section 2).
- Experiments with protocols which can only be achieved using the spaceflight environment available on board the ISS. Studies which can be addressed using other research platforms such as the ground based facilities or other platforms should be submitted to the appropriate continuously open research announcement (CORA).
- Compatible with the capabilities of ISS research facilities, in particular the ISS FLUMIAS microscope using the mammalian cell cultures (EB-C) and the small plant seedlings (EB-P) Experiment Blocks together with the anticipated resource envelope described above (Section 3). For this AO it is not envisaged to develop new experiment specific Experiment Blocks, therefore proposals should aim to use either the mammalian cell cultures (EB-C) or small plant seedlings (EB-P) Experiment Blocks (described in section 3.3.)

Proposals which do not satisfy the above criteria are considered out of scope for this AO and will not be evaluated further as part of this call. However, out of scope proposals may be relevant to the Continuously Open Research Announcements on other research platforms.

In this AO it is planned to select a limited number of projects which will be implemented in the initial phase of ISS FLUMIAS utilisation, i.e. the first 3 campaigns of the facility with a baseline of 6EBs used in each campaign. Subsequent utilisation will be subject of future AOs released at periodic intervals. The rationale for this phased approach is to provide regular opportunities for the scientific community to propose new experiments for ISS FLUMIAS. Furthermore, for subsequent AOs the boundary conditions may change to include possible evolution of capabilities, such as new Experiment Blocks.

5 APPLICATION PROCESS

5.1. Who can apply

Scientists from the member states participating to ESA’s SciSpacE programme element may apply to the programme. Participating countries are Austria, Belgium, Canada, Czech Republic, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Romania, Spain, Slovenia, Sweden, Switzerland and the United Kingdom.
Scientists from other ESA member states may participate in proposals as team members, but cannot act as lead investigator for the proposal. In addition scientists from non ESA member states may act as co-investigators or collaborators on proposals (but not lead investigators).

The lead investigator and all team members making a significant contribution to the proposed project will need to provide evidence of an appropriate level of commitment to the project if selected, including endorsement of the proposal by their respective national agency.

5.2 Letter of Intent

To facilitate proposal processing, potential investigators are requested to confirm their plans to submit a proposal in response to this Research Announcement by submitting a Letter of Intent. The letter of intent is not binding. The letter of intent should include the following:

- Title of the proposed project
- List the lead and co-investigators, with affiliation
- A short summary of the proposed project (no more than 400 words)

5.3 Preparing and submitting the proposal

The document "ESA-ISS FLUMIAS proposal template" shall be used for submission of the proposal.

The proposals shall be submitted electronically as one single file to:

ESA_Flumias@esa.int

An acknowledgement will be sent to the submitting proposer upon receipt and confirmation of completeness of the proposal.

5.4 Announcement of Opportunity Schedule and Deadlines

The schedule for this AO and deadline for submission of proposal documents are the following:

- Deadline for submission of Letter of Intent (non-binding) – 3rd March 2020
- Proposer workshop at ESA-ESTEC – 18th March 2020
- Deadline for submission of Proposals – 20th May 2020

It is anticipated that the approval of the final selection of proposals will be in Autumn 2020, after which the proposal coordinators will be informed of the outcome of the review.
5.5 Evaluation of proposals

Proposals will be evaluated according to the following criteria:

- Research objective and platform relevance
- Scientific Merit
- Technical Feasibility
- Programmatic Assessment

These criteria are described in further detail below:

(A) **Research objective and platform relevance.** An initial pre-screening of received proposals will be made to determine if the proposal is within scope of this AO, according to the criteria identified in Section 4. Proposals which are considered out of scope will not be reviewed further and the lead investigator will be informed of ESA’s decision. Applicants of an out of scope proposals may be invited to resubmit an updated proposal to one of ESA’s Continuously Open Research Announcement where appropriate.

