

# *ESA/ELGRA Gravity-Related Research Summer School*

Ricard González-Cinca  
Department of Physics  
UPC-BarcelonaTech  
Castelldefels (Barcelona), Spain  
[Ricard.gonzalez@upc.edu](mailto:Ricard.gonzalez@upc.edu)

Philip Carvil  
Centre of Human and Applied  
Physiological Sciences  
King's College London, UK  
[Philip.carvil@kcl.ac.uk](mailto:Philip.carvil@kcl.ac.uk)

Natacha Callens  
ESA Education Office  
ESA-ESEC  
Redu, Belgium  
[Natacha.callens@esa.int](mailto:Natacha.callens@esa.int)

**Abstract**— The European Low Gravity Research Association (ELGRA) and the European Space Agency (ESA) Education Office co-organise at the ESA Academy's Training and Learning Centre in ESA-ESEC, Belgium, a Summer School on gravity-related research since 2016. This Summer School explains the fundamentals of performing research at different gravity levels and offers an overview of current research activity under microgravity and hypergravity conditions in life and physical sciences. Over four and a half intensive days, 22 Bachelors or Masters students from ESA member and associate states attend stimulating lectures, and work within small groups to devise project ideas for prospective experiments. Gravity-related research is introduced to these future scientists and engineers by experienced professionals from across the European space and research sector. These professional trainers are ELGRA and ESA experts, freely sharing their experience and know-how with the students, including their day-to-day work and research experience in biology, human physiology, and physics. Many different scientific topics are addressed during the school including: solidification, fluid dynamics, heat and mass transfer, spaceflight analogues, animal models, cell biology, growth of plants, artificial gravity for astronaut countermeasures and space adaptation. Each year the programme incorporates new elements to enhance the experience for the students based on their feedback.

**Keywords**—*microgravity, hypergravity, research*

## I. INTRODUCTION

The European Low Gravity Research Association (ELGRA) [1] and the European Space Agency (ESA) [2] co-organise an annual Summer School on gravity-related research which takes place at the ESA Academy's Training and Learning Centre in ESA's European space Security and Education Centre (ESEC) in Redu (Belgium) over four and a half days.

The main objective of the Summer School is to promote gravity-related research amongst future scientists and engineers. These young minds are introduced to the benefits of performing research at different gravity levels and offered an overview of current research under microgravity and hypergravity conditions in both life and physical sciences. Other related objectives are:

- Transfer of knowledge and expertise,
- Inspire and network with the future generation,

- Encourage students to participate in hands-on opportunities,
- Attract future scientists and engineers into the space sector.

Each year, ELGRA contacts their members to offer them the opportunity to participate in the Summer School by submitting an abstract to propose a lecture in life or physical science. Three lectures in biology, human physiology and physics are selected. The selected ELGRA members join the Summer School for a minimum of one day and along with some additional ESA experts provide a background to their topic area, examples of gravity-related research and share their experience and expertise. Supporting the summer school is the student arm of the ELGRA association, SELGRA. SELGRA have created an active association for student members to communicate and share opportunities in gravity-related research, support conference attendance and communicate member activities. These experiences are shared at the Summer School and participating students offered the opportunity to join to provide further points of contact.



Fig. 1. Group picture at ESA/ELGRA Gravity-Related Research Summer School 2016

After the selection of the 15-20 experts and the finalisation of the programme of the Summer School, a call for student applications is launched by ESA Education Office. The Summer School is opened every year to 22 Bachelor and Master students in science or engineering disciplines from ESA Member and Associate States not yet involved in the space sector. Interested students apply via ESA Education website [3] by filling-in an application form and providing a motivation letter, a CV, a recommendation letter from a university professor or academic supervisor and an official copy of academic records. Selected students are informed at least one month before the Summer School starts.

The participating students and experts (Fig. 1) are sponsored by ESA and ELGRA to cover their travel, accommodation and meals.

## II. SUMMER SCHOOL CONTENTS

The Summer School programme includes lectures in the following topics:

- Gravity-related research and gravity-related platforms (ESA)
- Hands-on opportunities for university students (ESA)
- Introduction to project management (ESA)
- Gravity-related experiment development (ELGRA)
- Experiment life cycle (ESA)
- Physical sciences at different g levels - 3 lectures (ELGRA)
- Life sciences at different g levels - 3 lectures (ELGRA)
- Human physiology at different g levels - 3 lectures (ELGRA)

For example, for the Summer School 2017 the scientific lectures covered the following topics:

- life sciences: plant and cell biology in space; gravity machines; and animal models.
- physical sciences: solidification; blood flow; heat and mass transfer under microgravity conditions.
- human physiology: space adaptation; brain in microgravity and artificial gravity for astronauts.

These lectures are complemented by three testimonials from university students who have designed, built, tested and performed a scientific experiment or technology demonstration in the ZeroG airplane [4], the Bremen drop tower [5] and ESA's Large Diameter Centrifuge [6] in the frame of ESA Academy's hands-on projects [7]. These three university students present their projects as well as their lessons learned and give tips to the participating students for their potential future projects.

