HUMAN SPACEFLIGHT, MICROGRAVITY AND EXPLORATION

NOVEMBER 2007

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.

CLICK ON ONE OF THE HEADLINES BELOW TO GO TO THE RELEVANT TOPIC.

FEATURES

PUBLICATIONS ANNOUNCED IN OCTOBER 2007

- PARASKOV, GEORGI B., G. WURM AND O. KRAUSS:
  IMPACT INTO WEAK DUST TARGETS UNDER MICROGRAVITY AND THE FORMATION OF PLANETESIMALS ICARUS (2007). In press
- CLAIRE DEMIOT, FRANCOISE DIGNAT-GEORGE, JACQUES-OLIVIER FORTRAT, FLORENCE SABATIER, CLAUDE GHARIB, IRINA LARINA, GUILLEMETTE GAUQUELIN-KOCH, RICHARD HUGHSON, AND MARC-ANTOINE CUSTAUD:
  WISE 2005: CHRONIC BED REST IMPAIRS MICROCIRCULATORY ENDOTHELIUM IN WOMEN Source material: ESA's cooperative (with NASA and CNES participation) 2 months Bed Rest Study for women, France, 2005

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LAYOUT: WENDY MURRAY

SHORT UPDATES

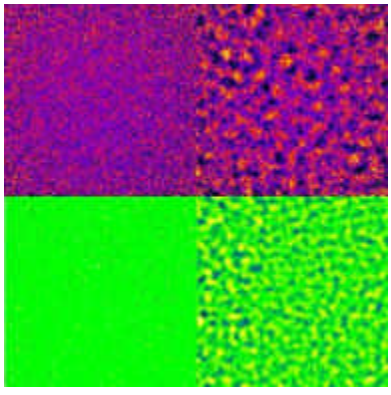
SCCO AND **GRADFLEX EXPERIMENT** ONBOARD FOTON-M3

SCCO

The experiment Soret Coefficients in Crude Oils (SCCO) has been successfully performed on board the FOTON M3 capsule. During the mission, 17 multicomponent mixtures of relevance for the oil industry have been exposed to a steady temperature difference for up to 200 hours. At the end of the experiment, the two end portions of the cells have been isolated from the bulk. Now the cells are safely back on ground, and the composition is being carefully analysed to retrieve the Soret coefficient of the different components of the mixtures. The results will shed light on the complex behaviour of oil reservoirs, where the Soret effect is believed to play a significant role in determining the composition of the constituents.

GRADFLEX

The GRADient Driven FLuctuation EXperiment (GRADFLEX) has been successfully performed on board the FOTON M3 capsule. The objective of the experiment was to observe fluctuations of temperature and concentration in pure fluid and a binary mixtures subjected to a temperature gradient. A preliminary analysis of the images donwlinked on ground at the FOTON Payload Operations Center in Kiruna, Sweden, shows the dramatic effect that was predicted almost than ten years ago: In absence of terrestrial gravity, fluctuations increase dramatically, both in size and amplitude. This exciting result is shown in the picture below, where the sample is observed on ground (left) and on board FOTON M3 under the same conditions (right). The science team is currently waiting for the full set of images to perform a thorough analysis. If you want to listen to the prime investigators, you find an interview under '**3rd FOTON-M3 Mission Report'**



Left: False color image of the fluctuations on board FOTON M3 (right) compared with the ones measured on ground (left). The purple pictures on top are observed in the binary mixture, while the green ones in a pure fluid

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THE END OF THE MULTIGEN EXPERIMENT ONBOARD THE ISS HAS ARRIVED

The MULTIGEN experiment does end up as a success,despite the many technical problems it experienced during the three months it was active. On the way, most plants did not survive well but at the end one strong plant had made it through and is now the basis for further investigation.
This plant provided around 10 blossoms, each of which will probably yield hundreds of seeds for later genetic examination. See **Newsletter September 2007** for details of the experiment. In addition a different growth could be observed than the normal 1-g representation. The material is however too limited to allow for further statements on that aspect.
The seeds are in an embryonic state when the experiment has been terminated and they will be harvested from the dried out plants when back in the laboratory on Earth. There after they will be used for a parallel investigation with those seeds that came out of the ground control plants, to look into the genetic material in the attempt to identify differences between Space and Earth-bound samples.

At a later stage it is the intention to try to utilise a Japanese experiment studying the same species, in order to improve the statistics of certain parameters.

Whether plants grow with a different pace in space than on ground is not possible to say from the available material, but there seems to be differences when compared to ground controls. Such questions may be answered in similar experiments in the near future.

MUSCLE AND BONE NEED LOADING – NEW BED REST STUDY CONTINUES THE SEARCH FOR DETAILS ....

ESA'S MICROGRAVITY APPLICATION PROGRAMME (MAP) MAKES LARGER INTERNATIONAL TEAM UNDERTAKINGS POSSIBLE. ONE TYPE OF MAP PROJECTS IS THE BED REST STUDIES. THE ONE NAMED BERLIN-BEDREST-STUDY 1 (BBR-1) THAT RAN IN THE PERIOD 2003-04 DELIVERED BOTH HIGH QUALITY DATA AND FORMED THE BASIS FOR THE FOLLOW-UP, THE BBR-2, THAT STARTED ON THE 17TH OF SEPTEMBER THIS YEAR AT THE CHARITÉ IN BERLIN. THE BBR-2 BUILDS ON THE FINDINGS FROM THE FIRST STUDY.

