newsletter

NEWSLETTER OF THE EUROPEAN LOW GRAVITY RESEARCH ASSOCIATION

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President's page

The space story started a little more than half a century ago, in a remote and desolate region of what is now the independent Republic of Kazakhstan. The Soviet Union launched Sputnik, the first artificial satellite to orbit the Earth, which was little more than a few pieces of metal with a transmitter and a battery.

In the years that have followed, human spaceflights inspired a generation of scientists, including some of you. The challenges of to-day space program are different, what was once a global competition has long since become a global collaboration wherein Europe plays a key role. ELIPS (European LIfe and Physical Science in Space) is the European Space Agency's (ESA) research programme for science and application in Space. It covers many scientific disciplines, spanning from human physiology to fundamental physics, and utilises a variety of facilities and platforms, from rather simple equipment such as ground-based clinostats to complex ISS equipment designed and developed for specific experiments. ESA provides the platforms and infrastructure while all other means to conduct investigations (including sample and data analysis) have to be provided by national research organisations.

One of the most useful means of contact between the ELIPS programme and the scientific community are ESA Topical Teams (TT). TTs are the instruments to identify scientific issues and suitable approaches for implementation through combined ground- and space-based research platforms and they simplify the coordination between scientists who had an experiment selected in an AO (Announcement of Opportunities). In this issue of the ELGRA Newsletter you will find presentation of several Topical Teams.

The ELIPS program also includes education and outreach programmes aimed to help young Europeans to gain and maintain an interest in science and technology, and ensuring the existence of a qualified workforce for future space activities. ELGRA is a long-lasting partner of this program; we conduct evaluation of proposals for the Fly-, Spin-, and Drop-Your-Thesis programs of ESA and provide mentors for the selected proposals among the ELGRA members. One of the sessions during the last ELGRA assembly in Antwerp in 2011 was devoted to the presentation of students, and authors of the best manuscripts have received financial support to attend the meeting.

Currently the ELIPS-3 programme is going to the end and an independent scientific evaluation of ESA's ELIPS programme was carried out by the European Science Foundation (ESF). As the results of evaluation, ELIPS was recognised as a high-level programme of great scientific value and fundamental to the success of European research in space science, and therefore should be continued. To make a programme of such importance even better, a set of recommendations has been developed and one of them is to strengthen the link between Space Research and Mainstream Research performed on Earth.

The future budget for research in Europe was under discussion at the ministerial meeting in Naples on 20–21 November. Space activities within the 20 ESA Member States and Canada will be settled in ELIPS-4 aiming to boost Europe's competitiveness and growth along with scientific advances. Your ELGRA committee had prepared supporting letters to the members of the ministerial meeting to underline the importance of continuation of such space research in Europe.

ELGRA strongly supports utilization of the ISS for scientific experiments. The giant, well equipped orbiting international laboratory represents the best platform to conduct research that can help to improve the daily lives of people on Earth, as well as testing and improving human capabilities in space. The life of the International Space Station has been extended by more than five years. In order to reach the space station, along with Russian vehicles the American private companies compete to make access to space easier. It enables opportunity for the continuation of the research on the ISS. However, the current economic situation in Europe is not in favourable conditions for research funding. The outcome of the Ministerial counsel indicted an essential reduction of budget for the ELIPS program in what was requested. Even so, it provides a basis to continue our efforts in space and gravity – related research. ESA experts say that all progress in space is done for the average cost of a cinema ticket per European per year. In the years to come we should all focus to obtain even more science with the limited budgets available in order to maintain our European leadership in this area. To assist in this efford we are very pleased to welcome our Romanian and British colleagues joining the ELIPS program. We are looking forward to an active participation of the British and Romanian science community within ELGRA.

Finally, please, note in your agenda that the 20th ELGRA biennial Symposium and General Assembly will be held 11-14 Sept. 2013, in the Vatican, in Rome, jointly with the XXVI National Meeting of the Italian Association for Aeronautical and Space Medicine, AIMAS. For more information about the event, please consult the ELGRA website (www.elgra.org). Do not hesitate to contact the local organizers by e-mail (monica.monici@unifi.it, francesca.cialdai@unifi.it, f.strollo@alice.it)

I wish you an excellent 2013 and I am looking forward to see you in the Vatican in September.

Sincerely yours

Valentina Shevtsova
ELGRA President

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www.elgra.org
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Elgra Biennal Symposium and General Assembly 2011
Gravity: from μ to x

This conference took place from 5 to 9 September 2011 at the Antwerp University in Belgium.
It was attended by 150 participants from all continents. The organizers were Prof. Valentina Shevtsova from the Free University of Brussels and Prof. Floris Wuyts from the Antwerp University.
A extensive series of topics were dealt with by experts and scientists from all over the world. For the Physical Sciences these were: convection phenomena, particles, emulsions, foams, vibrations and surface tension related phenomena. For the Life Sciences: sensory motor, cells, counter-measures, gene expressions, models and methods for physiology, micro-organisms and anthropods. A third series of lectures was devoted to plant biology. As in all previous conferences of ELGRA, also "joint sessions" were organized where scientists from both physical and life sciences and plant systems exchanged ideas and experiences. Additionally also a session was devoted to Facilities and Instruments for space exploration, interesting for both physical and life scientists.

There were also 51 poster presentations, and while delicious Belgian beer was served, lively discussions took place near the posters.

Plenary lectures were presented by Prof. Hansjörg Dittus and Prof. Pascale Ehrenfreund. A special session was devoted to the EU, where Mr. Reinhard Schultze-Braucks provided an overview of the EU grants and the FP7 program. Astronaut Christer Fuglesang and Olivier Minster from ESA informed the audience on their projects and programs.

The conference diner took place in the University Club of the Antwerp University, a building of the 16th century in the heart of Antwerp. There the awards were given to the 2 young scientists: Anja Simon from Germany for her presentation: "Levitron – functional weightlessness for gravisensingprotits generated by magnetic field?" and Francesc Suñol from Spain for his presentation "Impinging bubbly jets at different gravity levels."
A magician wondered from table to table to show his tricks that charmed most of the audience.

The medalist for the physical sciences was Prof Dr. Legros from the Micro Gravity Research Center who gave a brilliant talk on his career in the field of fluid properties in microgravity.

Similarly, for the life sciences also a medalist presented an overview of his life time achievements, and his excellent support support to the space biology community, namely Dr. Enno Brinckmann, who at the conference dinner even shared a bottle of 1990 Cahors red wine that was a special cuvee for the Biorack microgravity facility.

The conference went flawless thanks to the help of several people from the university of Antwerp.
As a whole, the conference was a great success, because many scientists from all over the world could exchange ideas and experimental data, flavoured with some Belgian beer or fine wine. At the very end of the conference, a city tour in Antwerp was organized with an overwhelming view of Antwerp on top of the very new Antwerp Museum near the Stream, a 'hot' place to be.

Valentina and Floris

Management Committe elected at the general meeting held during the conference

ELGRA International Biennial Symposium and AIMAS XXVI National Meeting

September 11-14, 2013
Vatican City, Rome, Italy
www.elgra.org

HOT TOPIC

ESA MINISTERIAL CONFERENCE

NAtional and ESA representatives during the
Ministerial Conference in Naples, Italy (picture ESA)

One of the most important events for our community is the ESA ministerial conference, MC2012.
At that conference budgets are set for the next 3-5 years. For the microgravity and manned space flight community this program is ELIPS: European program for Life and Physical Sciences. The council of ESA's 20 member countries' and Canada met November 20-21, 2012 in Naples, Italy.

Countries have to subscribe to the optional ELIPS program. This in contrast to other programs within ESA that basically have a more firm funding aspect, based on the GNP of each member state. The initial ELIPS plans contained a program of in total 388 M€. During the negotiations not more than 210 M€ had been secured for the program. This is a quite disappointing 54%. This means that a large number of activities have to be postponed or even cancelled. It is to be expected that less science can be performed with such a limited budget.

From the total of 210 M€ more than half is contributed by Germany. This confirms Germany's drive to keep on investing in manned spaceflight, microgravity and the use of ISS and other research platforms. Italy is the second largest contributor to the program but still some 5 times less than Germany. Other countries that contribute with relatively similar amount of Euros are Belgium (6,2M€), France (7,6M€), Sweden (6,7M€). Most other countries contribute less than 2 M€.

It is very good to see that two new countries are now contributing to the ELIPS program, Romania with 0,9M€ and the United Kingdom with a respectable 7.4 M€. As ELGRA we are very pleased that our colleagues in these countries can now act as full partners within the ELIPS program.
In general we cannot be too pleased with the current budget, surely not in light with the increasing activities at NASA over the last year or so. Part of this reduced funding may be attributed to the current economic situation within the various European countries. However, in part it may also be due to the slow emerging of research out of facilities such as the ISS. This should also be improved in the near future. Maybe this limited budget drives us all towards creative and budget saving initiatives while keeping sufficient possibilities for performing research.

Jack J.W.A. van Loon, VU-University Amsterdam

NEWS FROM MEETING AND SOCIETIES

Space Life Sciences on the 12th Ukrainian Conference on Space Research (Yevpatoria, Crimea, Ukraine, 3-7 September 2012)

12th Ukrainian Conference on Space Research has been organized by State Space Agency of Ukraine, National Academy of Sciences of Ukraine, Institute on Space Research of NAS of Ukraine and National Center on Administration and Testing of Space Systems. Within the limits of the conference, meetings of the section "Space Biology" are traditionally held on the main directions of Space Biology Program in Ukraine:

*Biology of a cell in microgravity,
*Developmental biology in microgravity,
*Interaction of eukaryotic (plants, animals, human), procaryotic (pathogenic, symbiotic and associated) organisms and viruses in microgravity,
*Use of magnetic fields for the research of plant gravisensitivity and plant gravitropism,
*Working out the technology of space planting,
*Astrobiology

Topics on space biology heard on the 12th conference include:

-Biology of plants in space: scientific results, problems and prospects (E.L. Kordyum, Institute of Botany of the National Academy of Sciences of Ukraine).
-Cellular mechanisms of gravity-dependent processes in the bones of the skeleton (N.V. Rodionova, Institute of Zoology of the National Academy of Sciences of Ukraine).
-Proliferation and ultrastructure of non-differentiated stromal cells in the zones of enchondral osteogenesis in simulated microgravity (E.V. Skrypchenko, Institute of Zoology of the National Academy of Sciences of Ukraine).
-Rearrangements of the structure of blood vessels in bone diaphyses under changes in the gravitational load on extremities (S.V. Babak, Institute of Zoology of the National Academy of Sciences of Ukraine).
-The influence of microgravity on the cytoskeleton in Arabidopsis thaliana roots (G.V. Shevchenko, Institute of Botany of the National Academy of Sciences of Ukraine).
-The structural and functional characteristic of the soybean callus cell cytoplasmic membrane under clinorotation (D.O. Klymchuk, Institute of Botany of the National Academy of Sciences of Ukraine).
-The effect of clinorotation on low molecular heat shock proteins in pea seedlings (O.S. Talalaev, Institute of Botany of the National Academy of Sciences of Ukraine).
-ROS, thioredoxin and histone acetylation and deacetylation in plant stress-reactions (S.I. Zhadko, Institute of Botany of the National Academy of Sciences of Ukraine).
-The effect of real microgravity on crop yield of tomato plants and its resistance to virus infection (L.T. Mischenko, Taras Shevchenko Kyiv National University).
-Protection of the photosystem in model plant Kalancho? daigremontiana Hamet et Perr. with bacterial strains under mars-like conditions (O.P. Burlak, Institute of Molecular Biology and Genetics of the National Academy of Sciences of Ukraine).
-Natural symbiotic microbial biofilm-producing community in BIOMEX project (O.V. Moshynets, Institute of Molecular Biology and Genetics of the National Academy of Sciences of Ukraine).
-Medusomyces gisevii Lindau as a promicing micro-community model for space research (I.Zaets, Institute of Molecular Biology and Genetics of the National Academy of Sciences of Ukraine).
-A role of Hsp90 in display of genetic disturbances induced by UV-B and ?-radiation in Arabidopsis thaliana seeds (L.E. Kozeko, Institute of Botany of the National Academy of Sciences of Ukraine).
-Cosmic rays and evolution of the biosphere: search for new approaches (L.I. Miroshnichenko, Institute of Terrestrial Magnetism and Radio Wave Propagation of the Russian Academy of Sciences).

In discussions, it was emphasized: while now we know sufficiently about the influence of microgravity on plant growth and development at the different levels of their organization and plant capability to adapt to microgravity, we are very far from plant utilization as food and an oxygen source in bioregenerative life support systems. Such situation may be first of all explained by two reasons: 1) the absence of the large green-house on board ISS that makes it impossible to obtain the plant material quantity sufficient to its proper testing, and 2) formation of seeds of decreased size, weight and viability in microgravity, that may be caused with revealed negative changes in character and accumulation temps of storage nutrients in embryo cotyledon and root cells in microgravity in comparison with ground control. Therefore, the main attention has to be paid in future research to understand the critical stages in development of embryo and endosperm as well as the processes of synthesis and accumulation of storage nutrients in seeds. In connection with this statement, it was stressed the necessity of carrying out the corresponding plant genetic and breeding works for obtaining cereals and vegetables, which must be adapted to microgravity and will produce food of high quality in CELSS during prolonged manned space flights.
Among lectures related to cell biology in microgravity, the questions on the probable mechanisms of the development of osteopenia and osteoporosis attracted audience attention. The loading deficit leads to an adaptive differentiation of stromal cells to fibroblast cells and androcytes in these remodeling loci. Such cell reactions are considered as adaptive-compensatory, but they don't result in rehabilitation of the resorption bone tissue. This sequence of events is considered as a mechanism of bone tissue loss which underlies the development of osteopenia and osteoporosis under the mechanical loading deficit. New data on the effects of clinorotation on the plant cell cytoskeleton, cytoplasmic membrane, and low molecular HSPs were considered as important and interesting.
The probable causes of higher crop yield and virus-resistance of tomato plants grown from seeds, which were

on board the orbital station Mir during 1992-1998 years in comparison with ground control, were actively discussed. A clear answer was not naturally got, although many speculations have been proposed.
Among the lectures related to astrobiology, the reasonability to use the combucha (Medusomyces gisevii Lindau) biofilm for the experiment on the ISS in order to know more about survival of complex biofilm-forming communities in harsh environments and about cellulose as potential resistance biosignature, was discussed. In the pre-flight test program of BIOMEX (Biology and Mars Experiment), what has been performed in the simulation facilities at the DLR Cologne, preliminary results on survival capacity and biofilm formation within the combucha culture were obtained. It was also considered a new model, Hsp90 functioning for monitoring of genetic disturbances and deviations in plant development caused by spaceflight factors. This chaperon was shown to be essential for the maintenance of viability, normal development, and stable phenotype formation under non lethal changes in the genetic material.
The next conference will be also in Yevpatoria, Crimea in September.
Everyone is welcome. The necessary information will be placed on the Website of the Institute of Space Research under National Academy of Sciences and State Space Agency of Ukraine: http://www.ikd.kiev.ua

Kordyum Elizabeth is a contact person on Space Biology
e-mail: cellbiol@ukr.net

ASGSR Meeting (New Orleans, November 2012)

As of June 2012, the former ASGSB (American Society for Gravitational and Space Biology) began its transformation to the ASGSR (American Society for Gravitational and Space Research) as a result of historical membership vote to expand the charter to include basic and applied physical sciences. The ASGSR brings together scientists and engineers to encourage an exchange of ideas bridging basic and applied biological and physical science research and technology in space and gravitational sciences. The members represent academia, government, and industry interests bonded by a common issue - how living organisms and physical systems respond to gravity. By including the physical sciences within that society the ASGSR has basically become the compeer of ELGRA at the other side of the Atlantic. The first meeting of the ASGSR was in New Orleans end November 2012. Some 250 persons participated in the meeting with plenary and parallel sessions and workshops on translating astronaut biomedical health issues, physical sciences and advanced life support systems. The meeting reflected a very positive vibe towards future science, research and technology making use if the ISS but also the commercial sub-orbital flyers such as XCOR, Virgin Galactic and Blue Origin, among others. NASA issues new research announcements making use of these infrastructures on a very regular basis. Also the representation of life and physical sciences at NASA headquarters has been revitalized compared to recent years.
The next meeting of the ASGSR is planned for November 2013 in Orlando, Florida. This will be a joint meeting the International Symposium on Physical Sciences in Space (ISPS). For more info see: www.asgsr.org.
Jack van Loon.

UNOOSA Meeting (Malaysia, November 2011)

The United Nations Office of Outer Space Affairs (UNOOSA) organized and expert meeting in Malaysia in November 2011. This meeting brought together representatives of various, mainly non-space faring countries, interested in human spaceflight, microgravity and engineering as well as experts, from mainly space faring countries, in the areas of research mentioned.
In these series of events, UNOOSA organized and additional Expert Meeting in June 2012 in Vienna, Austria, on the International Space Station Humanitarian Benefits, as part of the Human Space Technology Initiative (HSTI). The goal HSTI initiative, headed by the former Japanese astronaut Dr. Takao Doi, is to engage more countries in the area of manned spaceflight and microgravity in order to enable non-space faring nations to benefit from the research and technology the manned space sector has to offer and help to improve international cooperation, education and living standards in these countries.
UNOOSA is planning to launch the so called United Nations Zero-Gravity Instrument Project (ZGIP) as part of the HSTI. The purpose of this project is to distribute zero-gravity simulation instruments to suitable educational and research institutions (laboratories, universities, and schools) around the world, in particularly in developing countries, with the aim of enhancing capacity in microgravity research and science education. This project will be pursued to fulfill the mandates of the United Nations Program on Space Applications. Announcements of the ZGIP are expected in the first quarter 2013 and I am looking forward to the outcome of this novel initiative which brings our field of science and research closer to a much broader community. For more information:
http://www.oosa.unvienna.org/oosa/en/SAP/hsti/index.html.

