Human Spaceflight, Microgravity and Exploration
NEWS

MAY 2007

Compiled by HME Science and Applications Division

The S&A Division of the Directorate of Human Spaceflight, Microgravity and Exploration releases a Newsletter on highlights of the month. Clicking on one of the headlines below will take you to the relevant topic.

PUBLICATIONS ANNOUNCED IN MAY 2007

1. WHITE, OLIVER: THE ROLE OF GRAVITY IN DEXTEROUS MANIPULATION: A DRIVING FORCE RATHER THAN A PERTURBATION, **BRUSSELS, JUNE 4TH, 2007. THESIS**

2. MULDER, EDWIN: NEUROMUSCULAR ADAPTATIONS DURING LONG-TERM BED REST. **AMSTERDAM, JUNE 8TH. THESIS**

3. VERHEYDEN, BART: CARDIOVASCULAR CONTROL IN SPACE AND ON EARTH: THE CHALLENGE OF GRAVITY. **LEUVEN, B, JUNE 11TH 2007. THESIS**

3. DURANTE, MARCO ET AL.: PREPARATORY STUDY OF A GROUND-BASED SPACE RADIOBIOLOGY PROGRAM IN EUROPE. ADVANCES IN SPACE RESEARCH **39 (2007) 1082–1086**

4. DORFMAN TA, LEVINE BD, TILLERY T, PESHOCK RM, HASTINGS JL, SCHNEIDER SM, MACIAS BR, BIOLO G, HARGENS AR. CARDIAC ATROPHY IN WOMEN FOLLOWING BED REST. **J APPL PHYSIOL. 2007 MAR 22; SCIENTIFIC PUBLICATION.**

5. GARRABOS, Y. , D. BEYSENS, C. LECOUTRE, A. DEJOAN, V. POLEZHAEV, AND V. EMELIANOV THERMOCONVECTIONAL PHENOMENA INDUCED BY VIBRATIONS IN SUPERCRITICAL SF_6 UNDER WEIGHTLESSNESS, **Physical Review E, vol. 75, pag. 56317**

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Glovebox Technology Centre (GTC) inauguration at ESTEC on 21 May – Three gloveboxes for test and training

Pedro Duque working on the PROMISS experiment inside the Microgravity Science Glovebox, 2003.

THE MICROGRAVITY SCIENCE GLOVEBOX (MSG) IS ESA'S FIRST ISS RACK FACILITY AND HAS BEEN IN FUNCTION ONBOARD THE ISS SINCE JUNE 2002. THE GTC AT ESTEC NOW OFFERS FULL ACCESS TO A MSG GROUND MODEL PLUS TWO OTHER GLOVEBOXES, THE PORTABLE GLOVEBOX (PGB) THAT HAS BEEN IN ORBIT SINCE JUNE 2006, AND THE THIRD AND TILL NOW LAST IN THE ROW, THE BIOLOGICAL GLOVEBOX (BGB).

The Biological Glovebox is an integral part of the Biolab Facility to go up onboard ESA's ISS module, Columbus, planned for launch in December 2007.

Excerpts of datasheets for these devices, indicated below, demonstrate their main differences and qualities. The GTC at ESTEC is supported by the industrial partner, Bradford Engineering, as well as on-site ESA personnel. Demonstrations, tests and training can be requested, to the extent that it fits in with scheduled an assigned working periods.

In line with requests, routinely put forward by investigators who are preparing experiments, these devices are now available in flight-identical form, for training, development of procedures, and testing of all technical aspects of performing experiments under constrained conditions in space[1]. The outcome should be: Increased efficiency at all development levels and improved communication between involved teams. GTC is sponsored by the Dutch Ministry for Economic Affairs

Glovebox Technology Centre (GTC) inauguration at ESTEC

Microgravity Science Glovebox (on the ISS since 2002)

PERFORMANCE CHARACTERISTICS

Volume	255 litres (905 mm Wide, 637 mm High, 500mm Deep)
Inside the Work-Volume:	Temperature Control, Adjustable Illumination, 800W coldplate, Data I/F, Vacuum, Digital video
Glove Ports	1 x 4 inch port on Airlock, 4 x 6 inch port on Work Volume
Connection Ports	3 x 2 inch feedthrough ports (user adaptable), 2 x 16 inch loading ports.
Power Supply	28 VDC 7A (2x), 120 VDC 8A, +/-12 VDC 2A (2x), 5 VDC 4A (2x)
Bench Resources	Sensors for monitoring experiment health and status, MSG Laptop Computer (MLC), three stowage drawers

[1] Gloveboxes are used in ground laboratories, most often in the form of 'Laminar Flow Benches', which ensure safe working conditions for lab technicians, when processing toxic compounds. In a closed ISS atmosphere, all toxic compounds have to be safely removed, either via disintegration into non-toxic compounds, or via 'storing' e.g. bound in technical (often zeolite-activated charcoal) filters until these can be purged under safe conditions.