The BBR-2 is a follow-up of the first Berlin Bedrest Study (BBR-1), in which the Galileo-Space resistance vibration exercise (RVE) device was proven successful to counteract muscle and bone loss to a certain significant extent.

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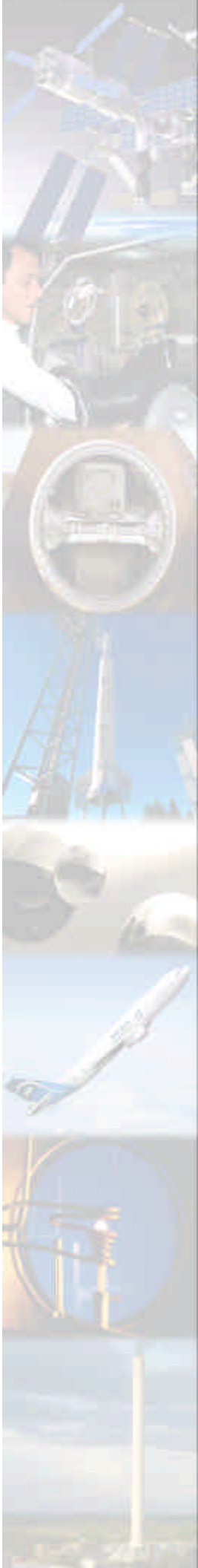

The study foresees 60 days of bed rest for 4x6 healthy male volunteers in 3 groups each: RVE, non-RVE and controls.

The aims of the current study (BBR 2-2) are:
1. To determine whether vibration per se is responsible for the high efficacy of muscle training in the earlier study.
2. To provide more information regarding the reasons for the individual differences in adaptation of muscles and bones among subjects, as was seen in the first study.
3. To implement more sophisticated monitoring systems of muscle, motor control and bone changes.
4. To apply more sophisticated histo-chemical (tissue samples and staining for certain compounds) analysis of muscle metabolism.
5. To obtain more information about angio-adaptation (circulatory adaptation aspects).
6. To investigate the influence of bed rest on the immunological system.

This could yield potential results such as:
a) Increasing training efficacy to save time.
b) Reconsidering influence of vibration on training efficacy.
c) Monitoring the use of relevant muscle groups over the whole body during bed rest (long-term EMG registration samples).
d) Demonstrating differential effects of bed rest with and without training on speed and torque parameters.
e) Hints for development of immunological deficits during bed rest.

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Contact – Study Coordinator: belavy@gmail.com
Contact ESA coordinator: jennifer.ngo-anh@esa.int

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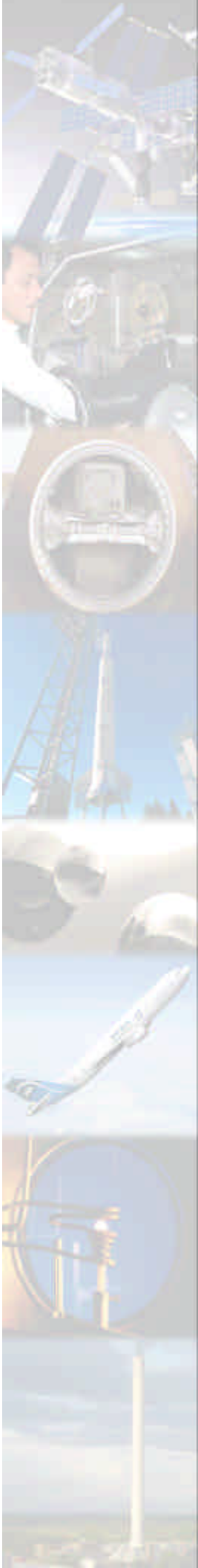

BREATHING GAS ANALYSER WILL SOON BE PORTABLE ON THE ISS – HIGH RESOLUTION PPFS TESTED BY CREW

ON 3 OCTOBER, THE MANUFACTURER TEAM FOR THE PORTABLE PULMONARY FUNCTION SYSTEM (PORTABLE PFS) MET UP AT ESTEC WITH THE MANAGEMENT TEAM AND ASTRONAUT ANDRE KUIPERS TO GO THROUGH THE DESIGN AND FUNCTIONALITY OF THE NEW DEVICE, TO BE SENT TO THE ISS SOON. THIS IS ONE OF THE STEPS IN FINALISATION OF THE DESIGN OF THE DEVICE BEFORE FINAL PRODUCTION OF THE FLIGHT AND TRAINING MODELS. THE PORTABLE PFS IS 5TH GENERATION OF WHAT STARTED IN 1985 AS A VERY AMBITIOUS PROJECT. THE RESULT TODAY IS THE MOST ADVANCED BREATH ANALYSER ASSEMBLY ON THE MARKET.

The approval cycle of the Portable PFS follows the routine, via the different Design Reviews, Safety Reviews, crew involvement sessions, which this one is one of, and finally the Final Acceptance Review.