Jack van Loon

SCIENCE

A brief summary of project 'AO-99-049', entitled simulation of geophysical fluid flows under microgravity 'GeoFlow'

Introduction

In mantle dynamics research, especially the laboratory experiments in rectangular geometries have the character of 'exploring new physics and testing theories' [1]. We introduce our spherical experiments on electro-hydrodynamical driven Rayleigh-Bénard convection that have been performed either with temperature-independent properties of the fluid, called 'GeoFlow I', or with temperature-dependent properties, called 'GeoFlow II'. To set up a self-gravitating force field with radial directed buoyancy, we use a high voltage potential between the inner and outer boundaries and a dielectric insulating liquid. Additionally, we perform the experiment in the microgravity conditions of the ISS [2, 3]. In comparison to the research mentioned above, it strongly simplifies the fluid dynamical aspects of the geophysical motivation (i. e. a weak temperature-dependent viscosity resulting in a viscosity contrast of at most 2). However, it delivers the possibility of including non-linear properties and related hydrodynamic instabilities in spherical geometry also in comparison to only numerically described fluid flow patterns.

[1] A. Davaille and A. Limare (2009). In: Schubert, G., Bercovici, D. (Eds.), Treatise on Geophysics - Mantle Dynamics.
[2] B. Futterer, C. Egbers, N. Dahley, S. Koch, L. Jehring (2010). Acta Astronautica 66, 193–100.
[3] B. Futterer, N. Dahley, S. Koch, N. Scurtu, C. Egbers (2012). Acta Astronautica 71, 11–19.

Milestones

The following history shortly summarises the milestones for GeoFlow I (as delivered also in the GeoFlow I 30-Days Accomplishment Report) and lists more detailed the ones for GeoFlow II:

1999 Proposal to ESA (AO-programme), international peer review
2000 Project start (co-ordination by BTU Cottbus)
2002 Build-up and testing of laboratory model 'Breadboard' (BB), Phase A/B
2004 Design and build-up of 'Engineering Model' (EM) including Experiment Container GEOFLOW together with Space industry (EADS Space Transportation), Phase C/D
2005 Topical Team established
2006 Build-up of 'Flight Model' (FM), first tests (EADS)
2007 Parameterisation and tests of EM-/FM-hardware
2008 Start of COLUMBUS (March) and GEOFLOW-I (July/August)
2009 End of GEOFLOW-I (January)
Return of EC GeoFlow with 15A (March 2009)
Confirmation of GeoFlow II in FSL in 2010
Start of refurbishment
2010 Science test campaigns for parameterisation of the on-orbit experiment (March, July)
2011 Launch of GeoFlow-II on Automatic Transfer Vehicle ATV „Johannes Keppler" (16. February 2011)
Integration of EC GeoFlow-II into the Fluid Science Laboratory FSL (19. March 2011)
March-June (selected activities with impact on science)

- Accomplishment of 'mandatory set points' from Experiment Scientific Requirements Document ESR with Wollaston prism position no. 1 (horizontal fringes in reference images)
- Data download and setup of GeoFlow-II data base for synchronization of images and telemetry
- Go for deletion of VMU hard disk drive (technical data transfer validation on the base of check sums)
- Monitoring of measurements with so called MMA data (microgravity measurements)
- Revision of thermal control of Fluid Cell Assembly FCA lead to modification and validation of Experiment Protocol EP (automated control of EC)
- Revision of Fluid Science Laboratory FSL and Video Managing Unit VMU

June-September

- Starting performance of 'desired set points' from Experiment Scientific Requirements Document ESR with Wollaston prism position no. 2 (vertical fringes in reference images)
- Stop of experimental runs for clarification of microgravity measurements
- Update of VMU hard disk, commissioning of GeoFlow-II database

September-December

- Further performance of 'desired set points' from Experiment Scientific Requirements Document ESR with Wollaston prism position no. 2 (vertical fringes in reference images)
- Monitoring of measurements with so called MVIS data (microgravity measurements)
- Implementation GO deletion MVIS hard disk
- Development of MVIS data analysis on the base of statistical methods

2012 Completion of the GEOFLOW-2 science runs (until May) and wrap up TT-Meeting with definition of additional runs for GeoFlow IIb (March) resulting in ESR GeoFlow II, document reference SCI-ESA-HSF-ESR-GEOFLOW_II, issue 4, revision 0, date of issue 23/4/2011, chapter 4.5 'Additional runs: GeoFlow IIb'

Mission performance

For achieving the objectives and analogue to GeoFlow-I, the so called experiment flow plan was refurbished including now also the reference for the working environment of the GeoFlow-II set up.

All other procedures were 're-used': splitting in so called Runs and Downloads, furthermore allocation of the Runs with priority levels. With this inputs the Spanish User Support and Operations Center in Madrid (E-USOC) refurbished (in co-operation with EADS Astrium GmbH,

Friedrichshafen, Germany) the Experiment Protocol (EP) for the specific Runs to operate the EC on orbit. After each Run next step was the Download (of telemetry and images, as well as microgravity data) from ISS via German COLUMBUS Control Center (COL-CC), Italian Microgravity Advanced Research and Support Center Naples, E-USOC to BTU Cottbus.

From a planned number of 2x19 Runs (Run 1-19, priority 1-5, Wollaston position II and priority 6-10, Wollaston position I) all set-points were performed. Downloading and decompressing the data (images from measurement technique and telemetry from experiment protocol, as well as microgravity data) delivered error rates less than 1%. Errors correspond to corrupted images not usable for scientific evaluation. Now there exists the following statistics: 236.136 images from 58 number of Runs (including repeated Runs/set-points) on 74 experiment days i.e. 263,5 GB over-all with 182,5 GB Images and 4 GB Telemetry, 21,5 GB MVIS, 14,5 GB familiarization, 25 GB MMA, 16 GB SAMS.

Nomenclature

MMA - Microgravity measurement assembly (Eilers & Hofer, Act. Astronaut. 19,1989)

MVIS - FSL Microgravity Vibration Isolation System (http://www.asc-csa.gc.ca/eng/sciences/mvis.asp)

SAMS - Space Acceleration Measurement System (http://issresearchproject.grc.nasa.gov/Acceleration/SAMS)

Results

An important finding is the difference in the flow pattern for our two experiments. We see a sheet like thermal flow, if the physical properties of the fluid are not varying with temperature - a result from 'GeoFlow I'. If we use a liquid with varying (electro-hydrodynamic) volume expansion and temperature-dependent viscosity (GeoFlow II), we observe a plume-like dominated flow. As in [1], where the authors give an illustrated overview on relevant numerical and experimental contributions in 3D cartesian box to classify the convective patterns depending on the Rayleigh number at the top and bottom boundaries, we show a regime diagram of the various numerically assessed viscosity regimes in spherical geometry including our unique experimental data. We will discuss the similarities and the differences between the GeoFlow experiments and the numerical simulations in terms of convective patterns.

Figure 1. Sheet-like thermal flow in the GeoFlow I spherical experiment with silicone oil of temperature-stable properties (left, RaE=1.17·10^6) and GeoFlow II experiment using a fluid with temperature dependent viscosity and volume expansion (right, RaE=1.87·10^6).

Figure 2. Sample of numerical model for plume-like upwelling thermal flow with no-slip conditions, 1/r5 buoyancy for Racentr=6.42·104, viscosity contrast ··=103.

[1] S. Androvandi, A. Davaille, A. Limare, A. Foucquiera, C. Marais (2011). Phys. Earth Planet. In. 188, 132–141.

Topical Team Activities

ESA AO-099-049 Team Members

Prof. Christoph Egbers, Brandenburg University of Technology Cottbus, Germany

Prof. Rainer Hollerbach University of Leeds, UK

Prof. Pascal Chossat University of Nice, Sophia Antipolis, INLN, France

Topical Team Members

Prof. Philippe Beltrame University of Avignon, France

Prof. Doris Breuer German Aerospace Center (DLR), Berlin, Germany

PD Dr. Fred Feudel University of Potsdam, Germany

Prof. Innocent Mutabazi University of Le Havre, France

Prof. Laurette Tuckerman PMMH-ESPCI Paris, France

Associated partners

Prof. Tilman Spohn German Aerospace Center (DLR), Berlin, Germany

Prof. Andreas Tilgner Georg-August University Göttingen, Germany

Additional scientist guest of last meeting (alphabetical order):

Oliver Crumeyrolle, University of LeHavre, France

Anne Davaille, CNRS FAST Paris, France

Dieter Etling, University of Hannover, Germany

Wolf-Gerrit Frueh Heriot Watt University Edingburgh, UK

Marcus Gellert, AIP Potsdam, Germany

Ana-Catalina Plesa, DLR Berlin, Germany

Anthony Randriamampiania, University of Marseille, France

Peter Read, University of Oxford, UK

Günther Rüdiger, AIP Potsdam, Germany

Thomas von Larcher, FU Berlin, Germany

Meeting, BTU Cottbus, March 22-23 2012, Summary for GeoFlow III

Baroclinic waves are responsible for the transport of heat and momentum in the oceans, in the Earth´s atmosphere and in other planetary atmospheres. A successfully experimental analogue for the investigation of atmospheric flows is the simplification of the physical effects (temperature field, boundaries, velocity …) into a plane layer.

Precisely, this plane layer is a rotating annulus, which is heated at the outside and cooled from within. It is regarded as a generic weakness of this cylinder, that e.g. the mid-latitude and equatorial dynamics is not essentially trapped, where the gravity is perpendicular to the rotational vector. Also the seasoning of the atmosphere is not captured with the annulus. Boundary conditions for the atmosphere are complicated. Usually atmospheres have convection in the tropics. For other latitudes the troposphere is stable and the upper atmosphere shows radiative cooling for all latitudes. If a spherical experiment as atmospheric analogue shall be investigated, flexible temperature conditions are of interest, e.g. a homogeneous cooled outer sphere and a gradually thermally heated inner sphere, where the polar parts are cooler than the equatorial parts. The radius ratio shall be small. On the other hand, the rotational rate (captured by the Taylor number) shall be reasonably high to reach an atmospheric wave regime. At the end, this implies a moderate radius ratio.

The following list contains several identified research topics (also from contributed talks during the meeting), which summarizes a variety of aspects that cannot be studied in annulus geometry:

·Equatorial waves (Kelvin-, Rossby-, mixed type waves)
·Interaction of equatorial dynamics with the mid-latitude
·Multiple scale processes (wave interactions, boundary layers)
·Transitions to turbulence in comparison with the classical annulus
·Baroclinic instability with real beta-effect
·Scaling of baroclinic heat and momentum transports
·Validate General Circulation Model (GCM) studies
·Gravity wave emission by mid-latitude Rossby waves
·Energy spectra of stratified turbulence

Besides optical methods for fluid flow diagnostics (as delivered by the Fluid Science Laboratory Optical Diagnostics Modul FSL ODM in GeoFlow I and GeoFlow II mission), further quantitative analysis methods are in focus, i.e. a Nusselt number/heat flux measurement or methods for velocity field components.

News regarding the COSMIC project

Project COSMIC: 500 thousand euros from ASI to design and test within one year new processes for manned exploration of the Moon and Mars.

The challenge: to develop, also by means of self-propagating chemical reactions under microgravity conditions, like those ones on the Moon and Mars, new processes for manned space exploration. The objective: to allow manned space missions to extract and to utilize in-situ resources like oxygen and nitrogen necessary for human survival without being equipped with huge amount of supplies and to utilize specific tools to repair lunar and/or martian platforms also using in-situ materials, without going necessarily back to the Earth. This is not the script of a science fiction movie, but the brief identity card of the COSMIC project which will be developed at the University of Cagliari, Dipartimento di Ingegneria Chimica e Materiali, where the project coordinator Prof. Giacomo Cao works. The involved partners are: Dipartimento Energia e Trasporti of CNR, Centro di Ricerca Sviluppo e Studi Superiori in Sardegna (CRS4), Istituto Tecnico Industriale “Enrico Fermi” (Fuscaldo), and COREM srl. COSMIC is the first Italian project sponsored by the Italian Space Agency (ASI) in the framework of the manned space exploration. ASI, whose responsible for the project is Ing. Andrea Lorenzoni, provided the financial support of about 500 thousand euros to develop research activities and technological innovation not only for the manned exploration, but particularly for the technology transfer in favour of several applications to be performed on the Earth, in the framework of which suitable spin-offs are foreseen through the propagation of the financial support allowed at this stage. The research activity will be also dedicated to the evaluation of both the physico-chemical and structural characteristics of the products obtained by means of the developed processes, and specific parameters such as initial mixture composition or reactants particle size. Suitable parabolic flights where the developed processes can be tested under martian and lunar gravity, will be also performed. The participation of the secondary school ITIS from Fuscaldo represents a symbol for the Italian space activities where young people are involved. From the technological innovation point of view, application sectors from NASA, i.e. ISFR (In Situ Fabrication and Repair) and ISRU (In Situ Resource Utilization), will be taken into account. Regarding ISRU, the possibility of exploiting in-situ resources, such as oxygen and nitrogen, will be able to guarantee more flexibility when scheduling and managing future space missions.

The COSMIC project obtained the financial support by the Italian Space Agency (ASI) at the end of year 2009 with the goal of developing new technologies for robotic and human space exploration in the framework of the two well known paradigms among all the Space Agencies: : ISRU (In Situ Resources Utilization) and ISFR (In situ Fabrication and Repair).

The project which is coordinated by the Professor Giacomo Cao has had the contribution of the following partners: University of Cagliari - Department of Chemical Enginering and Materials, CRS4 - Bioengineering program, National Research Council - Energy and Transport Department, COREM srl (Small Medium Enterprise) and ITIS-Fuscaldo (High School).

During the evolution of the project, two patents among the others, which are also owned by ASI, have been filed:

G. Cao, A. Concas, G. Corrias, R. Licheri, R. Orrù, M. Pisu and C. Zanotti, "Fabrication process of physical assets for civil and/or industrial structures on the surface of Moon, Mars and/or asteroids", Patent 10453PTWO, Applicant: Università di Cagliari and Italian Space Agency, Italy, 28/07/2011.

G. Cao, A. Concas, G. Corrias, R. Licheri, R. Orrù and M. Pisu, "A process for the production of useful materials to sustain manned space missions on Mars through in-situ resources utilization", Patent PCT/IB2012/053754, Applicant: Università di Cagliari, CRS4 and Italian Space Agency, Italy, 24/07/2012.

The first patent has already obtained a positive feedback from the relevant Patent Office from an originality and patentability point of view, while the second one has been filed recently after the corresponding Italian version has received a positive evaluation from the European Patent Office.

It should be also noted that two of the technologies recently developed and patented in the framework of the COSMIC project have been selected for the future scenarios of robotic and human space exploration by NASA within the ISECG (International Space Exploration Coordination Group) in which 14 space agencies are involved.

The future goals of the COSMIC project are:

- the design of ground breadboard of the patented technologies for future robotic missions
- the design of ground breadboard of the patented technologies for future human missions
- the realisation of ground breadboard of the patented technologies for future robotic missions
- the realisation of ground breadboard of the patented technologies for future human missions
- the realisation of the payloads related to the patented technologies that are compatible with the lunar landers which will be ready very soon
- the development of new technologies for robotic and human space exploration.

Barcelona Aerobatics Zero-g Challenge

Zero-gravity experiments carried out at Barcelona facility, first European platform for microgravity research based on aerobatic flights. The competition has the support of the United Nations through the Space Generation Advisory Council. The members of the winning team in the second edition are from Spain, Uruguay and Canada.

20/11/2011
On Saturday 19 November, the three winners of the *Barcelona Aerobatics Zero-Gravity Challenge* had the opportunity to conduct experiments in zero-gravity conditions for their project on cardiovascular alterations caused by mental stress. The experiment was carried out at the Sabadell Airport, the home of AeroClub Barcelona-Sabadell (see map), which has become the first European platform for achieving zero-gravity conditions based on aerobatic flights.

The *Barcelona Aerobatics Zero-Gravity Challenge* – a competition coordinated by Professor Antoni Pérez-Poch of the Aeronautics and Space Research Centre (CRAE) <https://recerca.upc.edu/crae/> at the *Universitat Politècnica de Catalunya. *Barcelona*Tech (UPC)* – challenges undergraduate and postgraduate students at the UPC to design and set up a zero-gravity experiment within a limited time. The project, launched in 2009, is made possible by a collaboration agreement between the UPC, AeroClub Barcelona-Sabadell <http://www.aeroclub.es/>, and the Aerospace Cluster of Catalonia – BAIE <http://www.bcnaerospace.org/>. The partner organisations have worked together to develop the platform, coordinated by Professor Pérez-Poch, which enables students and research groups from around the world to conduct experiments under microgravity conditions at a reasonable cost without going into space.

The role of AeroClub Barcelona-Sabadell is to provide aircraft and pilots who can execute the aerobatic manoeuvres required to achieve microgravity. The club also offers researchers technical assistance to ensure that aircraft-based experiments are compatible with safety procedures. The BAIE facilitates synergies with local industry and provides advice based on its experience in the Microgravity Research Campaign of the European Space Agency (ESA).

How are microgravity conditions achieved? It is not necessary to travel to space to create microgravity conditions; they can be produced by any flight system able to generate free-fall conditions.

Any object orbiting the Earth is subject to these conditions, but they can also be recreated without going into orbit. Rockets that make suborbital flights with a free-fall trajectory can create microgravity conditions for several minutes. Specially modified commercial aircraft can create

the same environment for up to 25 seconds (the Airbus A300 is used for this purpose by the European Space Agency, the KC-135 by NASA, and the Ilyushin-76 by the Russian Federal Space Agency). Drop towers are another means of achieving microgravity. In this case, the experiment is enclosed in a capsule and allowed to fall through a tube inside a tower approximately 150 m high, an approach that provides weightlessness for between five and ten seconds.