The Portable Glovebox (on the ISS since 2006)

PERFORMANCE CHARACTERISTICS

Volume	21 liters
Outer Dimensions	363 x 485 x 225 mm
Inner Dimensions	300 x 285 x 202 mm
Glove Ports	4 inch
Connection Ports	2 inch
Power Supply	28 Vdc (EXPRESS Rack, EDR, UDP Junction Box, MSG, Russian Segment)
Available Interfaces	Bungee Cord, Seat Track, Quick Disconnect Bracket (Camera Mount)
Negative Pressure	4 mbar

Biological Glovebox (on the ISS from late 2007)

PERFORMANCE CHARACTERISTICS

Volume	35 liters
Sterilization	O3-sterlization unit
Inside Work Volume	Illumination, Video, EC mounting plate
Glove Ports	2x 4 inch
Connection Ports	3 removable front doors, center one is user adaptable
Max Power consumption	150W
Airflow	50 to 300 litres/min
	4 replaceable filters

Visit the GTC here.
Contact and information: ewald.kufner@esa.int

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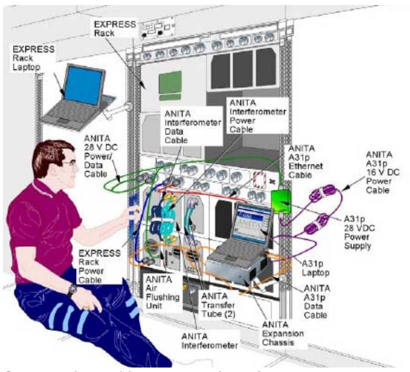
ANITA[2] – a potential 'next-generation' atmosphere trace-gas monitoring system for the International Space Station

Astronaut Greg Chamitoff training with the ANITA hardware

ONBOARD THE SHUTTLE FLIGHT 13.A.1 OR STS-118 SLATED FOR A 9 AUGUST 2007 LAUNCH, ANITA WILL BE ONE OF THE 'PASSENGERS'. THIS NOVEL GAS ANALYSER DEMONSTRATOR WILL HAVE TO SHOW ITS QUALITY OVER A 10-DAY COMMISSIONING PERIOD FOLLOWED BY A 6-MONTH OPERATION PHASE.

The cooperative ESA-NASA project, with the industrial contractors Kayser-Threde (D) and SINTEF (N), tests the ESA developed trace gas monitoring technology based on Fourier Transform Infrared (FTIR) Spectrometry. The instrument is based on the Michelson principle for interferometry, allowing with high precision quasi on-line to identify and to quantify at lower part per million 32 trace gases in the atmosphere simultaneously. The technique utilises the physical principle that different gases have different absorption features in the infrared spectrum and absorption intensity in the gas sample (lamberts-Beer law) Using the state-of-the-art analysis software in principle all gases (excluding O2, N2 ,H2 and other homonuclear diatomic gases) can be detected. The first flight version of the device is calibrated for the most important gases that have earlier been detected in the ISS atmosphere or are expected to be there from analysis. Gases and gas concentrations not a priori foreseen, but which show up as a result the analysis of the spectra, can be included in updates of the calibration models.



Source: http://www.exploration.nasa.gov

The 32 gases include; H2O, CO2, and CH4 and 29 organic and inorganic trace contaminants, including formaldehyde, perfluoropropane, ammonia, carbon monoxide, and three siloxanes.

Trace gases of highly toxic and hazardous compounds in the semi-closed atmosphere system onboard the ISS, represent a latent danger for long term missions where no external intervention is possible. In addition, the atmosphere in all single modules of the station is not equally circulated, due to the lack of natural convection and easy gas mixing. Thus the theoretical risk exists, that contaminants are abundant in different concentrations in different modules. In the longer term, therefore – provided ANITA lives up to her promises – it could be envisaged to have similar, and probably miniaturised units installed in each of the ISS modules and future spacecraft for planetary exploration.

