Helmholtz Space Life Sciences Research School - SpaceLife

An Interdisciplinary Doctoral Candidate Program
Institute of Aerospace Medicine, Cologne, Germany

DLR

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Description of the Helmholtz Space Life Sciences Research School (SpaceLife)

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Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

HELMHOLTZ GEMEINSCHAFT

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SpaceLife

Introduction

The Helmholtz Space Life Sciences Research School (SpaceLife) offers excellent and interdisciplinary training for doctoral students from different fields (biology, physics, psychology, veterinary medicine, nutrition or sports sciences) and all countries. In each generation, up to 25 students can participate in the three-year program. At the DLR, up to 13 doctoral students will participate in SpaceLife. Up to twelve doctoral students at the partner universities can be admitted to SpaceLife. Students will learn to develop integrated concepts to solve health issues in human spaceflight and in related disease patterns on Earth, and to further explore the requirements for life in extreme environments, enabling a better understanding of the ecosystem Earth and the search for life on other planets in unmanned and manned missions.

Thesis supervision is close meshed by two specialist Supervisors from DLR and the partner university, and a Mentor, as well as annual progress reports by the doctoral student in a Students' Workshop.

All students attend lectures in different subfields of space life sciences to attain an overview of the field: radiation and gravitational biology, astrobiology and space physiology, including psychological aspects of short and long term space missions. Seminars, advanced lectures, laboratory courses and stays at labs at the partner institutions or abroad are offered as elective course and will provide in-depth knowledge of the chosen subfield or will allow to appropriate innovative methods. In Journal Clubs of the participating working groups, doctoral students will learn critical reading of scientific literature, first steps in peer review, scientific writing during preparation of their own publication, and writing of the thesis. The training of soft skills will be offered as block course in cooperation with other Helmholtz Research Schools. The whole program encompasses 246 hours and is organized in semester terms. Most of the lectures will take place in Cologne at the Institute of Aerospace Medicine.

Doctoral students from Hamburg, Kiel, Aachen and Regensburg attend the lectures using teleconference tools, or block courses will be offered. Some elective courses take place at the University of Bonn and the DSHS Cologne. The spokesperson bears responsibility for SpaceLife. SpaceLife is organized by the coordinator and the secretary. The scientific members of SpaceLife form the Faculty which meets annually. The Faculty elects a Faculty Panel who assists the coordinator and the spokesperson in the student selection process and in formation of the curriculum. The doctoral students elect a Doctoral Spokesperson who participates in meetings of the Faculty and the Faculty Panel.

SpaceLife

Scientific Program

The mission of the Helmholtz Space Life Sciences Research School (SpaceLife) is to contribute to understanding the space frontier and the opportunities, capabilities, and limitations of humans living and working on that frontier and of the spread of life in the universe. The program's objective is to investigate the complex interactions of space environmental factors and humans or other organisms. To accomplish its mission, SpaceLife implements a broad range of applied and basic scientific research. Thereby it links theoretical and practical approaches of radiation dosimetry, microbiology, basic molecular and cellular research in radiation and gravitational biology with translational and clinical studies. This research is accomplished using ground-based laboratories, microgravity environments, space-analog simulation facilities and if available, space flight opportunities. The long-term goal is to contribute to the "safe, sustained, affordable exploration of the Moon, Mars, and beyond…". The European Space Agency's Aurora program and the US Vision for Space Exploration aim ultimately to land people on Mars, although it seems certain that the Moon will be an earlier target.

In the short term, Aurora features robotic missions while at the same time preparing for future human exploration missions. Humans bring speed, agility, versatility and intelligence to exploration in a way that robots cannot. Although it is true that humans will face many dangers and obstacles operating on other planets, mostly due to their physiological limitations when compared to robots, the potential scientific returns is more than sufficient to justify employing astronauts as field scientists on other planets. However, prior to manned missions to Mars, appropriate guidelines and methods need to be developed to protect the planet from human activities that may be harmful to its environment; this includes preventing the introduction of terrestrial biochemical compounds and microorganisms that could interfere with the search for indigenous Martian life, to protect the Earth from potentially harmful agents brought back from Mars or even sample return missions upon return of the explorers. Answers to these planetary protection issues need to be available well ahead of manned missions to Mars, e.g. by testing planetary protection protocols and guidelines during precursor missions and by investigating the extraordinary capability of terrestrial microorganisms to adapt to and live under extreme environmental conditions.

A key priority of European human spaceflight activities remains the effective use of the International Space Station (ISS) in the next 10 years in order to maximize the return on European investment. This aligns well with the current German Space Life Sciences Program, in which three main scientific fields have been identified in collaboration with the scientific community: integrative human physiology, biotechnological applications of the microgravity environment, and fundamental biology of gravity and radiation responses. In view of planning long-duration human exploration missions it is imperative that the ISS is used for the preparation of these new endeavors.

The ISS is ideally suited for testing hardware developments, and to perform long-term medical studies, related to future exploration missions to Moon and Mars. These medical studies on humans will be focused on the long-term effects of microgravity, radiation biology, and the psychological effects of long duration flight.

SpaceLife

Scientific Program

The European Columbus laboratory has been successfully launched on February 7, 2008 and paves the way for the implementation of a significant ISS utilization program which will further advance technical and scientific progress in human spaceflight.

Space life science research embraces the whole range of studies from molecular and cellular biology to whole-organism physiology. In the important area of human physiology and medicine, research in the space environment has demonstrated the potential to provide unique insights into such areas as gene expression, immunological function, bone physiology, and neurovestibular and cardiovascular function. These areas are important for understanding age-related phenomena and a range of terrestrial disease processes (e.g. osteoporosis, muscle atrophy, cardiac impairment, and balance and coordination defects), and as such have potential medical applications in prevention, diagnosis, and therapy here on Earth. Moreover, research in space physiology provides a stimulus for the development of innovative medical technology, much of which is directly applicable to terrestrial medicine.

In fundamental biology, questions on the understanding of the effects of cosmic radiation and of altered gravity (microgravity and hypergravity) on living systems as well as on the origin and distribution of life and its evolution, are tackled. Radiation is an acknowledged primary concern for manned spaceflight and is a potentially limiting factor for long term orbital and interplanetary missions. Results from numerous space probes demonstrate heightened radiation levels compared to the Earth's surface and a change in the nature of the radiation field - particularly the presence of high energy heavy ions. The biological effects of this extraordinary radiation quality and the depths dose distributions in the human body have to be assessed for risk estimation and countermeasure development. Of central importance is also the elucidation of the mechanisms of gravity perception and signal transduction. While there is an increase in knowledge of the biological and physiological consequences of short-term microgravity, the biological effects of prolonged exposure to low, but non-zero, gravity are largely unknown. For example, more or less open questions are adaptation phenomena to a long-term microgravity environment, the existence of sensitive windows in the development of organisms as well as thresholds of graviperception.There is particular interest in the long-term effects of reduced gravity on the human body as well as on multi-generation experiments with cells and multicellular systems. Of special importance is to determine potential gravity thresholds for different body functions, in particular with regard to loss of muscle and bone mass, reduced cardiovascular capacity, functioning of the central nervous system, and immune system deficiencies.

With respect to future long-term human space missions to Moon and Mars it is of utmost importance to enlarge our knowledge about life in extreme environments, to develop, not only adequate countermeasures to reduce the effects of low gravity, but also to perform research into the effects of space radiation on the human body. Therefore, the Institute of Aerospace Medicine at the DLR establishes the Helmholtz Space Life Sciences Research School (SpaceLife) in order to provide training at the highest level for excellent young scientists.

SpaceLife

Radiation Biology

Space Radiation Biology seeks to understand the biological effects of cosmic radiation by applying advanced methods of radiation dosimetry and cell biology. For proper risk assessment and amelioration of the effects of radiation encountered in space the knowledge of the radiation distribution throughout the body and hence on the body dose, of the relative biological effectiveness of cosmic radiation, of the effects of other spaceflight factors on the expression of radiation damage, and of the underlying biological responses are necessary.

Scientific Program

Radiation Protection and Space Radiation Measurements

In order to obtain precise data on radiation distribution throughout the body during an Extra Vehicular Activity (EVA), MATROSHKA -an ESA multi-user facility - was developed by the German Aerospace Centre (DLR), Institute of Aerospace Medicine. The key part of the facility is a human phantom upper torso, equipped with numerous radiation detectors. MATROSHKA was mounted on the exterior of the Russian Service Module of the International Space Station (ISS) in February 2004. After an exposure of about 18 month it was brought back inside the ISS and equipped with new detector sets and is still operating. The data gathered - in cooperation with 19 institutes worldwide - are used to reduce uncertainties in risk estimates for radiation-induced cancer, and for the refinement of the shielding needs for vehicles used for future long duration missions. They serve as benchmarks for space radiation models and radiation transport calculations and have important implications for ISS crew health and mission planning.

Topics and Doctoral Theses

Besides the MATROSHKA experiment, the group is in charge– as contractor for ESA – for the personal dosimetry of European Astronauts. This activity is supplemented by area dose measurements at several locations inside the European COLUMBUS Module. The development of active radiation detectors – in cooperation with the University of Kiel – for the European ExoMars and the US MSL Mission, as well as the determination of the radiation load on aircrew (LUFTHANSA) are further fields of study.

All space studies are accompanied by an extensive ground based intercalibration program. The detection efficiency of various passive (thermoluminescence detectors, nuclear track etch detectors) and active (silicon detectors, tissue equivalent proportional counters) radiation detectors is investigated in various heavy ion and neutron fields, in an international program.

Scientific Program

Doctoral Theses

Radiation Biology

Radiation Protection and Space Radiation Measurements

Topic of Doctoral Thesis

Simulations of the radiation exposure for human missions in Low Earth orbit and beyond – correlation with measured space radiation data

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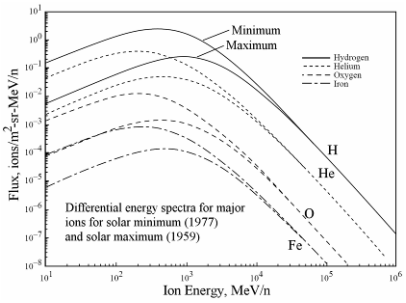
Thesis Description

Besides the effects of the microgravity environment, and the psychological and psychosocial problems encountered in confined spaces, radiation is the main health detriment for long duration human space missions. The radiation environment encountered in space differs in nature from that on earth, consisting mostly of high energetic ions from protons up to iron, resulting in radiation levels far exceeding the ones encountered on earth. The determination of the radiation load on humans in earth orbit is an essential task to be followed. Besides the measurements performed onboard the ISS – as for example in the framework of the MATROSHKA experiment – calculations are performed to simulate the radiation environment and the interaction of radiation with matter. The measured data acts hereby as a "benchmark" to verify the applied calculation codes.

The MATROSHKA experiment onboard the International Space Station ISS (2008)

In the frame of the PhD thesis calculations for the radiation environment and the radiation load onboard the ISS should be performed. The baseline should be the intercomparison of various input functions – as the different models for the GCR environment – as well as the intercomparison of various radiation transport codes – either based on Monte Carlo or on the solution of the one dimensional Boltzmann equation. Based on the output of this work a set of input functions and transport codes should be chosen to simulate various radiation experiments currently performed onboard the ISS – as MATROSHKA. The further aim of the thesis is to develop a concise set of radiation simulation tools – acting as a baseline requirement for further dose calculations and risk assessment for long duration human space flight.



Galactic Cosmic Ray spectra as input functions for radiation transport codes

Radiation Biology

Radiation Protection and Space Radiation Measurements

Topic of Doctoral Thesis

Construction and ground based verification of a miniaturized active radiation measurement system based on silicon detector technology

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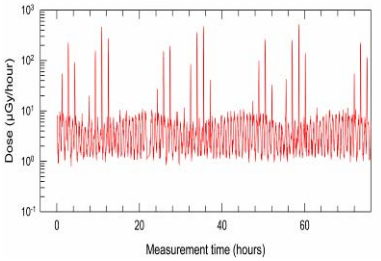
Thesis Description

The current system of radiation detectors onboard the International Space Station is based on active and passive radiation measurement systems. While active radiation detectors are capable of data storage and download in real-time – as well as having alarm functions for high radiation dose levels – due to Solar Particle Events – passive detectors have to be downloaded to ground for data evaluation. Besides the measurement of the radiation environment onboard the ISS, DLR also performs routinely measurement flights onboard aircraft, since also aircrew members are seen as occupational workers. The aim of this PhD thesis is to develop a miniaturized active radiation detector system, capable to determine radiation field parameters as absorbed dose, LET spectra, neutron dose and the biological relevant dose equivalent.

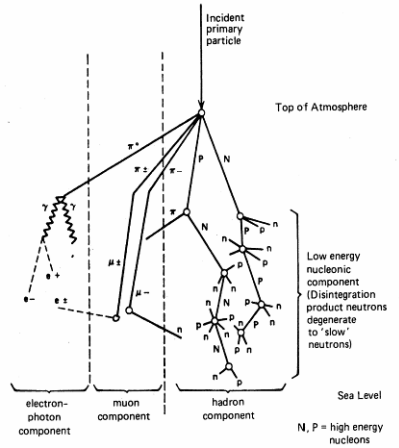
Scientific Program

Doctoral Theses

The system will be based on well established silicon detector technology and will consist in a baseline configuration of three silicon detectors arranged in a X / Y / Z assembly. Besides the construction of the system various ground based intercalibration experiments for detector verifications at Heavy Ion Accelerators as well as in different Neutron fields are foreseen. The output should be a small robust, easy to handle – battery driven active detector system for usage in aircraft as well as in space dosimetry.



Measured dose rate for an active silicon detector system applied onboard the International Space Station ISS



The radiation environment ("Particle Shower") in the Earth atmosphere

Scientific Program

Radiation Biology

Cellular Radiation Effects and Bystander Effects

For risk assessment and countermeasure development, pathways playing important roles in radiation induced cancerogenesis have to be understood. In view of its tumor-promoting capacity, Nuclear Factor κB (NF-κB) is an important factor involved in the modulation of environment-induced gene expression, especially in the interplay of the pro-apoptotic 53 pathway and the pro-survival NF-κB pathway after low and high dose radiation. The transcription factor p53 plays a central role as a principal regulator of the G1 cell cycle checkpoint in maintaining the integrity of genome after exposure to DNA-damaging agents, thereby acting as a tumor suppressor. p53 protein regulates the expression of specific genes involved in growth regulation and apoptosis, while NF-κB regulates the expression of specific anti-apoptotic genes involved in innate and adaptive immunity and in oncogenesis. Activation of the NF-κB pathway gives transformed cells a growth and survival advantage and further renders tumor cells resistant to chemo- and radiation therapy.

Doctoral Theses

NF-κB also enhances the expression of degradative enzymes, supporting the idea that it makes a major contribution to tumor progression.

At the Institute of Aerospace Medicine, the biological effects of cosmic radiation are analyzed by several approaches: Different radiation qualities (sparsely ionizing X-rays, densely ionizing α-particles and accelerated heavy ions as well as neutrons) are supposed to have different induction potencies for the NF-κB and the p53 pathway. Their effect on the biological outcome (alterations in gene expression, cell cycle arrest, apoptosis and other types of cell death, DNA repair) will be analyzed by microarrays, real-time quantitative Reverse Transcriptase Polymerase Chain Reaction (qRT-PCR), translocation vectors with fluorescent marker proteins and immunofluorescence (confocal microscopy), pulsed field gel electrophoresis, inhibitor and RNA interference studies, apoptosis assays and flow cytometric cell cycle analysis.

Scientific Program

Doctoral Theses

Radiation Biology

Cellular Radiation Effects and Bystander Effects

Topic of Doctoral Thesis

The interplay of death, survival and cell cycle arrest pathways in radiation-exposed human cells

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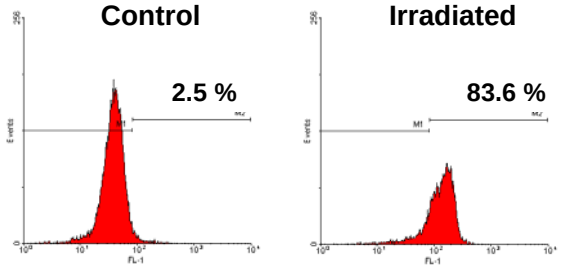
Thesis Description

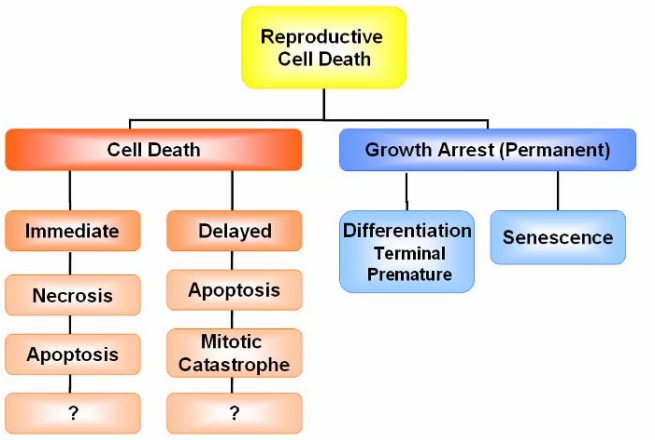
Radiation is a potentially limiting factor for long term orbital and interplanetary missions. For better risk estimation and development of appropriate countermeasures, the study of the cellular radiation response is necessary.

Exposure of human cells to ionizing radiation can provoke cell cycle, leading to cellular senescence or premature differentiation, and different types of cell death: apoptosis, necrosis, mitotic catastrophe. Previous experiments with space relevant radiation qualities have shown that two important pathways are activated by fluences that can be reached during long-term missions: the NF-κB and the p53 pathway.

In this thesis, the contribution of these pathways to different cellular outcomes (cell cycle arrest, survival, DNA repair, different types of cell death) will be analyzed by functional knockout of key components of the pathways using an RNA interference approach. Small interfering RNA constructs (shRNA) will be transfected in human cells and their functionality assessed by qRT-PCR.