The Portable PFS, as it is called in daily speech around, is the further-on development of the PFS that has been in function in the NASA Destiny module since Human Research Rack 2 (HRF-2) was activated onboard the International Space Station a few years ago. PFS is a European development, which builds on more than 20 years experience with such equipment, for accurate and fast response-time measurement of gases taken up or exhaled by humans when they breathe. In addition, gases that are used for measurement of one or the other physiological parameter are measured.

By exploiting the characteristic of different gases in general, and in relation to the human physiology in particular – namely the degree of inertness, their difference in specific mass, affinity for blood-binding, etc. - a host of factors such as the gas exchange between circulation and the lung, and the lung and the environment in turn, can be measured. Further, it is possible to indirectly measure the volume of blood pumped by the heart per unit time with the highest accuracy that any known method offers. Finally, several parameters, which are interesting in the context of exercise, can be measured, such as energy consumption, physical fitness and signs of exhaustion, read out via the exhaled gas composition.

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Andre Kuipers, who has been involved in earlier stages of development of such equipment for flight, was therefore a very good choice for obtaining first hand response from an 'operator' who has experience with the 'man-machine interface' on orbit, in addition to the more intrinsic characteristics of such equipment.

The portable PFS will evidently be mobile - in contrast to the PFS proper that is bolted into a rack, where it uses the computer and SW infrastructure of that rack in parallel with other rack-mounted equipment. For that reason the PPFS, as a unit, is merged with a computer on top of the gas analyser proper, and therefore provides an end-to-end facility for breath analyses.

The Portable PFS will go through the last set of tests and acceptance review during the first half of 2008, after which time it will be ready for flight. It is likely that a flight opportunity could come already within that same year, but this is still under discussion at this stage.

History: At one point in the past ESA insisted on the used technology - the infrared absorbtiometry (in combination with other techniques for certain gases) - at a time where it was on a fairly undeveloped stage. Status today is, that without choosing the IR technology then, measurement resolution development would have come to a halt, at a level at least one order of magnitude under what can be achieved today with the PFS.

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Manufacturer Innovision: info@damec.dk

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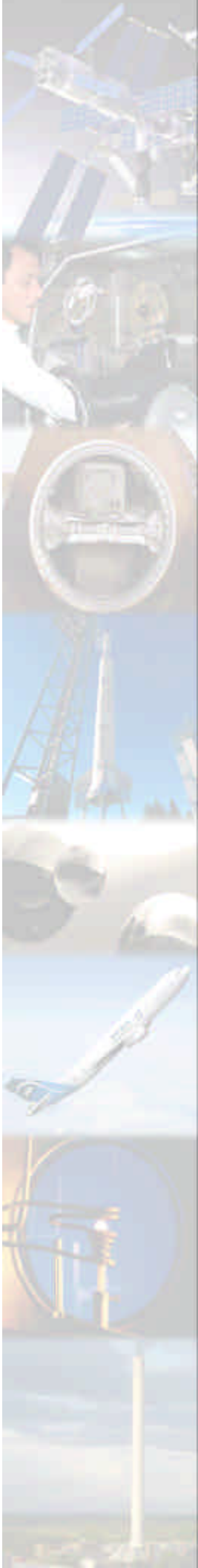
DROP TOWER EXPERIMENT - DUST AND ICE IN THE UNIVERSE MOVED BY SUNLIGHT



COMETS ARE WELL KNOWN FOR THEIR DUST TAILS, WHICH ARE DIRECTED AWAY FROM THE SUN. THIS IS THE EFFECT OF THE RADIATION PRESSURE FROM SUNLIGHT. LIGHT IS NOT ONLY CONTAINING ENERGY IN THE FORM OF THE RADIATED HEAT, THAT WE FEEL, BUT ALSO CARRIES MOMENTUM (MASS X VELOCITY IN A CERTAIN DIRECTION) BASED ON ITS SMALLEST COMPONENTS, THE PHOTONS. THE RADIATION PRESSURE FROM SUNLIGHT CAN BE LARGER NET FORCE THAN THE SUN'S GRAVITY IN CERTAIN SITUATIONS, AND DUST PARTICLES OF MICRON SIZE CAN BE EXPELLED FROM THE SOLAR SYSTEM ALLTOGETHER AS AN EFFECT. DUST AND ATMOSPHERE ICE CRYSTAL DYNAMICS CAN BE STUDIED ON EARTH USING DROP TOWERS.

Gravity and lack of it is central to most of our considerations, when we deal with Space: The effect of gravity and what happens when we can nullify it, is what we mostly concentrate on. Here the focus is on ALL measurable forces in the universe, and in certain situations, as mentioned above, gravity is over-powered by a force that we wouldn't think of as being of any considerable importance, namely the radiation pressure from sunlight.

The mass-less particle representation of light, the photon, moves with the speed of light, obviously, and can be calculated to carry the tiny amount of energy of roughly 4×10^{-19} Joules per particle, for photons in the visible light spectrum. Shorter wavelengths generate photons with higher energy, longer wavelengths photons with lower.

Photons exert radiation pressure via the momentum they possess as an effect of the speed. As momentum is always conserved, the collision of photons with particles will – in case the particles are small enough – lead to a movement in the direction that the initial momentum had. This is the basis for the experiment done in the Bremen Drop Tower: The investigation of the effect of photons on small particles, e.g. to which extent light can actually move them.