Now there is a new way to achieve these conditions. Aerobatic aircraft can perform the same manoeuvre executed by larger commercial aircraft (a parabolic flight) to create up to eight seconds of zero gravity, a duration similar to that provided by drop towers.

Up until now this method had not been used in Europe for research purposes. The platform set up by the UPC, AeroClub Barcelona-Sabadell, and the BAIE has taken a lead in establishing the system with the platform's flight campaign, launched in 2010.

The advantage.
The more seconds of microgravity are required and the more complex the aircraft, the higher the cost of conducting an experiment.

Aerobatic aircraft are widely available and are designed to perform parabolic flights, so the planes do not need to be modified. As a result, the costs involved are much lower. In fact, the cost of maintaining and operating this platform is estimated to be a thousand times lower than the cost of conventional parabolic flights.

For many experiments, zero-gravity conditions do not need to be maintained for very long. In these cases, aerobatic flights are an ideal solution.

By providing an additional means of achieving weightlessness, the new platform broadens the range of options available to researchers, who can choose the most suitable platform according to the duration of sustained weightlessness required and the budget available.

Experimenting with mental stress
The second edition of the Barcelona Aerobatics Zero-Gravity Challenge involves the participation of the Space Generation Advisory Council, a global organisation that represents university students and young space professionals, and serves as an advisory body to the United Nations Office for Outer Space Affairs (UNOOSA).

The competition was won by a team of three aeronautical engineering graduates: *David Ferrer *(of the UPC's School of Industrial and Aeronautical Engineering), *Victoria Alonso* (of the University of the Republic, Uruguay), and *Jeffrey Osborne* (of Queen's University, located in Kingston, Ontario). The three young engineers were able to put to the test their project entitled "The effect of mental stressors on the cardiovascular system under different gravitational conditions", which examines how mental stress contributes to alterations in the cardiovascular system when gravity is altered.

The project is supervised by Nandu Goswami, a researcher with the Centre for Physiological Medicine at the Medical University of Graz (Austria).

This year's winning experiment was developed within the framework of the International Space University's <http://www.isunet.edu/>postgraduate programme. Professor Antoni Pérez-Poch participated in the programme in Graz (Austria) in August, and 25 students from around the world took part.

International dimension
Apart from the support that the UPC-AeroClub-BAIE platform has received from UNOOSA for this year's event, the outcome of the competition is the result of an evaluation by international experts on space research who are members of the European Low-Gravity Research Association (ELGRA).<http://www.elgra.org/>

The expert evaluation process was coordinated by Professor Javier F. Medina of the Spanish National Research Council (CSIC), who is responsible for ELGRA's educational activities. The factors taken into account were scientific merit, the adaptation of the experiment to the aerobatic aircraft, safety, the international perspective of the team, and the existence of a plan to disseminate the results of the experiment. Dr. Monica Monici and Prof. Dr. Floris Wuyts from ELGRA volunteered to perform the evaluations.

Applications to research on the cardiovascular system
Thanks to the agreement between the UPC, AeroClub Barcelona-Sabadell, and the BAIE, the Sabadell Airport is now a microgravity experimentation platform open to European scientists who belong to the European Low-Gravity Research Association (ELGRA), as well as to university students. The research Professor Pérez-Poch has led since 2007 on how zero-gravity conditions affect the cardiovascular system has played a key role in developing the platform.

The research, carried out in collaboration with Daniel Ventura, an aerobatic pilot with the flying club, has validated Professor Pérez-Poch's NELME numerical model, which simulates the cardiovascular changes that result from exposure to microgravity.

The experiments carried out and the technologies being developed in this field have proven essential to our understanding of physical, chemical and physiological processes. One example is the discovery of a fundamental mechanism that helps to control the cells that produce red blood cells.
This discovery stemmed from a study of "space anaemia", a common condition among astronauts.

The CRAE at the UPC

The Aeronautics and Space Research Centre (CRAE) at the *Universitat Politècnica de Catalunya. *Barcelona*Tech (UPC)* concentrates the University's research effort in the aerospace field. The CRAE also organises a number of official European master's degrees, including the master's degree in Aerospace Science and Technology (MAST)<http://mastersdegrees.upc.edu/mast/>

BAIE

The Aerospace Cluster of Catalonia – BAIE was established in 2000 by the governments of Spain and Catalonia and the Barcelona City Council, together with an initial core group of companies and universities. The cluster currently brings together 73 companies and organisations whose activities in Catalonia are related to aeronautics and space. The BAIE's mission is to represent and promote the Catalan aerospace sector and work to maintain and boost excellence, competitiveness, technology transfer, and science communication to the general public.

ELGRA has its Facebook's group:
the ELGRA-space!

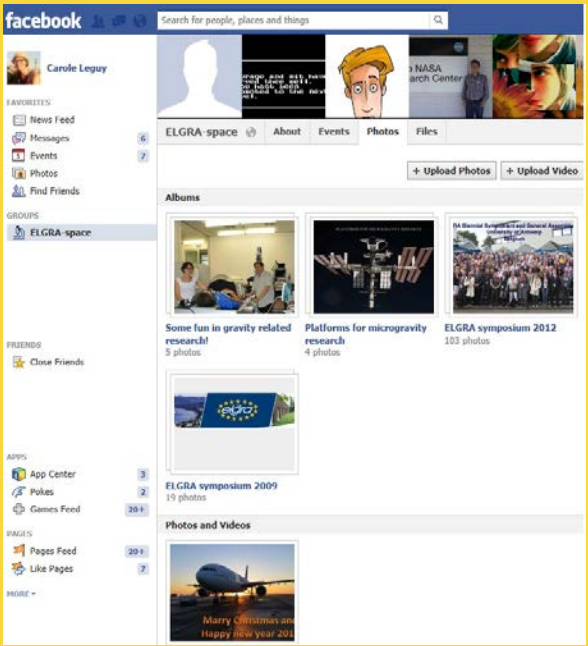
ELGRA members and friends can share pictures, as photos from ELGRA symposia and low-gravity research experiments. We thought that this group could generate new interactions between ELGRA members in an informal and convivial way whereas remaining space research related.

So please: Join us on Facebook and feel free to invite friends (colleagues) who are interested in low-gravity research! Add pictures of your experiments, post new events on the calendar (conferences, expositions, meetings,...), or other material and information that can be of interest for the ELGRA members.
To find us, you can search for Elgra-space once you are connected to Facebook.
http://www.facebook.com/groups/elgra/

We are looking forward meeting you on Elgra-space.

Visit and Rate our new Wikipedia page

We think that the visibility of our association on the web is very important, so we decided to create a Wikipedia page dedicated to ELGRA. Internauts can find basics information concerning the association as its hystory, the symposia ELGRA organized, the Management Committee and the activities in the educational field. Since this page is new, we need your support to validate it, so please visite our Wikipage and rate it at the bottom of the page!



IN FOCUS:

AMS-02 A Particle Experiment in Space, Searching for New Kind Of Matter

Roberto Battiston, University and INFN of Trento,
AMS Deputy Spokesperson

Cosmic rays were discovered by the Austrian American physicist Victor Hess in 1912. Indeed, until 1953 all the elementary particles (Muons, Kaons, Lambdas...) were discovered through the study of cosmic rays. Today, we know that there are two kinds of cosmic rays traveling through the vastness of space. The first type consists of neutral light rays and neutrinos that have been studied and measured for over fifty years. Many fundamental discoveries have been made as a result of studying light rays and neutrinos. The Hubble Telescope and ground based telescopes measure this type of cosmic ray. The second type consists of charged cosmic rays. Studying with high accuracy primary charged cosmic rays, before they interact with the atmosphere, is a much less explored realm in science. The Alpha Magnetic Spectrometer (AMS-02), installed on the International Space Station (ISS) and equipped with its magnet, its multilayer silicon detector to precisely track the trajectories of the particles and its array of precision particle detectors to study their specific properties, is expected to provide important data on the sources of these energetic particles. Because of its precision and discovery potential AMS has sometimes been referred to as the “Hubble Telescope for Charged Particles”.

The Search for Antimatter Universe

Each type of subatomic particle possesses an anti- particle counterpart with identical mass but opposite electric and magnetic properties. The existence of antiparticles was first predicted by the great British physicist Paul A.M. Dirac who noticed that in both the Theory of Relativity and the Theory of Quantum Mechanics there is complete symmetry between particles and antiparticles. Thus, it follows that along with antiparticles, antimatter, antistars and antigalaxies may exist.
According to the Big Bang Theory, equal amounts of matter and antimatter must have existed at the beginning of time and space. AMS will seek to answer the question why there is a preponderance of matter in our Universe. AMS will search for primordial antimatter extending by factors thousands to millions the current sensivity, approaching the TeV energy range. Matter and antimatter have opposite electric charges so the AMS magnet will be used to distinguish the sign of the charge of these particles emanating from distant galaxies. Antihelium and anticarbon are of particular interest because they could not have been formed by any known process since the time of the Big Bang. Therefore, the direct observation of just one antihelium or anticarbon nuclei would provide evidence for the existence of a large amount of antimatter somewhere in the Universe.

The Search for the Origin of Dark Matter

Experimental studies have shown that more than 90% of the matter in the Universe is not observable by optical means. The existence of this “Dark Matter” is discerned through its gravitational effects on other objects which can be seen. The Swiss Astrophysicist Fritz Zwicky first used this term to apply to evidence of missing mass in orbital velocities in galaxy clusters in 1933. There has been much research devoted to the understanding of Dark Matter but so far there has been no direct evidence of its existence nor solid understanding of its nature and composition.

AMS will study the question of Dark Matter through the characteristic distributions of positrons (e+), electrons (e−), anti-protons (p-bar) and gamma rays (γ). AMS will measure the cosmic ray spectra for e−, e+, p, p-bar and nuclei at energies ranging from 100 MeV to 2 TeV with 1% accuracy over the 11 year solar cycle. While collisions among these standard particles produces the expected background spectrum of positrons, collisions of Dark Matter particles would produce a characteristic additional flux of positrons and anti-protons, which adds to the the expected e+, p-bar spectrum generated from normal cosmic ray collision.

There is much theoretical speculation on this subject together with some puzzling experimental hints provided by the Pamela experiment, a space experiment which has observed a marked increase of the positron/electron ration as a function of the energy and above 10 GeV. Various models have been proposed: some have been ruled out from the first years of operation at Large Hadron Collider (LHC), some other will be tested by AMS-02. AMS-02 will be able to test the existence of Dark Matter particles up to masses in the range of TeV by studying the excess of high energy positrons, antiprotons and photons, secondary particles of dark matter particles annihilation.

AMS-02, with its sensitivity and the high statistics which will be accumulated during the lifetime of the ISS, will explore energy regions inaccessible to ground-based experiments at the LHC and beyond the capability of earlier balloon and small satellite space experiments.

Search for the Origin of Cosmic Rays and New Physics Phenomena

The accurate measurements of charged cosmic ray fluxes (for all nuclei) in space may yield surprising new and unexpected information on their origin, composition and propagation.

Cosmic rays are well known as the energetic particles that are constantly bombarding the Earth. These atomic nuclei have been studied by countless ground based and subatmospheric experiments. Unlike these experiments,

AMS-02 orbiting at an altitude of approximately 200 nautical miles (range 330-410 km.) above the Earth, will be able to detect the original cosmic rays in space before they collide with the Earth's atmospheric atoms. Through the detection of a complete spectrum of cosmic nuclei, we will gain important knowledge about cosmic radiation in space. The understanding of cosmic radiation is particularly important developing ways to mitigate its lethal effect on astronauts during long duration interplanetary flights.

AMS-02 will also study isotopes in cosmic rays which carry information on the nuclear processes like the trapping time of Cosmic Rays in our galaxy. In addition AMS-02 is uniquely capable of studying the existence of strange quark matter, or strangelets. Accelerator experiments over the last fifty years have shown that there are six types of quarks which are the building blocks of matter. All matter on Earth is made up of only two of the six known kinds of quarks; these are known as up (u) and down (d) quarks. The other four quarks are named strange (s), charm (c), bottom (b) and top (t). Strangelets, which were originally predicted by the physicist Edward Witten in 1984, represent a new type of matter composed of three types of quarks (up, down and strange) which should, in principle, exist in the cosmos. One candidate of a strangelet was experi- mentally observed in the data collected in the AMS-01 mission in 1998 and points the way for further searches in AMS-02.

These physics topics are among the interesting physics AMS-02 will address during its operation in space,. However the most exciting objective of AMS-02 is to probe the unknown realm of space where answers to many of the fundamental questions in physics, astrophysics and cosmology may be found.

AMS-02 Precision Particle Instrumentation

Since particles are identified by their mass, charge and energy, the AMS-02 detector has been designed and built to contain a magnet and an array of state of the art precision particle detectors. Together, this instrumentation defines and characterizes the charged particles that pass through AMS-02 from the far reaches of space.

The AMS-02 detector instrumentation is based on ground based accelerator physics technology but adapted to withstand the hostile environment of space, including forces of 3-12 g's at launch. For AMS-02, the instrumentation is required to operate flawlessly in zero gravity without the possibility of astronaut intervention for repair or maintenance. To ensure mission success, many modules were constructed for each subdetector component, the magnet and the 650 micro- processors (engineering modules (EM), qualification modules (QM), flight modules (FM) and flight spare modules (FS)) so that every system could be thoroughly tested and space qualified. Multiple redundancies have been built into every flight system, some as much as 400%. Associated with the detector instrumentation, are complex systems such as ultra fast electronics, thermal control, ground and flight software, alignment and positioning systems, interface and support structures, etc. These systems have also been developed specifically for AMS and have pushed existing state of the art technology to the limit. The completed detector measures 5m x 4m x 3m and weighs 15,251 lbs. (~7000 kg.) It has been built to fit within its Unique Support Structure (USS) which cradles the Detector within the shuttle cargo bay for its journey to the Space Station as well as to the attachment site on the Space Station external truss.

The centerpiece of AMS-02 is the large volume tracking spectrometer based on a permanent magnet coupled with 9 layers of high precision Silicon Trackers which will measure the sign of the charge and momentum of each particle traversing AMS-02. Particles and anti-particles will be identified according to their bending trajectories in the magnetic field. Entering from the top of AMS-02, positively charged particles (such as positrons, protons, nuclei, etc.) curve in one direction and negatively charged particles (such as electrons, antiprotons and anti-nuclei) curve in the opposite direction.

The magnet was made of 4,000 blocks of Neodymium Iron Boron (Nd2Fe14B) with a field intensity of 1,400 Gauss. The magnet was flown successfully on the AMS-01 engineering mission. Originally built in China, there were six magnets fabricated for tests including one to test to destruction. The magnet was designed and built to eliminate the effect of torque on the Shuttle or ISS instruments.

The Silicon Tracker contains 200,000 channels. Nine layers of precision silicon that measure the charge and momentum of the particles with unprecedented accuracy (a coordinate resolution of 10 microns or 1/10 millionths of a meter) comprise one of the largest and most precise detectors of its kind ever built to be used in space. Since the Tracker measures the curvature the corresponding rigidity (momentum divided by the charge) can be immediately derived and if the charge Z is also measured then the particle momentum can be calculated. The Tracker readout electronics is characterized by a very low power consumption with low noise and a large dynamic range.

There are a total of nine Tracker planes. Seven Tracker planes are located within the magnet bore (known as the inner Tracker). One is mounted on top of the Transition Radiation Detector (TRD) and one is mounted below the RICH detector to optimize the specrometer momentum resolution up to the TeV range.

The TRD is located on the upper portion of the AMS Detector. Its purpose is to identify and distinguish electrons and positrons from other cosmic rays. Since positrons can be mistaken for protons at high energies, the TRD suppresses the proton background which is important in the search for Dark Matter. Unlike the proton, the electrons and positrons emit gamma rays while crossing the TRD radiators surfaces. These gamma rays are recorded when electrons and positrons pass through the 20 layers of 6mm diameter

straw tubes alternating with 20 layers of 2 cm of polyethylene/polypropylene fleece radiator. Of the 9000 proportional mode straw tubes built, 5248 were selected based on the centering accuracy of the signal wire to 100 µm as measured in a hospital CAT scan. The leak-tight straw tubes are filled with an 80/20 ratio mixture of Xenon and CO2 at 1.25 bar absolute pressure from a re-circulating gas system. The gas system is carefully regulated to eliminate contamination and ensure stable pressure. Gas supply and circulation is continuously monitored. The endurance of the consumables based on usage and leak rate has been studied and data has shown that the consumables are sufficient to maintain the operation of the TRD for 30 years in space.

The Ring Imaging Cherenkov detector (RICH), with its 10,880 photosensors, will measure the charge and energy of the passing particles by precisely determining their velocities with an accuracy of 0.1%. Both the charge and the velocity are calculated from the geometrical shapes, circles or rings, generated by the Cherenkov effect.

The Electromagnetic Calorimeter (ECAL) is a 3-dimensional instrument made of 600 kg of lead sandwich and 10,000 optical fibers and will measure the energy and direction of trillion electron volt (TeV) light rays and electrons with high precision. Electrons, positrons or gamma rays interact in the dense material of the ECAL producing an electromagnetic shower of low energy particles. From the shape of the shower it is possible to reconstruct the direction (~ 1°) and energy (~2%) of the incident particle. This is particularly important for the measurements of high energy photons. From the shower development the ECAL distinguishes electrons/positrons from protons and heavier nuclei.

Launched to the ISS on may 16th 2011 on the STS-134 mission, in has been installed on may 19th and taking data since, at a rate of 1.5 billion events/month. CERN is hosting the Payload Operation Control Center (POCC) operating 24/7 directly on the loop together with the worldwide ISS control center network. The data processing and analysis is performed on a network of super-computer centers distributed worldwide, most notably at CERN, Italy, France, Spain and China. Since AMS is a precision experiment, the first year of data taking has been focused on the commissioning and devoted to the very detailed calibration of the various subsystems to get ready to the physics analysis which will be based on the initial set of 20 billion Cosmic Ray event.