In normal operational mode, ANITA automatically monitors the local air continuously, by filling its gas cell, measuring the sample and storing the analysis data. The gas cell is then flushed back into the cabin and refilled for the next measurement cycle, each of which takes six minutes. As the figure above demonstrates, it is foreseen to mount the ANITA facility in an EXPRESS rack. Thus, for analysing samples from other parts of the Station, a handpump and sample gas-bags are provided. After collection the air sample is connected to the ANITA air inlet and analysed by the instrument.

ANITA was conceived and the development started under the TRP/GSTP programme, and eventually fully developed and made flight-ready under the ISS Development Utilisation Programme.

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[2] Analysing Interferometer for Ambient Air

MELFI – ESA's minus 80 °C freezer does the job, powerfully and quietly

Thomas Reiter with one of the 'smoking' MELFI inserts, ¼ of a Dewar

COMING UP TO ITS 1-YEAR BIRTHDAY, POWERED FOR THE FIRST TIME ON ORBIT (19 JULY), MELFI IS GIVING A HELPING HAND DURING TIMES WITH SCARCE CONDITIONED SAMPLE RETURN POSSIBILITIES. WITH ATLANTIS TO RETURN TO EARTH IN A FEW DAYS, ITS MID DECK FREEZER WILL HOLD ESA SAMPLES THAT WERE TAKEN ON ORBIT IN OCTOBER/NOVEMBER 2006, AND SAFELY CONDITIONED IN MELFI.

Under the Early Utilisation Agreements, ESA delivered three MELFI flight models to NASA and one to the Japanese Space Agency, JAXA, in exchange for ISS racks. On his flight during the second half of 2006, ESA astronaut Thomas Reiter together with his American and Russian colleagues installed the freezer in the NASA Laboratory Destiny, ready to be powered up on 19 July 2006 in preparation for the on orbit commissioning with MPLM flights.

Although it was originally planned to cycle three MELFI units between the ISS and Earth, for maintenance purposes, the changes to the Station logistics plan after the Columbia disaster in 2003 induced the new approach under which MELFI will stay onboard and be maintained via provision of onboard spares and repairs.

Biosamples taken from crew onboard the ISS, in the form of urine and blood and to a lesser extent saliva, are temperature sensitive. In standard laboratory routines in ground laboratories, most samples are kept at around -20°C until they can be analysed, but certain compounds need an deeper freezing in order not to change character between the time they were sampled and the time for analysis. In addition, when samples have to wait in the frozen state for a longer time, - 80°C appear more safe in terms of conservation of the initial characteristics.

A full description of the facility can be seen in ESA Bulletin no. 128, November 2006. The following excerpt gives a short introduction to the technology: Samples are stored in four identical Dewar enclosures. Each Dewar can be set to cool at three different temperatures: -80°C , -26 °C , and +4 °C. The centralised cooling system is based on a so-called reverse Brayton cycle using very pure Nitrogen as cooling medium. The Brayton expander and the compressor wheels run at up to 96.000 rpm. At that speed, the system produces 90 W of cooling power at -97 °C.

Presently, three of the four Dewars are cooling at -95°C, whilst one is still set to ambient temperature. MELFI has the ability to freeze large volumes very fast at the same time as it makes less noise than the most silent dishwashers on the market today, less than 40 dB.

NASA Astronaut Mike Lopez-Alegria working with MELFI (courtesy NASA)

Samples related to the CARD experiment, an experiment type that has been performed in an evolutionary manner over the last 10 years or more (earlier experiments called differently and with different detail definition) will come back with Space Shuttle Atlantis soon. The experiment is looking at the manner in which the body controls the salt and water content under different gravity conditions. Blood samples are needed in order to analyse the hormones involved in the control cycles.

Read the full Bulletin article here.
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Onboard ISS in May 2007 - ESA Science Performance

'CARDIOCOG-2' done by Oleg V. Kotov on Increment 15

WITH SPACE SHUTTLE ATLANTIS DOCKED TO THE INTERNATIONAL SPACE STATION, A CREW EXCHANGE WILL NOW TAKE PLACE.