Radiation pressure depends on the way a particle absorbs or scatters light. If particles do not absorb but only scatter, measurements of the radiation pressure allow the immediate determination of the mean scattering properties. This scattering is important for example in the case of ice crystals in the Earth atmosphere, where large ice particles are abundant.
Scattering of sunlight by ice crystals in cirrus (highest altitude) clouds influences the

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energy budget of the Earth in a rather complex manner. Among other things scattering influences the splitting of ozone by UV light, which releases heat, and also affects the composition of the atmosphere, which retains or transmits heat depending on it actual gas and particle composition.

The FOTON-M3 mission, just flown successfully last month, carried a number of experiments investigating the effect of UV radiation on living matter and on genetic material. The highly harmful UV-c radiation is fully present at the FOTON orbit, whilst it is practically completely absorbed in the atmosphere before it reaches the surface of the Earth.
Sunlight is conceptually characterised to carry three wavelengths of UV light, UV-a with the longest and least harmful, in the middle UV-b, which is considerably more harmful, and UV-c, which is fatal. Luckily, UV-c is absorbed to near 100% on its way to the Earth surface through the atmosphere. Roughly 50% of the UV-a reaches the Earth surface, whilst only 1 per mille UV-b escapes absorption in diverse molecular constructions on the way. The absorption process is continuously splitting oxygen molecules off ozone (O3), which, in the next second are snatched up by O2 to form O3. That process repeats itself endlessly.

While the radiation pressure force is significant outside of planetary gravitational fields, it is still a small force in absolute terms and in comparison to the Earth's gravitational field. For small particles (< 10 µm), very low in density and which absorb light and can accommodate an intense radiation due to a high melting temperature, radiation pressure can be measured on the ground under free fall conditions for several milliseconds. As an example, this has been done for small graphite aggregates.

Thus, with respect to these two cases – the Earth's atmosphere and planetary systems – the measurement of radiation pressure on particles can provide fundamental data.

For large (100µm), transparent, volatile ice particles this is not possible in normal conditions on the ground but a measurement can be done within a few seconds of good quality microgravity. In the Drop Tower in Bremen, measurement of the radiation pressure on transparent glass spheres of 70 µm in size - for the first time at this size –were performed by illuminating a sample of very slowly moving particles by a strong continuous light source, observing particle trajectories being influenced by radiation pressure during 4 seconds. This was a first step to a more elaborate setup in the future, to measure radiation pressure on large ice crystals illuminated by a pulsed laser.

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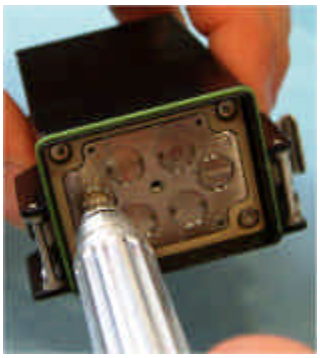
BIO-3 EXPERIMENTS IN KUBIK – ON THE 15S SOYUZ MISSION

From scientist to Moscow, samples for AT-SPACE And BIOKION are transported inside a passive thermocase with cool packs at 2..8 °C.

ON 10 OCTOBER, THE 11-DAY MISSION FOR THE EXCHANGE OF THE SOYUZ CAPSULE LIFTED OFF FROM BAIKONUR COSMODROME IN KAZAKHSTAN. A NUMBER OF PRE-LOADED EXPERIMENT CONTAINERS TO END UP IN KUBIK WERE TRAVELLING WITH THE 15S CREW. SOME CONTAINERS WERE ALREADY INSERTED IN THE KUBIK FM3 ONBOARD SOYUZ, WHILST OTHERS WERE INSERTED AFTER ARRIVAL AT THE ISS. THREE EXPERIMENTS HAVE BEEN USING KUBIK FOR THE EIGHT-DAY VISIT TO THE ISS, THE AT-SPACE, THE BIOKIN AND THE PKINASE EXPERIMENTS. SO WHAT ARE THESE EXPERIMENTS ABOUT?



The AT-SPACE Experiment

"AT" stands for ***A****rabidopsis* ***t****haliana*, a plant species that we already have onboard the ISS in the EMCS, see **Newsletter September** and the latest about the experiment in 'Short Updates' in the present Newsletter. Almost three months ago the growing of the *Arabidopsis thaliana* started in 8 growth chambers to produce multiple generations, in what is named the MULTIGEN experiment. In the meantime that experiment has been terminated.
The AT-SPACE experiment uses the same species, but with a different focus.

The AT-SPACE experiment is starting seeds off to grow for a short period, but long enough to allow for investigating the effect of microgravity on the cell signaling, related to the lack of gravity. It is the hoped that the DNA chip that is also going to be used in this experiments will reveal, if;

- gravity is driving the expression of particular classes of **genes**,
- microgravity does inhibit or induce a particular class of **gene**s, and if
- gravity influences the expression of the same **genes** in different organs.

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From Moscow to launch site Baikonur, samples are transported inside an active thermocase at 4 °C

The DNA chip has been applied post-flight, whilst the root developing from the seed has been dissected and stained in order to indicate growth related proteins, when examined under microscope.
The experiment samples in the 8 experiment containers were all activated at the same time, but stopped and fixated at different times. This should allow for a recording of the sequence of events.