AMS-02 has been designed, built and operated by a large international collaboration with a large European participation involving about 600 researchers from CERN Member States (France, Germany, Holland, Italy, Portugal, Spain, Switzerland) as well as from China, Korea, Mexico, Taiwan, and the United-States. Sponsored by US-DOE, AMS-02 has been launched and installed on the ISS by NASA.

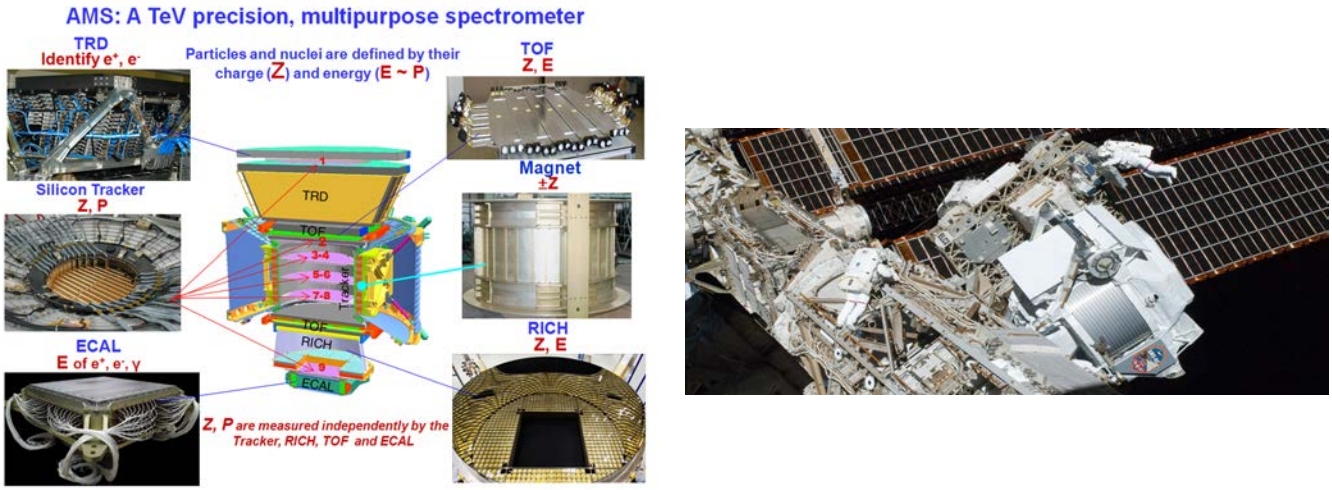


Figure 1: The images illustrate the structure and operation of AMS and its placement on the ISS

Application of diamagnetic levitation technology in space life sciences research in China

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As one of the ground-based alternatives for experiments in space, diamagnetic levitation technology now has been well established as a promising method to simulate weightless conditions [see also ELGRA Newsletter 2010]. However, relative to physics, chemistry and material sciences, the application of diamagnetic levitation technology in biological sciences has been rather late and the research remains at the initial stage and not perfect yet. In present paper, the studies on the biological effects of diamagnetic levitation in China, the advantages and disadvantages of diamagnetic levitation technology relative to competing approaches, and applications are discussed. It will be helpful to comprehensively understand and utilize the diamagnetic levitation technology.

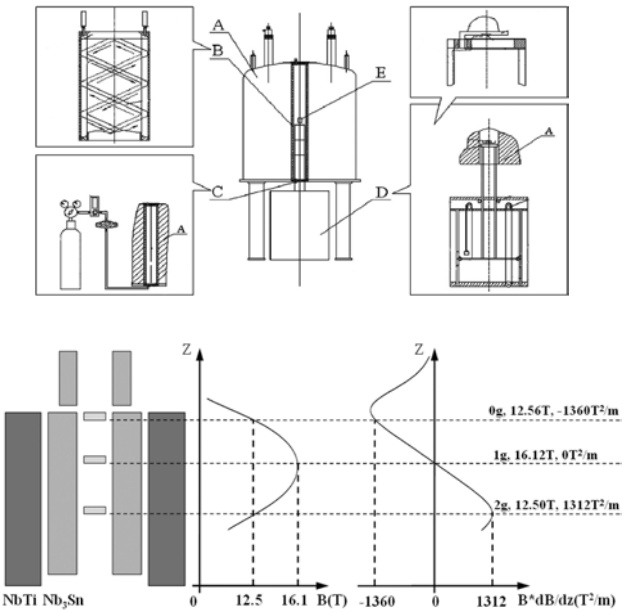

Fig 1. A diamagnetic levitation platform established by researchers in Northwestern Polytechnical University in China (high) and the distribution of magnetic density and magnetic field gradient in the superconducting magnet (low). (A) the superconducting magnet; (B) temperature control system; (C) gas control system; (D) object stage; (E) observing system.

A. Diamagnetic levitation platform in NPU

The specific specifications of superconducting magnet were proposed by authors in Northwestern Polytechnical University (NPU), China, and then the superconducting magnet was manufactured by JASTEC (Japan Superconductor Technology, Inc.) [1]. The superconducting magnet can generate a magnetic force field (B •dB/dz) of -1360 T2/m, 0 T2/m and 1312 T2/m in a 51 mm diameter room temperature bore and the corresponding magnetic field intensity is 12 T, 16 T and 12 T, respectively. So, the corresponding gradient (dB/dz) is -113.3T/m, 0T/m, and 109.3 T/m, respectively (Fig. 1).

The height of the superconducting magnet is 195 centimeters and a 51mm×450mm cylindrical cavity can be used for experiment. There are three special apparent gravity positions used for scientific research, namely μg, 1g and 2g in the bore of the superconducting magnet. Superconducting magnet is combined with main coils and a reverse coil. In order to obtain a high magnetic field gradient, the distance between main coils and a reverse coil is very close. The magnet consists of Nb3Sn and NbTi superconductors. The maximum magnetic field intensity in the centre is 16.1T at an operating current of 285.7 A. The maximum magnetic force field is -1513 T2/m, and the magnetic force field, which can make water be levitated, is higher than -1360 T2/m along 30 mm length in the bore of superconducting magnet. The measured field stability was about 0.27 ppm/h. At this stability, the levitation capability can maintain for more than four years.

B. Biological effects of diamagnetic levitation condition on animal and cells

Quail eggs and other biological samples were levitated by researchers in Northwestern Polytechical University (NPU) in China using diamagnetic levitation platform (Fig 1). The effects of diamagnetic levitation on silkworm embryogenesis have been investigated. Interestingly, the findings indicated that simulated weightlessness with diamagnetic levitation resulted in a lower hatching rate and a shorter life span but did not affect larvae growth velocity, incidence of abnormal markings and weight of cocoons compared with the control group [2]. The slow growth rate and curved shape of Arabidopsis seedlings exposed to diamagnetic levitation were observed by researcher in NPU compared to control. Changes in morphological behaviors, the activities of metabolites and genomic DNA of the filamentous fungus G. moniliformis EZG0807 were also observed under diamagnetic levitation condition [3].

The effects of diamagnetic levitation on mammalian cells have been carried out by researchers in Key Lab for Space Bioscience and Biotechnology [4]-[10]. Our results showed that diamagnetic levitation affected osteoblast morphology and cytoskeleton architecture. Moreover, cytoskeleton-associated gene expression and osteoblast functions such as proliferation and adhesion to extracellular matrix were also impacted. Diamagnetic levitation influenced osteocyte like cell MLO-Y4 morphology, nucleus size, cytoskeleton architecture and focal adhesion proteins distribution and expression. In addition, diamagnetic levitation induced human mesenchymal stem cells (hMSCs) apoptosis.

C. *Summery*

The magnetic force environment of high gradient magnetic field provides new opportunities for research in diverse areas. As a ground-based “zero-gravity simulator”, diamagnetic levitation has many attractive virtues, such as low cost, good reliability and repeatability. As all ground-based techniques, diamagnetic levitation technique also has its limitations. High magnetic field coexists with apparent gravity levels at all time, so it is difficult to absolutely distinguish the effects induced by the high magnetic field or by the simulated weightlessness. For biological organisms, the effect of additional stresses induced by the high magnetic field has to be considered, although there is no confirmed experimental evidence for deleterious effects of static magnetic fields on living biological specimens. While we cannot eliminate completely the possibility of magnetic field effects interfering with reduced gravity simulation, we can control for it by designing and comparing different experiment groups. Whether magnetic field effects interfere with the reduced gravity simulation can be determined by comparison of samples from each of these regions.

In addition, the limited bore size also restricts diamagnetic levitation technique to be widely applied in biological sciences. So far, the largest bore size of superconducting magnet effectively levitating diamagnetic materials is 66 millimeter [11], which is enough for cell culture and small model animal studies, such as Drosophila, Xenopus laevis, silkworm and paramecia, but it is difficult for large animal experiment. We believe that the new generation levitation instruments with much larger bore size will be built in the near future.

In any case, diamagnetic levitation, as a fascinating physical phenomenon, has many attractive properties and is worthy of further study. The diamagnetic levitation is a powerful technique to complement existing ground-based methods for simulating weightlessness and will be valuable for biological research and will yield some intriguing surprise.

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STUDENT'S SECTION

European Summer University: Origins of Life and Life in Space

Since years a summer school on space and life sciences research has been organized in Banyuls-sur-Mer in France. The initial courses were supported by European Union funding but for the last years the support came directly from various participating universities as well as from ESA and ELGRA. The course was previously organized by our former ELGRA president Prof. Gerald Perbal and after his retirement it is now managed by Prof. Marie-Chistine Maurel from the Universite Pierre-et-Marie-Curie. ELGRA first supported a number of students in 2007. Various ELGRA members also lecture at course.

Figure 1: Participants of course

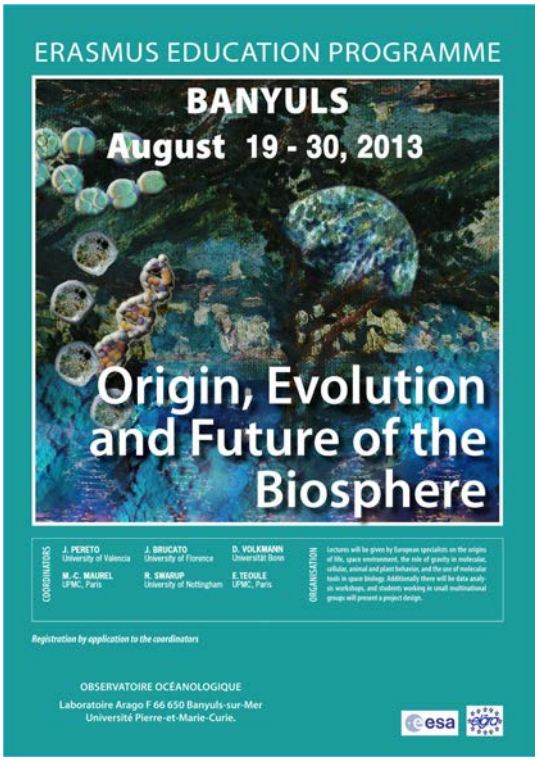
Last year, 2011, 38 students from France, Germany, Switzerland, Italy, the United Kingdom and Spain participated in the Banyuls course. This year 37 participated. We want to alert you on this possibility for you (as a student) or for educators who might forward this possibility to their students. Lectures were be given by European specialists on the origins of life, space environment, the role of gravity in molecular, cellular, animal and plant and human life. Additionally there were data analysis workshops and students working in small multinational groups in order to present a project design. We will inform you on next year's opportunity to participate in this summer school in due time.

Jack van Loon

Information of course content

The course Origins, evolution and future of the Biosphere takes place in the Observatory Océanologique of Banyuls-sur-Mer. The aim of the course is to form European students and giving them the means of a critical reading of actual knowledge concerning origins, evolution and functioning of the biosphere. The program will carry a general regard on the biosphere functioning, by being interested in the origins of life and in the training of the first ecosystems, in the possible roles of hydrothermal systems in biological evolution and in the elucidation of the metabolic ways kept in the course of evolution. Also environmental parameters such as pressure or gravity (microgravity) will be addressed. The social dimension of these scientific data will be also approached. Teachers of different disciplines participate to the course (biologists, biochemists, biophysicists, physicists).
Scientific data will be introduced during lectures and the critical analysis of results of experiments will be performed during tutorial courses. By multinational groups, the students will have to work out a plan of experimentation, which will be presented at the end of the intensive program.

Marie-Christine Maurel



ELGRA and ESA Education programmes : Drop Your Thesis! and Spin Your Thesis!

Since 2008, ELGRA has been involved in the definition, selection and progress of several ESA Education hands-on programmes for university students, starting with the challenging and popular « Fly Your Thesis ! » programme that gave the opportunity to 12 MSc and PhD student teams to develop and perform their own microgravity experiments in parabolic flights, before being placed on hold after the last campaign in autumn 2012.

Meanwhile, two other exciting programmes have been developped in collaboration with ELGRA to allow teams of students to experiment in microgravity or hypergravity conditions: « Drop Your Thesis ! » allows students to perform an experiment in the ZARM drop tower in Bremen, Germany, with an excellent level of microgravity as part of their Master or PhD thesis, while the « Spin Your Thesis ! » programme gives university students the opportunity to perform a scientific or technology experiment in the ESA Large Diameter Centrifuge at ESTEC, Noorwijk, the Netherlands, with a great flexibility over the duration, experiment sequence and level of hypergravity (up to 20 g).

From the start, these programmes have been designed like real space programmes, which not only provide the technology to gather scientific or technological data which is useful to the students' syllabi or projects, but involve the complete procedure from the idea and proposal writing to the results through design, development and experimental campaign in a professional environment. They are therefore a great introduction to the fields of space and gravity related research.

ELGRA is involved through a partnership with ESA Education at several levels, starting with the promotion of the programme and its expertise for the delicate task of proposal review, selection and suggesting mentors.
All ELGRA members have the possibility and are encouraged to contribute, participate and benefit from these programmes. First through their active promotion among the students and professors of our institutes and universities as a privileged mean to promote gravity related research. Second, by being associated to a project as the ELGRA mentor of selected teams to assist and advise young researchers in the design and development phases of their experiments, as well as in the exploitation and publication of results.

The calls for proposals for the 2013 campaigns are now open, with deadlines on 5 February for Spin Your Thesis! and 11 February for Drop Your Thesis! Detailed information can be found on http://www.esa.int/Education/

REPORTS FROM NATIONAL DELEGATES

France

France, through CNES and ESA, has had activities in life and physical sciences in space for several decades. Over the years, France has developed an expertise in many areas, with a focus on human physiology, physics of fluids, fundamental physics, biology and exobiology.

More specifically, in physiology, CNES, in cooperation with DLR, has developed the instrument CARDIOLAB for cardiovascular research on board the ISS. There is also a cooperation with Russia on CARDIOMED, an equipment for medical operations which has been on the Station since 2010. Besides, new perspectives in cardiovascular research with China are initiated. Other areas of interest in physiology are neurosciences and nutrition, for which many experiments are performed on the ISS in cooperation with several space agencies around the world. One has also to mention that in MEDES, a CNES subsidiary, many bedrest campaigns have been performed (some of them including artificial gravity through a short-arm centrifuge) to simulate the effects of weightlessness on the human body.
As far as physics of fluids is concerned, the highlight is DECLIC, an instrument operational on the ISS since 2009. DECLIC, which stands for DEvice for the study of Critical Liquids and Crystallization, has been realized in cooperation with NASA. CNES is also developing research in granular matter.

PHARAO, an atomic clock with a very high precision, is under development at CNES and is to be integrated in the Atomic Clock Ensemble in Space (ACES) project of ESA, which is supposed to be attached to an external pallet of COLUMBUS in a few years. It will provide a very high precision of time.

France has been active for years in biology. CNES is now studying an advanced incubator with a fluorescence capability. In exobiology, many French experiments are performed on the ISS (EXPOSE facility) and also on the Russian platform FOTON.

Most of the experiments in the fields mentioned before are operated from CADMOS, the French center of the COLUMBUS ground segment, co-funded by ESA and CNES and located in the CNES premises in Toulouse. CADMOS is in particular the leading European center for physiology.

Last but not least, France provides parabolic flights to Europe thanks to the NOVESPACE company. Experiments on board the zero-g aircraft often prepare the ones to be performed later on the ISS.

In summary, CNES has a variety of activities in life and physical sciences in space, mostly done in European or international cooperation.

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Spain

Spain is a member state of the ELIPS programme. Its contribution in the last Ministerial Conference (CM-08) reached 6 M€, that represents a participation of 2.5%.
The Scientific Spanish community is present in diverse disciplines covered by ELIPS, with more intensity in Physics research (corresponding to 65% of total experiments with Spanish participation) followed by Biology (15%) and Bedrest (8%).
Among the current projects with relevant Scientific Spanish contribution, it is worth to mention the following:
-ASIM (Atmosphere Space Interactions Monitor). The objective is to study high-altitude optical emissions from the stratosphere and mesosphere above intense thunderstorms. It is proposed for the International Space Station external facilities on the Columbus module.
-Seedling Growth. The project, under Spanish leadership, aims to determine the effects of gravity on cellular signaling mechanisms of phototropism and to better understand the cellular responses to light stimulation in microgravity conditions, regarding cell growth and proliferation.
-BedRest. Evaluation of changes in cardiac repolarization during Bedrest experiments.
On the other hand, the Spanish industry is increasing its participation in ELIPS. It is primarily oriented towards developing instruments for microgravity and manned flights, together with instrumentation and control systems for life-support systems. Some of the present projects that have significant participation of Spanish companies are:
-Mares (Muscle Atrophy Research and Exercise System). It is an ESA facility for research into the effects caused by weightlessness on human muscles. A Spanish company has been the prime contractor of this project.
-MiDASS (Microbial Detection in Air System for Space). To develop a miniaturized, automated system for sampling and monitoring the microbiological quality of air and surfaces.
Furthermore, Spain hosts one of the nine “European User Support and Operations Centres – USOCs” delegated by ESA for the preparation and execution of experiments aboard the International Space Station. The Spanish USOC (E-USOC) is mainly in charge of experiments concerning Fluid Science.