After setting a new record for women for long duration stay in space, NASA astronaut Sunnita Williams will return to Earth onboard Atlantis.

Cosmonaut Fyodor N. Yurchikhin, Expedition 15 commander, and Cosmonaut Oleg V. Kotov, Expedition 15 flight engineer, representing the Russian Space Agency, are the crew to stay over when Sunnita Williams is leaving. In her place NASA astronaut flight engineer Clayton C. Anderson will stay onboard. He will return to Earth aboard space shuttle Discovery on mission STS-120, scheduled for an October 20 launch.

ESA Science Activities in May:

After performance of the pre-flight programme

- CHROMOSOME-2
- LOW BACK PAIN, and
- NEOCYTOLYSIS

(these experiments were introduced in Newsletter April 2007), increment 15 has started with the crew arriving on 9 April, which means that the Increment is now around 2 months old. The following ESA experiments can be reported on:

- ALTCRISS (using the Italian ALTEINO equipment), has been moved to a new location inside ISS during the month of May. The automatic monitoring was upset for a period by a non-functioning memory card, but the problem was solved. The ALTEINO device has since been performing nominally. Next activities (shielding tile accommodation on the ALTEINO device, photographing the configuration and a memory card exchange, are planned to take place on 8 June. Thereafter the measurement data will go through a so-called 'memory card dump', that is planned for 9 June. Progress 25P brought 4 new dosimeter kits up for the experiment.
- CARDIOCOG-2 studies the impacts of microgravity on the cardiovascular system and the respiratory system. This investigation will examine the stress as well as the cognitive and physiological reactions of crewmembers during long-duration space missions. The first planned CARDIOCOG-2 session for the Increment 15 crew could not be performed since a power cable could not be found. In the meantime, as the image above shows, flight engineer Oleg Kotov was able to perform the experiment once, after a power cable was brought up onboard Progress 25P on May 12.
- NOA-2 is an alternative application of the NO device (Platon) of operational nature, compared to the NOA-1 experiment performed on earlier increments for indication of disturbance of the lining tissue in the airways. As a basis for the NOA-2 experiment, ground-based experiments have substantiated that potential decompression sickness can be estimated using this method. For this reason measurements will be done around times for EVA activities, as they entail so-called pre-breathing and different air pressure regimes. Unfortunately, as was the case at a technical check point in April for exchange of a vital limited-life part, the NOA-2 device has still not been located. This has the effect that the measurement points before and after the EVA that took place on 30 May could not be performed. ESA will procure a replacement Platon unit from DAMEC and launch it before the end 2007.

For more in depth description of the experiment and their background, please visit this location.

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FOTON-M3- Payload Interface Test in Samara, Russia

The Gazpromavia plane at Rotterdam, with the truck from ESTEC

AFTER FINALISATION OF THE SUCCESSFUL MISSION SEQUENCE TEST AT ESTEC, IMMEDIATE STEPS WERE TAKEN TO PREPARE THE PAYLOAD FOR TRANSPORT TO SAMARA, WHERE PAYLOAD INTERFACE TESTING WITH FOTON SYSTEM HW WOULD BE PERFORMED.

The special plane for the transport to Samara of 77 crates and a total of 3 tonnes of flight equipment took off from Rotterdam airport on Friday evening 11 May, at 10:02 p.m., one day later than scheduled, caused by administrative complications, with apparently missing documentation in Samara.

One day earlier all the Gradflex containers were shipped by road, due to the use of CS_2 in the facility – a compound on the IATA list of dangerous goods. What complicated it even more was 1) that permission to pass through certain Eastern European countries is known to be difficult to get, and 2) that the chemical in question can also not be sea-transported. The transport route, therefore has been much longer than the direct route to Samara. Despite of that, the truck load arrived in Samara and was unloaded at the customs warehouse as scheduled. Airlifted hardware arrived in Samara Saturday morning 12 May, around 6 a.m.

In Samara the following event flow is foreseen

- Incoming Inspection, Integration and Electrical Interface Tests of all 'active payloads', which will be concluded by the
- Foton-M3 Flight Readiness Review
  Finally, a general meeting with TsSKB and Roskosmos regarding mission planning will be held, namely the
- 9th Meeting of the Foton-M Coordination Board.