The BIOKON-4 Experiment

The first BIOKIN (**BIO**logical **KIN**etics) was performed onboard the Euromir missions in the mid 1990ies, to investigate the effect of space conditions on the ability of bacteria to break down noxious gases. This was the first experiment in the attempt to design Biological Air Filters (BAF), supposed to remove contaminants from the atmosphere of the Mir Space Station, by means of organic filters.
A second stage of the BIOKIN experiments was performed onboard the Shuttle flight STS-107. BIOKIN data from that mission were not obtained due to the return disaster.

Now BIOKIN-4, the present version of the experiment, based on the same nitrogen-fixing bacteria as used in 1995, namely *Xanthobacter autotropicus* GJ10, is used for monitoring of growth on the contaminant 1,2-dichlorethane (DCA), which the bacteria is supposed to metabolise or basically 'consume' (takes carbon and energy from it). The experiment is done in a new membrane bioreactor, and the more advanced set-up now hopefully allows for estimation of phase lag, degradation rate and biomass yield differences between space experiments and a ground set-up.

BIOKIN samples are transported to the ISS already inserted in the KUBIK FM3

Normally DCA arises from terrestrial fuel dispensing and refining systems and is often re-found in contaminated soil and ground water. DCA is carcinogenic and cyto(*cell*-)toxic.
The degradation of DCA is dependant on among others one central enzyme

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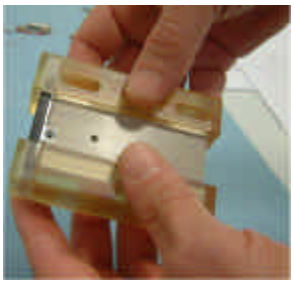
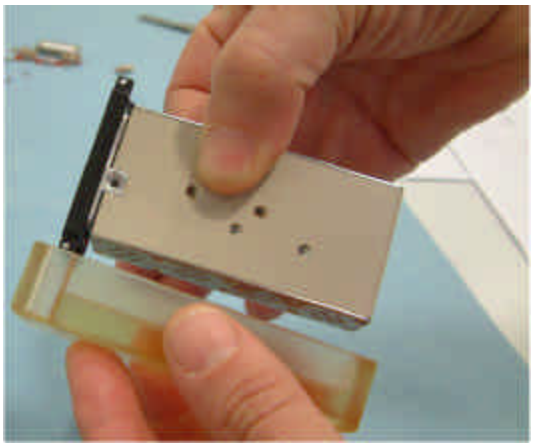
produced by the bacteria, namely haloalkane[1] dehalogenase, a 35 kd[2] enzyme with 310 amino acid residues or building stones, which catalyses the break-down of the DCA under release of free chloride and the corresponding alcohol. It 'chops off' the terminal groups of 'halogenated alkanes', found in many industrial solvents, pesticides and intermediates for chemical syntheses. (Franken et al. The EMBO journal, vol.10, 1991)

The experiment makes use of 2 x 4 experiment containers, loaded on Earth and brought to the ISS in the KUBIK FM3 under temperature control, in the range of 28-31 degrees C, which is the optimal operational temperature for the involved enzymes.
Activation of the experiment in KUBIK now happens automatically by mechanical breakage of ampoules containing the DCA.

The PKINASE experiment





This experiment addresses an essential question in cell differentiation in the human body, the development of monocytes into macrophages (Greek: big eaters) which happens as soon as the blood-borne monocyte enters tissue to perform the macrophage role. Macrophages work as 'scavengers'.
Both cell types perform phagocytosis in the body, an action under which inclusion and digestion of pathogens and cell waste takes place.
Earlier findings indicate that the development from monocyte to macrophage under space conditions is altered, via an apparent inhibition of the protein kinase C - a protein central to the differentiation of monocytes into macrophages.

A further examination will "determine the effect of microgravity on expression of genes critical to monocyte differentiation into macrophages". The latter step will be analysed after the flight by use of DNA chips. Further, one essential marker for the differentiation action, which can be identified on the cell surface by application of fluorometry, is being examined (the sites of interest on

[1] Alkane: A hydrocarbon with only single C-C bindings, example C2H6. In haloalkanes one or more hydrogen atoms are exchanged by a halogen (Iodine, Bromide, Flouride and Chloride)
[2] 'kd' means 'kilo Dalton' and is a measure for the **size**, or actually directly the **mass** of a protein. One hydrogen atom has the mass of 1 Dalton (Da). 30 kd then, does give a feeling of the size of the protein. 'Size' is important in different contexts.

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the cell membrane are brought to fluorise by chemical binding and can be seen under microscope).
Finally, the conversion of PKC enzyme from its passive to its active form is investigated, in order to determine if changes take place at that level, as a possible reason for the earlier observed inhibition of the PKC activation.

The central question asked in this experiment is, if the translocation of activated PKC from the cytosol (cell fluid) to the surface of the inner membrane takes place. This seems to be dependant on binding of at least one co-factor to it, as an 'activator' of the 'passive' enzyme. The translocation is considered an indication of activation of the enzyme, as a necessity to start the differentiation of the monocyte into the macrophage.

Eight containers were inserted into the KUBIK incubator. Later, and for the first samples already after 3 hours, the experiment was stopped by means of a fixation chemical.
One of the latest sequential events, the RNA coding for the specific protein inside the cell, takes longer time to yield markers for the process.

