

**Announcement of Opportunity
soliciting for proposals using the Human
Spaceflight Analogue
“Parabolic Flight”
ISLSWG-AO-2016-PFC**



Images : Novespace/CNES/DLR/ESA

**Proposals due:
December 2nd, 2016**

Summary for the Research Opportunity

- ESA's Directorate of Human Spaceflight and Robotic Exploration Programmes of the European Space Agency announces an opportunity to propose human research using the human spaceflight analogue "Parabolic Flight". Proposals selected in response to this Announcement of Opportunity (AO) will be implemented in a Parabolic Flight Campaign foreseen to take place in Spring 2018.
- The planned Parabolic Flight Campaign will be implemented jointly with members of the International Space Life Sciences Working Group (ISLSWG) consisting of the Italian Space Agency (ASI) Canadian Space Agency (CSA), the French Space Agency (CNES), the German Space Agency (DLR), the European Space Agency (ESA), the Japanese Space Agency (JAXA) and the U.S. Space Agency (NASA). International cooperation to strengthen scientific excellence in this parabolic flight campaign is strongly encouraged.
- Eligibility: The scientific institution for which the coordinator of a proposal is working must be located in one of the ESA member or associated member states contributing to the ESA's ISS, ELIPS or successor programmes (AT, BE, CH, CZ, DE, DK, ES, FR, IE, IT, NL, NO, RO, SE, UK and CA).
- The campaign planned by the ISLSWG members is dedicated to different partial-G levels.
- Submission of proposals will be done electronically via a document template that can be found under the following address: http://www.esa.int/Our_Activities/Human_Spaceflight/Research/Research_Announcements
- Proposals are due by December 2nd, 2016.
- For questions related to this Announcement of Opportunity please contact:
Dr. med., Dr. rer. nat. Thu Jennifer Ngo-Anh
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- Implementation schedule: Preparation of the campaign will start in 2017. The Parabolic Flight Campaign itself is foreseen in 2018.



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1 Introduction

Parabolic flights are used to conduct short-term standalone scientific and technological investigations in microgravity and other (reduced) gravity levels and also for testing instrumentation prior to use in space, to validate operational and experimental procedures, and to train astronauts for future spaceflight. Parabolic flights are the only sub-orbital carriers allowing scientists to carry out biological, biomedical and physiological experiments under conditions of microgravity or other (reduced) gravity levels as self-standing experiments. It also complements studies conducted in space and in simulated microgravity conditions on ground (e.g. dry-immersion, bed-rest).

Such flights are conducted on a specially-configured aircraft, and provide repetitively periods of up to 22 seconds of weightlessness, and correspondent periods for different partial-G levels. During a flight campaign, which normally consists of three individual flights, 30 parabolas are flown on each flight, i.e. 90 parabolas in total. On each parabola, there is a period of increased gravity (1.8 g), which lasts for about 20 seconds immediately prior to and following the 22 seconds period of reduced gravity.

ESA and its partners from the International Life Science Working Group ISLSWG are now calling for experiment proposals to be conducted during a Parabolic Flight Campaign planned to take place in spring 2018. The campaign will take place with the Airbus A310 ZERO-G operated out of the Bordeaux-Mérignac airport by the company Novespace.

In accordance with the objectives of ISLSWG, namely to coordinate international space life sciences research and foster collaborations, the objective of this Announcement of Opportunity (AO) is to offer an opportunity for cooperative research that requires various reduced gravity levels in addition to microgravity conditions.

2 The Parabolic Flight Campaign targeted with this AO

Novespace's A310 aircraft has been certified for flying parabolas that provides, in addition to microgravity, reduced gravity levels of 0.16g (Lunar gravity level) for approximately 23s and 0.38g (Martian gravity level) for approximately 30s. Also other G-levels can be achieved. The purpose of flying parabolas with Lunar and Martian gravity levels or gradients of reduced g-levels is to conduct gravity-related science at different gravity levels between 0g and 1g (1g being Earth's gravity), in preparation of future human exploration missions.

Two scenarios of gravity levels will be offered:

- a. parabolas at different g-level gradients between 0g and 1g and/or
- b. g-levels corresponding to Lunar and Martian gravity conditions.

Interested science teams are invited to check the box for the respective scenario of the proposal template to indicate their preferred g-level scenario. The final g-level gradient set-up will be defined after selection of the proposals.