Activation of the p53 pathway by ionizing radiation, flow cytometric analysis of irradiated human lung epithelial cells carrying a p53-responsive reporter plasmid



Reproductive cell death in the cellular radiation response

Radiation Biology

Cellular Radiation Effects and Bystander Effects

Topic of Doctoral Thesis

Cellular Radiation Effects and Bystander Effects: Gene expression modulation in the cellular radiation response

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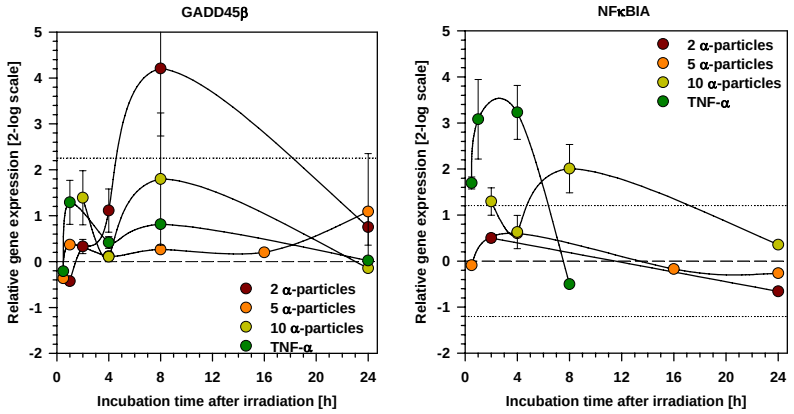
Thesis Description

Radiation is a potentially limiting factor for long term orbital and interplanetary missions. The exposure of astronauts to space radiation differs in quality and quantity compared to other occupationally exposed radiation workers. For better risk estimation and development of appropriate countermeasures, the study of the cellular radiation response is necessary. Exposure of human cells to ionizing radiation can provoke active cellular responses (cell cycle arrest, DNA repair, apoptosis or other forms of cell type) which rely on gene expression changes. Previous high-dose-rate experiments have shown up-regulation of several target genes of the important NF-κB and p53 stress response pathways (e.g. GADD45β, NFKBIA, p21, p53R2). In this work, a comprehensive study of NF-κB and p53 target gene expression after high and low dose and dose rate exposure of human cells to ionizing radiation by commercially available qRT-PCR arrays will be performed and correlated with different cellular outcomes.



Expression of the growth arrest and DNA damage inducible gene GADD45β and of the inhibitor of NF-κB gene (NFKBIA) in human embryonic kidney cells after exposure to nucleus-targeted α-particles

Exposure of human cells to energetic heavy ions at the "Grand Accélérateur des Ions Lourds" (GANIL) in Caen, France

Gravitational Biology

The evolution of life on Earth occurred under the persistent influence of gravity. As gravity is constant with respect to its direction and magnitude, the vectorial information of gravitational acceleration is a most reliable reference point for orientation. Sensors for the gravity stimulus, specialized organelles for gravity sensing and mechanisms for active responses have been found in unicellular organisms as well as in multicellular animal and plant systems. Recent studies support the hypothesis that gravity is perceived either by intracellular receptors (statocyst-like organelles), heavy cell organelles (such as nucleus) and/or by sensing the cell mass by means of ion channels located in the cell membrane. Consequently the question arises about a general gravisensitivity of cells including mammalian cells.

Though severe effects of microgravity on cells (e.g. lymphocytes) have been stated, the development of complex organisms occurs more or less undisturbed under this condition. However, a systematic approach and multi-generation experiments with animals and plants in microgravity are necessary as they are the key players in life support systems which are necessary for long-term manned space missions.

Space simulation facilities

In addition to rather exclusive experiments under real microgravity conditions, different ground-based methods have been developed to achieve either the status of functional weightlessness or hypergravity (artificial gravity) conditions. The DLR Institute of Aerospace Medicine has a long-term experience in developing and using space simulation facilities: so-called clinostats enable the rotation of a sample perpendicular to the gravitational field assuming that a continuously reoriented biological system does not perceive the gravitational stimulus. The results of some experiments also performed in real microgravity conditions support this hypothesis. Various clinostat devices have been constructed enabling a broad variety of experimental performances (e.g. microscopic observation of the sample during rotation in a clinostat). Combination with our irradiation facilities (see section Radiation Biology) enables the investigation of the combined effect of functional weightlessness and radiation. Correspondingly, different centrifuge devices – such as centrifuge microscope (NIZEMI = Niedergeschwindigkeits-Zentrifugenmikroskop) - complete our experimental scenario. Furthermore, the Institute of Aerospace Medicine is the facility responsible centre for Biolab, a laboratory facility on ISS. Biolab provides the possibility to investigate various cell types and small biological systems (plants and animals) under microgravity conditions.

DLR short arm human centrifuge (SAHC); bottom EEG ActiCap®.

Gravitational Biology

Space simulation facilities

Topic of Doctoral Thesis

Physiology and interaction of organisms under altered gravity conditions using a bioregenerative life support system

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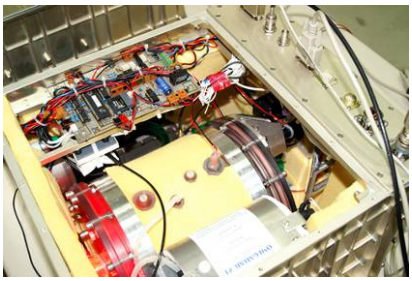
Oreochromis mossambicus

Scientific Program

Thesis Description

Few is known about the effects of long-term altered gravity conditions on the development and the physiology of organisms. In particular, it has never been analyzed if altered gravity such as hypergravity may affect interactive processes among plant and animal species housed within a closed bioregenerative life support system. Such devices are favored in numerous conceptual studies and comparatively simple entities have already been developed due to the following reasons: Such systems are regarded to be of high value in analyzing trophic, ecophysiological parameters eventually leading to solutions concerning the provision of animal protein, oxygen and further consumables for long-term manned space missions, and these systems are useful platforms to maintain experimental animals and plants under altered gravity conditions.



OMEGAHAB (*Oreochromis mossambicus Euglena gracilis* Aquatic Habitat) – Flight module

Doctoral Theses

OMEGAHAB is an aquatic life support system developed by the universities of Erlangen and Hohenheim. It is dedicated for testing various physiological parameters and the interaction of unicellular algae (*E. gracilis*, a phytoflagellate) and developing cichlid fish (*O. mosambicus).* It has been successfully flown in the FOTON M-3 space/satellite mission. Within this system, the algae profit from the fish waste products and the fish profit from the oxygen of the algae.

Aim of the thesis is to study the influence of increased acceleration (hypergravity up to 3g) on different physiological parameters of the organisms. Thus, the life support system has to be adapted to the short arm human centrifuge (SAHC) at DLR. Then, the system will be exposed to hypergravity conditions under the variation of time and amount of acceleration. Experiment analyses will cover computer analysis of videos (behavior and morphometric parameters of the organisms) up to morphological investigations including light (laser-scan, fluorescence) as well as biochemical/molecular analyses.

Euglena gracilis

Gravitational Biology

Space simulation facilities

Topic of Doctoral Thesis

The effects of artificial gravity on brain cortical function. Localization of electro cortical activity using EEG tomography and its impact on performance, stress/ arousal and sleep regulation.

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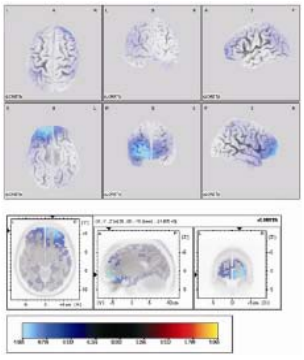

Scientific Program

Thesis Description

Studies of the last decade have well documented influences of changes in gravitational forces on cardiovascular, muscle and bone physiology. Beyond these topics, there has been an increased focus on the interactions between central nervous activity and changing gravity conditions. Recent studies have related hypergravity (hyper-g) to decreases in both sensorimotor and cognitive abilities. Due to technical and organizational limits, it has not been possible to apply imaging methods to study brain metabolism in a hyper-g environment. Therefore, it remains unclear whether these alterations in sensorimotor and cognitive function are the primary physiological effects of changed gravity conditions, or whether they are secondary effects associated with environmental and physiological factors such as for example workload or hemodynamic changes. The use of the DLR short arm human centrifuge (SAHC) in combination with electromyography offers a unique research platform to explore possible effects of changed gravity conditions on human physiology and psychology. Standardized low resolution brain electromagnetic tomography (sLORETA) enables spatial identification and analysis of brain cortical activity via traditional EEG recordings and has recently been established to show gravity induced changes (weightlessness & hyper-g).

Doctoral Theses

Aims of this doctoral thesis are to correlate central and peripheral parameters of artificial gravity as well as the impact of artificial gravity on mood and sleep regulation. Subjects will be exposed to various gravity levels, as 0,38 Gz (Martian acceleration) and 1 Gz as both proposed to be used in countermeasures protocols, as well as higher levels as two and three times terrestrial gravity (Gz) while wearing an active electrode cap (ActiCAp®, Brain Products, Munich). Apart from the electroencephalogram (EEG) a wide variety of peripheral physiological parameters (e.g. heart rate, blood pressure, electromyogram (EMG), motor performance) and psychological parameters (mood) will be recorded in order to correlate central and peripheral aspects of hyper-g and its influence on performance and wellbeing. These extensive experiments seem to be of fundamental interest as the SAHC is planned to be used during manned space flight to act as a countermeasure to weightlessness induced deficits in physiological and performance parameters.

Gravitational Biology

Human cells

Gravity alteration (micro- and hypergravity) is known to influence cell functions. Space experiments with different cell systems have shown altered gene expression and signal transduction, chromosomal abnormalities as well as changes in energy metabolism, cell proliferation, and the cytoskeleton. We are especially interested in the regulation of signaling activities in normal and transformed cells under altered gravity conditions, e.g. how normal and transformed human melanocytes respond to changed environmental factors. These studies are essential with respect to the minimization of the cancer risk for astronauts during long-term spaceflight.

Scientific Program

For human melanocytes, it has been shown that signaling via the second messenger cyclic guanosine 3′:5′-monophosphate (cGMP) plays an important role in melanocyte biology, e.g., the nitric oxide (NO)/soluble guanylyl cyclase (sGC)/cGMP pathway is involved in UVB-induced melanogenesis and melanocyte-extracellular matrix component interactions, which may contribute to loss of melanocytes or melanoma metastasis. In addition, we found that different guanylyl cyclase isoforms are responsible for cGMP synthesis in melanocytic cells. Furthermore, we could demonstrate that the cGMP turnover is altered under variable gravity conditions (hypergravity): normal melanocytes and nonmetastatic, but not highly metastatic cells responded with an increase in cGMP efflux under conditions of reduced cGMP hydrolysis or accelerated cGMP synthesis, which was related to an enhanced expression of the multidrug resistance proteins 4/5 as selective cGMP exporters as shown on mRNA and protein levels using real-time polymerase chain reaction and flow cytometric analysis.

Doctoral Theses

Thus, cGMP appears to be important in the adaptation process of human melanocytes to gravitational stress and important for malignant transformation. The scientific goal is therefore to investigate the role of NO and cGMP-modulated gene expression which is involved in (patho)physiological processes such as the regulation of melanocyte and melanoma cell proliferation and apoptosis, melanogenesis, cell-cell and cell-extracellular matrix interactions, or metastasis under the conditions of simulated and/or real microgravity (s. Space simulation facilities) with or without an irradiation.

Gravitational Biology

Human Cells

Topic of Doctoral Thesis

Gravity effects on human cells - Role of nitric oxide and cyclic GMP signaling in the melanocyte response to simulated microgravity

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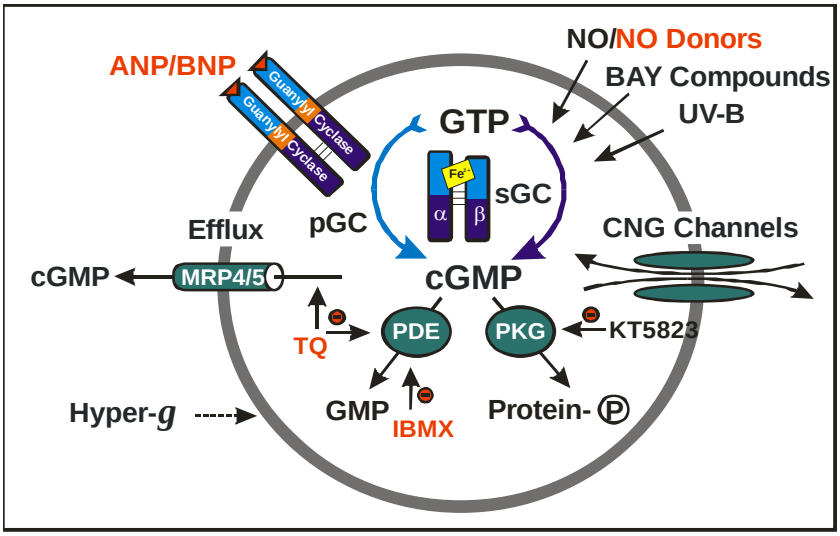
Thesis Description

Gravity alteration (micro- and hypergravity) is known to influence cell functions. In spite of the growing interest in the regulation of signaling activities in normal and transformed cells under altered gravity conditions, little is known how normal human melanocytes and melanoma cells respond to such environmental factors.

For human melanocytic cells, it has been shown that signaling via the nitric oxide (NO) and cyclic guanosine 3':5'-monophosphate (cGMP) plays an important role in the melanocyte biology, e.g., the NO/soluble guanylyl cyclase (sGC)/cGMP pathway is involved in UVB-induced melanogenesis, melanocyte-extracellular matrix (ECM) component interactions, which may contribute to loss of melanocytes (e.g., vitiligo) or melanoma metastasis and in the response of human melanocytic cells to hypergravity. The aim of the thesis will be to investigate whether the NO/cGMP-pathway is involved in the regulation of melanocyte and melanoma cell growth, melanogenesis, and cell-ECM interactions under the conditions of simulated microgravity with or without an irradiation. These studies could be essential with respect to the minimization of the skin disease risk, especially melanoma for astronauts during long-term spaceflight.



NO-cGMP signaling in melanocytes.
cGMP: cyclic guanosine 3':5'-monophosphate; sGC: soluble guanylyl cyclase [modulators: NO (nitric oxide)/NO donors, BAY Compounds and UV-B); pGC: particulate guanylyl cyclase [modulators: ANP (atrial natriuretic peptide)/BNP (brain natriuretic peptide)]; PDE: phosphodiesterase; IBMX: non-selective inhibitor of PDE; PKG: cGMP-dependet protein kinase; KT5823: selective inhibitor of PKG; MRP4/5: multidrug resistance proteins 4 and 5; TQ (trequinsin): selective inhibitor of cGMP-binding cGMP-specific PDE (PDE5) and MRP4/5; CNG channels (cyclic nucleotide-gated channels); hyper-g: hypergravity.

Gravitational Biology

Human Cells

Topic of Doctoral Thesis

Melanoma-endothelial cell interactions in gravitational stress: role of nitric oxide, natriuretic peptides, and cGMP

DLR Supervisor

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University Supervisor

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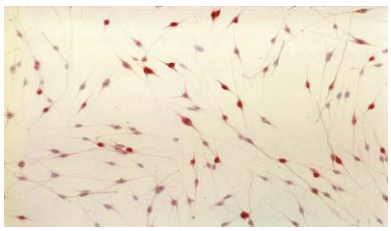
Thesis Description

Nitric oxide (NO) has a prominent role in many (patho)



Expression of NOS in melanocytes. Immunocytochemical analysis of neuronal NO synthase (nNOS) expression in normal human melanocytes by indirect immunostaining of adherent cells.

Scientific Program

physiological processes in the skin including erythema, inflammation, and cancerogenesis. The soluble guanylyl cyclase (sGC), a key transducer in the NO signaling, catalyzes the formation of guanosine 3′,5′-cyclic monophosphate (cGMP). For human melanocytic cells, we and others have shown that signaling via the NO-cGMP play an important role in melanocyte (patho)biology, e.g., the NO/sGC/cGMP pathway is involved in UVB-induced melanogenesis and melanocyte-extracellular matrix (ECM) interactions, which may contribute to loss of melanocytes (e.g., vitiligo) or melanoma metastasis. Melanoma is a deadly skin cancer that arises from transformed melanocytes and is characterized by a resistance to chemotherapy. Moreover, we found differential expression of guanylyl cyclase (GC) in melanocytic cells. Normal human melanocytes (NHMs) and non-metastatic melanoma cells (MCs) predominantly express the sGC, which appears to be associated with melanogenesis, whereas the absences of NO-sensitive sGC, but up-regulated activities of the natriuretic peptide-sensitive membrane isoforms were found in highly metastatic phenotypes.

Doctoral Theses

Finally, we were able to show, that NHMs and non-metastatic MCs, but not highly MCs respond to long-term hyper-g exposure with an extrusion of cGMP under conditions of reduced cGMP hydrolysis or accelerated cGMP synthesis (e.g., by NO). The elevated cGMP efflux was related to hyper-g-induced increase in the expression of the selective cGMP exporters the multidrug resistance proteins 4 and 5. The effects of extracellular cGMP in the cell-cell communications particularly in the interplay of MCs with other cell types of the tumor microenvironment including endothelial cells are however not well investigated. In the frame of the current space exploration, studies on the influence of altered gravity on melanocyte (patho)physiology are of special interest. The aim of the thesis will be to investigate the role of NO, natriuretic peptides and cGMP in melanoma-endothelial cell interactions (important for metastasis) using centrifuges and/or clinostats. These studies could be essential with respect to the minimization of the risk and/or treatment of skin disease particularly of melanoma that contain high levels of vascularization for astronauts during long-term spaceflight.

SpaceLife

Astrobiology

Astrobiology is the interdisciplinary study of life in the universe, focused primarily on investigations to the origin, distribution and evolution of life. One major astrobiological research topic encompasses the question of what kind of environments can life tolerate. In the last decades the number of organisms discovered at locations, which would have been classified still recently as 'life-hostile', has increased immensely. Examples of such extremophilic terrestrial organisms are microorganisms from hot springs, hydrothermal vents, deserts, permafrost, salt crystals, and very acid or basic water. The increasing knowledge of the microbial adaptability and its fundamental molecular mechanisms enable the estimation of their hypothetical viability on other planets in our solar system, e.g. on Mars. The ability of life to move beyond Earth will depend upon the potential for microorganisms to utilize resources, and to adapt and evolve in extraterrestrial environments. Viable microorganisms might be transported by natural events such as impacts or by robotic spacecraft, but they most certainly will accompany human missions. Life forms will be challenged by extremes in temperature, pressure, radiation and the availability of nutrients. Studies of adaptation and survival will indicate not only whether microbial life can expand its evolutionary trajectories beyond Earth but also how it can play key supporting roles in human exploration.