After 36 hours also these samples have been fixated and placed in cold stowage until return. In parallel with the space experiment on the ISS, an experiment has been run following an identical protocol in the ground model of the KUBIK facility, as a control under normal gravity.

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Contact biological experiments in KUBIK: jason.hatton@esa.int

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FOTON-M3 LANDED AND RECOVERED – FIRST STATUS

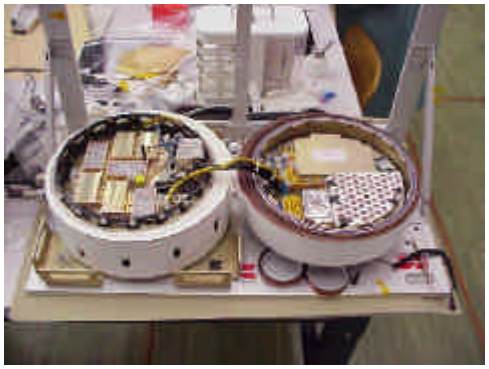
ON 26 SEPTEMBER, 14:06 LOCAL TIME, 10:06 MET THE FOTO-M3 CAPSULE TOUCHED DOWN, ONLY FEW KILOMETERS FROM THE CALCULATED LANDING TARGET. BEFORE THE CAPSULE TOUCHED THE GROUND UNDER THE STILL FULLY BEARING PARACHUTES THE FIRST HELICOPTER WAS ON THE LOCATION.

BIOLOGICAL AND OTHER SAMPLES, IN ADDITION TO THE SCCO EXPERIMENT HARDWARE, THAT HAD A HIGH PRESSURE CARTRIDGE TO BE CARED FOR, WERE REMOVED IMMEDIATELY AND TAKEN CARE OF. THIRTY-SIX HOURS AFTER TOUCHDOWN IN KAZAKHSTAN THIS MATERIAL WAS BACK AT ESTEC FOR FURTHER PROCESSING IN THE LAB.

The mission management reports about a very successful mission, with only very few and mostly minor problems. One problem with some significance was that in one of the two BIOBOX incubators the 1-g reference centrifuge didn't function as expected. Actually, the centrifuge which was supposed to rotate with a speed such that samples inserted in it would be exposed to 1-g, as a means to provide an 'in-flight 1-g reference sample set', never started at all. The reason for the problem is not yet fully understood.

On the other hand this had the effect that a double set of 0-g – undisturbed - samples could be harvested. The 1-g reference may now be performed on the ground after the flight. Although this approach is not perfect (samples are from a different batch, have not be exposed to transport and launch stress in general) it will still reliably provide many of the examined parameters.

Regarding the temperature conditions that BIOBOX functioned under during the mission, temperature could be optimised even more than expected: The promised lowest temperature of 8 degrees C for preserving sample material (based on pre-mission calculation of the available energy budget) could be set as low as the optimal 4 degrees C instead.



BIOPAN, the facility that during the flight exposes its samples to space vacuum and its rough conditions, was successfully opened back in the ESTEC lab, after a delay of several days. Normally BIOPAN would be opened short time after having arrived back in the lab, but due to logistics problems related to some of the Ground Support

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Equipment, GSE, used prior to launch in Baikonur, an emergency procedure was used to - successfully – open BIOPAN in due time. Time was critical for the electronic memory, which in the automated mode registers data from the facility, but which also, as an effect of the automation, will start overwriting the earliest recorded data, once the memory has run full. This problem was omitted in time, however.

Samples in BIOPAN looked unharmed, at least as far as the naked eye could see. These samples now undergo further examination and processing, before results can be provided, probably not until a few months from now.

This mission implemented a number of improvements compared to earlier FOTON missions, in the area of mission control and monitoring.
The Mission Control Center was this time located in TsSUP near Moscow which gave first hand access to important data during the 5 daily pass-overs of the FOTON capsule, over the Moscow based control center. Further, as an effect of the excellent collaboration with the Canadian Space Agency (CSA) on this mission, two Canadian ground stations had been made available. Early in the mission it was planned to test and fine-tune the communication with the onboard TeleSupport Unit, with the intention of down-linking data that way in addition to the primary Payload Operations Center, POC, at ESRANGE in Kiruna, Sweden. This had the effect that probably as much as 20% more data overall could be down-linked during the flight. All in all, an impressive 1 GB of data was down-linked from FOTON-M3 during its 12 days' flight.

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FOTON-M3 UPDATE - OVERVIEW OVER IMAGES, VIDEO AND MATERIAL FROM THE SUCCESSFUL MISSION

FOTON-M3 MISSION REPORTS / WEB STREAMING

1ST MISSION REPORT PRESENTS: INTEGRATION OF THE MISSION AND LAUNCH

- Overview of the integration activities and the successful launch on Friday 14/09/2007.
- Look at some of the late access activities that were carried out at ESTEC a week before the launch.
- Brief report on the status of some of the experiments that have been activated since the launch.

2ND MISSION REPORT PRESENTS: LIFE SCIENCE S EXPERIMENTS

- Rene Demets (ESA) has been interviewed on the biology experiments on-board.
- Report from Kiruna (Sweden) about the Esrange tracking station and some of the mission's life science experiments.