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Belgium

Every three to four years, ESA (European Space Agency) has a Ministerial meeting to decide the level of budgetary resources for science and technology programmes. During the last one which took place in Naples on 20-21 November, Belgium demonstrated again a dynamic willingness to take part into the odyssey of space at paneuropean level. Most of its scientific activities are related to astrophysics, meteorology, aeronomy, microgravity phenomena, remote sensing and “space weather”.
Since the 1960's, Belgium is a strongly reliable partner of Europe in space. With an annual budget of some 175 millions € per year - some 15 euros per inhabitant - for Europe’s presence in space, it remains the most active player in the European Space Agency. Described as "the largest of the smallest countries or the smallest of the largest countries" of Europe in space, the federal Kingdom of Belgium is contributing to every ESA programme. It is the n°5 of ESA for its contribution to the optional programmes, just after Germany, France, Italy and the United Kingdom.
In Belgium, space development, as a matter of international affairs, is a federal competence managed by the Space Research and Applications Department – a team of 25-people - of Belspo (Belgian Public Office for Science Policy). With the efficient partnership of the BHRS (Belgian High Representation for Space Policy), this Department is acting as the effective “agency” for the Belgian space activities in universities, research institutes, industries. It obtains from the national government the budget of 1,018 million € for space activities during the next five years (some 200 million € annually). From this budget, 497 million € will finance the new programmes of ESA for the period 2013-2016: scientific missions, new launchers (access to space), ISS (International Space Station) exploitation, manned spaceflight technology, Earth observations, telecommunications systems, navsat applications, small missions, support technology, SSA (space situational awareness) for the “space weather” aspect.
Space in Belgium must take into account the scientific community and the industrial competences of the Regions and Communities for their sustainable participation to the high-tech activities and innovative programmes of ESA for transportation, exploration, applications, and experimentation. Through space research & development activities, Belgian high-tech industries, scientific institutes and laboratories are involved with original ventures in space systems and applications within a national strategy of technological niches :
- The Centre Spatial de Liege (CSL), consisting of large simulators (vacuum chambers, shakers) to calibrate and qualify sophisticated optical systems, is a key element for the European network of space test facilities. It designs and develops new instrumentation for astrophysics and environment-monitoring observatories in space, not only for ESA missions but also for NASA spacecraft. CSL is the heart

of the Walloon “spatiopole” with many spin-offs in aerospace technologies: Amos (vacuum chambers, mobile telescopes, opto-mechanical structures), Spacebel (tailored software for space systems and missions, including manned spaceflight), LMS Samtech and Gdtech (modelling processes and engineering studies using finite element analysis software).

- The Space Pole of "Plateau d'Uccle" in Brussels combines research, with spacecraft and ground instruments, in earth and space sciences at the Royal Observatory of Belgium (ROB), the Royal Meteorological Institute (RMI), the Belgian Institute for Space Aeronomy (BISA). These federal institutes are not only meeting the requirements of the science community, but also serving the needs of the society (global change, environmental health, space weather). Recently, a spectrometer which will be developed by an international team under the management of BISA was selected as the European instrument for the ExoMars 2016 mission around the Red Planet to study the components of the Martian atmosphere. The Belgian User Support and Operation Centre (B.USOC) is the main site to control scientific and technological experiments in the International Space Station (ISS), as well as to manage operations with observatories in space. For example, the French Piccard satellite for solar observations, combined with the “made in Belgium” PROBA-2 observatory.

- Engineering and space technology incubators are taking form in Wallonia and in Flanders in Europe’s framework of ESA BIC (Business Incubation Centres). Their role is to help start-up enterprises as “spin-offs” of R & D efforts in space systems. Created with the support of WSL (Wallonia Space Logistics) and Idelux, ESA BIC Redu - near ESA Redu Centre - is located in the Galaxia Business Park of Transinne-Libin (Province of Luxembourg). ESA BIC Flanders is managed by Innotek at Geel (Province of Anvers).

- The VITO (Vlaamse Instelling voor Technologisch Onderzoek) in Mol has a very active department in remote sensing and earth observation processing (Teledetectie en Aardobservatie Processen). It promotes a lot of applications with Vegetation data received from French SPOT-4 and SPOT-5 satellites, while it works on the advanced technologies of hyperspectral sensors. It will be the main user of the PROBA-Vegetation mini-satellite to be launched during 2013.

- The “Magnetic Valley” in Viroinval, with the Centre de Physique du Globe (CPG) of Dourbes, is looking for spin-offs through applications in satellite navigation and communications signals. The CPG, part of the Royal Meteorological Institute, is well equipped to establish precise measurements related to seismic action, to changes in the magnetosphere and the ionosphere. In order to accurately use navsat positioning for Galileo applications, it is crucial to know permanently the disturbances in ionospheric layers, due to the activity of the Sun.

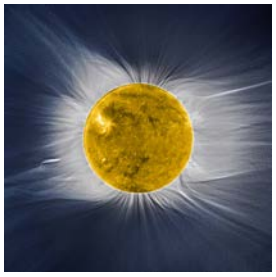
Belgium is onboard the ISS (International Space Station) in 400-km orbit, permanently inhabited by 6 astronauts and cosmonauts for periods of six months. QinetiQ Space, with the Microgravity Research Center of Université Libre de Bruxelles (ULB), and the Lambda-X company (in Nivelles) also provide some essential structures and some instrumentation for ISS facilities.

The second “made in Belgium” spacecraft or PROBA-2 (Project for OnBoard Autonomy) was launched on 2 November 2009. This enhanced micro-satellite of 130 kg is a compact scientific observatory carrying Belgian instruments for solar observations, with a multi-purpose technological payload for the European industry. It comes along and after the successful PROBA-1 which is still functioning satisfactorily around the globe since 22 October 2001. It continues to collect fine photographs of various areas in the world, about fires, pollutions, environmental changes.... This experimental microsatellite of 94 kg is equipped with sensors and cameras for high-resolution earth observations (panchromatic vision of 10-m resolution, multi-spectral images of 25-m resolution) and with systems for space environment measurements. Currently in development for a Vega launch in March 2013, PROBA-Vegetation will monitor, every two days, the agricultural resources around the glob

Most of the Belgian universities are concerned by specific aspects in space research. The ULB is studying fluid physics phenomena with its MRC (Microgravity Research Center). The KU Leuven is involved with the development of micro-electronics for space systems. The VKI (Von Karman Institute) is specialized in aerodynamics and re-entry problems; it is the prime contractor of the QB50 constellation with some 50 Cubesats to be deployed for thermosphere “in situ” measurements. The University of Liege is organizing two Masters in space science and in aerospace systems. It is developing Cubesat-type nanosatellites for scientific purposes and it has studied the evolution of foams in the ISS (International Space Station). Inside MELISSA (Micro-Ecological Life Support System Alternative) consortium for ESA, SCK/CEN or StudieCentrum voor Kernergie/Centre d’Etude de l’Energie Nucléaire (Mol) and University of Mons are designing and testing an innovating ecosystem for long-duration human life in space; they are part. The main force of Belgium in space is its strongly active role in international cooperation for new steps towards the future of Europe in space research and applications.

Theo PIRARD Space Information Center/Belgium

Illustrations:



V_Proba2_ECLIPSE2010_Comp-WL_SWAP_11

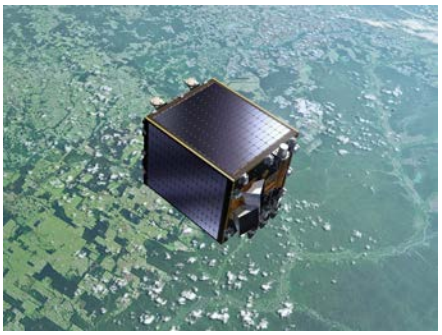
Spectacular vision of the solar activity, with the use of the observations of « made in Belgium » PROBA-2 satellite of ESA.

© ESA

V_PROBA2_thermal-test

The small solar observatory PROBA-2 of ESA was developed by Belgian firms QinetiQ Space and Spacebel. It is seen during thermal tests at ESTEC before its launch from Russia.

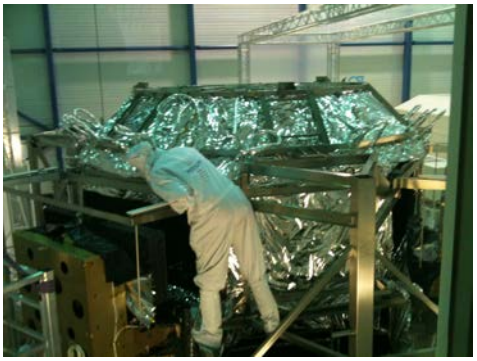
© QinetiQ Space



V-PROBA-V-03-LR_H

PROBA V(egetation) has a dedicated payload to monitor the global vegetation. Its launch with Vega from Kourou is scheduled for Spring 2013.

© QinetiQ Space



V-CSL-Gaia_photo1

The payload of Gaia, the next scientific mission of ESA, during tests at Centre Spatial de Liège. The astrometry observatory will be launched by end of 2013.

© CSL-P.Rochus

The Mouse Drawer System, MDS developed by ASI and flown with STS-128 (August 2009) to the ISS. Possible reflight of MDS in near future. Astronaut Nocole Scott with the MDS in the JEM. (Picture NASA)

Italy

The Italian Space Agency (ASI) Life Sciences Programme began in 1990 as part of a general, overall scientific programme. Today, the Medicine and Biotechnologies Programme has the specific objective of gaining knowledge through space research and transferring it to medical applications on Earth.

The primary goals of the ASI MED Programme are:

- To understand life processes and adaptation mechanisms in the space environment in the long term. That issue will undoubtedly require a new understanding of the biological organization theory
- To sustain a human programme to explore the solar system and beyond;
- To boost medical research on ground with the results of the medical investigations in space;
- To foster the integration of multi-disciplinary expertise, both scientific and industrial, for programmes of high-level technology transfer.

The Programme is focused on five main application-oriented research areas which require special facilities and flight opportunities. ASI provides access to different space platform, from parabolic flights to International Space Station, thanks to a cooperation mainly with ESA, NASA and Russian Space Agency, FSA.

To reach the goals of these programmes a scientific and industrial network has been created over the years. Today, more than one thousand researchers, 164 Institutes of research and 18 industries are fully involved in Biomedicine and Biotechnology research in space.

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The Netherlands

The Netherlands had a very disappointing last two years regarding gravity related research. The Dutch science authorities, NWO and the Ministry of Education Science and Culture have decided, based on a very biased and unfunded report from the Royal Academy of Sciences, KNAW, not to have dedicated grant opportunities for (micro-)gravity research and manned space flight anymore. This is quite catastrophic for our science community. Through that program we could apply for PhD and Postdoc positions as well as support for execution of flight campaigns. Such funding now has to be obtained through a very broad and general research program. This means competition with area's as cancer or cardiovascular research. This in contrast with disciplines as astronomy, Earth observation and planetary research which did keep their earmarked funding programs. An initiative where some 180 scientists appealed to this decision was apparently not convincing enough.

The decision is even more striking if one realizes that out of all the selected proposals from the 2009 ESA ELIPS AO proposals more than 20% had a Dutch participation. Such numbers clearly show the interests and needs of the Dutch science community to make use of the ELIPS program. The participating role of Dutch scientists in these, most international, proposals was also voiced in letters from ELGRA, but also COSPAR and or colleague organizations from Japan (JASMA and JSBSS) and the United States (ASGSB). We hope that this current lack of support to our community will be temporarily and that the need for funding for such research is recognized again in future years.

A very positive note to this was the flight of the ESA astronaut from Duch origin, André Kuipers, to the International Space Station. Kuipers was launched on 21 December 2011 from Baikonur and returned on the 1st of July, 2012. A record time of 193 continuous days in orbit for a European astronaut.

During his mission Andre generated quite some attention in Europe but especially in the Netherlands. This is one of the reasons that the Dutch are still participating within the new ELIPS-4 program although with a contribution not reflecting the interests of the science community. We also hope and believe that André's drive to advocacy for manned spaceflight and gravity related research brings a positive attitude for future opportunities.

Jack J. W. A. van Loon : j.vanloon@vumc.nl
Chairman, Dutch Microgravity Platform

André Kuipers (picture ESA)

During his mission Kuipers also assisted in the docking of the first commercial capsule, the Space-X Dragon, arriving at the ISS. The Dragon system will take over significant logstics tasks now the Shuttle is not in survice anymore. (picture NASA)

TOPICAL TEAMS

ESA Arabidopsis Topical Team

The European Space Agency (ESA) has initiated an Arabidopsis Topical Team with the objective to discuss how equipment developed for plant experiments in the European Modular Cultivation System (EMCS) can be re-used to gain needed scientific knowledge in the future. In addition potential use of ground based facilities should be discussed. The focus has been on equipment that can support Arabidopsis thalianain different development stages:

- the TROPI equipment for experiments with young seedlings up to 5-6 days old,
- the GRAVI equipment with a modification for cultivating Arabidopsis, supporting up to 12 days old seedlings, and,
- the MULTIGEN equipment where the whole life cycle can be supported.

An open splinter meeting was organised during the ESA Life Science Symposium in Aberdeen, UK on the 21st of June 2012 by a group of scientists (Table 1) with experience with the EMCS and the above mentioned experiment equipment. The EMCS and equipment were introduced at the meeting.

Team members	Affiliation
Eugenie Carnero-Diaz	Universite Pierre et Marie Curie, Paris, France
Javier Medina	Centro de Investigaciones Biologicas, Madrid, Spain
Raúl Herranz	Centro de Investigaciones Biologicas, Madrid, Spain
ElodieBoucheron	Universite Pierre et Marie Curie, Paris, France
Veronica Pereda-Loth	Universite Paul Sabatier, Toulouse, France
Christian Mazars	Universite Paul Sabatier, Toulouse, France
Tor-Henning Iversen	Norwegian University of Science and Technology (NTNU), Trondheim, Norway
Abdul Basit Mohammad	NTNU Samfunnsforskning, Trondheim Norway
Ann-Iren Kittang (chair)	NTNU Samfunnsforskning, Trondheim Norway
Valérie Legué	Lorraine University, Nancy, France

Table 1

The participants at the meeting pointed out that more detailed information on the technical and operational experience with the equipment needs to be provided to the scientific community since the strategy now is to re-use rather than develop new equipment.

During the meeting the fundamental research areas requiring investigations in the future were discussed; different areas within plant development (gravitropism, phototropism, cell cycle, cell differentiation, adaptation to microgravity) and molecular and cellular mechanisms (perception, plant signalling, epigenetics). It was agreed that exposures such as gravity and interaction between gravity and other factors (e.g. light) should be studied, as well as radiation (e.g. low doses of gamma radiation in experiments on ground). Microarrays, proteomics, molecular reporter systems, macromolecules and metabolites, were important keywords in the discussions when it came to analyses to be performed.

A more coordinated approach from the ESA side between fundamental and applied research was recommended. It was suggested during the meeting to focus the prioritized research area in a long term strategy linked to the functions of plant totipotency, autotrophy, meristematic competence and acclimation. This can be interesting both from a fundamental and applied point of view. This matter will be discussed further in the Arabidopsis Topical Team. The KUBIK facility should also be included in the long term strategy and research plan where e.g. cell culture experiments can be performed.

An alternative two-step model for the selection of new experiments was suggested: 1)ESA initially i.e. before the Announcement of Opportunity (AO) stage, announce an obligatory “call for experiment ideas”, and, 2)Based on the similarities and synergies of the different science team ideas, it is recommended that the scientific teams are asked to work together and submit a joint proposal at the AO within clearly defined scientific and technical frames. ESA has previously organised workshops linked to the AO trying to get scientists to collaborate in teams, but the number of scientists who wanted to do so was limited.

It was agreed in the meeting that in order to obtain integrated results from space experiments a database where all results (meta data, analyses) are collected will be useful. Sample «archives» post-flight are not recommended. The use of the samples should be carefully planned pre-flight ensuring that all samples will be used. If this is not possible, samples should be shared directly between the investigators.

The use of ground based facilities was regarded as important for both answering fundamental questions such as the “gravity effect on life” rather than only microgravity, and to optimise the experiment protocol prior to flight. For investigators with already approved space experiments, access to such ground based facilities is essential.

For more information on the ESA Arabidopsis Topical Team work please feel free to contact the chair via email: Ann-Iren.Kittang@ciris.no

DELTA-G: motor control in unstable dynamics

Neurological and cognitive responses to spaceflight challenge the performance of crewmembers at critical times during missions, including launch and entry. Operational performance such as controlling a vehicle or manipulating a complex system may be impaired by altered sensorimotor control, all of which are triggered by g-transitions and persist for some time after the central nervous system adapts to the new gravitational environment. Most investigations that addressed motor adaptation in new gravitational contexts focused on distinct stable phases, such as the 0, 1 and 1.8g intervals in parabolic flights.

However, gravity may also vary significantly and continuously over time. Multi-sensory recalibration is already time consuming in a stable new dynamical context but raises even more challenges when the underlying environment is also varying itself, bringing an additional cloud of uncertainty on motor processes. A new ESA Topical Team has been founded with scientists who paved the first track to our understanding of the effect of altered gravity on motor control. The kick off meeting (29-30 Oct 2012) provided the basis for an ambitious research plan (see picture).