Scientific Program

The Lehrstuhl für Mikrobiologie and the Archaea Centre of the University of Regensburg have a long-lasting expertise in isolating, growing and characterizing extremophilic Bacteria and Archaea. These microorganisms are able to thrive under physicochemical conditions which are extreme and hostile for most life forms known on this planet. They are a rich resource of model organisms also for studying the effect of conditions in outer space or on other planets of our solar system, concerning radiation of various kinds (UV, ionizing), and extreme draught, i.e. low water pressure. While the Archaea Centre in Regensburg has tested the microorganisms under several kinds of extreme conditions, further astrobiological experiments cannot be performed in Regensburg.

Doctoral Theses

The Research School provides the unique opportunity to join the biological resources of the Regensburg Archaea Centre with the equipment and expertise of the DLR research group 'Photo- and Exobiology', where laboratory and space experiments concerning research on viability and adaptability to space as well as to simulated Martian conditions are accomplished. The molecular and cellular mechanisms for the adaptation to extreme environmental conditions and the capability to repair different kinds of damages will be investigated in several microbial model organisms. The response of cells exposed to vacuum and ionizing radiation will be tested, and the cellular content of small and large molecules which are known to help microorganisms to sustain extreme conditions, like compatible solutes and protein complexes called chaperonins will be analyzed. Both molecules have been described to accumulate to great extent in the cytosol upon exposure to stress conditions.

The results of these ongoing investigations are also important for the development of ESA planetary protection guidelines for the future exploration of our solar system.

Astrobiology

Topic of Doctoral Thesis

Comparison of UV and desiccation resistance of the thermophilic, hydrogen-oxidizing bacterium *Hydrogenothermus marinus* to the polyextremophilic, highly radiation-resistant bacterium *Deinococcus radiodurans*: DNA damage induction and repair

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Thesis Description

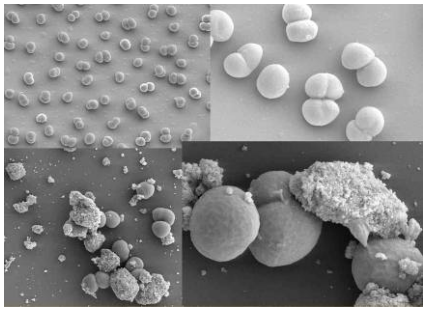
Deinococcus radiodurans is a red-pigmented, non-sporulating, heterotrophic bacterium that is characterized by an extraordinary ability to withstand the lethal effects of DNA-damaging agents, including ionizing and UV radiation, desiccation, and oxidants. The organism can survive up to 15

Scientific Program

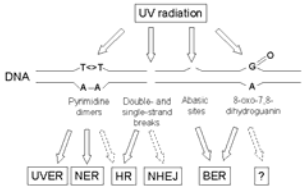
Doctoral Theses

kGy, which induce 150 to 200 DNA double-strand breaks per chromosome. Regarding its polyextremophile features, *D. radiodurans* has been considered a model for astrobiological studies concerning the survival under space or Mars conditions.

Recently, a novel thermophilic, hydrogen-oxidizing bacterium, called *Hydrogenothermus marinus* has been isolated from a marine hydrothermal area of Vulcano Island, Italy. First experiments could show that cells of this microaerophile microorganism are very resistant to desiccation, even under aerobic conditions. While very few is known about the radiation and desiccation resistance of thermophilic bacteria, a direct comparison of *H. marinus* with one of most radiation-resistant microbe on Earth will give insights in the UV photobiology and desiccation resistance of these bacteria. The terrestrial UV spectrum extends from about 290 to 400 nm, but shorter wavelengths may become more prevailing in the future due to the loss of ozone in the stratosphere. Therefore, it is crucial to gain a better understanding of the damaging effects of polychromatic environmental UV radiation as well as the mechanisms for repair of this damage. In previous studies of the DLR Exobiology workgroup, the induction and repair of UV-induced photoproducts in various microorganisms was examined, but other kinds of damage remain to be elucidated. In this thesis, new methods will be used to study in detail the survivability and DNA damage profiles induced by different qualities of UV radiation, as well as the repair kinetics in *D. radiodurans* and *H. marinus* to determine effectiveness of selected DNA repair pathways in both species. Further on, oxidative protein damage by radiation- or desiccation-induced radicals will also be of great interest, since this is considered to be one of the factors of cellular ageing processes.



D. radiodurans cells covered with (below) & without (above) soil particles (SEM)



DNA damage induced by UV radiation and repair pathways.

Scientific Program

Doctoral Theses

Space Physiology

Bone and muscle loss in space

Microgravity is a challenging environment for the human organism. In particular, the mechanical loading of muscles and bones in the back, the hip area, and the legs is severely reduced in microgravity compared to earthbound conditions. This leads to sarcopenia and osteoporosis. For long-term spaceflight, the deconditioning of the musculo-skeletal system belongs to the most risky physiological changes observed in response to microgravity. To obtain health and effectiveness of astronauts especially for planned long-duration space flights, it is mandatory to develop efficient countermeasures. Current countermeasures are either less effective or too time-consuming for application during long-term mission. New developments are mandatory in order to keep muscle and bone function during the astronauts' long-term flight.

However, the observed changes are comparable to processes observed during ageing or in handicapped people with inborn or chronic diseases of the neuro-musculo-skeletal system. Insofar, the foreseen projects will aim at astronauts, ageing people and patients. Under consideration are special training measurements and nutraceuticals with a postulated positive effect on muscle and/or bone mass and function. To conduct research in this field on Earth, methods using 6° head-down tilt bed rest (HDTBR) as a simulation model for muscle and bone unloading (immobilization) are utilized.

The adequate stimulus for muscle growth keeping or increasing muscle trophy and strength is a given by a combination of high intense muscle contraction and passive stretches. These stimuli are e.g. provided by concentric-eccentric resistive exercise or by jumps and landings. Bone growth is locally triggered by strain and the best strain pattern in a bone is naturally generated by high intense muscle work or by impacts like the heel impact on ground during running.

A most time efficient training of all leg muscles is given by a leg press like apparatus. In microgravity, heavy weights cannot provide counter forces for muscle training. Existing, even newly developed training devices do not fulfill the required efficiency of a training method for microgravity.

We therefore intend to verify and apply a Sensodrive-leg press as an upgrade and technological progress of the current flywheel device. Robotic controlled Sensodrives have originally been developed for ultra light weight robotic arms on the ISS. This novel technology combined with a leg press allows the application of various patterns of force and velocity at any angle of the hips, the knees, or the ankles during leg movement. During training the subject must not adapt to the physical properties of the device, but like a physiotherapist the device with its one intelligent robotic motor control also adapts to the needs of the subject. Time optimized and variable training stimuli and protocols can be developed, that provide optimum intense and maximum save stimuli for all groups of leg muscles and bones. The simulation of naturally earth bound situations like hopping or trampoline jumping will potentially also keep up motor control and balance. Little is known about the interrelations between muscle fatigue and the growth stimulus of training. The combination of the Sensodrive leg press and a lower body negative pressure device will be built to study the effects of alterations in muscle perfusion by gravity independent simulation of various levels of orthostasis.

Scientific Program

Doctoral Theses

Space Physiology

Bone and muscle loss in space

Topic of Doctoral Thesis

Development and verification of a time efficient training for lower and upper leg muscles using a robotic controlled Sensodrive leg press

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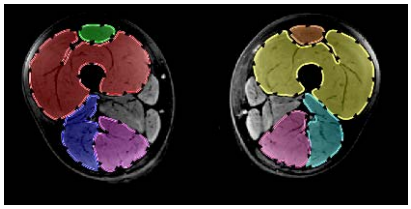
Thesis Description

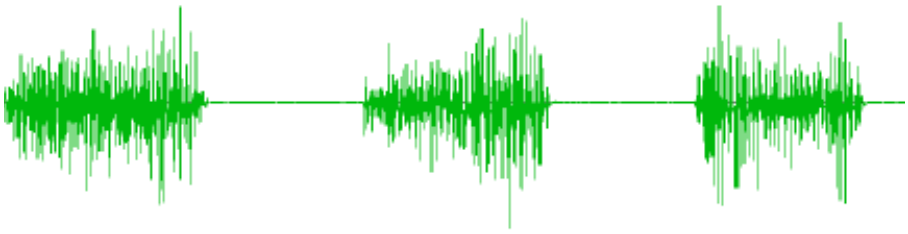
The adequate stimulus keeping or increasing muscle volume and strength is given by a combination of high intense muscle contraction and passive stretches. These stimuli are e.g. provided by concentric-eccentric resistive exercise. A most time efficient training of all leg muscles is given by a leg press like apparatus. In microgravity, heavy weights cannot provide counter forces for muscle training. We propose the verification and application of a robotic controlled Sensodrive leg press which allows the application of various patterns of force and velocity at any angle of the hips, the knees, or the ankles during leg movement.



Leg cross section (thigh)

Using this instrument a set of short and motivating exercise profiles shall be developed and verified for their efficiency in increasing muscle volume and strength in sedentary subjects during ambulant training or preventing leg muscle from disuse atrophy during simulated microgravity conditions like bed rest or unilateral leg suspension.

Sensodrive®



Muscle action potentials (Electromyogramm, EMG)

Space Physiology

Bone and muscle loss in space

Topic of Doctoral Thesis

Peripheral perfusion, peripheral fatigue, and their interaction in the control of muscle growth and fiber type composition during strength training using a robotic controlled device

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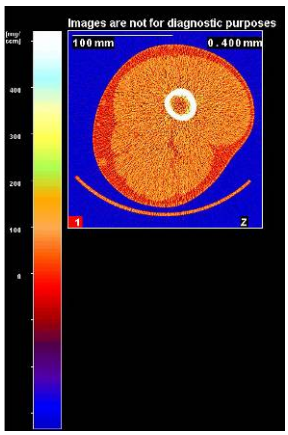
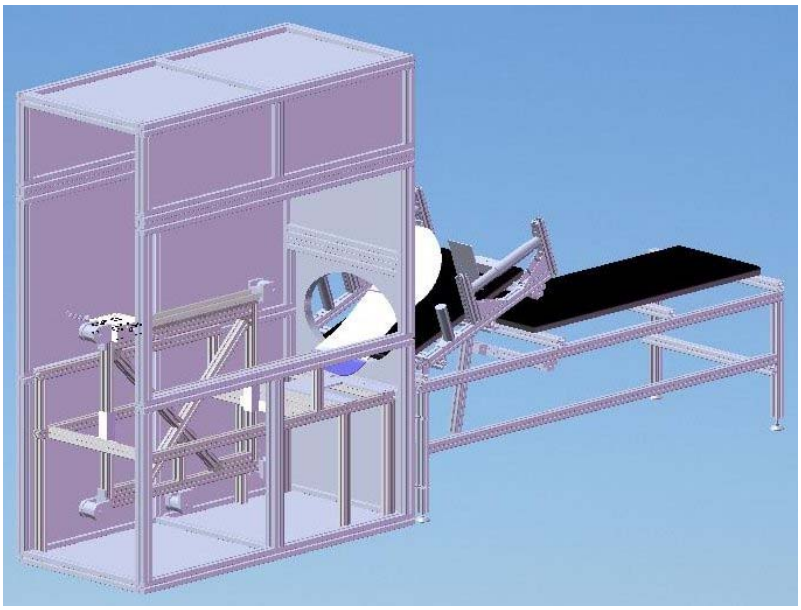


Muscle and bone visualization

Thesis Description

The adequate stimulus for muscle growth keeping or increasing muscle volume and strength is given by a combination of high intense muscle contractions and passive stretches. These stimuli are e.g. provided by concentric-eccentric resistive exercise. It is generally assumed that muscle work and passive loading determined growth and strength whereas the processes of fatigue determined muscle endurance parameters. However, little is known about the mechanistic interrelations between muscle perfusion and the processes of peripheral fatigue and the growth stimulus of training.

The combination of a robotic controlled Sensodrive leg press and a lower body negative pressure device will be used for a well controlled application of various types of work and loading in combination with alterations in muscle perfusion by various levels of simulated orthostasis. Immediately after training and during recovery from training the interstitial and systemic activity of hormones controlling protein synthesis, proteolysis, and angiogenesis will be analyzed in samples generated by microdialysis in muscle and in blood.



Robotic controlled training under lower body negative pressure (LBNP) orthostasis (A. Hoff)

Space Physiology

Psychophysiological Performance

Topic of Doctoral Thesis

Psychophysiological Strain Assessment

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University Supervisor

NN

Thesis Description

During space missions, psychological problems in the crew can challenge the mission success. The Space Division of the Aviation and Space Psychology Department of the DLR Institute of Aerospace Medicine selects and trains the operational personnel (scientific astronauts) for space missions. For the evaluation of a certain skill reliability (e.g. manual docking of a spacecraft on a space station), indicators of work quality as well as indicators that characterize the psychophysiological state during the work have to be considered.

Methods and measurement equipment were developed and tested in numerous terrestrial and space experiments using a simulation of a spacecraft docking on a space station. An integral problem in the interpretation of any physiological measurement as a strain indicator is the individuality of human physiological reactions. In our approach we differentiated individual systemic psychophysiological responses to mental load into Autonomic Outlet Types (AOT). The AOT was defined as the individual systemic outcome pattern of the common activation reaction of the autonomic nervous system to psychological stressors, which is assessable by non-invasive physiological measurements. The AOT is characterized by the physiological measurement with the largest changes over a protocol including a series of changes between rest and mental load. Studies of pulse or heart rate (HR) and heart rate variability (HRV) and of voice frequency parameters as indicators of emotional stress have proven the applicability, feasibility, and usefulness of psychophysiological measurements under field conditions. For practical applications physiological correlates of different functional body subsystems have to be integrated into one common indicator of "physiological costs". The statistical methodology of integrating the measured correlates of physiological processes into a "strain scale" is based on the assumption that all physiological measurements have a "normal working range" which can be approximately described by a linear function. Once linearity is demonstrated, one can use statistical methods for detecting independent linear information (factor analysis), subsequently integrating the found vector room by a standard vector sum (root of the sum of factor weight squares) as Psychophysiological Arousal Vector (PAV). The elaboration of the mathematical functions will be based on the data of the classification procedure for the AOT. We will consider the statistical approach (or model) of the PAV to be verified, if the individual differences in the single physiological parameters between the AOT groups found during the mentally loading protocol are also found in the data obtained during the FST - but without indication of differences between the AOT groups in the calculated PAV-data during the FST. Furthermore we will demonstrate that these deindividualized strain indices still provide the possibility of grouping and differentiation e.g. by means of cluster analysis.

SpaceLife

The three-year program reflects the increasing importance of interdisciplinarity in life science research and provides comprehensive training for scientific, methodological and "soft" skills. The program will provide training and translational research towards a career in life sciences and space research. The SpaceLife program consists of a three-year research project as well as introductory and advanced lectures, student workshops, journal clubs, the active attendance of congresses, participation in laboratory and transferable skill courses.

Thesis supervision

Expert supervision throughout the research activities leading towards a doctoral degree within 3 years is regarded of the utmost importance. In addition to the day-to-day supervision, each doctoral student has a Thesis Advisory Committee (TAC). The main task of the TAC is to guide the doctoral students throughout their thesis work and to monitor and evaluate the progress of the research project and the individual development of the doctoral student.

Professional Training Program

The TAC consists of three faculty members. First and second Supervisors are chosen on the basis of their research specialty in order to provide as far as possible the complete scientific expertise required to realize the proposed thesis project.

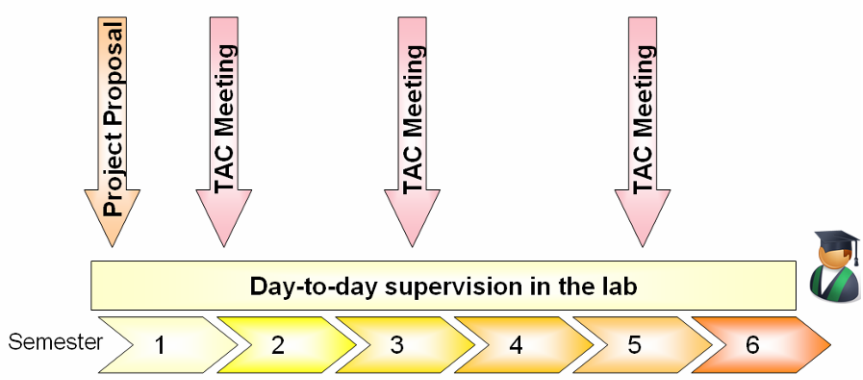
The DLR Supervisor is a scientist at the Institute of Aerospace Medicine working at the laboratory where the research is being performed. At least one member of each TAC must be a university professor.

The Mentor is a scientist from a different scientific field and gives general advise to the doctoral student, e.g. for career planning.

The TAC will help to design and monitor the trainee's thesis work and will help the trainee to establish contacts inside and outside the institution.

Thesis Supervision

Following the submission of a project proposal after one month, and an initial report meeting after 3 to 6 months, TAC meetings are scheduled on an annual basis. TAC meetings include a written report and an oral presentation which covers the theoretical background, research progress, results obtained so far and experiments to be done in the future. The Initial Report focuses on the detailed outline of the thesis project and planning for future experiments. The 3rd Annual Report meeting defines the work to be done prior to writing and submitting the thesis, and the time frame for obtaining the doctorate. TAC meetings can be integrated in the Students' Workshop or organized separately.



SpaceLife

Professional Training Program

Curriculum

The three-year doctoral program is divided into six semesters (half-years). In addition to the laboratory-based experimental thesis work, doctoral students participate in a structured training program, which consists of 246 hours of practical courses, workshops, lectures, seminars, and journal clubs.