3RD MISSION REPORT PRESENTS: PHYSICAL SCIENCES EXPERIMENTS

- Olivier Minster (ESA) has been interviewed on the physical sciences experiments on-board. *Four main Physical sciences experiments have been performed onboard the mission*
- Report from Kiruna (Sweden) about some of the mission's fluid physics experiments. *Originating scientists tell the story of a how an old theory now have been proven to be correct.*

4TH MISSION REPORT PRESENTS: MISSION OVERVIEW, LANDING AND TELESCIENCE

- Martin Zell (ESA) has been interviewed on what happened during landing and retrieval events of the Foton capsule.
- Vladimir Pletser (ESA) has been interviewed on a general overview of the mission.
- Reports from Kiruna (Sweden) about the DIMAC hardware and the telescience activities.

http://streamiss.spaceflight.esa.int/?pg=production&dm=1&PID=fotonm3

BACKGROUND INFORMATION

FOTON-M3 BROCHURE:

http://esamultimedia.esa.int/docs/foton/FOTON-M3_brochure.pdf

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YES2 WEBSITE:

http://www.esa.int/yes2

NEWS ARTICLES:

LAUNCH OF FOTON-M3:

http://www.esa.int/esaHS/SEMQDB13J6F_index_0.html

FLUID THEORY CONFIRMED:

http://www.esa.int/esaHS/SEM585C1S6F_index_0.html

YES2 PAYLOAD RELEASED:

http://www.esa.int/esaHS/SEMBBBC1S6F_index_0.html

VIDEOS:

WATCH THE LAUNCH:

http://www.esa.int/esaHS/SEMVIOK5P6F_research_0.html

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46th ESA PARABOLIC FLIGHT CAMPAIGN – NOVEMBER 2007

PRELIMINARY LIST OF EXPERIMENTS (status 25/10/2007)

PS-46/B TRANSIENT TIME OF THERMAL-VIBRATIONAL CONVECTION IN REDUCED GRAVITY

AO-2000-096 DR V. SHEVTSOVA, PROF. J.C. LEGROS (UNIV. BRUXELLES, B)

PS-46/C HYDROPHOBICITY EXPERIMENT FOR THE DOLFIN PROJECT

AO2004-132 PROF. C. TROPEA, DR I. ROISMAN (TECHNICAL UNIV.DARMSTADT, D)

PS-46/E AGGREGATION PROPERTIES OF ICE AND DUST IN PLANET FORMING REGIONS

AO2004-115 PROF. J. BLUM (BRAUNSCHWEIG UNIV., D), PROF. H. FRASER (STRATHCLYDE UNIV., UK), MRS D. SALTER (LEIDEN UNIV., NL),

PS-46/G ICAPS/IMPACT LSU SAMPLE TESTING

AO-99-018 DR J.B. RENARD, DR A.C. LEVASSEUR-REGOURD (LPCE-CNRS, ORLEANS, F)

PS-46/H CHEMO-MARANGONI CONVECTION IN CAPILLARIES (CMCC)

AO-2004-071 DR K. ECKERT (TECHN. UNIV. DRESDEN, D)

PS-46/J METALLIC FOAM EXPERIMENT WITH X-RAY DIAGNOSTIC

AO-99-075
AO-2004-046 PROF. J. BANHART, DR F. GARCIA-MORENO (TECHN. UNIV. BERLIN, D)

PS-46/K BEHAVIOUR OF DENSE SAMPLES OF GRANULAR MATTER UNDER LINEAR VIBRATION

DR P. EVESQUE (ECOLE CENTRALE, PARIS, F)

LS-46/A DEVELOPMENT OF A GRAVITY SIMULATOR CREATING CORRECT MECHANICS OF LOCOMOTION IN MICROGRAVITY

PROFS. N. HEGLUND, P. WILLEMS (UNIV. LOUVAIN, LOUVAIN-LA-NEUVE, B)

LS-46/C OXIDATIVE BURST: EARLIEST RESPONSE OF ROOTS FROM MAIZE (*ZEA MAYS*) AND ARABIDOPSIS (*ARABIDOPSIS THALIANA*) TO CHANGES OF GRAVITATIONAL FORCE

PROF. D. VOLKMANN (UNIV. BONN, D), DR S. MANCUSO (FIRENZE UNIV., I)

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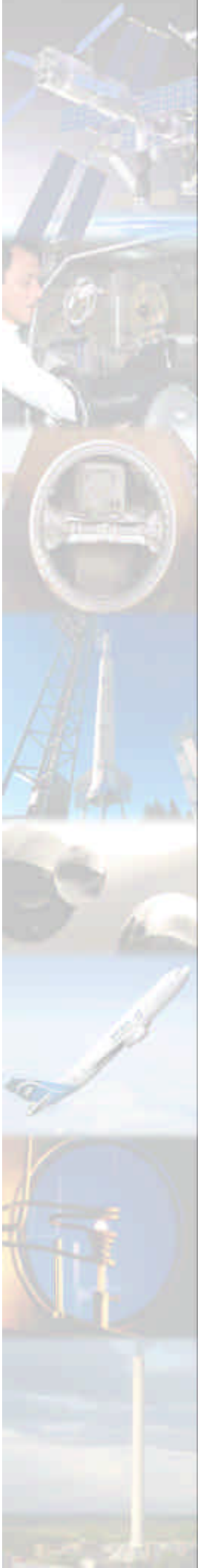