(B) **Scientific Merit.** ESA will make use of independent experts for the evaluation of proposals considered in scope of this AO. The evaluation criteria that will be applied for evaluation of the proposals are:

- Significance (30%): Does this study address an important problem? If the aims of the application are achieved, how will scientific knowledge or technology be advanced? What will be the effect of these studies on the concepts, methods, or products that drive this field?
- Approach (25%): Are the conceptual framework, design, methods, and analyses adequately developed, well integrated, and appropriate to the aims of the project? Does a flight proposal build upon a successful foundation of ground studies? Is the proposed approach likely to yield the desired results? Does the applicant acknowledge potential problem areas and consider alternative tactics?
- Innovation (20%): Does the project employ novel concepts, approaches, or methods? Are the aims original and innovative? Does the project challenge existing paradigms or develop new methodologies or technologies?
- Personnel (15%): Does the scientific team have the appropriate level of experience, are sufficient & appropriate personnel dedicated to the project. Is there evidence of the science team’s satisfactory productivity?
- Environment (10%): Does the scientific environment in which the work will be performed contribute to the probability of success? Do the proposed experiments take advantage of the scientific environment or employ useful collaborative arrangements? Is there evidence of institutional support?
(C) Technical feasibility review. Proposals with a science merit score above the threshold considered for selection will be subject to an ESA internal technical feasibility review. This will:

- Assess the compatibility of the proposed project objectives and requirements with research platform capabilities (Facility and operation constraints);
- Assess the required experiment specific hardware technical complexity (in this case primarily compatibility with the baseline EB designs) and costs for development as required to fulfil the project requirements;
- Identify and rank the areas of technical risk or uncertainty;
- Perform the preliminary assessment of resources required for implementation and operation of the proposed project.

(D) Programmatic assessment. Following Peer and Technical review the proposals will be given an overall integrated ranking according to science merit score, technical feasibility score and estimated resource requirements. The final recommendation of proposals to be selected will take into account the known boundary conditions of the programme to ensure that only projects with a realistic implementation perspective will be selected. ESA’s current assessment is that a maximum of 3-4 proposals would be selected targeting the first 3 campaigns of the facility (with as a baseline of 6EB’s used in each campaign).

The proposed final selection will be presented to ESA’s Programme Board of Human Spaceflight and Exploration (PB-HME) for approval. Each proposal coordinator will receive information on the outcome of the review in a confidential letter, typically within 2 months after the selection decision.

The results of the selection will be final and not open to appeal.

6 IMPLEMENTATION OF THE SELECTED PROPOSALS

An ESA project scientist will be assigned to the project at selection. Proposals will be initially selected as Candidate Projects for the definition phase where the science requirements are baselined. Therefore, selection does not automatically imply flight implementation of the project as this is contingent on successful baselining of the science requirements, confirmation to technical feasibility and availability of the flight opportunity.

The key steps leading to flight implementation of the project are the following:

- Confirmation by science team of appropriate level of institutional / national support and commitment of personnel to support definition work. Detailed definition of science requirements in close coordination with ESA.
- Successful completion of definition phase with a baselined Experiment Science Requirements, assessed to be technical feasible with the capabilities of the research platform.
• Selection of the project for development / implementation as an experiment for an available flight opportunity, contingent on documented evidence of appropriate level of national / institutional support and commitment of science team personnel to support the project through all phases of implementation

• Development of Experiment Specific Hardware along with implementation and operations planning under ESA responsibility, according to approved ESA rules and procedures

• Flight implementation of the experiment with return of experimental samples and associated data to the science team

It is currently anticipated that projects selected in this AO will be implemented on board the ISS in the 2022-2024 timeframe.

7 DATA RIGHTS

7.1 General

The general data policies of ESA’s Directorate for Human and Robotic Exploration Programmes will apply to all data resulting from the experiments in the context of this Continuously Open Research Announcement.

Final results of the study shall be made available by the scientific teams to the scientific community through publication in appropriate journals or other established channels as soon as practicable and consistent with good scientific practice. In the event such reports or publications are copyrighted, ESA shall have a royalty-free right under the copyright to reproduce, distribute, and use such copyrighted work for its own purposes.

7.2 The Erasmus Experiment Archive (EEA)

The EEA covers both physical and life sciences, and can be found at the following URL: http://eea.spaceflight.esa.int The EEA is an ESA service to the international scientific community. Abstracts, from all European microgravity experiments performed to date are collected in this database. Experimenters sponsored by ESA have the obligation to provide these abstracts themselves. Special emphasis is placed on the completeness of the list of references of articles where the experiment results can be found.

Scientists in Europe, who have performed experiments, be it in orbiting or ground-based facilities are encouraged to either provide an abstract on each of their experiments, or to provide information enabling the updating of their existing abstracts, in particular the list of articles published.