CORA-GROUND BASED FACILITIES 2023 SYMPOSIUM

Summary

The First CORA-Ground Based Facilities Symposium was held 05 December 2023 at ESA – ESTEC, The Netherlands, and online to allow the Science Teams to showcase their completed CORA-GBF experiments and for participating facilities to demonstrate the service they provide.

Furthermore, all participants were invited to discuss how each project aligned with the ESA HRE-HR Scientific Spotlights and Key Questions and lessons learned to understand the utility of the CORA-GBF programme.

All material presented in the symposium can be found at the dedicated GBF SharePoint site (with controlled access).

CORA-GBF Facility Overview

Six facility representatives presented the service and worked performed at their facility:

- Four facilities located in Germany:
  - Micro-g lab (DLR) - *presented by Christian Liemersdorf*,
  - Short-Arm Human Centrifuge (SAHC – DLR) - *presented by Timo Frett*,
  - Hyperscope - *presented by Yannick Lichterfeld*,
  - Larg Diameter Centrifuge and Medium Diameter Centrifuge - *presented by Jack van Loon.*
- One facility located in France:
  - Gravitational Experimental Platform for Animal Models (GEPAM) - *presented by Julie Bonnefoy & Jean-Paul Frippiat.*
- One facility located in Italy:
  - Locomotion On Other Planets (LOOP) - *presented by Gaspere Pavei.*

Project Outcomes

Seven projects presented their outcomes:

- Projects carried out at the Mirco-g lab, DLR:
  - ‘’Establishing the BAG3 protein homeostasis as a diagnostic marker and potential therapeutic target for space flight induced muscle loss’’ – *presented by Jörg Höhfeld*
  - ‘’Function of EHB1 and AGD12 in root gravitropism of *A. thaliana*’’ – *presented by Magnus Rath, Christoph Forreiter*
  - ‘’Application of hyper-g as a countermeasure option for immune deficiencies’’ – *presented by Dominique Moser*
  - ‘’Novel ketamine derivatives and their potential as a pharmacological treatment to counteract loss of synaptic plasticity evoked by exposure to microgravity’’ – *presented by Sherif El Sheikh*
- Project carried out at the SAHC facility, DLR:
  - ‘’The illusion of tilt: does your sex define your perception of upright?’’

– *presented by Nils Bury*

- Project carried out at the GEPAM facility:
  - ''Embryogenesis of an aquaculture fish (*Dicentrarchus labrax*) under simulated altered gravity''
    – *presented by Cyrille Przybyla*
- Project carried out at the LOOP facility:
  - ''Estimating lower limb joint internal loading during locomotion and plyometric movement and their relationship to simulated hypogravity: *in vivo* data to inform *in sililco* analyses''
    – *presented by Darioa Cazzola*

Discussion and Outcome

The participating science teams were requested to briefly summarise how their own project aligns with the SciSpacE Spotlights and Key Questions (outlined in the symposium material), and furthermore, comment on exploration relevance and future purpose.

See Table 1 for the alignment of Spotlights and Key Questions for the participating projects.

The projects collectively cover most of the defined subjects, with the exception of the 4th Spotlight (Origin, Evolution and protection of extra-terrestrial life), despite only a handful of projects participating in the symposium.

Lessons Learned

The participants were asked to reflect on the lessons learned during the course of their projects. This included challenges encountered, unexpected discoveries, and insights gained, which in turn lead to discussions about future research directions and planning within the programme.

The following outline the main points:

- **Limited project budget.**
  The experimental time available in relation to the project budget from the programme is a limiting factor. Given that the funding through the programme covers neither travel cost nor consumables, there is a need for increased funding for each project to accommodate longer experimental time to achieve meaningful results.
- **Application process improvement.**
  The application process to participate in the programme needs clarifications. New science teams have found it difficult to understand the stages of the application process and to navigate the ESA/OSIP environment. The GBF coordinators will see to that the application process will be easier to understand.
- **Make programme's work output more visible for outsiders.**
  The symposium appears to be a good forum to allow the involved community to be more aware of activities and opportunities with other facilities in the programme. However, the programme is not greatly visible to outsider community. The GBF coordinators can work with the facilities so they are presented in a similar fashion and use the SciSpacE website to host information about the programme and the facilities in an attractive way.
- **Increase collaboration between different facilities and science teams.**
  As part of the discussions on the presentations in the symposium, some Science Teams realised that with understanding the capacities of other facilities and understanding the

research focus of other teams, that collaboration for future projects might be fruitful. Across the facilities, it appeared it would also make sense to work on standardising the hardware and the measurements to ease the comparison of experiment and generate a bigger pool of measurements.