Throughout the Summer School, the students are asked in groups of four or five to generate an idea for a future gravity-related experiment. During the time allocated for this group exercise, they are asked to come up with a scientific or engineering objective, to choose a gravity-related platform and propose a preliminary experimental setup and procedure. Students take advantage of the continuous presence of experts in the room to discuss their ideas. In the



Fig. 2. Student group presenting their project to ESA and ELGRA experts during the ESA/ELGRA Gravity-Related Research Summer School 2017

final day of the Summer School, as shown on Fig. 2 the student groups get the opportunity to present their project and are evaluated by experts from ELGRA and ESA. Upon completion of this process the students are presented with a certificate of participation and a course transcript including their score to allow them to claim ECTS credit(s) for their participation to their respective universities.

Aside from the lectures and team work, students have the opportunity to visit space-related centres in the region. In 2016 and 2017, the students visited:

- ESA's European Space Security and Education Centre (ESEC) [8] and learned about ESA operations activities, as well as the Proba and Galileo programmes.
- The Euro Space Center (ESC) [9], a science museum and educational tourist attraction devoted to space science and astronautics where they had the opportunity to perform moon or mars walk and test the 3-axis rotating chair.
- The Centre Spatial de Liège (CSL) [10], an applied Research Centre owned by the University of Liège, focused on design, integration and calibration of space observation instruments. Students had the opportunity to hear about their diverse activities and to see their cleanroom and test facilities (Fig.3).

## III. STUDENT STATISTICS & FEEDBACK

The ESA/ELGRA Gravity-Related Research Summer School has been organised twice and each time involved 22 university students and 18 experts. The 44 participating students were 39% females and 61% males, 45% at Bachelor level and 55% at Master level, 52% in a scientific discipline and 48% in an engineering discipline. They were citizens of 12 ESA member states and studied in 36 different European universities. The feedback from the participating students was very positive, as shown on Fig. 3, they gained knowledge and increased their interest in gravity-related research. They consider that their participation will be useful for their future career. After the Summer School 80% of the students are envisaging to apply for an ESA Education gravity-related hands-on opportunity.



Fig. 3. Student and experts visiting the Centre Spatial de Liège (CSL) during the ESA/ELGRA Gravity-Related Research Summer School 2016

#### IV. CONCLUSIONS

The ESA/ELGRA Gravity-Related Research Summer School is a unique opportunity for university students to acquire new understanding on different topics of space research, work on a group exercise and network with experts in gravity-related research. With this Summer School ELGRA and ESA aims at complementing what future scientists and engineers learn at university, inspire them and attract them into the space sector and its multiple research opportunities.

The third edition of the Summer School will be organised from 25 to 29 June 2018 and the call for applications is opened until 7 May 2018.

The atmosphere during the summer schools has always been very pleasant not only for the students but also for the experts and organisers, with relaxed conversations intertwined with scientific and technical discussions. The comments from students of the two first editions reflect the success of the school:

“It has been easily the most inspiring week of my life. I have learned so many different things about performing experiments in altered gravity platforms and I believe this has been an

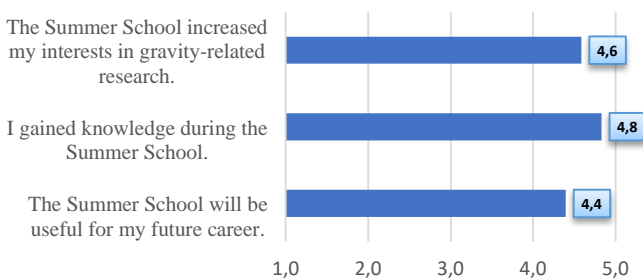


Fig. 4. Feedback from the university students who participated to the ESA/ELGRA Gravity-Related Research Summer School in 2016 and 2017

important milestone in my education in Physics. I also loved the multicultural environment as I think I have made some friends for life and I have now made contacts that I am sure will be crucial in the future!”, from a Portuguese student from the University of Porto, Portugal.

“I could not be happier that I took part in ESA/ELGRA Summer School. The opportunity to listen and talk to people that are working in space sector and spending time with other students with different backgrounds from all over the Europe was an amazing experience. During this week I learned a lot and expanded my horizons. With a clear conscience I can recommend it to every student.”, from a Polish student from the Warsaw University of Technology, Poland.

“The ESA/ELGRA Gravity-Related Research Summer School has been a fantastic experience that I could not recommend more highly to anyone with an interest in research and the space sector. Hearing about cutting-edge microgravity research from the experts in each field has been a wonderful opportunity that has not only increased my interest in the subject but in a career within the space sector in general. It was also great to be able to meet highly motivated students with such a range of backgrounds and interests. I am very grateful to have been given such an amazing opportunity and would like to thank everyone involved in the organisation and running of the summer school!”, from a British student from University of Surrey, United Kingdom.

“A once-in-a-lifetime opportunity to discover the fascinating science behind space experiments, meet with top experts in the space sector and connect with passionate individuals from all over Europe.”, from a Greek student from Aristotle University of Thessaloniki, Greece.

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