TT-46/A TEST OF THE SELF-STANDING ACCELEROMETER FBME: FLIGHT BODY MOTION EXPERIMENT

D. NIXON, M. RIEDEL, L. HOLT (ASTROCOURIER, COUNTY CLARE, IRL)

TT-46/C TEST OF THE URINE COLLECTION SYSTEM (UCS)

M. CORK (ESA-ESTEC/HME-GPL), L. BECK, P. GAUGER (DLR),

OEI(ESTEC SUPPORT)

TT-46/D TESTS OF THE NEUROSPAT AND 3D-SPACE INTERFACES

DR J. NGO-ANH (ESA-ESTEC/HME-GPA), E. LORIGNY (CNES, TOULOUSE, F)

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PUBLICATIONS

PARASKOV, GEORGI B., G. WURM AND O. KRAUSS:

IMPACT INTO WEAK DUST TARGETS UNDER MICROGRAVITY AND THE FORMATION OF PLANETESIMALS.

ICARUS (2007). IN PRESS. SCIENTIFIC PAPER.

SOURCE MATERIAL: BREMEN DROP TOWER, ZARM, 2005 CAMPAIGN.

Objective: To investigate the effect in form of video data of individual collision, the behaviour of the target and the production and motion of the fragments. More precisely, measurement of the amount of mass added to, or lost by, the target and measurements of the velocity of the ejecta.

Subjects: Not applicable.

Test regime: 1-g and almost identical 0-g vacuum impact chamber. Vacuum (P<0.002 mbar) is needed in order to rule out gas drag in the miniscule particles involved. Target centred in the middle of the chamber. A 48 mm diameter tube with an aperture in one side holds polydisperse silicate dust with a particle range between 0.1 and 10 microns. Depth of dust layer is 4-4.5 cm. After initiation of the circa 4.7 sec o-g phase in the drop tower, a projectile is accelerated form a spring launcher to hit the dust pit. Two kinds of prejectiles were used: Compact dust aggregates of 5-10 mm size and same material as dust, and secondly solid spheres with a 5-8 mm diameter. Video recordings are made of the target area eith 50 frames per sec, under flashlight illumination. Impact recording is timed to take place 0.2 sec before landing impact. Two types of dust are: Highly porous and highly compact dust aggregates as extreme candidates for protoplanetary disks. Particles of the size in question stick together well by surface forces if they are mechanically lightly compressed.

Results: The effect of collision between dust particles and large dust targets and the influence of velocity, hardness of components and projectile type has been demonstrated via a set of high resolution data.

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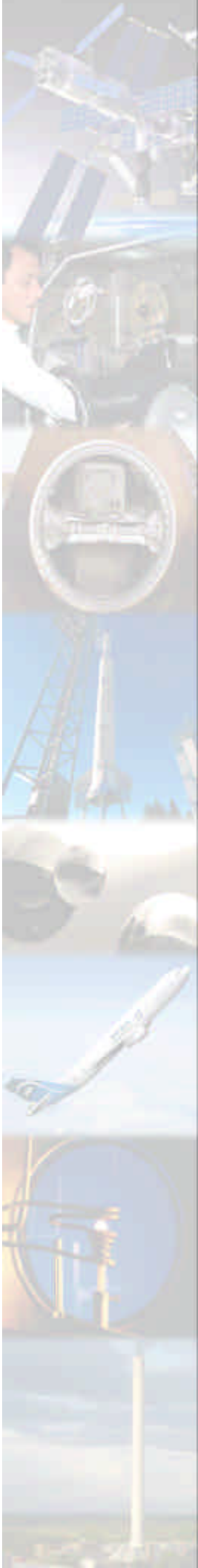

CLAIRE DEMIOT, FRANCOISE DIGNAT-GEORGE, JACQUES-OLIVIER FORTRAT, FLORENCE SABATIER, CLAUDE GHARIB, IRINA LARINA, GUILLEMETTE GAUQUELIN-KOCH, RICHARD HUGHSON, AND MARC-ANTOINE CUSTAUD

WISE 2005: CHRONIC BED REST IMPAIRS MICROCIRCULATORY ENDOTHELIUM IN WOMEN

SOURCE MATERIAL: ESA'S COOPERATIVE (WITH NASA AND CNES PARTICIPATION) 2 MONTHS BED REST STUDY FOR WOMEN, FRANCE, 2005.

Objective: To assess the specific effects of prolonged inactivity without other vascular risk factors on the endothelium in peripheral blood vessels. Endothelial properties were investigated before and after 56 days of bed rest. The microcirculation in the skin was examined using laser Doppler flow measurements. Certain interventions were undertaken in order to assess the ability of the vessels to constrict and dilate. Finally a count of circulating endothelial cells was performed.

Subjects: Eight healthy women performing a 2-months bed rest without any activity programme, compared to eight women, who underwent a specific exercise and activity programme, e.g. treadmill exercise in a Lower Body Negative Pressure chamber, as well as resistance exercise.

Test regime: Two months strict bed rest study involving women, organised and managed by ESA on behalf of the international space life sciences partners.

Results: The study shows in humans that prolonged bed rest causes impairment of endothelium-dependent function at the microcirculatory level, along with an increase in circulating endothelial cells, and as an effect it is concluded that the endothelium should be a target for countermeasures during periods of prolonged deconditioning.

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