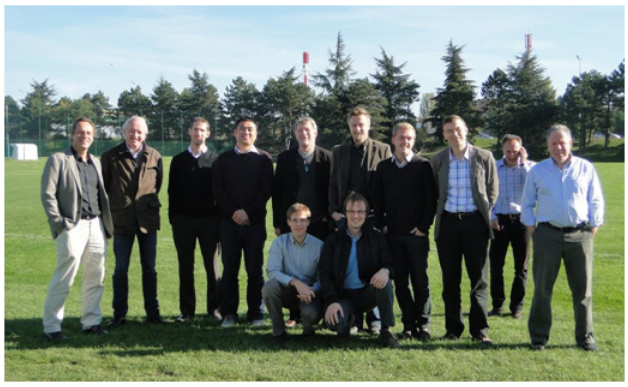

Figure 1. Participants at the kick off meeting held in Dijon, France. Dr. Gunnar Blohm (CA), Dr. Frédéric Crevecoeur (CA), Prof. Joachim Hermsdörfer (DE), Prof. Amir Karniel (videoconference from IL), Prof. Thomas Lang (US), Prof. Philippe Lefèvre (BE), Prof. Thierry Pozzo (FR), Dr. Jon Scott (UK), Prof. Jean-Louis Thonnard (BE), Dr. Olivier White (FR), Dr. Jack Van Loon (NL) and Dr. Jan Babic (SI).

Robotic experiments – in which a programmed force field deviates a reaching movement – don't provide a holistic method to study motor control adaptation: only the end-effector is perturbed whilst e.g. feedback and vision remain unaltered. Here, we propose a series of experiments utilizing centrifuges. These unique ground-based facilities provide a way to control accurately a profile of hyper-gravity that can, for instance, mimic what the crew undergoes during the launch phase (see Fig. 2).

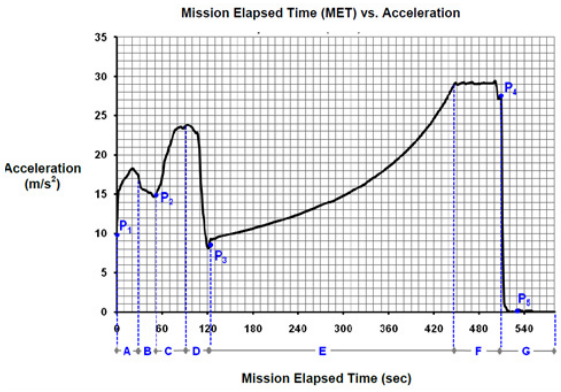

Figure 2. Typical acceleration profile of the spacecraft during the first 10 minutes of a mission. P1 to P5 correspond to key points during the initial phase of the mission.

In particular, we will address the following questions. What is the exact role of passive exposure to hyper-gravity on subsequent motor tasks? What are the effect and persistence of long-term hyper-gravity (1h) on motor tasks and cognitive functions? What oculo-motor strategies are developed when gravity varies? Why do some motor control features adapt in a few seconds to a new environment while others don't even show a sign of convergence to an optimal behavior? The next meeting will be organized in Sweden mid next year near a centrifuge facility.

Spatial disorientation and situational awareness issues are responsible for up to a quarter of all civil aviation accidents. Better understanding of the mechanisms underlying disorientation as well as development of physical aids (e.g., tactile situational awareness system) might also be useful for commercial and military aviation. Knowledge gained from the proposed investigations can be transferred directly to patients with specific lesions or disorders requiring retraining or rehabilitation.

Contact: Dr. O. White (olivier.white@u-bourgogne.fr, Website: http://deltag.weebly.com).

Report from Topical Team "Geodesy, Clocks and Time Transfer"

The ESA Topical Team "Geodesy, Clocks and Time Transfer" held its biennial workshop in Potsdam, Germany on October 25-26, 2011. The workshop took place at the Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, located in the science campus "Albert Einstein". The campus on the Telegraphenberg is situated in a park-like setting with a number of research facilities and several historic buildings, the most famous being the "Einsteinturm" (Einstein tower).

The workshop focussed on "Geodesy Applications of the ACES Mission". The Atomic Clock Ensemble in Space (ACES) mission is a fundamental physics experiment carrying the PHARAO (Projet d'horloge atomique par refroidissement d'atomes en orbite) and SHM (Space Hydrogen Maser) instruments. ACES primary objectives are tests of these two high-performance atomic clocks under microgravity conditions and additional validations of Einstein's theory of general relativity. Further mission objectives are related to time and frequency metrology as well as space geodesy and gravimetry. ACES will be attached to the International Space Station's Columbus module and is scheduled for launch in spring of 2016. The contributions covered a wide range of technical and scientific aspects of precision time and frequency generation and distribution and demonstrated an advanced status of the project.

For the workshop about thirty scientists from six countries including the US convened at GFZ. In eighteen presentations various topics ranging from the current status of the ACES mission, microwave and optical techniques for frequency transfer and the ACES data processing to GNSS applications, future technologies and future missions were discussed. In the evening of the first day the participants were given a guided tour through GFZ's satellite laser ranging facility. In a splinter meeting following the workshop a proposal of Topical Team members in response to the ESA research announcement for "ISS Experiments relevant to study of Global Climate Change" was discussed and finalized.

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Stress Challenges and Immunity in Space: From Diagnosis to Preventive and Therapeutic Strategies

The Topical Team “Stress Challenges and Immunity in Space” has been set up to address and identify in an interdisciplinary approach the role and impact of important stressful conditions occurring in space or in future extraterrestrial habitats. Especially the interaction of stressor: e.g. confinement, weightlessness, different level of oxygen tension, radiation effects) with interacting neural- and immune functions has been defined to be a major topic to be addressed. For this purpose the Topical Team met since its inauguration in 2008, nine times to develop integrative theories and suggestions to open up a better understanding of stress-immune interactions with the goal to set-up new preventive or therapeutic strategies to protect from and to treat stress-associated immune alterations in space. Also, the Topical Team has discussed, as planned, the development and use of new technical tools to help assessing the individual´s homeostasis under stressful condition, always keeping – beyond applications for space- also a future application for life on Earth in the focus as well. Overall the multidisciplinary approach has resulted in very fruitful discussions and complementary scientific approaches.

Achievements and Perspectives:
1.) In response to the ILSRA 2009 for research on the ISS, the TT together with non TT-members have submitted two research protocolsThe realization of the protocols CONSCIOUS/IMMUNO-2 [Consequences of Stress Challenges on stress response systems and Immunity in Space: a multidisciplinary approach] and MoCISS [Monitoring the Cellular Immunity by in vitro Delayed Type Hypersensitivity assay on the ISS] for the ISS is under way. Also fruitful scientific exchange and data extraction on previous and on-going projects from the TT members was set up in order to get advantage of the new thoughts and inputs generated in the group.
2.) The discussions at the TT meetings have initiated a project to publish a book on “Stress & Immunity in Space” which was accomplished as a Springer publication in early 2012. With the authors from the Topical Team and their associates morethan 60 authors from different continents have contributed to it.
3.) The planning and organization of an international workshop addressing new multidisciplinary approaches to countermeasure unfavourable changes of immune and organ homeostasis under the conditions of and in response to (space flight related) stressors (TT plus 20 non-TT experts from US, Russia and Europe).

Members:
Baatout, Sarah Dr.; Belgian Nuclear Research Centre, SCK-CEN, B-2400 Mol

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ESA Topical Team on Arts & Sciences: ETTAS

Arts and space project samples

Bradley Pitts: Singular Oscillations

SINGULAR OSCILLATIONS attempts to know the oscillating space of parabolic-flight in its own right rather than use it to understand its effect on other phenomena. The project is an ongoing collaboration between Bradley Pitts, Projekt Atol Flight Operations, and the Gagarin Cosmonaut Training Center in which the entire cabin of the IL76-MDK is cleared except for one subject who is allowed to float and fall freely with their eyes closed, ears blocked, and naked. This immerses the subject in the variable-gravity space and heightens their awareness of it, while minimizing their affect upon it. Thus SINGULAR OSCILLATIONS explores the empty volume of the plane in and of itself. While SINGULAR OSCILLATIONS takes place within the context of a scientific facility, the expressed aim of the project is to produce immeasurable, subjective experience.

Year : 2008

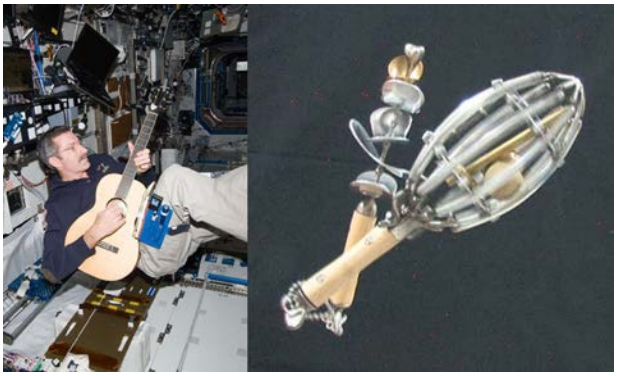
Partners : Projekt Atol Flight Operations, Gagarin Cosmonaut Training Center, Russian Air Force

Production : Star City, RU

Websites :
http://www.bradleypitts.net/projects/singularoscillations/

Thanks : Rob Defares, Fokker Technologies, and the Rijksakademie van beeldende kunsten, Erwan van Buuren, Ben Geraerts, Eddo Hartmann

Credit : © 2008 Bradley Pitts



Ayako Ono & So Negishi : Space Musical Instruments

To represent the theme of Cultural and Artistic Utilization of the International Space Station the Japan Aerospace Exploration Agency (JAXA) selected a project by Ayako Ono for implementation.
Space Musical Instruments consists of a pair of musical instruments suitable for weightlessness, which can be played easily (with or without musical accompaignment). The aim of this project is to foster the development of new musical communication tools, and to inspire the public about space and science.
The instruments were launched to the ISS on October 31, 2011. NASA astronaut Daniel C. Burbank played the instruments on the ISS on February 10, 2012, extending his time of involvement beyond the the procedure manual.
Two pieces of music were played (with specially prepared background music):
— “Dream Starts" (composed for the space musical instruments by artist Jaakko Saari), and
— a two minute edition of "Kiyoraka na sora", composed by acclaimed pianist Akira Takahashi

Year : 2009 – 2012

Partner : JAXA

Production : Development of Instruments: So Negishi (metal artist) & Ayako Ono (artist, leader)

Websites : http://iss.jaxa.jp/kiboexp/news/120213_smi.html
http://ameblo.jp/hiikalu/day-20120209.html

Credit : © 2012 JAXA & Ayako Ono / So Negishi

Christian Waldvogel: The Earth turns without me

The Earth's rotation was cancelled by travelling westward across the Alps at the speed with which the Earth turns in Switzerland (1158 km/h). In order to reach this speed, a cooperation with the demonstration team of the Swiss Air Force was established.
In order to document (or «prove») the standstill, a military jet was converted into a supersonic pinhole camera, using red filter gel and film which is susceptible only to blue light. During the four minutes of standstill — in which the Earth turned by one degree of longitude — this pinhole camera was used to photograph the Sun in a single exposure. Due to the relative motionlessness between the camera and
the Sun the resulting image shows a point (instead of a streak, which would result when using a camera that turns along with the Earth.
Furthermore, a film was made that shows the Earth turning as seen from a point fixed in space, by filming out of the front cockpit. Camera crews on the ground and aboard a chase plane provided footage for a documentary movie.

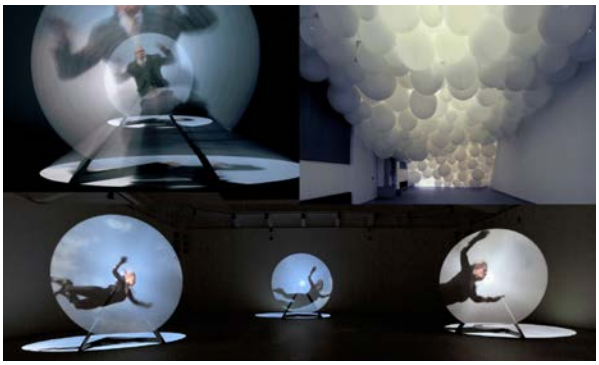
Year : 2010 / 2011

Partners : Swiss Air Force, Swiss National Television

Production : Switzerland

Websites :
www.waldvogel.com/art.php?jahr=2010&id=54&abstand=2
www.vimeo.com/waldvogel/kulturplatz

Credit : ©2010 Christian Waldvogel



Eva Schlegel: In Between

Schlegel’s work «In Between» consists of three aircraft rotors, each with a diameter of 3.80 m, where films are projected onto, giving the impression of floating images. Schlegel's projections on these rotors are films of people free flying, ascending weather balloons and related physical phenomena.
In a second installation, an amorphous sculpture of giant white floating weather balloons fills the space .

Year : 2010

Partners : MAK — Museum of Applied Arts, Vienna, and Bodyflying, Zurich

Production : Austria, Switzerland

Websites : http//www.evaschlegel.com

Credit : ©2010 Eva Schlegel

Sarah Jane Pell: Undercurrent

Pell's performances highlight the body's transfer of air and our dependence on air as living, breathing beings.
They explore the physical and emotional limits of the body… Undercurrent presents a single performer contained within a sealed transparent dome with a finite amount of breathable air. [Undercurrent] is extremely physically demanding for the performer and has an overwhelming emotional intensity…* Undercurrent brings awareness to the fragility of our species and planet. As air runs out in her mini biosphere, the artist’s dancerly body begins to display violently sublime contortions and amplified breathing — real live flight/flight/surrender survival instincts — in the face of an impending state of emergency.
Audiences reflect on the act/action/activism a poetic metaphor for embracing every last breath of life and as a call-to-action for responsible human exploration of space with immediate spin-off benefits for Earth. * Aer — The Vehicle of the Soul by Andrea Polli 2007

Years : 2003–2005

Partners : Perth Institute for Contemporary Arts, Edith Cowan University, Freedman Foundation, DANCE4, Bonnington Gallery.

Production : Nottingham Trent University Live Art Unit.

Websites : http://www.sarahjanepell.com/undercurrent.html http://greenmuseum.org/c/aer/projects/interdepend/index.htm

Credit : ©2004 Sarah Jane Pell / Video Stills: Richard Graham

A Very Large Centrifuge for Human Research.

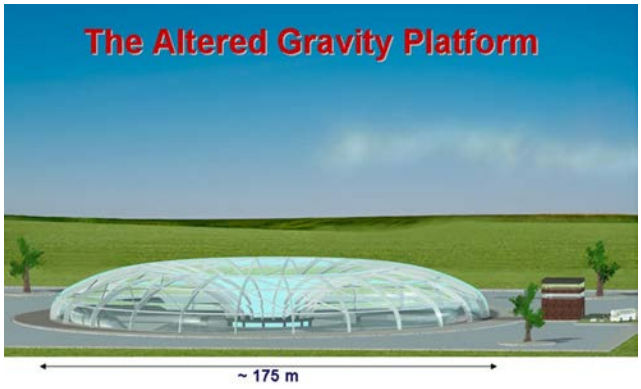


Figure: A sketch of the 175 m diameter AGP dome enclosing the rotating platform.

This initiative stating of as an ESA Topical Team, on the "Altered Gravity Platform", AGP a human hypergravity habitat. The AGP serves as a research platform both in preparation for the human space exploration initiative as well as a facility for basic science questions.

Space flight causes a multitude of physiological problems, many of which are due to gravity level transitions. Going from Earth's gravity to microgravity generates fluid shifts, space motion sickness, cardiovascular deconditioning etc., but returning into a gravity environment puts the astronauts similarly under stress. To prepare for future manned space exploration missions, we should look into the feasibility of a platform for countermeasure research against the deleterious effects of g-level transitions.

AGP is a large rotating facility (diameter ~> 150 m, tbc), where increased gravity levels (up to ~1.5g) can be generated, from short, transit simulations to prolonged stays of weeks or even months. On this platform, facilities are built where a crew of 6 to 8 humans can live autonomously. Adaptation from 1g to higher g levels can be studied extensively. Conversely, re-adaptation back to 1g, after a prolonged period of altered g can also be investigated.
The study of the physiological and psychological adaptation to g-level changes will provide the scientific community with instrumental and fundamental knowledge to better define and predict the ultimate countermeasures that are needed for future successful manned space missions. Besides knowledge for space exploration the system can also be used for research regarding obesity, sports and training or rehabilitation.
The initial approach for the AGP was to provide an altered gravity environment. However, Moon or Mars habitats might not have an Earth like atmosphere with ~ 1013 hPa pressure and a 21% O_2 fraction. The AGP might additionally be used as closed research platform to explore altered environments as well. In addition the AGP could also be a test bed for Life Support Systems currently under development. Finally, such a large rotating platform could also serve as Coriolis platform for research on e.g. tornados. Because so many different science and engineering issues are involved, a multidisciplinary approach is crucial. But like the ISS, it is a unique laboratory to investigate human behavior to altered environmental conditions, and as such advances science in general and in particular for future spaceflight.