Potential Literature collaboration

After discussing the Lessons Learned, and in relation to making the programme more visible to outsiders, the participating teams are interested in collaborating on a paper to showcase the activities and results by using of ground-based facilities. This collaborative effort can be a powerful way to increase visibility to a broader audience.

Interest in maintaining the GBF programme alive

Platforms like the International Space Station (ISS) provide unique opportunities for conducting microgravity experiments, but they come with significant costs and logistical challenges. Ground-based facilities offer a more cost-effective, accessible, and less time-consuming option for conducting space-related research and are therefore an extremely necessary alternative. With greater visibility the programme serves a good foundation for expanding the space science community across Europe.

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Table 1. Spotlights and Key Questions addressed for each project being part of CORA-GBF 2023 Symposium

Project/Facility	[1] Humans living on other worlds	[2] Astronauts 2.0	[3] Space Travel and Transport	[4] Origin, Evolution and protection of extra-terrestrial life	[5] Exploring the Principles of Nature using the exploration destinations	[6] The nature of exploration destinations
Establishing the BAG3 protein homeostasis as a diagnostic marker and potential therapeutic target for space flight induced muscle loss *Micro-g Lab, DLR*	[**1.4**] What are the medical capabilities to assess health risks, and protect humans on Moon and Mars?	[**2.2**] What countermeasures are needed to overcome the limitations and mitigate risks and hazards to promote health and performance of astronauts?	[**3.1**] How does long term duration space travel modulate cell senescence and its relationship to aging mechanisms and integrated tissue/organ dysfunctions?		[**5.4**] How does the exposome affect cells, tissues and fundamental biological processes and how do cells, tissues and organisms sense the exposome and react to it? How can this be modelled, predicted and mitigated?	[**6.2**] How does the nature of the exploration destinations/locations affect exploration? (e.g. gravity, radiation, climate, resources, natural hazards)
Function of EHB1 and AGD12 in root gravitropism of *A. thaliana* *Micro-g Lab, DLR*					[**5.4**] (See description above)	
Application of hyper-g as a countermeasure option for immune deficiencies *Micro-g Lab, DLR*					[**5.1**] How can we go deeper in our understanding and use of gravitation and spacetime? [**5.4**] (See description above)	
Novel ketamine derivatives and their potential as a pharmacological treatment to counteract loss of synaptic plasticity evoked by exposure to microgravity *Micro-g Lab, DLR*		[**2.2**] (See description above)			[**5.4**] (See description above)	
The illusion of tilt: does your sex define your perception of upright? *SACH, DLR*		[**2.5**] What training and adjustments to operations are necessary for each mission/destination?				
Embryogenesis of an aquaculture fish (*Dicentrarchus labrax*) under stimulated altered gravity *GEPAM*	[**1.1**] How to develop technological and functional requirements for an optimal Moon and/or Mars habitat concept? [**1.2**] How to enable a nutritious, palatable, safe and sustainable diet?					
Estimating lower limb joint internal loading during locomotion and plyometric movement and their relationship to simulated hypogravity: *in vivo* data to inform *in silico* analyses *LOOP*	*(- Future Direction:* *[**1.3**] What are the human responses to environmental and social stressors on Moon and Mars, and howto mitigate them?* *[**1.5**] Howto assess risks and perform safe surface operations to ensure human health protection and maximize performance?* *-)*	[**2.2**] (See description above) [**2.3**] What biopsychosocial characteristics are required of an astronaut/crew to adapt to new destinations? [**2.5**] (See description above)				