The first event, the Payload Interface Test in short, has been ongoing for around 3 weeks now, and will have a total duration of around 6 weeks before all equipment has been tested and conclusions have been drawn.
Personnel related to the different equipment will attend during the specific days, where their equipment is being tested. Flights to Samara for most people go via Frankfurt. They are night flights that arrive in Samara 04:50 in the morning local time (+3 hours time difference).

Payloads that have been tested till now, have faced no problems, that couldn't be solved on the spot, apart from one case. The TEPLO payload, an experiment investigating the functioning of advanced heat pipes, demonstrated a leak, and a crack has been identified. This has delayed further confirmation for the time being. Steps have been taken to have the problem resolved on-site, by help of technical expertise from ESTEC as well. In principle there should be time enough to correct the problem, if physically possible.

Map:
The road transport took several days. A long transit-stop at the Finnish-Russian border took its part of that. On the map the launch site, Baikonur in Kazakstan is identified. When ready to go, the FOTON payload will be brought to the launch site via an ESA chartered flight.

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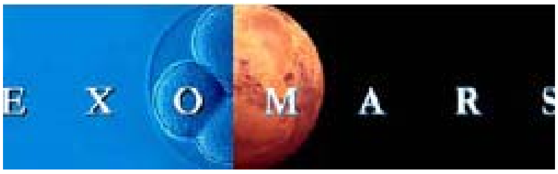
EXOMARS Payload Confirmation Board Report, April 2007



ESA PLANS TO LAUNCH THE EXOMARS MISSION NO LATER THAN 2013. EXOMARS WILL DEPLOY ON THE MARTIAN SURFACE TWO SCIENCE ELEMENTS: 1) A ROVER DEDICATED TO EXOBIOLOGY RESEARCH AND 2) A SMALL, FIXED STATION FOR ENVIRONMENTAL AND GEOPHYSICS STUDIES.

In the framework of the 2007 ExoMars Payload Confirmation Review (PCR), ESA has organised an independent science peer review and a technical review of candidate instruments with the goal to identify the best possible payload that can be accommodated in each of the mission configurations being considered for the ExoMars mission. The PCR took place between November 2006 and February 2007. Rover payloads were identified by independent scientific peers for 16.5, 12.5, and 8 kg, as instructed. The preliminary result is, however, that the 8-kg payload is not recommended as it cannot address the highest priority science objectives. The PCR panel recommended the 16.5-kg payload because it has the highest science return. It nevertheless considered that also the 12.5-kg payload will result in a good, solid mission. A 3.5-kg payload was also recommended for the Geophysical & Environmental Payload, the GEP, presently under study for accommodation on the landing platform.

On 22 May 2007 and on 11 June 2007, the PB-HME Programe Board authorised ESA to proceed with the release of a Request for Quotation (RFQ) for the ExoMars implementation phase on the basis of a newly developed technical baseline.

This ExoMars 'enhanced baseline' configuration includes a 205-kg Rover, carrying a subsurface drill capable to reach down to 2 m into the ground to collect samples, the sample preparation and distribution system, and the large, 16.5-kg Pasteur payload. The GEP will be in the order of 30 kg and accommodate a large number of instruments. The mission will require a heavy launcher (Ariane 5 or Proton). The data relay function will be implemented using NASA Mars orbiting spacecraft.

For further information, please contact jorge.vago@esa.int or look for 'Life on Mars' here.

For ExoMars in the frame of the Aurora Exploration Programme, visit this location.

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Publications announced in the period of May 2007

WHITE, OLIVER: THE ROLE OF GRAVITY IN DEXTEROUS MANIPULATION: A DRIVING FORCE RATHER THAN A PERTURBATION, **BRUSSELS, JUNE 4TH, 2007. THESIS**

Source material: ESA's 35th and 38th Parabolic Flight campaigns. Scientific experiments on ESA's Parabolic Flight campaigns are as a rule selected via standard procedure implemented by the Science & Application division.