3 Campaign Organization

A typical campaign is normally scheduled for two weeks, with the first week dedicated to experiment receipt, followed by installation, test and calibration within the aircraft. The second week is devoted to the parabolic flights themselves. At the start of the second week (on a Monday), attendance at a medical and safety briefing is mandatory by all persons planning to fly.

Three flights of 30 parabolas each are nominally scheduled for the Tuesday, Wednesday and Thursday mornings, with a flight duration of approximately three hours. In the case of inclement weather or technical problem with the aircraft, a flight is delayed to the afternoon of the same day or morning of the next day. The Friday of the second week is reserved as a back-up flight day.

Investigators who are foreseen to participate to the parabolic flights will have to pass a medical examination, abide to the "Terms and Conditions for Participation to ESA Parabolic Flight Campaigns" and sign dedicated agreements.

4 A310 ZERO-G characteristics

The main technical characteristics of the Novespace A310 ZERO-G cabin are:

- The equipment test area measures 20m x 5m x 2.2m (L x W x H);
- All equipment must be loaded through an access door of 1.8m x 1.06m;
- Cabin pressure during flight is 825 +/-5 hPa, with a temperature range of 17 to 20 °C, and relative humidity <15%;
- Electrical power is available: 230 V AC at 50 Hz (single phase);
- A ventline is provided for the purging of gases and liquids from the aircraft during flight;
- There is continuous in-flight lighting;
- Protective white foam padding covers internal surfaces to prevent injury to flight personnel

Detailed information on design guidelines for instruments and/or payloads, the A310 ZERO-G interfaces, and the applicable procedures for parabolic flights, will be provided upon experiment selection. Specific information may be requested prior to proposal submission if necessary.

Parabolic Flight Manoeuvre

Starting from a steady horizontal flight, each parabola begins with a "pull up" phase lasting about 20 seconds, during which the aircraft experiences a vertical acceleration of around 1.8g (i.e.: 1.8 times normal Earth gravity). Once the aircraft is approximately 50 degrees nose-up, there is a short "injection" phase of 3-5 seconds during which the acceleration reduces to the target level. This is achieved by reducing engine thrust to just compensate for air drag.

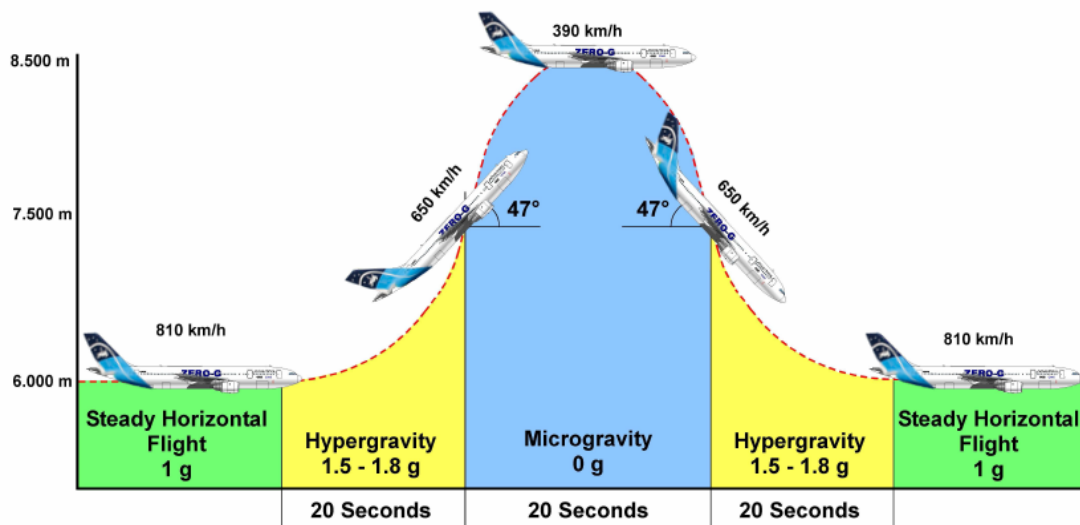
During a microgravity parabola, the aircraft pitch is controlled to provide a 'zero-lift angle of attack', and the aircraft therefore follows a free-fall ballistic

trajectory. Weightless conditions are achieved within the aircraft for approximately 20 seconds.

During Lunar (0.16g) or Martian (0.38g) low-gravity parabolas, the flight parameters are adjusted accordingly, to provide reduced gravity levels for approximately 23 and 30 seconds, respectively. For other G-levels the respective duration is similar.