The curriculum of training is composed of mandatory and elective modules:

- Introductory Lectures during the 1st and 2nd semester (mandatory)
- Advanced Lectures during the 3rd semester (elective)
- Students' Workshop during the 1st, 4th and 6th semester (mandatory)
- Seminars, Workshops and Experimental Courses (elective, 30 h during the program)
- Journal Club during the 2nd, 3rd, 5th and 6th semester (mandatory)
- 2 ½ days soft skill training per year (mandatory)
- Additional soft skill training based on individual needs (DLR education program), e.g. project management (optional)
- Active participation in a Workshop or Conference (mandatory)
- Internal Seminars (optional)

Students' Workshop

In the 1st semester, each student is given a valuable opportunity to present his/her research project including the hypothesis, methods to be applied and the work schedule. During the 4th Semester, students are once again given the opportunity to present the current findings of their research projects in front of the class and TAC, giving the student valuable feedback on how they are progressing. This enables the student not only to develop his/her presentation skills but to critically analyze their own findings and those of others. During the last term, the students present the final report on their thesis.

Journal Clubs

Journal Clubs are held during the second, third, fifth and sixth semester in the working groups of the Institute of Aerospace Medicine and the Partner Universities. They offer the opportunity to read papers together and to discuss them with members of the working group. Each student is required to present an original paper and review. The topic of the original paper is always related to the general field of the student's research project, requiring the student to research and subsequently present the topic in a succinct and critical way. Doctoral students will familiarize with critical reading, preparation of manuscripts and scientific figures, and designing of a doctoral thesis and a research proposal in the Journal Clubs.

Internal Seminars

Doctoral students participate at the Internal Seminars organized by the Institute of Aerospace Medicine. International renowned scientists are invited to present their scientific work in Cologne. At least once during the doctoral thesis work, each doctoral student will have the opportunity to present the own scientific work to a large audience.

Conferences/Symposia

Participation in national as well as international conferences will be encouraged. The trainee will have to present her/his work at least during one conference either by a poster or an oral presentation, which will be financially supported.

Career Day

During the third year of the program, the doctoral students attend or organize and chair a Career Day, for example during the Space Life Science Congress ("Medicine and Mobility") organized by members of the Institute of Aerospace Medicine, during which invited speakers from academia, industry, scientific journals and funding bodies present career paths to the students.

Optional lab rotations

Optional lab rotations will be encouraged on an individual basis, especially if

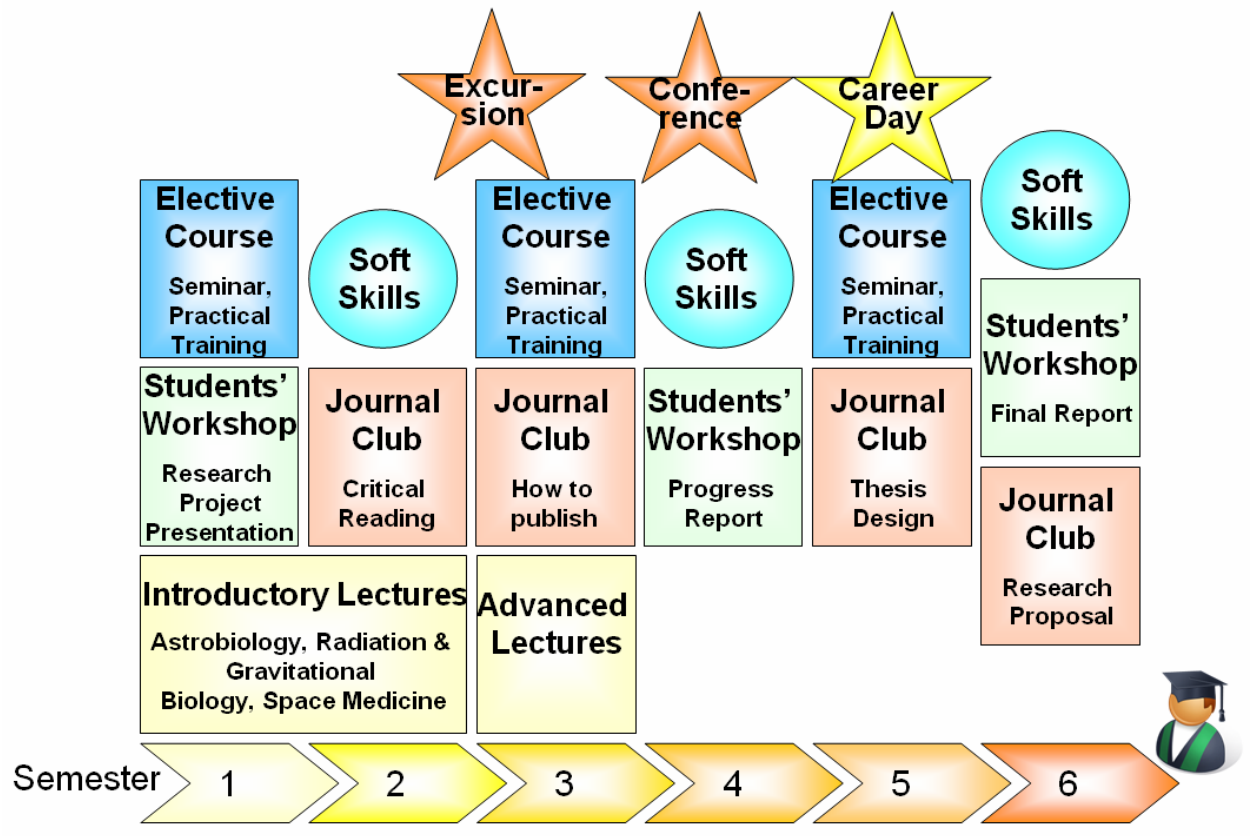
- the graduate training is conducted in a research area different from the undergraduate studies
- the thesis work is interdisciplinary
- the thesis requires methods which are not established in the hosting lab.

External work of trainees

If appropriate, the trainees will have the opportunity of a short-term stay in a partner institute or organization, in industry, or in a specialized laboratory to complement her/his skills or to carry out work that cannot be done within the partnering institutions. This might also be abroad. The trainees can apply for support through SpaceLife.

Final examination

The doctoral examination can comprise a public presentation of the trainee in which she/he will present the results of her/his doctoral work which will subsequently be discussed with the auditorium, depending on the regulations of the university.



SpaceLife

Professional Training Program

Curriculum

Introductory Lectures

As the doctoral program is open to candidates from diverse backgrounds, the 1st semester, as well as part of the 2nd, concentrates on the basics of Space Life Sciences. Doctoral students participate in a mandatory lecture covering the topics space medicine, radiobiology, astrobiology and gravitational biology. The lectures introduce the space life sciences research program and the theoretical background of the topic and provide the scientific background of the applied methods. The learning success is controlled by a written exam.

Space Life Sciences

Semester

1st

Duration

2 h

Subjects

Introduction to Space Life Sciences (Gerzer, Anken)

Space Life Sciences Research Program (Hemmersbach, Ruyters)

Learning Objectives

Getting a glimpse of the fascination of human spaceflight and the unsolved questions for long-term manned missions

Space Medicine

Semester

1st

Duration

6 h

Subjects

History of Space Medicine, Atmosphere, Radiation, Space Weather

Space Transport Systems, Space Station

Human Physiology in Space I: Short an mid-term adaptation

Human Physiology in Space II: Longterm adaptation, Countermeasure Development

Astronaut Selection, Training, Work Schedule in Space, EVA, Medical Problems

Future Plans for Human Spaceflight

(Gerzer)

Learning Objectives

Basic Information on Space Physiology and Medicine - medical problems during short-term and long-term manned space missions and their solutions available currently.

Prerequisites for the Course

Participation in SpaceLife

Radiation Biology

Semester

1st

Duration

6 h

Subjects

Interplanetary radiation field (Heber)

Radiation Environments on Planets & other Celestial Bodies (Wimmer-Schweingruber)

Earth Radiation Environment and Space Radiation - Quantities and Measurements (Berger)

Radiation Exposure during Space Missions (Reitz, Berger)

Biological Effects of Space Radiation (Hellweg), Acute & Chronic Radiation Effects in Humans (Baumstark-Khan)

Learning Objectives

Overview of the space radiation environment, with emphasis on energetic particle environment in interplanetary space & planetary magnetospheres; Introduction to dose quantities for radiation protection in space, comprehensive survey of space radiation measurements with view to future human mission to Mars, radiation exposure during space missions & biological risks for humans.

Prerequisites for the Course

None

Introductory Lectures

Astrobiology

Semester

2nd

Duration

6 h

Subjects

1. Steps to Life (Horneck tbc)

2. History of Life on Earth (Rabbow)

3. Life under Extreme Conditions (Huber)

4. Looking for Life, Searching the Inner Solar System (Rettberg)

5. Interplanetary Transfer of Life (Panitz)

6. Astrobiological Space Experiments - Past and Present (Rabbow)

Learning Objectives

ad 1. Understanding the definitions of life, definition and aim of astrobiology, formation of the precursors of life (atoms, molecules of life), how and where.

ad 2. Learning the records of life, the sources of prebiotic organic molecules, the fossil records, the molecular biology record; understanding general strategies of life for adaptation to extreme environments, metabolism, growth & survival.

Learning Objectives (continued)

ad 3. Understanding the adaptation of specialized extremophiles to high and low temperatures, to high salinity, to high pressure, to low water activity.

ad 4. Understanding the prerequisites of habitability, the habitable zone of our solar system; learning astrobiological aspects of Mars, its history of water, results from past and ongoing missions to Mars, planned missions to Mars.

ad 5. Learning the hypothesis of "Panspermia" and "Lithopanspermia", experimental tests of those and conclusions from the results.

ad 6. Knowing the ongoing and planned astrobiological space experiments

Prerequisites for the Course

Basic knowledge in natural sciences, i.e. physics, chemistry, biology

Gravitational Biology

Semester

2nd

Duration

6 h

Subjects

Theoretical Background in Gravitational Biology:

1. Methods on ground and in space (flight opportunities)

2. Graviperzeption in unicellular systems

3. Gravity related signal transduction pathways

4. Graviperception in multicellular systems (plants, animals)

5. Life Support Systems, Exploration

Learning Objectives

Fundamental aspects and experimental approaches in gravitational biology.

Prerequisites for the Course

None

SpaceLife

Professional Training Program

Curriculum

Advanced Lectures

During the 3rd semester, doctoral students participate in an advanced lecture in a topic of their interest. They elect at least one advanced lecture from one of the following topics:

- Space Physiology
- Radiation Biology
- Gravitational Biology
- Astrobiology
- Aerospace Dosimetry
- Extraterrestrial Physics
- The Interplanetary Medium

Space Physiology

Semester

3rd

Duration

10 h

Subjects

Cardiovascular System, Fluid & Salt balance (Guest Speaker)

Skeletal System & Muscles (Zange)

Neurosensory & Vestibular System (Balance & Motion Sickness) (Guest speaker)

Immunological & Hormonal Response (Guest speaker)

Medical Research aboard the ISS (Ruyters)

Current Countermeasure Developments (Zange)

Psycho-Sociological Aspects (Johannes)

Human Health Concerns for Lunar & Martian Exploration (Gerzer)

Learning Objectives

Detailed Insight into Space Physiology, including ground based research, space analogs (bed rest etc.), and development of countermeasures. Refreshing of knowledge from introductory cours.

Prerequisites for the Course

Introductory Lectures "Space Life Sciences", "Space Medicine"

Advanced Lectures

Radiation Biology

Semester

3rd

Duration

30 h

Subjects

Natural and man-made sources of radiation; Types of ionizing radiation; Radiation interaction with matter; Radiation quantities, Physics of radiation absorption; Radiation dosimetry and dosimeters (Berger)

Interactions of radiation with matter: Chemistry of radiation absorption in solutions & living systems. Radiation protectors: Chemistry of radiation scavenging (Baumstark-Khan)

DNA damage: DNA as the principle target of radiation killing; Single and double strand DNA breaks; Mechanisms of DNA repair (Hellweg); Chromosomal aberrations & their use as 'radiation dosimeters' (Baumstark-Khan)

Cytosol and radiation response: Mechanisms of signal transduction from the cytosol to the nucleus, or vice versa, factors influencing radiation response of mammalian cells; Important gene products (Hellweg)

Subjects (continued)

Characteristics of cell survival curves - interpretive models based on target theory or repair theory; Radiosensitivity of various tissues. Role of oxygen in modifying the chemistry of radiation damage and cellular radio sensitivity; Mammalian cell radio sensitivity: Interphase, reproductive and apoptotic cell death; Cellular factors that modify radiation response: The role of the cell cycle in influencing radiation response (Baumstark-Khan)

Use of radiation for cancer therapy: Deficient vascularisation, high interstitial pressure and hypoxia in solid tumors; Significance of tumor physiology for radiation treatment; Tumor regrowth and tumor cure assays. (Baumstark-Khan)

Low dose effects on humans: The mechanisms of radiation-induced mutagenesis and carcinogenesis; Oncogenes and suppressor genes; Susceptibility of various organs; Risks of developing cancers from present-day sources; The hereditary effects of radiation; Effects on the embryo and fetus (Baumstark-Khan)

Whole body irradiation - acute effects of high doses: Prodromal syndromes; Cerebro-vascular,

Subjects (continued)

gastrointestinal and haematopoietic syndromes; Mean lethal doses; Treatments for whole body exposure. (Baumstark-Khan)

Lessons from Hiroshima, Nagasaki and Chernobyl: Acute & chronic health effects on those exposed; Assessment of exposure doses; Assessment of present day risks, & radiation protection standards (Baumstark-Khan)

Learning Objectives

The course RADIATION BIOLOGY will focus on the biological changes which follow the interaction of ionizing and non-ionizing radiation with living matter from molecular interactions to whole body responses. Particular emphasis will be placed on the role of ionizing radiation in the treatment of cancer, mechanisms of radiation-induced carcinogenesis, and changes in normal and tumor cells at the molecular, cellular and tissue level. The course includes the biological aspects of environmental radiation exposure.

Prerequisites for the Course

Introductory Lecture "Radiation Biology"

Advanced Lectures

Gravitational Biology

Semester

3rd

Duration

4 x 1,5 h

Subjects

1. Gravity Effects on Cells

2. Gravity Effects on Animals

3. Space Biological Experiment Design. Graviperzeption in Unicellular Systems

4. Graviperception in Multicellular Systems (Plants, Animals)

5. Life Support Systems, Exploration

Learning Objectives

Enhanced aspects and experimental approaches in gravitational biology; dedicated examples from experiments under altered space conditions

Prerequisites for the Course

Introductory Lecture "Gravitational Biology"

Astrobiology

Semester

3rd

Duration

6 x 1 h

Subjects

1. *Bacillus subtilis* - a Model Organism for Space Research (Möller)

2. Pitfalls of Detecting Life (Rabbow)

3. Planetary Protection (Rettberg)

4. Hyperthermophile Archaea tbc (Huber)

5. Robotic Solar System Exploration - Europa, Titan, Enceladus (Panitz)

6. Human Missions (Horneck tbc)

Learning Objectives

ad 1. Understanding the microorganisms *B. subtilis*, spore formation, adaptation strategies to extreme environmental conditions, knowing space experiments with *B. subtilis*, understanding results.

ad 2. Understanding the obstacles for detecting life, implications for past and present experiments for detecting life.

Learning Objectives (continued)

ad 3. Understanding the aim of PP, learning the regulations and related methods, their advantages and disadvantage.

ad 4. Understanding the specialization of extremophiles drawing the example of hyperthermophiles: metabolism, adaptation strategies

ad 5. Knowing the robotic space missions connected to Astrobiology, past, present and future, understanding their rationale

ad 6. Understanding the complexity and constrains of human missions in general and to Mars in particular, their opportunities and the consequences for the target planet

Prerequisites for the Course

Introductory Lecture "Astrobiology"

Advanced Lectures

Aerospace Dosimetry (CAU Kiel 060374)

Semester
3rd or 5th

Duration
30 h

Subjects
Radiation environment, including the origin and composition of primary particles, interaction of these primaries with matter (e.g. ionization, electromagnetic and hadronic interactions, secondary particle production)

Methods for measurements

Characterization and analysis of radiation in space

Physical and medical parameters in dosimetry like LET; dose; effective dose and quality factor (Heber)

Learning Objectives
The students learn the basic principles and applications of experimental measurements and interaction of radiation with matter as well as properties of different radiation environments important to humans in space

Prerequisites for the Course
Introductory Lecture "Radiation Biology"

Extraterrestrial Physics (CAU Kiel 060346)

Semester
1st or 3rd

Duration
30 h

Subjects
The course gives a solid introduction to the Earth's space environment starting with the atmosphere, ionosphere, magnetosphere, and continuing with the origin of the solar wind, its interaction with planetary bodies and the overall structure of the heliosphere.

(Heber, Wimmer-Schweingruber)

Learning Objectives
Understanding of the Earth's space environment

Understanding of particle propagation and acceleration

Prerequisites for the Course
Introductory Lecture "Radiation Biology"

The Interplanetary Medium (CAU Kiel)

Semester
2nd or 4th or 6th

Duration
30 h

Subjects
The interplanetary medium (Heliosphere) fills the space between the planets. It has its origin in the solar wind emanating from the Sun and interacting with the interstellar medium. Several properties of the interplanetary medium are important for our understanding of radiation exposure of astronauts and, in some cases, of aircraft crews. The interplanetary medium and its boundary region with the interstellar medium modulate galactic cosmic rays; it is also the medium through which solar energetic particles propagate (Heber, Wimmer-Schweingruber)

Learning Objectives
Understanding of the large-scale structure & origins of the heliosphere; Capability to interpret real-time space weather data & knowledge of data sources

Prerequisites for the Course
Introductory Lecture "Radiation Biology"

Seminars, Workshops and Experimental Courses

Elective Seminars, Workshops and Experimental Courses are offered in the first, third and fifth semester of the program. During the three year period, Doctoral students should participate in 30 hours of electives courses. The participation in each course must be discussed with the primary Supervisor.