The current group of researchers and more industrial partners involved are:
J. Albiol (Barcelona, ES), J. P. Baeyens (Kortrijk, BE), D. Belavy (Berlin, DE), J. Berte (Brussels, BE), S. Blanc (Strasbourg, FR), K. Bok (Hardinxveld-Giessendam, NL), J. Bos (Amsterdam / Soesterberg, NL), R. Boyle (Moffett Field, US), L. Braak (Toulouse, FR), N. Bravenboer (Amsterdam, NL), A. Chouker (Munich, DE), G. Clement (Strasbourg, FR), P. Cras (Antwerp, BE), E. Cross (Nijmegen, NL), M-A. Custaud (Anger, FR), M. De Angelis (L'Aquila, IT), P. de Boever (Mol, BE), O. de Haas (Dresden, DE), T. Delavaux (Cologne, BE), R. Delfos (Delft, NL), P. Denise (Caen, FR), M. Eekhoff (Amsterdam, NL), O. Eiken (Stockholm, SE), D. Felsenberg (Berlin, DE), K. Fong (London, UK), C. Fuller (Davis, US), N. Goswami (Graz, AT), S. Grillner (Stockholm, SE), E. Groen (Soesterberg, NL), J. Harlaar (Amsterdam, NL), M. Heer (Cologne, DE), N. Heglund (Leuven, BE), H. Hinghofer-Szalkay (Graz, AT), M. Hughes-Fulford (San Francisco, US), S. Iwase (Aichi, JP), J.M. Karemaker (Amsterdam, NL), B. Langdahl (Aarhus, DK), D. Linnarsson (Stockholm, SE), C. Lobascio (Turin, IT), C. Lüthen (Rotterdam, NL), M. Mayrhofer (Ranshofen, AT), I. Mekjavic (Ljubljana, SI), M. Monici (Florence, IT), M. Moss (New Castle, UK), E. Mulder (Cologne, DE), M. Narici (Nottingham, UK), P. Norsk (Copenhagen DK / Houston, US), W. Paloski (Houston, US), C. Poelma (Delft, NL), K. Prisk (San Diego, US), M. Rutten (Eindhoven, NL), P. Singer (Tel Aviv, IL), J. Sommeria (Grenoble, FR), D. Stegeman (Nijmegen, NL), A. Stephan (Dresden, DE), G. Stienen (Amsterdam, NL), P. Suedfeld (Vancouver, CA), P. Tesch (Stockholm, SE), O. Ullrich (Zurich, CH), R. van den Berg (Noordwijk, NL), P. van de Heyning (Antwerp, BE), GJ. van Heijst (Eindhoven, NL), J.J.W.A. van Loon (Amsterdam, NL)*, L. Vico (St. Etienne, FR), E. Woodward (Hampton Hill, EU), L. Young (Boston, US), F. L. Wuyts (Antwerp, BE)*. *: coordinators.

For additional info contact: Jack van Loon, ACTA - VU-University, Amsterdam: j.vanloon@vumc.nl

MEMBERS' SECTION

Kayser-Threde GmbH (KT)

Dr. Mario Schweitzer,
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Over the last year, KT was active in many fields of microgravity research.

PK-3 Plus
The PK-3 Plus plasma crystal facility is successfully operational on the ISS for 7 years now. In January 2013 the 20th Mission will be performed together with scientists from MPE, Garching and JIHT, Moscow.

PK-4
The Flight Model of the next generation of plasma crystal facility, focusing more on dynamic aspects in complex plasma, is currently in preparation. In summer 2012 the CDR has been performed, the facility is expected to be ready for launch in early 2014. It will be located inside the EPM rack of the Columbus module.

Figure 1: PK4 experiment integrated into the Experiment Apparatus Container (EAC)

SKIN B
As contractor to DLR Kayser-Threde is responsible to adapt and qualify a skin physiological experiment (SKIN B) to be used in the Columbus module. The hardware and software is based on commercial products from the company Courage+Khazaka in Cologne. The scientific PI of the project is Prof. Dr. U. Heinrich from Derma Tronnier GmbH & Co. KG. In 2012 KT delivered three identical ground models while the final proto-flightmodel delivery will be at the beginning of 2013. The launch is planned at the end of March 2013. It is planned that five astronauts will use the experiment in space and on ground. The experiment will complement the scientific data taken during the ASTROLAB mission 2006 with the precursor experiment SKINCARE. Compared to SKINCARE several technical improvements could be achieved to guaranty aneven better data quality and handling comfort.(DLR project ; support code: 50WP1106)

Figure 2: SKIN B experiment stowed in Launch Pouch

EXPOSE R2
After the successful missions EXPOSE-E and EXPOSE-R, KayserThrede will be the prime contractor to ESA for the mission EXPOSE-R2. The project will start at the end of 2012 and last for about 12 month. New experiment trays will be procured (supported by the subcontractor RUAG) that will be mounted into the EXPOSE-R facility located on the outer surface of the Russian ISS module Zvezda. The trays will carry biological samples that will be exposed to space conditions to improve our knowledge related to astrobiology and the origin of life.

BMTC-GD
The 2 Biotechnological Mammalian Tissue Culture Ground Demonstrators are stored and waiting for green light from ESA for delivery to university of Marburg (David Jones) and university of St. Etienne (Laurence Vico). The particular challenges of biocompatibility and bubble free operation of the Fluid Storage Cassettes have been solved and the contractual lot of 250 units has been manufactured and sterilized. For safe operation the 2 units have been subject to a CE certification process.

OMEGAHAB
OMEGAHAB is a scientific biological-zoological experiment (co-operation of German and Russian scientists), which will be performed under microgravity conditions on board the unmanned re-entry capsule BION-M1. The mission duration will be 30 days, and is scheduled for April 2013. Fish, algae, snails, water fleas, and aquatic plants are the biological samples in the aquarium with different connected compartments. The photosynthetic algae will produce the oxygen for the fish, controlled by LED illumination. Kayser-Threde is responsible for the OMEGAHAB boxes (EM, FM, FSM), all mechanical and electrical interfaces to the BION satellite, the project co-ordination between the partners, logistics, experimenter and mission support (DLR project; support code 50WF1003).

POLIZON

POLIZON-2 is a crystal growth facility, developed by TsENKI-NIISK, Moscow. Five crystal growth experiments (co-operation of German and Russian scientists) will be performed under microgravity conditions on board the unmanned re-entry capsule FOTON-M4. Kayser-Threde is responsible for the project co-ordination between the partners, ground support program, logistics, experimenter and mission support (DLR project; support code 50WF1101).


Sample ampoule from the University of Freiburg

TEXUS 50/51

Two TEXUS microgravity sounding rocket missions are envisaged for spring 2013. The experiments on TEXUS-50 are dendrite growth velocity and microstructure of Ni68.5Al31.5 Raney alloy solidified in micro gravity environment experiment from DLR Köln, gravity-induced absorbance changes in Phycomyces (2) experiment from University Marburg and Konstanz as well as isolation of mRNA from microgravity and ground control samples to identify gravity related gene expression from University Freiburg. The experiments on TEXUS-51 are laser based optical frequency comb from MPQ Munich, critical speed for collection of particles during solidification of solar silica from Fraunhofer Institut Erlangen, signal transduction in immune cells from University Magdeburg as well as directional and unidirectional solidification in transparent alloy from ACCESS Aachen. The launches of the VSB-30 sounding rocket are planned for 12th and 19th of April 2013.

AWARD-WINNING STUDENT PRESENTATIONS

The Student Session of the Antwerp Symposium consisted of six oral communications, three of Life Sciences and three of Physical Sciences, previously selected from the total of 19 applications received, based on the contents of two-page abstracts sent by applicants. The presenters were: Marie-Laure Machado, Ana I. Manzano, Anja Simon, Francesc Suñol, Stefan Krämer and Johannes Weppler. Student communications not selected for oral presentation were presented as posters in their corresponding subject sessions.

In addition to the presentations by students, the session included a contribution of the ESA Education Office on the opportunities offered by the Agency to University students in the fields of microgravity and hypergravity research, as well as the presentation of the initiative for the establishment of a European Network of students in the field of altered gravity promoted by ELGRA and coordinated by the Spanish Association LEEM.

Among the student oral presentations, the attendants voted for election of the best presentations in Life and Physical Sciences, respectively. A total of 50 votes were recorded for LS and 49 for PS. The winners of the Student Contest were:

Anja Simon (Life Sciences)

Francesc Suñol (Physical Sciences).

Figure 1: Students who participated in the Student Competition.

Figure 2: The winners Francesc Suñol (left) and Anja Simon (right)

Levitron-Functional Weighlessness For Gravisensing Protists Generated By Magnetic Field?

Student: Anja Simon

Academic Supervisor: Ruth Hemmersbach

German Aerospace Center, Institute of Aerospace Medicine, Biomedical Science Support Center, Linder Hoehe, Germany; Friedrich-Wilhelm-University of Bonn, Institute of Zoology, Bonn, Germany

The ciliate Paramecium and the flagellate Euglena are model systems for the mechanism of gravisensing in protists. Both show at 1g negative gravitaxis (orientation against the gravity vector) which guides them to the surface and thus to optimal living conditions. Due to current knowledge graviperception is based on mechanosensitive ion channels in the cell membrane which are stimulated by the mechanical load of the cytoplasm [1]. Both organisms have been extensively studied in real microgravity, functional weightlessness (clinorotation) and under hyper-g conditions (centrifugation). By rising gravity the orientation of a gravitactic cell population becomes more pronounced, indicating that the response at 1g is not saturated. In microgravity both unicellular organisms show a random distribution.

The orientation of Paramecium and Euglena was analysed in the course of exposing them to a magnetic field gradient (High Field Magnet Laboratory Nijmegen, The Netherlands) to investigate whether the effect of diamagnetic levitation generates functional microgravity conditions for them. The cells were immobilised by means of NiCl2 or liquid nitrogen and then observed at different field intensities (T) in order to find their point of levitation. This value will be assumed as 0g, higher field intensities will be assumed as inverted gravity environments [2]. Even at 4450 T2/m immobilised cells of both types still sediment. Levitation could not be achieved for those organisms by a magnetic field strength of as much as 30T. However, by changing the magnetic susceptibility of the medium or an enforcement of the magnetic field strength it might be possible to levitate those objects. But two facts have to be mentioned: For one thing both organisms show a strong alignment with respect to the magnetic field. Even if levitation is achieved by changing the mentioned parameters it will not be possible to check whether free swimming cells experience altered gravity conditions [fig. 1].

The field-induced alignment will hide the expected response (random swimming distribution) known from real microgravity. Furthermore it is important to notice that every component of the cell experiences a different force due to the different material it consists of and the varying magnetic susceptibilities. Though the magnet might provide the possibility to levitate objects, it will not provide functional weightlessness for the chosen test systems due to the strong alignment of cells, the restricted area of exposure, and the difference in forces acting on the subjects.

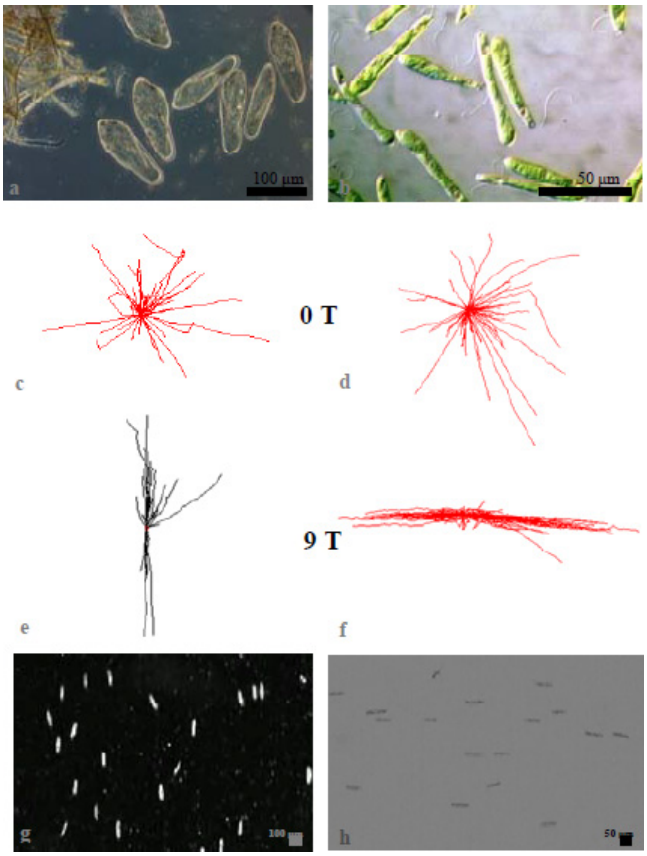

Figure 1: Alignment of Paramecium aurelia and Euglena gracilis to a magnetic field at different strength. (a) P. aurelia in bright-field microscopy. (b) E. gracilis in brigth-field microscopy. (c) circular histograms of the distribution of P. aurelia at 0T. (d) distribution of E. gracilis at 0T. (e+g) vertical alignment of P. aurelia with respect to the magnetic field at 9T. (f+ h) perpendicular alignment of E. gracilis with respect to the magnetic field at 9T.

References:

1. Häder, D.-P., Hemmersbach, R., Lebert, M., “Gravity and the behaviour of unicellular organisms”, Cambridge University Press, (2005).

2. Guevorkian, K., Valles, J.M., “Swimming Paramecium in magnetically simulated enhanced, reduced and inverted gravity environments.”, PNAS, Vol. 35, p.13051-13056, (2006)

Impinging Bubbly Jets At Different Gravity Level

Francesc Suñol and Ricard Gonzalez-Cinca Department of Applied Physics, Universitat Politecnica de Catalunya C/ Esteve Terradas 5, 08860 Castelldefels (Barcelona), Spain

Bubbly jet impingement have been studied experimentally and numerically in normal gravity and in microgravity conditions. Zero gravity results have been obtained at the ZARM Drop Tower, which allows 4.7 s of a microgravity level of g $10^{-4}g_0$, where g_0 = 9:81 m/s^2. In order to generate millimetric bubbles, a slug flow is created inside a capillary T-junction (d = 1 mm inner diameter) prior to injection into a test tank full of distilled water. A detailed study of this bubble generation method is reported in Arias et al. [1]. Bubble size and velocity are controlled via the gas and liquid ow rates. Different separations between jets have been considered (from 50 mm up to 100 mm). Results on the global structure of the impinging jets and the individual behavior of bubbles are presented.

In Figure 1, the measured bubble velocities at jet centerline are presented, for different distances between injectors (right, same distances correspond to different liquids (i.e. distilled water and ethanol), and for different momentum fluxes (left). Good agreement with a modified Schlichting [2, 3] solution for a single-phase jet have been obtained near the nozzles.

Bubble size distribution in microgravity conditions is shown in Figure 2. The size distribution varies in time due to the increasing number of bubbles in time, together with numerous coalescence events which are the responsible of the wider tail in the bubble size distribution. However, in normal gravity, the bubble size distribution attains a steady state due to the fact the number of bubbles does not increase with time, all the bubbles that enter the recorded region, leave it after a few milliseconds (t 100 ms) due to the buoyancy force [4].

CFD simulations have been carried out at different gravity levels and different separation between jets. A qualitative comparison between the CFD simulations and the experimental results have been carried out, obtaining a good agreement on the global structure of the impinging jets.

In Figure 3, the time evolution of the gas volume fraction is presented for the normal gravity and microgravity cases.

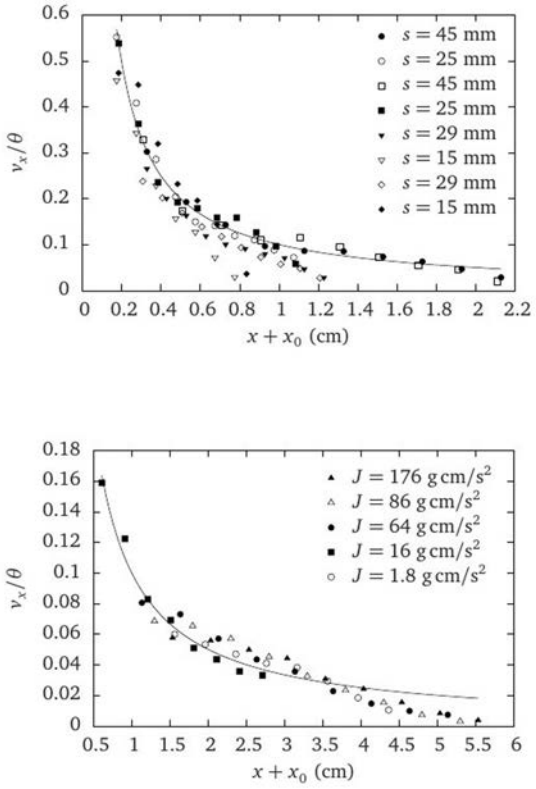

Figure 1: Bubble velocities at jet centerline. High: normal gravity case. Low: microgravity case.

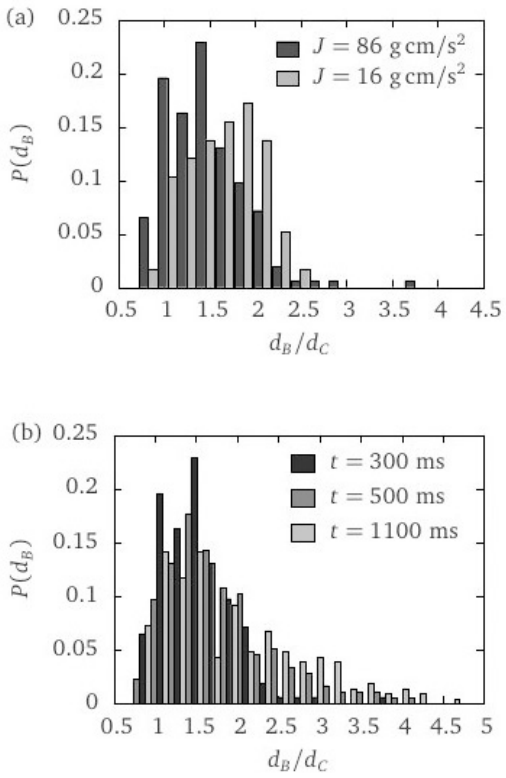

Figure 2: Bubble size distribution in microgravity conditions. (a) Different momentum fluxes at a fixed time. (b) different times at a fixed momentum flux.