General Objective: To investigate the role of gravity in motor control, under consideration of feed-back and feed-forward models for motor control. To 'understand internal models in objective manipulations when the gravitational environment is dramatically altered….',

- Objective 1: To investigate the functioning of the intrinsic 'Central Pattern Generators' of the human central nervous system, CNS.
  Source material, objective 1: ESA's 35th and 38th Parabolic Flight campaigns, 180 parabolas in total.
  Subjects: Twelve healthy, right-handed volunteers performed on the parabolic flights
  Test regime: Performance of rhythmic arm movements around two virtual obstacles situated three meters in front of them following an '"infinity-shaped" trajectory with a handheld instrument object
- Objective 2: To investigate if novel gravitational environments alter the grip force/load force coupling at the fingertips.
  Source material, objective 2: ESA's 35th and 38th Parabolic Flight campaigns, 30 parabolas
  Subjects: Six healthy, right-handed volunteers performed on the parabolic flights
  Test regime: Performance of cyclic, vertical arm movements at a frequency of 1 Hz, aided by a metronome. Tests were performed with three different mass / loads /travelling distance combinations.
- Objective 3: Investigation of whether the 'Grip Force Controller (in the central nervous system), differentiates the inertial and the gravitational components of the load.
  Source material, objective 3: ESA's 35th and 38th Parabolic Flight campaigns.
  Subjects: Six healthy, right-handed volunteers performed on the parabolic flights
  Test regime: Performance of cyclic, vertical arm movements at a frequency of 1 Hz, aided by a metronome. Tests were performed with three different mass / loads /travelling distance combinations.
- Objective 4: Investigation of grip-force coupling and gaze-hand coordination in high impact loads
  Source material, objective 4:
  ESA's 35th and 38th Parabolic Flight campaigns.
  Subjects: Seven healthy, right-handed volunteers performed on the parabolic flights
  Test regime: Performance of vertical tapping task with a load, moving from a home position either up or down to tap a target and then return to the home position.
- Objective 5: Investigation of predictive grip for high impact loads in altered gravity.
  Source material, objective 5:
  ESA's 35th and 38th Parabolic Flight campaigns.
  Subjects: Seven healthy, right-handed volunteers performed on the parabolic flights
  Test regime: Performance of vertical tapping task with a load, moving from a home position either up or down to tap a target and then return to the home position, started on the stimulus from an audible signal to go either up or down – aspect of pre-programming grip force.

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MULDER, EDWIN: NEUROMUSCULAR ADAPTATIONS DURING LONG-TERM BED REST, AMSTERDAM, THE NETHERLANDS, JUNE 8TH, 2007. THESIS

Source material: The thesis is based on the Berlin Bed Rest study I, a MAP project supported by ESA Science & Application.

Objective: To test different leg exercise regimes and monitoring approaches to decipher reasons for reduction in muscle performance during bed rest and thereby indirectly as an indicator of events during space flights. Main study focused on the effect of bed rest on bone tissue and means to prevent it. The present thesis is based on the obvious overlap between muscle and bone changes, via the functional interaction between the two tissue forms.

Subjects: Around 6 subjects in a control group and a similar number in the test group. Both groups bed rested for 2 months, the test group underwent a test regime with exercise sessions almost every day and the control group was involved in no exercise

Test regime: Diverse leg exercise forms, of which some involved vibration superimposed on the exercise.

A further thesis is foreseen from the Australian (Queensland University) cooperating group, to be written by Daniel Belavy

VERHEYDEN, BART: CARDIOVASCULAR CONTROL IN SPACE AND ON EARTH: THE CHALLENGE OF GRAVITY. LEUVEN, BELGIUM, JUNE 11TH 2007. THESIS

Source material: The thesis is based on 1) ESA Parabolic Flight Campaigns, and 2) Clinical Tilt Table exposure to the subjects. Scientific experiments on ESA's Parabolic Flight campaigns are as a rule selected via standard procedure implemented by the Science & Application division.

Objective: To test;

- The effect of acute gravity changes, induced by parabolic flight
- The effect of water immersion on cardiovascular control parameters
- The effect of a 10-day spaceflight on cardiovascular control parameter.

Further, to test different therapies in patient's cardiovascular problems related among others to the gravity loading. Thus, to test

- Potential age-relation of observed cardiovascular parameters in patients with a history of fainting, and
- The effect of repeated challenging of the cardiovascular reflexes by means of exposure to a leg-down tilt table regime.

Subjects:

- Fourteen healthy subject on ESA's 29th and 32nd Parabolic Flight campaigns, in November 2000 and April 2002
- Ten healthy young women and 10 healthy young men in exposed to 60 minutes thermo-neutral water immersion after a 6 hours fasting period
- Five male astronauts on one of three short term space missions, the Belgian Odissea, the Spanish Cervantes and the Dutch Delta mission.
- Twelve men and 17 women with positive indications of vasovagal syncope (spontaneous fainting episodes) for the tilt table examination of cardiovascular reflexes.