The workshop "Biomathematics" combines lectures and exercises, and provides skills towards the quantitative analysis of experimental data and experiment configuration and study design. Experimental Courses cover different methods in space life science research. A series of laboratory courses that have already been installed by the partner institutions will offer the trainees a special training in specific areas including laboratory as well as theoretical work

Seminars

Role of Nutraceutics as Countermeasures in Prevention of Organ Degradation (RFWU Bonn)

Semester

3rd

Duration

30 h

Subjects

Basics of nutrient related organ functions: Role of glutamine, omega3 fatty acids, secondary plant products (polyphenols), vitamins (D, E) and mineral/trace elements (calcium, selenium, zinc) on gut integrity, bone/muscle metabolism and immune response

Presentation of actual research work (journal club)

(Stehle)

Learning Objectives

Evaluation of the effects of dietetic measures on organ integrity and function

Formulation and implementation of dietetic measures in practice

Planning of clinical studies

Prerequisites for the Course

Introductory Lecture "Space Medicine"

Structure and function of adaptation processes; Performance and ageing; Performance diagnostics (DSHS Köln)

Semester

2nd or 4th or 6th

Duration

15 x 1 h

Subjects

General physiological mechanisms of adaptation

Definition of metabolic and mechanical stimuli between micro- and ultra-loading

Biological response to stimuli at organ- and cell-level

Age depending adaptation

Empirical approaches to adaptation (time course)

(Mester)

Learning Objectives

Establish an understanding of adaptation between stimulus and molecular mechanisms

Tuning of stimuli under various conditions (from microgravity to bedrest to ultrahigh loads)

Prerequisites for the Course

Introductory Lecture "Space Medicine"

Seminars

Gravitational Biology (RFWU Bonn)

Semester

2nd or 3rd

Duration

15 h

Subjects

Enhanced Background in Gravitational Biology:

1. Methods on ground and in space (flight opportunities)

2. Graviperzeption in unicellular systems

3. Graviperception in multicellular systems (plants, animals)

5. Life Support Systems, Exploration

(Hemmersbach, Braun)

Learning Objectives

Enhanced aspects and experimental approaches in gravitational biology; dedicated examples from experiments under altered space conditions

Prerequisites for the Course

None

Heliospherical Astroparticle Physics & Dosimetry (CAU Kiel)

Semester

3rd or 5th

Duration

30 h

Subjects

During the seminar student will present recent research in the following topics: Structure of the heliosphere, planetary magneto- and atmospheres; processes and stability. The composition, acceleration and propagation of charged particles in magnetized plasmas including scattering, drifts, magnetospheric transmission and secondary particle production in matter; dependence on solar activity. Spectral measurements of particle radiation and standards for space dosimetry measurements (e.g. LET, (effective) dose).

(Heber, Burmeister, Wimmer-Schweingruber)

Learning Objectives

Students learn how to work out and present fundamental and recent research topics in heliospheric astroparticle physics, with emphasis on acceleration and transport of energetic particles and galactic cosmic rays in the heliosphere, planetary magneto- and atmospheres, as well as basic principles and methods in space dosimetry.

Prerequisites for the Course

Introductory Lectures "Radiation Biology"

Aerospace Dosimetry (CAU Kiel 060374) or

The Interplanetary Medium or

Extraterrestrial Physics (CAU Kiel 060346)

Seminars

Current Topics in Space Physics (CAU Kiel)

Semester

2nd, 3rd, 4th, 5th or 6th

Duration

30 h

Subjects

The students read and present two papers from the recent space physics literature. During the course of the seminar, a broad range of current space physics is covered. Thus, the students are exposed to current problems in the subject as well as a real-life presentation atmosphere (Heber, Wimmer-Schweingruber).

Learning Objectives

Presentation skills

Use of presentation software

Overview of current topics in space physics

Prerequisites for the Course

Introductory Lecture "Radiation Biology"

Extraterrestrial Physics (CAU Kiel 060346)

Workshop

Biomathematics (Universität zu Köln)

Semester

2nd, 3rd, 4th, 5th or 6th

Duration

30 h

Subjects

Theory of Probabilities

Descriptive and Inferring Statistics

Confidence Intervals

Significance Tests

Non-parametric Tests

Correlation, Regression

Epidemiology

Clinical Study and Experimental Design

Variance Analysis, Crossover

(Lehmacher).

Learning Objectives

Acquire statistical tools for data interpretation in doctoral thesis

Prerequisites for the Course

None

Practical Training

Microgravity Simulation and Hyper-g Stimulation

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

10 h

Subjects

Types of Klinostats

Centrifuges

Experiment Preparation and Implementation (Hemmersbach, Ivanova)

Learning Objectives

Overview of Altered Gravity Experimental Methods (for Beginners)

Safe and Efficient Working with the Microgravity Simulation und Centrifuges Facilities at the Institute of Aerospace Medicine (for Advanced Students)

Prerequisites for the Course

For Beginners: None

For Advanced Students (Planning to use the Experimental Facilities in their Thesis): Knowledge About Mammalian Cells and Cell Culture Techniques

Microscopic and Analytic Techniques

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

10 h

Subjects

Light Microscopy, Phase Contrast Microscopy (Baumstark-Khan)

Fluorescence Microscopy (Hellweg)

Digital Photography and Image Analysis (Axiovision) (Hellweg)

Confocal Microscopy (Hemmersbach)

Fluorescence and Radioimmunoassays (Ivanova)

Learning Objectives

Safe and Efficient Working with the Microscopes at the Institute of Aerospace Medicine for Documentation and Analysis of Living or Fixed Cells with or without Immunochemical or Immunofluorescent Staining

Prerequisites for the Course

Basic Microscopy Experience

Cell Culture Techniques

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

10 h

Subjects

Preparation of Buffer and Media

Sterile Working Techniques

Routine Culturing (Medium Change, Passages, Phase Contrast Microscopy, Freezing and Thawing of Cells, Counting of Cells)

Preparation of Cells for Experiments

Mycoplasma Detection

Genetically Altered Cell Lines (Baumstark-Khan, Hellweg, Ivanova)

Learning Objectives

Safe and Efficient Working with Cell Cultures without Contaminations

Working with Genetically Altered Organisms According to German Laws

Prerequisites for the Course

Basic Laboratory Experience

Practical Training

Flow Cytometry

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

10 h

Subjects

Parameters, Probes and Labels (Hellweg)

Data Analysis (Hellweg)

Troubleshooting (Hellweg)

DNA Content / Cell Cycle Analysis (Baumstark-Khan)

Reporter Protein Analysis (Hellweg)

Antibody Staining: Cell Surface and Intracellular Antigens (Ivanova)

Learning Objectives

Safe and Efficient Working with the Fluorescent Activated Cell Scanner (FACScan) at the Institute of Aerospace Medicine for Analysis of Mammalian Cells

Prerequisites for the Course

Basic Knowledge of the Principles of Flow Cytometry

Thermoluminescence Dosimetry and Nuclear Track Etch Detectors

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

10 h

Subjects

Introduction to passive radiation detectors

Thermoluminescence detectors - Principles and Data evaluation procedures

Nuclear Track Etch Detectors - Principles and Data evaluation procedures

Thermoluminescence detectors for space applications - practical examples of detector evaluation based on experiments performed in space and at heavy ion medical accelerators.

Nuclear Track Etch Detectors - practical examples of detector evaluation based on experiments performed in space and at heavy ion medical accelerators

(Berger)

Learning Objectives

The course focuses on the principle of passive radiation dosimetry, introduces thermoluminescence and nuclear track etch detectors, gives an overview of their application for space radiation dosimetry and will enable the students to work on laboratory data evaluation systems, including evaluation of detectors exposed in space.

Prerequisites for the Course

Introductory Lectures "Radiation Biology"

Practical Training

Non-invasive & Invasive Methods in Physiology

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

10 h

Subjects

Muscle: Performance tests, MRI and ultrasound, EMG, MRS, blood parameter and microdialysis, taking, conserving and analysing biopsies

Cardio-vascular system: Test scenarious: tilt table, LBNP, ergometer, centrifuge; measurements: ECG, porta press, impedance, rebreathing (Zange)

Learning Objectives

Measurement of physical and chemical parameters and their validity in interpretation as physiological variables

Statistical reliability of measure outcomes

Phenomena and their precise recording in quantity and time course.

How to analyze the mechanism behind a phenomenon?

Prerequisites for the Course

Lectures "Space Medicine" and "Space Physiology"

Research in Extraterrestrial Physics

Semester

1st, 2nd, 3rd, 4th, 5th or 6th

Duration

30 h

Subjects

Methods for the characterization and analysis of radiation in space: Basic principles of the measurements by particle detectors using different methods (e.g. dEx/dx-E-method, dE/dx-dE/dx-method, dE/dx-v-method) including the determination of important radiation parameters & variation of these parameters with the solar cycle and the position in space (Heber, Wimmer-Schweingruber, Boettcher, Burmeister)

Learning Objectives

Basic principles & applications of experimental & analysis methods for characterization of the radiation and its modulation in the heliosphere, planetary magnetosphere and atmospheres.

Prerequisites for the Course

Introductory Lectures "Radiation Biology"

"Aerospace Dosimetry" or "The Interplanetary Medium" or "Extraterrestrial Physics"

Practical Exercises in Instrument Development

Semester

2nd, 4th, or 6th

Duration

30 h

Subjects

The course begins with a summary of nuclear physics & electronics which is required to understand the operating principles of particle or radiation detection instruments. Various types of detection techniques are introduced, as are relevant electronics concepts such as pulse shaping etc. Additional topics are Monte-Carlo & other numerical techniques (Wimmer-Schweingruber, Boettcher, and Steigies).

Learning Objectives

Understanding of the underlying nuclear physics and relevant electronics

Knowledge of key detection technologies

Capability to interpret "raw" radiation measurements

Prerequisites for the Course

Introductory Lectures "Radiation Biology", Introductory Physics & Electronics Classes

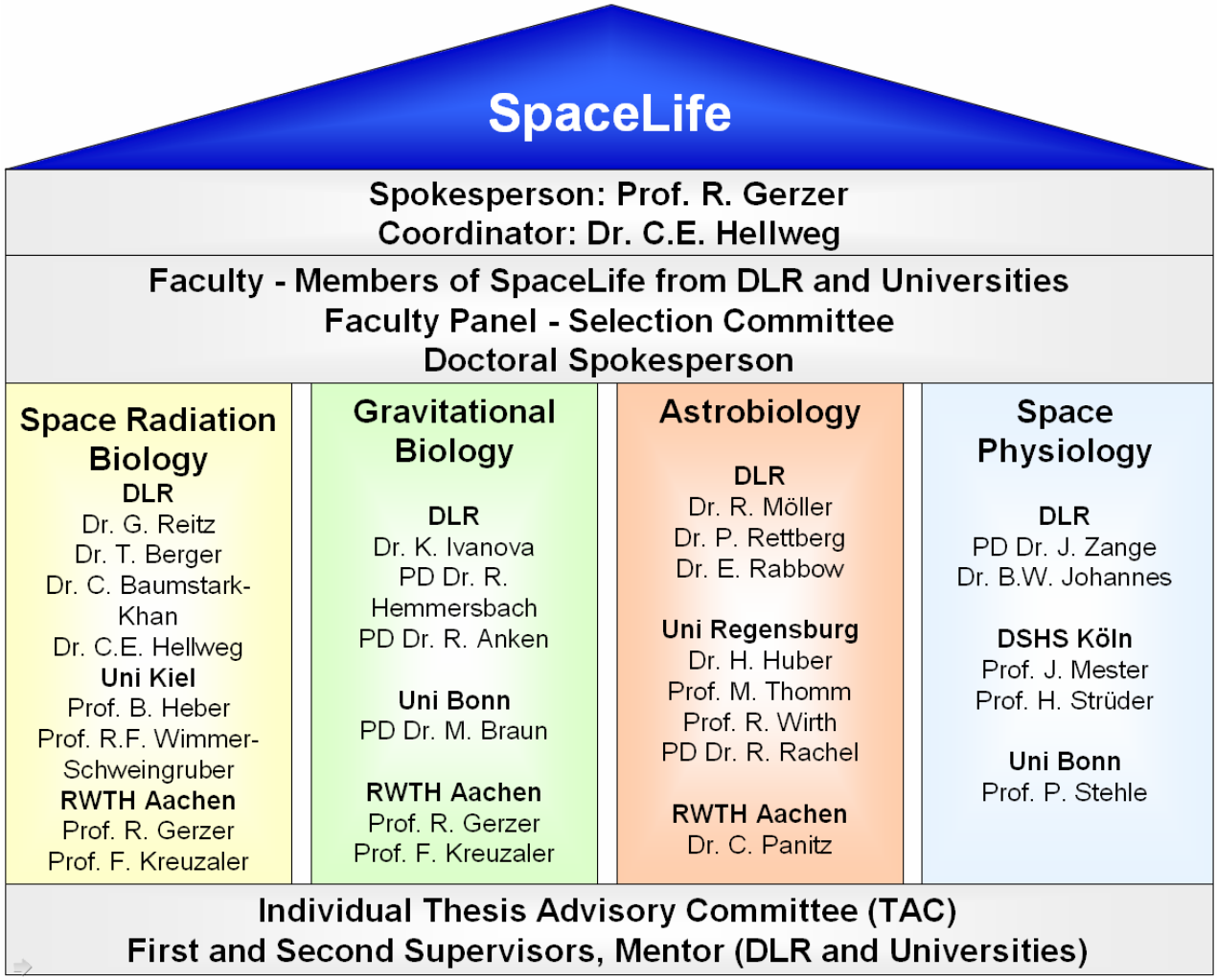
SpaceLife

Management Structure

The **Spokesperson** of SpaceLife is Prof. Dr. R. Gerzer, director of the DLR Institute of Aerospace Medicine (Figure). The **Coordinator** Dr. C. Hellweg, scientist in the Radiobiology department of the Institute, coordinates the activities of SpaceLife (applicants' selection, curriculum, evaluation, public relations).

A **Secretary** assists the coordinator in all administrative processes of SpaceLife, including setup of the Research School webpage, organization of the curriculum, and support for the doctoral students (visa application, living space).

The thesis **Supervisors** at the DLR and the partner universities and scientists who conduct courses in the Research School form the **SpaceLife Faculty**. All faculty members will be invited for a kick-off meeting before start of the Research School and for subsequent annual meetings.



SpaceLife

Management Structure

During the kick-off meeting, a **Faculty Panel** of five members will be elected, and the curriculum of SpaceLife will be determined. The Faculty Panel will form the **Selection Committee** during the interview week and will assist the Spokesperson and the Coordinator in the selection process.

The **doctoral candidates** in SpaceLife will have an employment contract with the DLR or the partner universities or a scholarship contract with SpaceLife. Furthermore, a **Doctorate Contract** between the DLR and the doctoral student keeps records of the rights and duties of the doctoral student, the DLR and the Supervisors, and the doctorate regulations of the university. A synopsis of the doctoral thesis containing the name of the student, the names and institutions of the Supervisors and of the **Mentor**, title and description of the thesis, start of the thesis, and a work plan including milestones, risk assessment and alternatives will be attached to the Doctorate Contract. The approval of the University Supervisor to accept the candidate as doctoral student is also part of the Doctorate Contract.

The **TAC** will be formed as described above. The doctoral students invite the TAC for their thesis presentations in the Students' Workshop (1st, 4th and 6th semester) and arrange an independent meeting with the TAC during the first month of the thesis to discuss the subject and approach.

The doctoral students elect a **Doctoral Spokesperson** during the first Students' Workshop. The Doctoral Spokesperson participates in meetings of the Faculty Panel or the full SpaceLife Faculty. In conflict situations, the Mentor and the Doctoral Spokesperson develop a solution together with the doctoral student and the Supervisors.

SpaceLife can make use of the infrastructure of the Institute of Aerospace Medicine, including the laboratories and meeting rooms of different sizes for the lectures and workshops. The internal communication will be facilitated by means of an **intranet teamsite** accessible to all members of SpaceLife, which will be operated by the Coordinator and the Secretary. The lectures and workshops will be transmitted online to the partners in Hamburg, Regensburg, Kiel and Aachen, using teleconference tools to be installed (webcam, microphone and loudspeaker). At the DLR, the video conference software Adobe Connect Professional is provided by T-Systems-SFR. Doctoral students from the universities of Bonn and Cologne can attend the courses personally.

SpaceLife will be **evaluated** annually by questionnaires to the doctoral students, the Supervisors and the lecturers. Results of the evaluation will be discussed in the annual SpaceLife Faculty meeting and the curriculum will be adapted accordingly.

SpaceLife

Members

Deutsches Zentrum für Luft- und Raumfahrt

Institut für Luft- und Raumfahrtmedizin

Prof. Dr. Rupert Gerzer

Strahlenbiologie

Dr. Christa Baumstark-Khan
Dr. Thomas Berger
Dr. Christine Hellweg
Dr. Ralf Möller
Dr. Elke Rabbow
Dr. Petra Rettberg
Dr. Günther Reitz

Weltraumphysiologie

Dr. Krassimira Ivanova
PD Dr. Jochen Zange

BSSC

Prof. Dr. Ralf H. Anken
Dr. Sven Baerwalde
PD Dr. Ruth Hemmersbach

Psychologie

Dr. Bernd-W. Johannes

Deutsche Sporthochschule (DSHS), Köln

The German Research Center of Elite Sport

Prof. Dr. paed. Dr. h.c. mult. Joachim Mester
Prof. Heiko Strüder

Christian-Albrechts-Universität (CAU) zu Kiel

Institut für Experimentelle und Angewandte Physik

Extraterrestrische Physik

Prof. Robert F. Wimmer-Schweingruber

Heliosphärische Astroteilchenphysik

Prof. Bernd Heber

Universität Regensburg

Lehrstuhl für Mikrobiologie und Archaeenzentrum

Dr. Harald Huber
PD Dr. Reinhard Rachel
Prof. Dr. Michael Thomm
Prof. Dr. Reinhard Wirth

Universität Hamburg

Fakultät für Erziehungswissenschaft, Psychologie und Bewegungswissenschaft

NN

Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen

Botanik und Institut für Biologie I

Prof. Dr. Fritz Kreuzaler

Institut für Flugmedizin, Zentrum für Medizin & Mobilität

Prof. Dr. med. Rupert Gerzer
Dr. rer. nat. Corinna Panitz

Rheinische Friedrich-Wilhelms-Universität Bonn

Institut für Molekulare Physiologie und Biotechnologie der Pflanzen (IMBIO)

Gravitationsbiologie

PD Dr. Markus Braun

Institut für Ernährungs- und Lebensmittelwissenschaften

Fachgebiet Humanernährung

Prof. Dr. Peter Stehle

SpaceLife

Members

Institute for Aerospace Medicine

Within the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt e.V., DLR), the Institute of Aerospace Medicine is the only research institution that primarily deals with life science problems concerning traffic, aviation, and space flight.