Target reduced gravity levels are typically achieved within +/- 0.02g, and at least within +/- 0.05g, on all three primary axes.

At the end of the reduced gravity period, the aircraft is approximately 47 degrees nose-down and a “pull out” phase begins. This gives rise to another 20 second period of 1.8g, after which the aircraft returns to normal steady flight.



Parabolic manoeuvres are flown repeatedly, with a period of 3 minutes between the start of each two consecutive parabolas. After each group of five parabolas, there is a rest interval of 5 to 8 minutes.

Throughout the flight, all personnel are kept continuously informed of the flight status, including an indication of the upcoming parabola number, and the rest period durations. The entire flight duration is around three hours, from take-off to landing.

5 Safety and Health Regulations

The safety of personnel and equipment are of paramount importance during all ESA campaigns. Parabolic flights are considered as test flights, and therefore particular precautions are taken to ensure that in-flight operations are made safely, and that all participants in the flights are adequately prepared for repeated high and low gravity phases.

Prior to an individual campaign, support is provided to researchers in their equipment design and safety aspects. As deemed necessary, experiments may be reviewed by experts during visits to the investigators' home laboratories. All experiments characteristics and safety processes are assessed by both

Novespace and ESA and its partners. A safety review (only within Novespace) is held one month prior to the campaign, where the integration of all equipment is discussed and the overall safety aspects of the campaign is assessed. Finally, a safety inspection is performed in the aircraft prior to the first flight to verify that all equipment complies with the applicable safety rules.

All researchers selected to participate in parabolic flights must pass a medical examination. On-board, researchers must wear special flight suits, provided on loan during the campaign.

For experiments proposed to be conducted on human subjects, medical protocols submitted by the researchers shall be reviewed by relevant Medical Boards to ensure that the proposed research is conducted according to established ethical and safety rules.

During the flights, specialised personnel supervise and support the in-flight experiment operations. A Flight Surgeon participates to all flights to supervise the medical aspect of in-flight operations, and to assist flying participants in case of sickness. Due to the association of low and high gravity flight phases, motion sickness may appear among participants to parabolic flights, sometimes hampering them to conduct their tasks. Prior to the flights, anti-motion sickness medication is made available to all participants and is strongly recommended.

6 Proposal Preparation and Selection Procedures

For this Announcement of Opportunity proposals shall be submitted electronically by December 2nd, 2016 using the form, which can be found by clicking on the following link:

http://www.esa.int/Our_Activities/Human_Spaceflight/Research/Research_Announcements

The proposal should provide scientific as well as technical information as outlined in the template, such as science team details, scientific objectives, description and performance of the experiment (sketches or photos are appreciated) as well as technical information (estimations) on size/dimensions, weight and power consumption of payloads (if applicable), number of mandatory personnel on board to perform the experiment (per day), number of flight days needed, special requirements, the preferred gravity levels and number of parabolas per each level, information, if the experiment is flexible to the scenario of different gravity levels (e.g. 10 parabolas with lunar gravity levels, 10 parabolas with Martian gravity levels, 10 parabolas with microgravity levels)

An independent scientific merit peer review will be performed. Only those proposals that are most highly rated in the merit and relevance review process will undergo additional reviews for feasibility. A panel of technical experts from ESA, CNES and DLR will evaluate the feasibility of carrying out the experiment and the potential for establishing cooperation between different teams to optimize utilization of human subjects, samples, data, and resources. This review

will be conducted by technical experts familiar with the conduct of parabolic flight campaigns.

The timeline of important events is therefore as follows:

Submission deadline for proposals:	December 2 nd , 2016
Completion of peer review and feasibility assessment:	April 2017
ISLSWG Parabolic Flight Campaign:	April 2018 (tbc)

Due to the experience in recent years, it is strongly advised that all scientists contact their national representatives to investigate possible national funding procedures and timelines as well as probability of funding in order to identify alternative funding sources if necessary. As a minimum, it is recommended to submit the proposal to their national bodies in parallel to their application in response to this AO, in order to commence applying for national funding as early as possible.

If the proposed experiment is selected, a proof of appropriate funding is mandatory before commencing implementation of the proposals.

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7 Data Rights

7.1 General

The general data policies of ESA's Directorate for Human Spaceflight and Robotic Exploration Programmes will apply to all data resulting from the experiments in the context of this AO.

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 their 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.