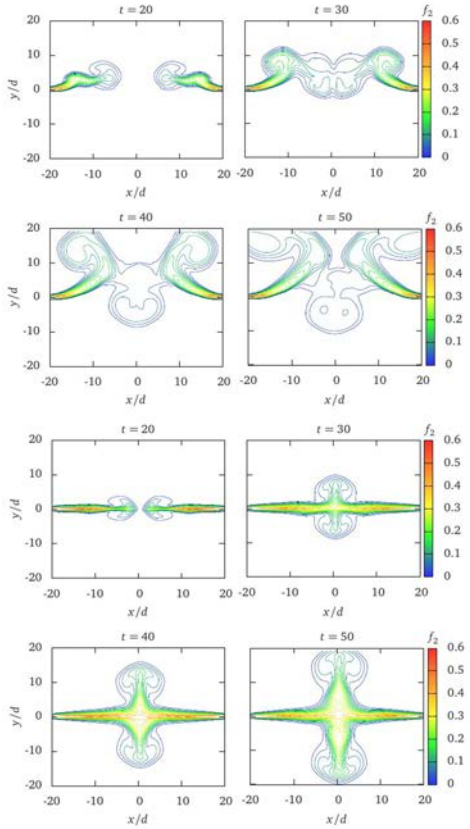

Figure 3: Time evolution of gas volume fraction for a separation between jets of s = 40dC, and Re = 1000. High: normal gravity. Low: microgravity.

References

[1] S. Arias, R. Gonzalez-Cinca, X. Ruiz, L. Ramirez-Piscina, and J. Casademunt. Characterization of the performance of a minibubble generator in conditions relevant to microgravity. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 365:52{55, 2010.

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ELGRA Medalist Physical Sciences:

Prof. Dr. J. C. Legros

Université Libre de Bruxelles, Micro Gravity Research Center

Jean Claude Legros (born 24.2.1942) is Emeritus Professor of the Université Libre de Bruxelles and during 20 years he held an administrative appointment as the director of the Microgravity Research Center (ULB).

He received his PhD in Sciences (supervised by Professor I. Prigogine) in 1971. His scientific interests are centered on coupling between the Soret effect and the Marangoni convection, especially on the influence of these temperature induced concentration fields on the onset of hydrodynamic instabilities in non-isothermal liquid solutions, on evaporation and on heat transfer. He has an outstanding track record at least in two of these three areas.

On top of his pedagogical activities in thermodynamics, since 1983, Professor Legros is managing research works in physics of fluids and of interfaces inside the Microgravity Research Centre which became under his supervision an innovative Centre which is at the forefront of experimental and theoretical researches related to experiments performed on earth orbit.

By using experimental skills and physical intuition he has overcome the great difficulties which are obviously inherent in investigations of fluid properties under microgravity conditions. He obtained with his team excellent results on the role of surface tension forces in convective transport. He initiated and coordinated experiments on Spacelab (D1 and D2 missions, IML2, LMS), on Eureca 1, on Russian FOTON's (12, M1, M2 and M3), and used extensively the MSG on ISS. These experiments were prepared by sounding rocket and parabolic flights (KC135, DC8, Caravelle, Airbus 300, Fouga Magister).

His efforts supported by Belspo and ESA result in a series of contributions consisting of more than 250 refereed publications and some of them are highly cited. Jean Claude Legros is also the coauthor of 4 books related to the convection in liquid phases and published in prestigious editing companies. He presented numerous scientific reports at international Congresses.

Besides academic works, Professor Legros was always interested by the applications. Using the tools and knowledge developed in MRC he founded with some staff members 2 companies: Lambda-X and EHP (Euro Heat Pipes SA). The first one is active in optical metrology; its partnership with Verhaert D&D (now Qinetiq) is very fruitful (see e.g.; FSL on ISS and FLUIDPAC on Foton platforms).

The second was created 10 years ago through a venture with SABCA is now the European leader for the design and production of thermal control systems for satellites (e.g. for ATV). J.C. Legros is still a senior consultant in EHP.

ELGRA Medalist Life Sciences:

Dr. Enno Brinckmann

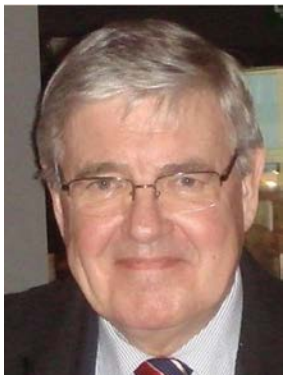
European Space Agency (retired)
Currently:
Eschenweg 16, 26789 Leer, Germany

The German biologist (born 22.11.1946) got his scientific education at universities in Darmstadt and Tübingen. He got a diploma in biology 1971 and completed his studies 1973 with a dissertation about light induced oscillations of membrane potentials in higher plant cells.

He worked from 1975 until 1989 in the field of plant ecology at the University of Bayreuth as an academic lecturer. In addition to his administrative and lecturing duties for the department he supported several eco-physiologic field studies in the Namib-Desert, the results of which had been published 1992 in a book (von Willert, Eller, Werger, Brinckmann and Ihlenfeldt: "Life Strategies of Succulents in Deserts", Cambridge University Press).

In the lab he used the pressure probe to study water relations in single cells of higher plant leaves. 1989 he got a position as Senior Biologist at the European Space Agency (ESA) in Noordwijk, the Netherlands. Working as Project Scientist for the Biorack facility and Experiment Coordinator for Biolab, Dr. Brinckmann was involved in the accommodation, preparation and control of about 100 biological experiments in Spacelab, Spacehab and the International Space Station (ISS).

After the IML-2 mission in 1994, he received the Silver Snoopy Award by NASA astronaut Don Thomas. Besides 50 original papers (29 as coauthor) he published several short communications, posters and non-reviewed articles in scientific and popular journals. In addition, he gave invited lectures at universities in Germany, France, England, Italy, the Netherlands, USA and Sweden and edited 2007 the book "Biology in Space and Life on Earth" (Wiley-VCH). He retired from ESA in 2006 and lives now in Leer (Germany). From there he is supporting the University of Trondheim as an external advisor for plant space research questions.



Prof. Dr. J. C. Legros

Dr. Enno Brinckmann

REPORT OF THE ELGRA GENERAL ASSEMBLY 2011

7 Sept. 2011

Location: University of Antwerp, Campus Drie Eiken, BE

The General assembly started at 18:00

Number of participants: 30

1. Kurt Kemmerle presented the finantial report. The auditors and the Assembly approved the finantial report.

2. Jack van Loon presented to the Assembly the proposal to prolong from 4 to 6 years the time a member can stay in the same position and to limit the total stay in the ELGRA MC to 12 years. The discussion was opened. Thodoris Karapantsios proposed to fix the total stay in the ELGRA MC to 8 or max 10 years, without limits of stay in the same position.
At the end of the discussion we proceeded to vote by show of hands.
Results of the vote: of a total of 30 voters, 13 voted against the new proposal and against the change of the Statute, 10 voted in favour of the proposal, 7 abstained. So, while respecting the wishes of the majority, the Statute has not be changed and the rules of stay in the ELGRA MC remain unchanged.

3. Election of the new ELGRA MC:

Jack van Loon presented to the Assembly the team proposed by the outgoing MC:

PRESIDENT: Valentina Shevtsova
VICE-PRESIDENT: Monica Monici
SECRETARY GENERAL: Floris Wuyts
TREASURER: Kurt Kemmerle (this position is not subject to the time limitation)
MEMBERS: Jack van Loon, Thomas Podgorski, Hans Fecht

The position of "Education Coordinator" was explained to the Assembly: a) he is needed to coordinate the growing ELGRA activities for education and information of students; b) the Education Coordinator is out of the committee, therefore he is not subject to the vote of the Assembly but chosen directly by the MC; c) he attend the MCM but is not entitled to vote.
The assembly was informed that the person chosen by the MC was Javier Medina

Jack van Loon asked the Assembly for candidates alternative to those presented by the outgoing MC.
Thodoris Karapantsios invited all the participants in the Assembly, and in particular young members, to propose alternative candidacies. Carole Leguy presented her candidacy.
The new candidates Valentina Shevtsova, Thomas Podgorski and Carole Leguy briefly introduced themselves to the Assembly.

The vote (by ballots) began. The results were the following:
PRESIDENT: V. Shevtsova, elected with 30 votes
VICE-PRESIDENT: M. Monici, elected with 30 votes
SECRETARY GENERAL: F. Wuyts, elected with 30 votes
TREASURER: K. Kemmerle, elected with 30 votes

MEMBERS:
J. van Loon, elected with 28 votes
T. Podgorski, elected with 30 votes
C. Leguy, elected with 26 votes
H. Fecht, non elected 13 votes

4. The outgoing President, Jack van Loon, informed the Assembly that the ELGRA Symposium 2013 will be organized together with AIMAS, Italian Society of Aviation and Space Medicine.
Dates: from 9 to 13 september 2013.
Location: Vatican City, Rome

The General Assembly was closed at 19:30

OBITUARY

Hans Josef Rath †

With consternation we received the sad news that our ELGRA member Hans Rath, director of ZARM, suddenly and unexpectedly passed away on September 4, 2012. His death is a great loss, which we cannot yet fully assess, to the microgravity research community.

Hans Rath was born in 1947 in Nuttlar, Westfalia in Germany, and started as an apprentice for dead-mould steel making. As he was very eager to learn he successively made his way, via second-chance education, to the University of Hannover where he obtained his diploma in Engineering in 1974. Already in 1976 he received a PhD in Engineering from the University of Hannover with a thesis on the Calculation of a valve-less pump principle. After several year as a postgraduate researcher in the group of Prof. Pestel of Hannover University Hans Rath was promoted in 1981 to a full professor for Mechanics and Fluid Mechanics at the University of Bremen.

In 1985 Hans Rath founded ZARM, the Center of Applied Space Technology and Microgravity,at the University of Bremen. He was a maker: one of the most significant qualities of Hans Rath has been his talent to motivate, excite and attract to ZARM gifted people and to perfectly assign the proper tasks to the appropriate people. With their help not only the drop tower building was erected. Under Rath's directorate his research center has grown, over the years, to about 130 employees and a budget beyond ten million Euros, most of which was funded externally. Rath always had a vision -- and his vision was large-scale. He desired to push things forward and to foster space-related research. Along this way, he had a big heart for fundamental studies and he supported basic research whenever possible. His enormous success was, at times, considered critically by competitors in the microgravity scene. But this was more an incentive for him to try harder, and he used to say: Nothing's more successful than the success itself.

Hans Rath was the founding editor of the now well-known journal Microgravity Science and Technology, which became a successful Springer publication and which is the only journal today in this field. During his scientific career Rath has published more than 289 journal papers and book publications as the author or as a co-author. In fact, a great amount of knowledge in the field of microgravity science and technology acquired during the last two decades or so is due to his activities in enabling such research at his ZARM institute. The scientific progress which has been moderated and enabled by Hans Rath becomes even more apparent when recognizing that no less than thirteen scientists who experienced years formation at ZARM and who have been continuously supported by him are now carrying on their scientific career as professors at various universities in Germany, Austria and Japan.

During his professional career Rath served the scientific community in many top-level functions. To mention only a few, he was president of the German Society for Aeronautics and Astronautics (DGLR) from 1998 to 2000 and he also acted as vice-president of the International Astronautical Federation (IAF) from 1997 to 2000. Rath was a social person and he loved bringing people together. This is not only true for the legendary Xmas partiesof ZARM. He also initiated the well-known Drop Tower Days starting in 1992 in Bremen which continues to be organized every second year alternatingly in Bremen and Japan. Subsequently, he organized many more conferences of various scales up to the International Astronautical Congress 2003 (IAC 2003)and the 38th COSPAR Scientific Assembly 2010, both held in Bremen.

In his private life, Hans Rath cultivated his interest in the visual arts. Over the years he developed his own style of painting working in his own studio. His artwork was shown at various individual and group exhibitions in Germany and Europe. Moreover, he was quite engaged in the local Rotary Club as well as in many local scientific and artistic organizations.

The demise of Hans Rath symbolizes a marked break for the microgravity-science community. It is perhaps only due to such a radial disruption that one becomes much better aware of all the achievements of a great man.

In sadness,
Hansjörg Dittus and Hendrik Kuhlmann

CALENDAR OF EVENTS

Space Technology for Competitiveness, non-dependence and innovation in Space
(Horizon 2020 Workshops on Space Research and Technology Development)
30-31 January 2013
Brussel, Belgium

19th IAA Human in Space Symposium
07-12 July 2013
Cologne, Germany
Contact: Dr. Bernhard Koch
bernhard.koch@dlr.de

Space Science and Exploration (Horizon 2020 Workshops on Space Research and Technology Development)
18-19 February 2013
Madrid, Spain

2nd Annual International Space Station Research and Development Conference
Denver, Colorado, USA
16-18 July 2013
http://www.astronautical.org/node/96

17th ISU Annual International Symposium
5-7 March 2013
Strasbourg, France
Web: www.isunet.edu

5th International Academy of Astronautics Symposium on Searching for Life Signatures,
18-20 September 2013
Beijing, China

4th International Conference on Advanced Space Technologies for Humankind Prosperity
17-19 April 2013
Dnepropetrovsk, Ukraine
Web-site: http://www.dpukrconfiaa.org
abstract deadline: 15 March 2013

64th IAC International Astronautical Congress
23-25 September 2013
Beijing, China
Web: www.iac2013.org (not yet online)
Contact email: info@iafastro.org

8th World Conference on Experimental Heat Transfer, Fluid Dynamics and Thermodynamics
Lisbon, Portugal
16-20 June 2013
http://www.exhft8.org/

ELGRA International Biennal Symposyum and Italian Association for Aeronautical and Space Medicine
XXVI National Meeting
11-14 September 2013
Rome, Italy

8th IAA Symposium On The Future of Space Exploration Toward The Stars
July 3-5, 2013
Torino, Italy
abstract deadline: February 28, 2013
Contact: gspinasanta@corep.it

American Society for Gravitationsl and Space Research (ASGSR) combined with the **International Space Psysical Sciences (ISPS)**
Orlando, FL, USA
3-8 November, 2013
http://www.asgsr.org/

In the Spirit of Discovery

ELGRA
European Low Gravity
Research Association
International Biennial Symposyum
& General Assembly

AIMAS
Italian Association for
Aeronautical and Space Medicine
XXVI National Meeting

Joint in Rome
Vatican City
11th-14 th September 2013

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(ELGRA Management Committee)

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Monica Monici	**Vice-President**
Floris Wuyts	**Gen. Secretary**
Kurt Kemmerle	**Treasurer**
Jack van Loon	**Member**
Thomas Podgorski	**Member**
Carole Leguy	**Member**
F. Javier Medina	**Special Advisor to the Management**

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Welcome

The European Low gravity Research Association (ELGRA) is pleased to invite you to the Symposium and General Assembly, which will be held in Rome, 11-14 Sept. 2013, jointly with the XXVI National Meeting of the Italian Association for Aeronautical and Space Medicine. The symposium will last 4 days, with plenary lectures, oral and poster sessions.
For more information about the event, please consult the ELGRA website (www.elgra.org).
Do not hesitate to contact the local organizers or the secretariat by phone (+ 39 055 4271217 or +39 055 4271216) or e-mail (monica.monici@unifi.it, francesca.cialdai@unifi.it, f.strollo@alice.it)

Venue: Rome and the Vatican City

Rome, the 'Eternal City', is the capital of Italy and of the Lazio region. It's the famed city of the Seven Hills, La Dolce Vita, and Three Coins in the Fountain. The Historic Centre is a UNESCO World Heritage Site, hosting many monuments and what all people are mostly attracted by, i.e., the ancient area with the Colosseum, the Roman Forum, the Forum of Augustus, the Forum and Markets of Trajan, the Capitoline and its museums. But around and close to that, visitors will appreciate how's life like in the centre of the Roman medieval and Renaissance periods, with beautiful squares, cathedrals, the Pantheon, Piazza Navona, Campo de' Fiori, the Jewish Ghetto neighbourhoods and, northwards, the Villa Borghese, the Spanish Steps and their elegant neighbourhoods.
Rome is also where the Vatican City has its location with the Papal City State and its endless treasure troves of sights, relics, and museums, as well as the surrounding Italian Vatican area.
As ELGRA we are really proud to be hosted inside the Vatican City this time, so that we will be able not only to take a close glance to the Vatican Museums and the Gardens, which are not too easy to see as laymen, but also to take advantage of 2013 being the "year of culture" to start fruitful contacts with the cultural Institutions within the Vatican.
These few lines would never be able to list all you could do or see in Rome before and after the congress, so we invite you to see these wonders yourself and breath Rome's evening Ponentino wind through these places still waiting for being admired.

Call for abstracts

Traditionally, the ELGRA Symposium is a forum for scientific and technological reports in gravity dependent and space related research. Abstracts in the fields of life sciences, biotechnology, physiology, physical and material sciences, fluid physics, and other (micro-)gravity related topics are welcome. Abstracts may be submitted via the symposia link on the website www.elgra.org

Topics:

Life Sciences
The human body and long lasting missions
Adaptation of cells and biological tissues to long-term conditions of altered gravity
Psychological and behavioural aspects in long lasting missions
Life support systems
Moon and Mars environments
Countermeasures
Soft matter mechanics of living cells
From science to health

Physical Sciences:
Material sciences
Fluid physics
Plasma physics

Others:
Ethical aspects in space exploration
New opportunities from commercial suborbital flights
Artificial gravity and simulation
Dust in space
From Science to Philosophy

Student Contest

As every Symposium, ELGRA will establish a program to support student attendance and organize a student contest. More information will be provided, in due time, on the ELGRA web site: www.elgra.org

Important deadlines

Submission of abstracts: March 31, 2013
Notification of acceptance: June 15, 2013
Early Registration: June 30, 2013

Attention

Information for abstract submission, social program, registration and hotel reservation will be communicated starting from February. Please consult the web site www.elgra.org:

Poster of the symposium

“Creation of Adam” one of the most famous frescoes created by Michelangelo in the Sistine Chapel.

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Discipline: Plant Cell Biology / Cell Nucleus

EUROPEAN LOW GRAVITY RESEARCH ASSOCIATION - ELGRA

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Science discipline: ... e.g. material sci., fluid sci., plant physiology, cell biology, ...)

Additional details: .....
Date and Place: Signature:

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Announcement of the

ELGRA International Biennial Symposium and AIMAS XXVI National Meeting

September 11-14, 2013
Vatican City, Rome, Italy
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