The Institute's research activities are focused on the central task of providing for the health and performance of the persons involved (pilot, crew, passenger, astronaut, motorist, resident etc.).

Furthermore, from a medical point of view the development of countermeasures to protect humans from the effects of weightlessness, like the loss of bone and muscle mass is one of our main tasks to enable long-term stays of humans in space for example.

At the same time, when conducting research under microgravity conditions basic functions of the human body are examined by eliminating the interfering influence of gravity in a system-physiological approach.

In the field of psychology the selection of qualified personnel (pilots, astronauts, air traffic controllers) and the development of suitable scientific instruments for the selection procedure are another main task of the Institute. Finally, we also deal with the problem of adaptation of life to extreme environments and take part in projects that are concerned with the search for life in space.

Institute of Aerospace Medicine, Cologne, Germany

SpaceLife

Members

Partner Universities

Christian-Albrechts-Universität zu Kiel

The **Institute for Experimental and Applied Physics** at the CAU in Kiel has a long-lasting experience in extraterrestrial physics and heliospherical astroparticle physics.

Since many years, a main focus at the **Institute for Molecular Physiology and Biotechnology of Plants (IMBIO)** at the University of Bonn, Germany, is gravitational biology.

The **Department of Nutrition and Food Science (IEL) - Nutritional Physiology** at the University of Bonn investigates nutrient utilization and demands in microgravity, the relationship of Vitamin D, calcium and bone health and nutrition in the elderly.

The **Lehrstuhl für Mikrobiologie and the Archaea Centre** of the University of Regensburg stand for excellent expertise in isolating, growing and characterizing extremophilic Bacteria and Archaea into the Astrobiology field of SpaceLife.

Expertise in Astrobiology and in Space Physiology is contributed by the **Institute of Aerospace Medicine** at the RWTH Aachen.

The **Institute of Botany** at the RWTH has established expertise in cell biology, microbiology and plant biology, combined with experience in space life sciences, particularly by participation in the Space Research Group – Project Mars, a students' working group at the RWTH Aachen.

Deutsche Sporthochschule Köln
German Sport University Cologne

The **Institute for Training Science and Sports Informatics** of the DSHS Köln, Germany, contributes excellent expertise in the development and evaluation of efficient countermeasures to muscle and bone degradation during space missions.

The **Institute of Motor Control and Movement Technique** of the DSHS Köln has excellent professional competence in exercise neuroscience and investigates the effects of artificial gravity on the brain.

SpaceLife

Members

PD Dr. Franz Rödel
Klinik für Strahlentherapie und Onkologie
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SpaceLife

Members

National Associated Partners

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Prof. Dr. Dr. Oliver Ullrich
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SpaceLife

Members

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Prof. Dr. Dr. Oliver Ullrich
Full Professor and Chair
Institute of Anatomy
Faculty of Medicine
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Dr. Isabelle Testard
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SpaceLife

Profiles of the Members

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Scientific Career

1991 Diploma in Biology
1995 PhD in Natural Sciences (Zoology)
1999 Habilitation (Zoology)
2008 Professorship (apl)

Professional Experience

1992 – 2008 Scientific Employee, Zoological Institute, University of Hohenheim, Germany
Since 2008 Scientific Employee, German Aerospace Center, Cologne, Institute of Aerospace Medicine, BSSC, Germany

Research Topics

Biology, inner ear otolith calcification in fish, fish as model system in understanding motion sickness susceptibility, neuroscience, neurovestibular behaviour, sensorimotoric disorders, aquatic life support systems.

Space Related Activities:

Experiments flown on STS-55 (2nd German Spacelab Mission D2, 1993), STS-89 (1998), STS 90 (1998), NEUROLAB (1998), STS-107 (2003), FOTON M-3 (2007), TEXUS 45 (2008), Parabolic Aircraft and Drop-Tower Flights, experiments at simulated microgravity (clinostat) and hypergravity (centrifuge)

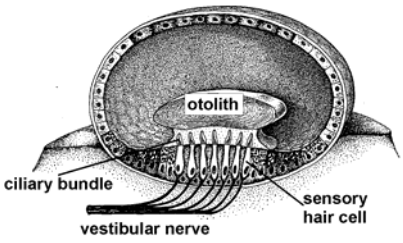
Selected Publications

Anken R, Rahmann H (2002) Gravitational Zoology: How animals use and cope with gravity. Astrobiology, The Quest for the Conditions of Life, Springer, Berlin Heidelberg New York, G. Horneck and C. Baumstark-Khan eds., Springer: Heidelberg, 315-336.

Anken R (2003) Neurophysiology of Developing Fish at Altered Gravity: Background – Facts – Perspectives. In: Advances in Space Biology and Medicine – Developmental Biology Vol. 9, H.-J. Marthy ed., Elsevier, Amsterdam: 173-200.

Anken R (2006) On the role of the central nervous system in regulating the mineralisation of inner-ear otoliths of fish. Protoplasma 229: 205-208.

Hilbig R, Anken R, Rahmann H (2003) On the origin of susceptibility to kinetotic swimming behaviour in fish. A parabolic aircraft flight study. J vest Res 12: 185-189.



Gravisensor of vertebrates

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Scientific career

1994 state exam in biology, sports sciences, pedagogy, psychology
2001 PhD in zoology

Professional Experience

1995 – 1997 Research associate, Medical High School Hannover, Department of Physiology
1997 – 2000 Research associate, DLR, Institute of Aerospace Medicine, Microgravity User Support Center
2000 – 2003 GLOBE project manager, DLR, Institute of Space Operations and Astronaut Training
2004 – 2008 Cosmos Cologne Project Coordinator, Institute of Aerospace Medicine, Biomedical Science Support Center, BSSC
Since 2007 Head Biomedical Information Technology, Institute of Aerospace Medicine, BSSC
Since 2007 Team leader of the short-arm human centrifuge operations and clinical trial team

Awards:

Letter of Appreciation from the U.S. Embassador Daniel R. Coats

Letter of Appreciation by the University Corporation for Atmospheric Research (UCAR)

Research Topics

Exercise physiology

Space related activities

Countermeasure development for astronauts using a short-arm human centrifuge as method. In this context, special focus refers to cardio-vascular, bone and muscle research.

Selected Publications

Chudalla R; Baerwalde S; Schneider G; Maassen N (2006) Local and systemic effects on blood lactate concentration during exercise with small and large muscle groups. Pflügers Archiv European Journal of Physiology: 452 (6).

Baerwalde S; Müller K; Zange J; Maassen N (2000) Alterations in skeletal muscle energy metabolism under LBNP are independent from blood flow. 21st Annual International Gravitational Physiology Meeting,: 127 -, 21st Annual International Gravitational Physiology Meeting: Nagoya.

Baerwalde S; Maassen N; Stifft F; Schneide G (1999) Hypoxia influences lactate elimination and not lactate production during exercise of medium intensity. International Journal of Sports Medicine, :8 - 8, 36th German Congress of Sports Medicine and Prevention.

Baerwalde S; Zange J; Müller K; Maassen N (1999) High-energy-phosphates measured by 31P-MRS during LBNP in exercising human leg muscle. Journal of Gravitational Physiology, 6 (1): :37 – 38, Orlando.

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Scientific Career

1978	Diploma in Biology
1985	PhD in Radiobiology
2004	Lecturer at University of Applied Sciences Bonn-Rhein-Sieg

Professional Experience

1982 – 1991	Research scientist, Experimental Radiology & Radiation Biology, Radiologic University Clinics, Medical Faculty, University of Bonn, Germany
1991 – 1993	Project scientist, Preparation of KINETICS experiment, NASA Spacelab mission IML-2
1995 – 1998	Research scientist, DLR, Institute of Aerospace Medicine, Radiation Biology
1998 – 2000	Group Leader of the Project Group Human Radiation Risk, Aerospace Medicine, University Clinics, RWTH Aachen
Since 2000	Group Leader, DLR Institute of Aerospace Medicine, Cellular Biodiagnostics

Research Topics

Biological effects of different environmental stressors at the cellular & molecular level (radiation, esp. heavy & light ion exposure, nanoparticles, mechanical stress) - Gene expression & signal transduction in mammalian cells, Apoptosis and cell cycle control

Bacterial cyto- & genotoxicity assays

Molecular bone metabolism under conditions of space flight

Space related activities

Co-Investigator:

IML-2: Cellular Repair of Radiation Damage, KINETICS; TRIPLE-LUX.

Principal Investigator:

'Cellular Responses to Radiation in Space (CERASP): The effects of single and combined space flight conditions on mammalian cells' - to be flown.

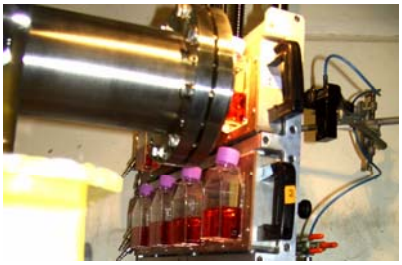
'Modifications of Cellular Signalling Pathways and DNA damage Processing by Radiation in Space (CELLPATH)' - to be flown

Selected Publications

Baumstark-Khan C, Horneck G (2007) Results from the "Technical workshop on genotoxicity Biosensing" on the micro-scale fluorometric assay of deoxyribonucleic acid unwinding. Anal Chim Acta. 593(1): 75-81.

Baumstark-Khan C, Rosendahl IM, Rink H (2006) On the quality of mutations in mammalian cells induced by high LET radiations. Adv Space Res.. 40: 474-482.

Baumstark-Khan C, Hellweg CE, Arenz A, and Meier M M (2005) Cellular Monitoring of the Nuclear Factor κB Pathway for the Assessment of Space Environmental Radiation. Radiation Research 164: 527-30.



Heavy Ion exposure of human cells at GANIL, Caen, France

Dr. Thomas Berger

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Scientific Career

1998 Diploma in Physics
2003 PhD in Radiation Physics

Professional Experience

2003- Postdoc, Institute of Aerospace Medicine, DLR, Cologne, Germany
Since 2003 Scientific Employee, Institute of Aerospace Medicine, DLR, Cologne, Germany

Research Topics

Radiation protection and dosimetry for human space flight and for aircrew

Development and investigation of the radiation detection properties of active and passive radiation detectors

Organization of ground based radiation intercalibration campaigns

Space Related Activities

Co-Investigator in the space experiments:

MATROSHKA, DOSIS, ExoMARS, ALTEINO, BRADOS – Space ICCHIBAN.

Ground-based radiation detector studies at the Heavy Ion Medical Accelerator HIMAC, Chiba, Japan; the CERF High Energy Neutron Field, CERN, Switzerland, the iThemba Neutron Field, Capetown, South Africa

Selected Publications

Berger T (2008) Radiation dosimetry onboard the International Space Station ISS. Zeitschrift für Medizinische Physik, doi 10.1016/j.zemedi.2008.06.014.

Berger T, Hajek M (2008), TL-efficiency-Overview and experimental results over the years. Radiation Measurements, 43(2-6): 146-156.

Berger T, Meier MM, Reitz G, Schridde M (2008) Long term dose measurements applying a human anthropomorphic phantom onboard an aircraft, Radiation Measurements 43: 580-584.

Reitz G, Berger T (2006) The MATROSHKA Facility – Dose determination during an EVA. Radiation Protection Dosimetry 120: 442-445.

MATROSHKA on the International Space Station (ISS)

PD Dr. Markus Braun

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Scientific Career

1991 Diploma in Biology

1994 PhD in Natural Sciences (Botany)

1999 Habilitation (Botany)

Professional Experience

1995-2001 DFG Fellowship, University Canberra, Australia

1999-2001 Professor (C3), University Bonn, Germany

2001-2003 Senior Scientist, University Erlangen, Germany

Since-2003 Project Coordinator, IMBIO, University of Bonn, Germany

Since-2006 Project Manager at DLR Space Agency, Germany

Awards

1991 Heinrich-Hörlein Award, Univ. Bonn

2002 Thora Halstead Young Investigator Award, American Society of Gravitational & Space Biology (ASGSB)

Research Topics

Biology, Plant signal transduction, tip growth, gravity perception, plant cytoskeleton, biosensors, experimentation microgravity

Space Related Activities

Experiments flown on Space-Shuttles:

STS-55 (2nd German Spacelab Mission D2, 1993)

STS-65 (1994)

STS-81 (1997)

TEXUS Sounding rockets: 21, 25, 28, 29, 30, 37, 43

MAXUS 3 & 5

Parabolic Plane Flight Campaigns (7)

Selected Publications

Braun M, Hauslage J, Czogalla A, Limbach C (2004) Tip-localized actin polymerization and remodeling, reflected by the localization of ADF, profilin and villin, are fundamental for gravitropic tip growth in characeen rhizoids. Planta 219: 379-388.

Limbach C, Hauslage J, Schaefer C, Braun M (2005) How to activate a plant gravireceptor - early mechanisms of gravity sensing studied in characean rhizoids during parabolic flights. Plant Physiol 139: 1-11.

Braun M (2007) Primary responses of gravity sensing in plants. In: Brinckmann E, (eds.). Biology in Space and Life on Earth. Wiley Verlag, Weinheim: 33-52.

Gravitropic responses of plant organs

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Scientific Career

1977	Dr. med., Univ. of Munich
1987	Habilitation, University of Munich
Since 1992	Head, Institute of Aerospace Medicine, DLR Cologne and Head, Institute of Aerospace Medicine, RWTH Aachen

Professional Experience

1978-1980	DFG Fellow, University of Heidelberg, Germany
1980-1983	DFG Fellow abroad, Vanderbilt University, Nashville, TN, USA
1984-1998	Resident Internal Medicine, University of Munich, Germany
1992-1998	DFG Heisenberg Fellowship
1992-	Founder, DFG Clinical Research Group, University of Munich, Germany
2005-	Space Life Sciences Award, International Academy of Astronautics
Since-2007	Head, University Council, University of Applied Sciences Bonn

Research Topics

Signal transduction pathways, esp. cyclic GMP, Space Physiology, Telemedicine

Space Related Activities

Participation in many space missions as a scientist and in the present function; member, Board of Trustees, International Academy of Astronautics since 1999; President, German Society for Aerospace Medicine, 1999-2001; Editor-in-Chief, Acta Astronautica since 2008

Selected Publications

Stasch JP, Becker EM, Alonso-Alija C, Apeler H, Dembowsky K, Feurer A, Gerzer R, Minuth T, Perzborn E, Pleiß U, Schröder H, Schröder W, Stahl E, Steinke W, Straub A, Schramm M (2001) NO-independent regulatory site on soluble guanylate cyclase. Nature 410: 212-215.

Horneck G, Facius R, Reichert M, Rettberg P, Seboldt W, Manzey D, Comet B, Maillet A, Presii H, Schauer L, Dussap CG, Poughon L, Belyavin A, Reitz G, Baumstark-Khan C, Gerzer R (2003) HUMEX: a study on the survivability and adaptation of humans to long-duration exploratory missions. Part I, Lunar Missions, Adv Space Res 31: 2389-2401.

Gerzer R, Hemmersbach R, Horneck G (2005) Life Sciences: Utilization of Space eds: Feuerbacher B, Stoewer H; Springer Verlag: 341-373.

Gerzer R, Heer M (2005) Regulation of body fluid and salt homeostasis – from observations in space to new concepts on earth. Curr. Pharmaceut. Biotechnol. 6: 299-304.

Horneck G, Facius R, Reichert M, Rettberg P, Seboldt W, Manzey D, Comet B, Maillet A, Preiss H, Schauer L, Dussap CG, Poughon L, Belyavin A, Reitz G, Baumstark-Khan C, Gerzer R (2006) HUMEX: a Study on the Survivability and Adaptation of Humans to Long-Duration Exploratory Missions, Part II: Missions to Mars. Adv Space Res. 38: 752-759.

Prof. Dr. Bernd Heber

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Scientific Career

1991 Diploma in Physics Christian-Albrechts-Universität Kiel, Germany
1997 Dr. rer. nat./PhD, Christian-Albrechts-Universität Kiel, Germany
2004 Habilitation, Universität Osnabrück, Germany

Professional Experience

1991-1997 Research Associate, Christian-Albrechts-Universität Kiel, Germany
1998-1999 Research Associate, Centre Etude Atomique, Saclay, France
1999-2000 Research Scientist, Max-Planck-Institute for Aeronomie, Katlenburg-Lindau, Germany
2001 Assistant, Universität
2005 Osnabrück, Germany
2005 Assistent: Universität Stuttgart, Germany
Since 2005 Full Professor, Christian-Albrechts-Universität Kiel, Germany, Institute for Experimental and Applied Physics

Awards

1992 Group Achievement Award "Ulysses Jupiter Flyby"

Research Topics

Sun and heliosphere

Cosmic radiation

Interaction of cosmic radiation with the atmosphere

Space Related Activities

Since 1997 Co-I: Ulysses/ Kiel Electron Telescope
Since 2006 P-I: Ulysses/ Kiel Electron Telescope
Since 2006 P-I: Proton Helium Instrument
Since 2006 Co-I: STEREO/ Electron Proton Telescope

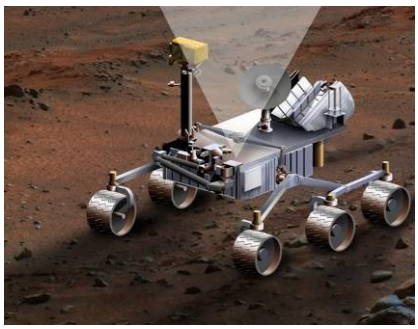
Selected Publications

Heber B, and Potgieter MS (2006) Cosmic Rays at High Heliolatitudes. Space Science Reviews 127: 117-194.

Heber B, Fichtner H, Scherer K (2006) Solar and Heliospheric Modulation of Galactic Cosmic Rays. Space Science Reviews 125: 81-93.

Heber B, Wibberenz G, Potgieter MS, Burger RA, Ferreira SES, Müller-Mellon R, Kunow H, Ferrando P, Raviart A, Paizis C, Lopate C, McDonald FB, Cane HV (2002) Ulysses Cosmic Ray and Solar Particle Investigation/Kiel Electron Telescope observations: Charge sign dependence and spatial gradients during the 1990-2000 A o solar magnetic cycle. Journal of Geophysical Research (Space Physics) 107: 1274.