Test regime: Described under 'Source material' above.

A further thesis is foreseen from the Australian (Queensland University) cooperating group, to be written by Daniel Belavy

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M. DURANTE ET AL.: PREPARATORY STUDY OF A GROUND-BASED SPACE RADIOBIOLOGY PROGRAM IN EUROPE. ADVANCES IN SPACE RESEARCH 39 (2007) 1082–1086. SCIENTIFIC PUBLICATION.

Source material: This paper suggests a way ahead based on the decision under the AURORA programme to initiate a space radiation research programme.

Objective: ESA issued a call for tender in 2005 or a preliminary study of investigations on biological effects of space radiation (IBER). Objective of this study is to provide guidance on future ESA-supported activities by (a) collecting data on suitable facilities that will allow identification of the most appropriate accelerators to be targeted for cooperation, and (b) drafting a road-map for future research activities.

Material: Key questions in the research field in question are identified in table 1 of the paper. A list of high-energy ion accelerators in Europe, relevant for the purpose in question is identified in table 2 of the paper.

Conclusion: Due to Europe's research focus and long standing expertise in radiobiology research at accelerators, facilities, unlike in the USA, are already available in Europe for the needed research. Even the crucial biology laboratories and support infrastructures are already available in several of the accelerator facilities.

DORFMAN TA, LEVINE BD, TILLERY T, PESHOCK RM, HASTINGS JL, SCHNEIDER SM, MACIAS BR, BIOLO G, HARGENS AR. CARDIAC ATROPHY IN WOMEN FOLLOWING BED REST. J APPL PHYSIOL. 2007 MAR 22. SCIENTIFIC PUBLICATION.

Source material: ESA-WISE Bed Rest study, Toulouse, France
Lack of exercise in women, whilst in strict 60-days bed rest leads to reduction in the heart's Left Ventricle Volume and Right Ventricle Volume and reduction in the mass of the Right Ventricle in addition to the masses of the two sides of the heart muscle. This is similar to what has been observed earlier in bed rested men. The volume changes are not found in the bed rest group that has been exercising whilst bed rested, and the RV mass is increased compared to control. Providing food supplement in the form of 0.45 g protein/kg bodyweight/day plus branched chain amino acid, developed an intermediate population amongst the test subjects, where heart mass was conserved, but the Left Ventricle Volume still significantly reduced as a result of no exercise during bed rest.
All subjects lost an equivalent amount of body mass.

Conclusion: Exercise training and to a lesser extent protein supplementation may be potential countermeasures to the cardiac atrophy associated with chronic unloading conditions such as space flight or prolonged bed rest.

GARRABOS, Y. , D. BEYSENS, C. LECOUTRE, A. DEJOAN, V. POLEZHAEV, AND V. EMELIANOV THERMOCONVECTIONAL PHENOMENA INDUCED BY VIBRATIONS IN SUPERCRITICAL SF_6 UNDER WEIGHTLESSNESS, SCIENTIFIC PUBLICATION.

Source material: The scientific paper bases its findings on data obtained from use of the ALICE facility onboard the Russian MIR space station.

Objective: To investigate, in a gravity-free environment (0-g) the effects of two vibration regimes, differing wrt. frequency and amplitude, in the region of transition of a gas into the super-critical range. Industrially vibration is often used to control transitional phases, and in this gravity plays an important role.

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It is a subject of the paper to investigate *basic thermal processes* in a fluid under weightlessness submitted to linear harmonic oscillation.

Material: A 12-mm test cylinder in ALICE positioned between two parallel sapphire video observation windows.

Test regime: ALICE was suspended with rubber belts within the module 'Priroda', with an internal shaker to produce the controlled vibration. Experiment done at 5 reduced temperatures. Two minutes test time, 1 hour interval, shift to different regime, and so on. Total test run approximately 30 hours.

Results: the presence of vibration has a profound influence on the heat convection patterns that are formed and, in the end, on the overall thermal transport properties of the sample. This unexpected behaviour shows that some basic mechanisms are still not fully understood. Considering the interest and potential space application in supercritical media, these results show a need for further investigation, to better understand the behaviour and improve the management of critical fluids in space conditions.

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