Heber B, Clem JM, Müller-Mellin R, Kunow H, Ferreira SES, Potgieter MS (2003) Evolution of the galactic cosmic ray electron to proton ratio: Ulysses COSPIN/KET observations. Geophys Res Lett 30: 6-1.



Rover for the US Mars Science Laboratory (MSL) Mission

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Scientific Career

1996 Approbation as Veterinarian
2001 PhD in Veterinary Medicine

Professional Experience

2001-2001 Postdoc, Dermatology, University of Cologne, Germany
2001-2004 Postdoc, Institute of Aerospace Medicine, DLR, Cologne, Germany
Since-2004 Scientific Employee, Institute of Aerospace Medicine, DLR, Cologne, Germany

Research Topics

Biological effects of different environmental stressors at the cellular and molecular level (radiation, especially heavy and light ion exposure, nanoparticles, mechanical stress) - Gene expression and signal transduction in mammalian cells, Apoptosis and cell cycle control Molecular bone metabolism under conditions of space flight

Space Related Activities

Co-Investigator in the space experiments CERASP and CELLPATH

Ground-based radiobiological studies at the heavy ion accelerators GANIL (Caen, France) and GSI (Darmstadt, Germany), at the neutron reactor FRMII (Garching, Germany) and the PTB microbeam (Braunschweig, Germany)

Selected Publications

Hellweg CE, Spitta, L, Arenz A, Bogner SC, Ruscher R, Baumstark-Khan C, Greif K-D, Giesen U (2007) Transcriptional response of human cells to microbeam irradiation with 2.1 MeV α-particles. Adv Space Res 39(6): 1056-1065.

Hellweg CE, and Baumstark-Khan C (2007) Getting Ready for the Manned Mission to Mars: The Astronauts' Risk from Space Radiation. Naturwissenschaften 94: 517-526.

Hellweg CE, Arenz A, Bogner SC, Schmitz C, Baumstark-Khan C (2006) Activation of Nuclear Factor κB by different agents – influence of culture conditions in a cell-based assay. Annals of the New York Academy of Sciences 1091: 191-204.

Hellweg CE, Baumstark-Khan C, Horneck G (2003) Generation of Stably Transfected Mammalian Cell Lines as Fluorescent NF-κB Activation Reporter Assay. J Biomol Screen 8(5): 511-521. aircraft flight study. J. vest. Res. 12: 185-189.

Heavy ion exposure campaign at GANIL, Caen, France

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Scientific Career

1985 Diploma in Biology
1988 PhD in Natural Sciences (Zoology)
1998 Habilitation (Zoology)

Professional Experience

1985-1992 Doctorial grant, PostDoc at the Institute of Aerospace Medicine, DLR, Cologne, Germany
1992-2005 Scientific Employee at the Institute of Aerospace Medicine, DLR, Cologne, Germany
Since-2005 Head of the group Interdisciplinary Gravity Research at the BSSC, Institute of Aerospace Medicine, DLR, Cologne, Germany

Awards

1991 Junior Scientist Award of the DLR
1992 Zeldovich Award of the Cospar Life Sciences behaviour, sensorimotoric disorders, aquatic life support systems.

Research Topics

Gravitational biology; perception of gravity on the cellular level; gravisensors in unicellular systems; experiments under altered gravitational stimulation; simulation of functional weightlessness; scientific user support

Space Related Activities

TEXUS 27 (1990); TEXUS 28 (1991)

Spacelab-Mission IML-2 (1994)

MAXUS 2 (1995)

Shuttle-Mission SMM06 (1997)

TEXUS 39 (2001)

5. DLR Parabolic Flight Campaign (2003)

Selected Publications

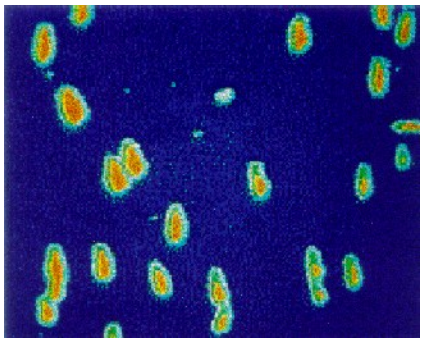
Häder DP, Hemmersbach R, Lebert M (2005) Gravity and the behaviour of unicellular organisms. Cambridge University Press, Cambridge.

Hemmersbach R, von der Wiesche M, Seibt D (2006) Experimental platforms in gravitational biology. Signal Transduction 6: 381-387.

Hemmersbach R, Braun M (2006): Gravity-sensing and gravity-related signaling pathways in unicellular model systems of protists and plants. Signal Transduction 6: 432-442.

Hemmersbach R, Krause M, Bräucker R, Ivanova K (2005) Graviperception in ciliates: steps in the transduction chain. Adv Space Res 35: 296-299.

Krause M, Bräucker R, Hemmersbach R (2006) Graviresponses of Paramecium biaurelia during parabolic flights. Protoplasma 229: 109-116.



Gravitaxis of cells

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Website: http://www.biologie.uni-regensburg.de/Mikrobio/Thomm/Arbeitsgruppen/huber.htm

Scientific Career

1982 Diploma in Biology
1987 PhD in natural sciences (Microbiology)

Professional Experience

1987-1990 PostDoc at the Institute for Microbiology, University of Regensburg, Germany

Since-1990 Permanent position (Akad. Oberrat) at the Institute for Microbiology, University of Regensburg, Germany; Work group leader for microbial research projects

Research Topics

Isolation and characterization of novel hyperthermophilic Archaea and Bacteria;
Physiology and molecular biology of extremophilic microorganisms;

Optimization of fermentation processes in biogas plants.

Bacterial leaching of sulfidic ores by Archaea and Bacteria.

Space Related Activities

Ground-based studies on the resistance of extremophilic microorganisms to radiation, desiccation and high vacuum conditions (collaboration with the DLR in Cologne, Germany, group of Dr. Petra Rettberg).

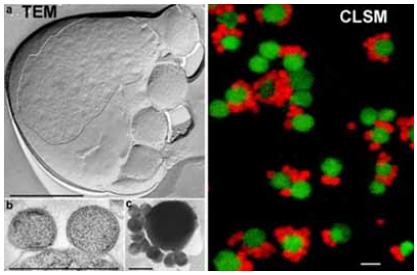
Selected Publications

Huber H, Hohn MJ, Rachel R, Fuchs T, Wimmer VC Stetter KO (2002) A New Phylum of Archaea represented by a nano-sized hyperthermophilic symbiont. Nature 417: 63-67.

Paper W, Jahn U, Hohn MJ, Kronner M, Näther DJ, Burghardt T, Rachel R, Stetter KO, Huber H (2007): Ignicoccus hospitalis sp. nov., the host of Nanoarchaeum equitans. Int. J. System. Evol. Microbiol. 57: 803-808.

Etzel K, Huber H, Rachel R, Schmalz G, Thomm M, Depmeier W (2007) Pyrite surface alteration of synthetic single crystals as effect of microbial activity and crystallographic orientation. Adv. Mat. Res. 20-21: 350-353.

Huber H, Gallenberger M, Jahn U, Eylert E, Berg I, Kockelkorn D, Eisenreich W, Fuchs G (2008) A dicarboxylate/4-hydroxybutyrate autotrophic carbon assimilation cycle in the hyperthermophilic Archaeum Ignicoccus hospitalis. PNAS 105: 7851-7856.



Electron micrographs and fluorescence image of the *Nanoarchaeum equitans-Ignicoccus hospitalis* Co-culture

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Scientific Career

1971 Diploma in Chemistry (Thesis in Spectroscopy), TU Dresden
1984 PhD (Biology), Med. Academy (MA), Sofia
1985 Diploma in Theoretical Medical Chemistry, MA, Sofia
1990 Habilitation (Biochemisty), MA, Sofia
1988 PhD, Medical Faculty, Amsterdam University

Professional Experience

1972-1990 Assistant & Associated Professor, Departments of Pharmacology, Medical Chemistry & Biochemistry, Medical University, Varna
1991-1993 Research Scientist, Division of Clinical Pharmacology, Medizinische Klinik Innenstadt, University of Munich, Germany
Since-1993 Research Scientist, Head of Cell- & Molecular Biology Subdivision, Division of Space Physiology, Institute of Aerospace Medicine, DLR
Since 2000 Adjunct Research Scientist Department of Pathology, Academic of Amsterdam, Netherlands

Research Topics and Space Related Activities

Role of cGMP signalling in the melanocyte response to hyper-g (DLR-IBMP).

Selected Publications:

Ivanova K., Lambers B, van den Wijngaard R, Le Poole I C, Grigorieva G, Gerzer R, Das PK (2008) Immortalization of human melanocytes does not alter the de novo properties of nitric oxide to induce cell detachment from extracellular matrix components via cGMP. In Vitro Cellular & Developmental Biology – Animal 44(8-9): 385-395.

Ivanova K, Block I, Das PK, Gerzer R (2006) Role of cyclic GMP signaling in the melanocyte response to hypergravity. Signal Transduction 6: 406-413.

Ivanova K, van den Wijngaard R, Gerzer R, Lamers WH, Das PK (2005) Non-lesional vitiliginous melanocytes are not characterized by an increased proneness to nitric oxide-induced apoptosis. Exp Dermatol 14: 445-453.

Ivanova K, Das P K, van den Wijngaard R, Lenz W, Ivanova K, Zadeh NH Block, I, Das P K, Gerzer R (2004) Stimulation of cyclic GMP efflux in human melanocytes by hypergravity generated by centrifugal acceleration. Pigment Cell Res 17: 471-479.

Ivanova K, Das P K, van den Wijngaard R, Lenz W, Klockenbring T, Malcharzyk V, Drummer C, Gerzer R (2001) Differential expression of functional guanylyl cyclases in melanocytes: absence of nitric-oxide-sensitive isoform in metastatic cells. J Invest Dermatol 116: 409-416

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Scientific Career

1981 Diploma in Psychology
1991 PhD in Psychology

Professional Experience

1987-1991 Scientific Assistant, Central Institute of Cardiovascular Research, Academy of Sciences (AdW), Berlin, Germany
1991-1993 Scientific Assistant, Max-Delbrück Center for Molecular Medicine (MDC), Berlin-Buch, Germany
1995-2002 Scientific Assistant, Dept. Physiology, Free University Berlin, Germany
Since 2002 Scientific Employee, DLR, Institute of Aerospace Medicine, Hamburg, Germany

Research Topics

Human factors in extreme environments

Performance-Strain research

Space Related Activities:

1996-2000 Neurolab-B on space station MIR
1999 Participant 110-day-Isolation study SFINCCS, IBMP, Moscow
2008 HealthLab on International Space Station

Selected Publications:

Johannes BW, Wittels P, Enne R, Eisinger G, Castro C, Thomas J, Adler A, Gerzer R (2007) Non-linear function model of voice pitch dependency on physical and mental load. Eur J Appl Physiol 101: 267-276.

Johannes BW, Salnitski V, Rauch M, Goeters K-M, Maschke P, Stelling D, Eißfeldt H (2007) Performance assessment in flight simulator test - Validation of a space psychology methodology. Acta Astronautica 60: 379-382.

Johannes BW, Salnitski VP (2004) Integration of different autonomic measures into common indicators of "Psychological Costs". In: Goeters K-M (ed.) Aviation Psychology: Practice and Research, Ashgate, pp. 327-342.

Johannes BW, Salnitski VP, Thieme K, Kirsch KA (2003) Differences in the automatic pattern to psychological load in patients with hypertension and rheumatic diseases. Aviakosmicheskaya i Ekologicheskaya Meditsina 37(1): 28-42.

Johannes BW, Salnitski VP, Polyakov VV, Kirsch KA (2003) Changes in the automatic reactivity pattern to psyhological load under long-term microgravity - twelve men during 6-month spaceflight. Aviakosmicheskaya i Ekologicheskaya Meditsina, 37(3): 6-16.

Johannes BW, Salnitski VP, Gunga HC, Kirsch K (2000) Voice stress monitoring in space- possibilities and limits. Workshop Human factors in space, Tokyo, 7.-9.7.1999. Aviat Space Environ Med 71(9,II): A58-A65.

Equipment for Neurolab

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Website: http://www.bio1. rwth-aachen.de/MolGenetic/Molgenetic_frame.htm

Scientific Career

1971 Diploma in Biology
1974 PhD in Natural Sciences
1986 Habilitation

Professional Experience

1981-1986 Assistant, Max-Planck-Institute for Breeding Research
Since-1986 Professor for Botany, RWTH Aachen

Awards:

1974 Godecke Forschungspreis

Research Topics

Photorespiration

Gene Technology

Chromatin

Maize Mutants

White Biotechnology

Space Related Activities:

Member of the Space Research Group – Project Mars

Selected Publications:

Niessen M, Thiruveedhi K, Rosenkranz R, Kebeish R, Hirsch HJ, Kreuzaler F, Peterhänsel C (2007) Mitochondrial glycolate oxidation contributes to photorespiration in higher plants. Journal of Experimental Botany 58: 2709-2715.

Kebeish R, Niessen M, Thiruveedhi K, Bari R, Hirsch HJ, Rosenkranz R, Stabler N, Schonfeld B, Kreuzaler F, Peterhansel C (2007) Chloroplastic photorespiratory bypass increases photosynthesis and biomass production in Arabidopsis thaliana. Nature Biotechnology 25: 593-599.

Cavalar M, Phlippen Y, Kreuzaler F, Peterhansel C (2007) A drastic reduction in DOF1 transcript levels does not affect C4-specific gene expression in maize. Journal of Plant Physiology 164: 1665-1674.

Bari R, Kebeish RM, Kalamajka R, Rademacher T, Kreuzaler F, Peterhansel C (2004) A glycolate dehydrogenase in the mitochondria of Arabidopsis thaliana. Journal of Experimental Botany 397: 623-630.

Peschen D, Li HP, Fischer R, Kreuzaler F, Liao YC (2004) Fusion proteins comprising a Fusarium-specific antibody linked to antifungal peptides protect plants against a fungal pathogen. Nature Biotechnology 22: 732-738.

Enhanced growth of transgenic plants with modified photosynthesis.

Deutsche Sporthochschule (DSHS)

Prof. Dr. Dr. h.c. mult. Joachim Mester

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Scientific Career

1974 State examination in Sports Science, University of Bochum
1978 PhD (Motoric Learning, Movement Coordination)
1984 Habilitation (Diagnostics of Sense Organs, Motor Learning, Training

Professional Experience

1974-1985 Scientific Assistant at the Institute of Sports Medicine, Ruhr University Bochum
1986 Appointment as Professor at the DSHS, Head of the Institute of Training Science and Mechanics

Awards

1984 Carl-Diem-Plakette (Deutscher Sportbund) for the Habilitation thesis
1984 Carl-Diem-Plakette (Deutscher Sportbund) for the Habilitation thesis
1994 Dr. h.c. Sportuniversität Budapest
2004 Dr. h.c. Universität Jyväskylä, Finnland

Research Topics

Analysis of human adaptation to training
Scientific support in top performance sport: national teams in alpine skiing, tennis, ski-jumping, fencing, rowing, track and field

Space Related Activities:

Empirical Modeling of human performance and adaptation under normal conditions and µg
Research cooperation with DLR

Selected Publications:

Mester J, Kleinöder H, Yue Z (2006) Vibration training: benefits and risks. J Biomech 39(6): 1056-1065.

Kolb JC, Farran P, Norris SR, Smith D, Mester J (2004) Validation of pulse oximetry during progressive normobaric hypoxia utilizing a portable chamber. Can J Appl Physiol 29(1): 3-15.

Yue Z, Mester J (2002) A model analysis of internal loads, energetics, and effects of wobbling mass during the whole-body vibration. J Biomech 35(5): 639-647.

Koehler K, Parr MK, Geyer H, Mester J, Schänzer W (2007) Serum testosterone and urinary excretion of steroid hormone metabolites after administration of a high-dose zinc supplement. Eur J Clin Nutr doi:10.1038/sj.ejcn.1602899.

Suhr F, Brixius K, de Marées M, Bölck B, Kleinöder H, Achtzehn S, Bloch W, Mester J (2007) Effects of short-term vibration and hypoxia during high-intensity cycling exercise on circulating levels of angiogenic regulators in humans. J Appl Physiol 103(2): 474-483.

Dr. Ralf Möller

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Radiation Biology

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Website: http://www.dlr.de/me/

Scientific Career

2003	Diploma in Biology
2007	PhD in Natural Sciences (Microbiology, Biochemistry)

Professional Experience

2003-2007	PhD student, German Collection of Microorganisms and Cell Cultures (DSMZ), Braunschweig, Germany and German Aerospace Center, Cologne, Germany
Since 2007	Scientific Employee, German Aerospace Center, Cologne, Germany

Research Topics

Microbiology, Astrobiology, Radiation biology, DNA repair, DNA protection, Gene expression analyses, Regulation networks on microbial model systems

Space Related Activities

Visiting scientist at NASA KSC, USA; ISRL NIRS, Japan; MPI-IB, Germany; Co-investigator of DFG-"Meteorite ejection and life", ESA/DLR-"ADAPT" und "PROTECT"

Selected Publications:

Moeller et al., (2008) Role of the major small, acid-soluble spore proteins, spore specific and universal DNA repair mechanisms in the resistance of Bacillus subtilis spores to ionizing radiation from X-rays and high energy charged (HZE) particle bombardment. J Bacteriol 190: 1134-1140.

Moeller et al., (2007) UV radiation induced formation of DNA bipyrimidine photoproducts in Bacillus subtilis endospores and their repair during germination. Int Microbiol 10: 39-46.

Moeller et al., (2007) Role of DNA repair by non-homologous end joining (NHEJ) in Bacillus subtilis spore resistance to extreme dryness, mono- and polychromatic UV and ionizing radiation. J Bacteriol 189: 3306-3311.

Moeller et al., (2007) DNA bipyrimidine photoproduct repair and transcriptional response of UV-C irradiated Bacillus subtilis. Arch Microbiol 188: 421-431.

Moeller et al., (2006) A method for extracting RNA from dormant and germinating Bacillus subtilis strain 168 endospores. Curr Microbiol 53: 227-231.

Moeller et al., (2005) Role of pigmentation in protecting Bacillus sp. endospores against environmental UV radiation. FEMS Microbiol Ecol 51: 231-236.

Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen

Dr. Corinna Panitz

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Scientific Career

1989 Diploma in Biology
1993 PhD in Biology

Professional Experience

1994-2000 Educational work - two children
2000-2005 Scientific employee at the German Aerospace Center, Cologne, Germany
2005-present Scientific employee at the RWTH Aachen

Research Topics

Exo/Astrobiology, Photobiology, Microbiology, Genetics, space experiments.

Space Related Activities:

PI for ESA Ground experiment SSIOUX Candy

Co-Investigator of Space experiments:

MARSTOX I and II on BIOPAN IV, V and VI

ADAPT and PROTECT on EXPOSE-E

TRIPLE-LUX in Biolab, Columbus on ISS

Coordinator for Ground Simulation of all EXPOSE-R space experiments

Coordinator for of Rose Consortium and EVT and EST Program for EXPOSE-R space experiments SPORES on EXPOSE-R

Selected Publications:

De la Torre Noetzel R, Sancho LG, Pintado A, Rettberg P, Rabbow E, Panitz C, Deutschmann U, Reina M, Horneck G (2007) BIOPAN experiment LICHENS on the Foton M2 mission Pre-flight verification tests of the -granite ecosystem. Adv Space Res 40: 1665-1671

Cockell Ch S, Schuerger A C, Billi D, Friedmann EI, Panitz C (2005) Effects of Simulated Martian UV Flux on the Cyanobacterium, *Chroococcidiopsis* sp. 029, Astrobiology, Vol. 5, Number 2

Rabbow E, Rettberg P, Panitz C., Drescher J, Horneck G (2005), SSIOUX – Space Simulation for Investigating Organics, Evolution and Exobiology. Adv Space Res 36: 297-302

Rabbow E, Rettberg P, Baumstark-Khan C, Horneck G (2003) SOS-LUX-LAC-FLUORO-Toxicity-test on the International Space Station (ISS). Adv Space Res 31: 1513-1524

Biological samples accommodated for EXPOSE-R EST

Dr. Elke Rabbow

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Radiation Biology, Astro-/ Exobiology

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Scientific Career

1993 Diploma in Biology
2000 PhD in Biology

Professional Experience

1999-2000 Scientific employee at the Project Management at DLR
2000-2005 Scientific employee at the RWTH Aachen
2005-Present Scientific employee at the German Aerospace Center Cologne, Germany

Research Topics

Exo/Astrobiology, Photobiology, Microbiology, Genetics, space experiments.

Space Related Activities:

ESA Point of Contact/coordination of EXPOSE on ISS

PI for DFG-Project Impact II

Co-Investigator of Space experiments:

SURVIVAL I on BIOPAN III

MARSTOX I and II on BIOPAN IV, V and VI

SPORES on EXPOSE-R

TARDIS on BIOPAN VI

ADAPT and PROTECT on EXPOSE-E

TRIPLE-LUX in Biolab, Columbus on ISS

Coordinator for ESA Ground experiment SSIOUX

Coordinator for Ground Simulation of all above space experiments

DFG-Project UV radiation and *Deinococcus radiodurans*

Coordinator for DLR-EnviHab

Selected Publications:

De la Torre Noetzel R, Sancho LG, Pintado A, Rettberg P, Rabbow E, Panitz C, Deutschmann U, Reina M., Horneck G (2007) BIOPAN experiment LICHENS on the Foton M2 mission Pre-flight verification tests of the granite ecosystem. Adv Space Res 40: 1665-1671.

Rabbow E, Stojicic N, Walrafen D, Baumstark-Khan C, Rettberg P, Schulze-Varnholt D, Franz M, Reitz G (2006) SOS-LUX-Toxicity-Test on the International Space Station. Research in Microbiology 157: 30-36.

Rabbow E, Rettberg P, Panitz C, Drescher J, Horneck G (2005) SSIOUX – Space Simulation for Investigating Organics, Evolution and Exobiology. Adv Space Res 36: 297-302.

Rabbow E, Rettberg P, Baumstark-Khan C, Horneck G (2003) SOS-LUX-LAC-FLUORO-Toxicity-test on the International Space Station (ISS). Adv Space Res 31: 1513-1524.

STS 122 lift off on February 7th, 2008

External payloads EuTEF and SOLAR in the cargo bay of STS 122

Prof. Dr. Reinhard Rachel

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Website: http://www.biologie.uni-regensburg.de/Mikrobio/Thomm/

Scientific Career

1982 Diploma in Biology, University of Düsseldorf
1987 PhD at the Technical University of Munich

Professional Experience

1987-1988 PostDoc at the MPI for Biochemistry, Munich
1988-1990 PostDoc at the MRC-LMB in Cambridge, England
since-1990 Permanent position at the Institute for Microbiology, University of Regensburg, Germany; group leader for Ultrastructure and Electron Microscopy in Microbiology
since-2004 Head of the Centre of Electron Microscopy

Research Topics

Structural characterization of hyperthermophilic Archaea and Bacteria
Cell surface, membrane proteins and Surface layer of extremophilic microorganisms

Cell-cell and cell-surface interaction of Archaea

Selected Publications:

Rachel R, Wyschkony, Riehl S, Huber H (2002) The ultrastructure of *Ignicoccus*: evidence for a novel outer membrane and for intracellular vesicle budding in an archaeon. Archaea 1: 9-18.

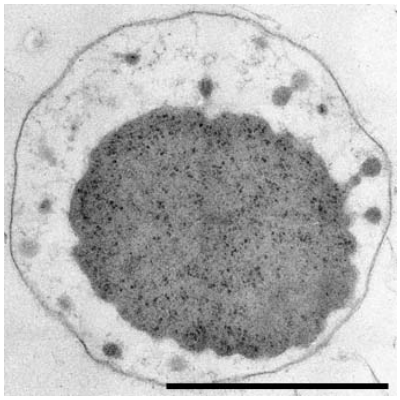
Näther DJ, Rachel R, Wanner G, Wirth R (2006) The flagella of *Pyrococcus furiosus* are multifunctional organelles, also serving for surface adhesion and cell-cell contacts. J. Bacteriol. 188: 6915-6923.

Burghardt T, Näther DJ, Junglas B, Huber H, Rachel R (2007) The dominating outer membrane protein of the hyperthermophilic Archaeum *Ignicoccus hospitalis*: a novel pore-forming complex. Mol. Microbiol. 63: 166-176.

Häring M, Vestergaard G, Rachel R, Chen L, Garrett RA, Prangishvili D (2005) Independent virus development outside a host. Nature 436: 1101-1102.

Prangishvili D, Vestergaard G, Häring M, Aramayo R, Basta T, Rachel R, Garrett RA (2006) Structural and genomic properties of the hyperthermophilic archaeal virus ATV with an extracellular stage of the reproductive cycle. J Mol Biol 359: 1203-1216.

Paper W, Jahn U, Hohn MJ, Brandl M, Näther DJ, Burghardt T, Rachel R, Stetter KO, Huber H (2007) *Ignicoccus hospitalis sp. nov.*, the host of *Nanoarchaeum equitans*. Int J Syst Evol Microbiol 57: 803-808.



Electron micrograph of an ultrathin section of *Ignicoccus hospitalis*

Dr. Günther Reitz

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Scientific Career

1972 Diploma in Physics
1990 PhD in Biophysics

Professional Experience

1975-2004 Scientific Employee, Institute of Aerospace Medicine, DLR, Cologne
Since-2004 Head of the Radiation Biology Section

Awards:

Scientific Award of DGLRM

Research Topics

Radiation Protection and Dosimetry for human space flight and for aircrew. Development and investigation of the radiation detection properties of active and passive radiation detectors. Organization of ground based radiation intercalibration campaigns.

Space Related Activities:

Project manager:

SL1 experiment Microorganisms

Free Flyer Biostack on LDEF

Payload element Radiation on D2

Dosimetry Mapping in US Lab

ESA-Multiuser-Facility MATROSHKA

Principal Investigator:

Dosimetric Mapping Experiments on EURECA I, D2, IML 1 & 2, Biocosmos 9 & 10 missions, BIOPAN flights, MIR92, EUROMIR94 & EUROMIR 95 & on BIORACK Missions on STS 76, 81 and 84

Biostack Experiments on IML2 and D2 and BIOPAN

Co-investigator:

Biostack Experiments I, II, & III, in "Advanced Biostack" Experiment on SL1 & IML1 & in "Free Flyer Biostack" on EURECA; SL1 & D2 Experiments "Microorganisms"; Dosimetric Mapping" & "Carausius" in BIORACK in SL-D1, IML1

Selected Publications:

Reitz G, Berger T (2006) The MATROSHKA Facility – Dose determination during an EVA. Radiat Prot Dosim 120: 442-445.

Reitz G, Beaujean R, Benton E, Burmeister S, Dachev T, Deme S et al. (2005) Space Radiation Measurements onboard ISS – The Dosmap Experiment. Radiat Prot Dosim 116: 374-379.

Reitz G (2006) Past and future application of solid-state detectors in manned spaceflight. Radiat Prot Dosim 120: 387-396.

Beaujean R, Burmeister S, Petersen F, Reitz G (2005) Radiation exposure measurement onboard civil aircraft. Radiat Prot Dosim 116: 312-315.

Dachev TP, Spurny F, Reitz G, Tomov BT, Dimitrov PG, Matviichuk YN (2005) Simultaneous investigation of galactic cosmic rays on aircrafts and on International Space Station. Adv Space Res 36: 1665-1670.

Reitz G, Facius R, Bilski P, Olko P (2002) Investigation of Radiation Doses in Open Space using TLD Detectors. Radiat Prot Dosim 100: 533-536.

Reitz G (2001) Neutron dosimetric measurements in shuttle and MIR. Radiat Meas 33: 341-346.

MATROSHKA

Dr. Petra Rettberg

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51147 Cologne
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Scientific Career

1977-1983 Study of Chemistry, Ruhr-Universität Bochum, Germany

1983-1988 Dissertation (Dr. rer. nat.), Ruhr-Universität Bochum, Germany

Professional Experience

1988 Scholar of the Max Planck-Society

1988-1992 Head of the research group 'Radiation Biology', Max-Planck-Institute for Radiation Chemistry, Mülheim, Germany

1993-1995 Junior research scientist, 'Radiation Biology', DLR, Institute of Aerospace Medicine, Radiation Biology, Köln, Germany

1996 present Head of the research group 'Photo- & Exobiology', DLR, Institute of Aerospace Medicine, Radiation Biology, Köln, Germany

Awards:

2001 DLR-Competition of Visions, 2. Place

1999 Poster award, symposium Biosensors for Environmental Monitoring: Response to New Analytical Demands, Paris

Research Topics

Exo/Astrobiology, Photobiology, Microbiology, Genetics, space experiments.

Space Related Activities:

Co-Investigator of the following international space experiments:

SURVIVAL II on BIOPAN I and II

SURVIVAL I on BIOPAN III, UVRAD of the mission D-2

REPAIR of the mission IML-2

KINETICS of the mission IML-2

UVE of the mission Mir'97

EXOBIOLOGIE of the mission PERSEUS, HighRad of the FOTON M-3 mission), Lithopanspermia of the FOTON M-3 mission, PROTECT since 2008 on the ISS, SPORES (2008 on the ISS), UREY (2013, ExoMars)

Principal Investigator of the following international space experiments:

MARSTOX I of the mission FOTON M-2, MARSTOX II on the FOTON M-3 mission, ADAPT since 2008 on the ISS

TRIPLELUX (2009 on the ISS)

Selected Publications:

Rettberg P, Fritze D, Verbarg S, Nellen J, Horneck G, Stackebrandt E, Kminek G (2006) Determination of the microbial diversity of spacecraft assembly, testing & launch facilities: First results of the ESA project MiDiv. Adv Space Res 38: 1260-1265.

Rettberg P, Rabbow E, Panitz C, Horneck G (2004) Biological space experiments for the simulation of Martian conditions: UV radiation and Martian soil analogues. Adv Space Res 33(8): 1294-1301.

Pogoda de la Vega U, Rettberg P, Douki T, Cadet J, Horneck G (2005) Sensitivity to polychromatic UV-radiation of strains of Deinococcus radiodurans differing in their DNA repair capacity. Int J Radiat Biol 81: 601-611.

Prof. Dr. Peter Stehle

Institut für Ernährungs- und Lebensmittelwissenschaften (IEL) - Ernährungsphysiologie

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Scientific Career

1981 Diploma in Nutrition Sciences, University Hohenheim-Stuttgart, Germany

1984 PhD in Nutrition Sciences

2001 Habilitation in Nutritional Biochemistry

Professional Experience

1984-1991 Postdoc, Department of Biological Chemistry & Nutrition Science, University Hohenheim-Stuttgart, Germany

1992-1994 Associate Professor, Department of Biological Chemistry & Nutrition Science, University Hohenheim-Stuttgart, Germany

since-1994 University Professor in Nutritional Physiology, University Bonn, Germany

Awards:

1994 Konrad-Lang-Preis, Deutsche Gesellschaft für Ernährungsmedizin (DGEM)

2004 Arnold-Durig-Gedächtnisvorlesung, Österreichische Gesellschaft für Ernährung (ÖGE)

Research Topics

Vitamin D, calcium and bone health; nutrient utilization and demands in microgravity; amino acid, peptide, phospholipid metabolism; nutrient bioavailability (experimental models, human studies); nutrition in the elderly

Space Related Activities:

Metabolic ward in space – calcium and bone metabolism: Zittermann A et al, Eur J (2000) Clin Invest 30: 1036-1043

Nitrogen metabolism during immobilisation: Scheld K et al. (2001) Clin Chem 47:1688-1695

Selected Publications:

Volkert D, Kreuel K, Heseker H, Stehle P (2004) Energy and nutrient intake of young old, old-old and very old elderly in Germany. Eur J Clin Nutr 58: 1190-1200.

Schleithoff SS, Zittermann A, Tenderich G, Berthold HK, Stehle P, Koerfer R (2006) Vitamin D supplementation improves cytokine profiles in patients with congestive heart failure: a double-blind, randomized, placebo-controlled trial. Am J Clin Nutr; 83: 754-759.

Beale RJ, Sherry T, Lei K, Campbell-Stephen L, McCook J, Smith J, Venetz W, Alteheld B, Stehle P, Schneider H (2008) Early enteral supplementation with key pharmaconutrients improves Sequential Organ Failure Assessment score in critically ill patients with sepsis: Outcome of a randomized, controlled, double-blind trial. Crit Care Med 36: 131-144.

Univ.-Prof. Dr. Heiko Strüder

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Scientific career

1993 PhD in Exercise Science
2001 Professorship (C3) for Sports Medicine, TU Chemnitz
2002 Professorship (C4) for Exercise Science, German Sport University (DSHS) Cologne

Professional Experience

Since 2002 Director of the Institute of Motor Control and Movement Technique at the DSHS Cologne
Since 2006 Vice President for Research at the German Sport University Cologne

Awards

1993 Arno Arnold Award of the German Federation of Sport Physicians
1993/94 Toyota Award at the German Sport University Cologne
1993/94 Compliments at the "Carl-Diem" competition of the German Sport Federation

Research Topics

Exercise Neuroscience

Serotonergic system

Artificial gravity and the brain

Space related activities

Participation in the ESAs MARS500 and ANTARCTICA program

Parabolic flights

Human centrifuge

Selected Publications

Schneider S, Brummer V, Carnahan H, Dubrowski A, Askew CD, Strüder HK (2008) What happens to the brain in weightlessness? A first approach by EEG tomography. Neuroimage 42: 1316-1323

Schneider S, Brummer V, Mierau A, Carnahan H, Dubrowski A, Strüder HK (2008) Increased brain cortical activity during parabolic flights has no influence on a motor tracking task. Exp Brain Res 185: 571-579

Schneider S, Guardiera S, Kleinert J, Steinbacher A, Abel T, Carnahan H, Strüder HK (2008) Centrifugal acceleration to 3Gz is related to increased release of stress hormones and decreased mood in men and women. Stress 11: 339-347

Schneider S, Kleinert J, Steinbacher A, Brümmer V, Strüder HK (2008) The effect of parabolic flight on perceived physical, motivational and psychological state in men and women: correlation with neuroendocrine stress parameters and electrocortical activity. Stress: in press

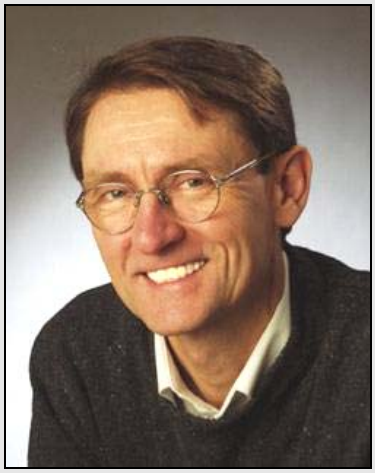
Schneider S, Brummer V, Gobel S, Carnahan H, Dubrowski A, Strüder HK (2007) Parabolic flight experience is related to increased release of stress hormones. Eur J Appl Physiol 100: 301-308

Rojas Vega S, Strüder HK, Vera Wahrmann B, Schmidt A, Bloch W, Hollmann W (2006) Acute BDNF and cortisol response to low intensity exercise and following ramp incremental exercise to exhaustion in humans. Brain Res 1121: 59-65

Strüder HK, Weicker H (2001) Physiology and pathophysiology of the serotonergic system and its implications on mental and physical performance. Part I. Int J Sports Med 22: 467-481

Strüder HK, Weicker H (2001) Physiology and pathophysiology of the serotonergic system and its implications on mental and physical performance. Part II. Int J Sports Med 22: 482-497

Prof. Dr. Michael Thomm



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Scientific Career

1980 Dipl.-Biol. (Master of Science), Univ. of Munich
1983 Dr. rer. nat. (Ph.D.), Univ. of Regensburg (Microbiology)
1988 Dr. rer. nat. habil., Univ. of Regensburg (Microbiology)

Professional Experience

1983 Postdoctoral fellow at the
1988 University of Regensburg (Prof. Dr. Karl O. Stetter)
1988 Research assistant at the
1991 University of Regensburg Department of Microbiology
1991- Christian-Albrechts-
2002 University of Kiel: Full professor of Microbiology, Head of the Institute of General Microbiology
2002- University of Regensburg,
present Germany: Full professor of Microbiology, Head of the Department of Microbiology & Archaeencenter

Research Topics

Mechanism of transcription in Archaea;

Regulation of transcription in Archaea and Eukarya;

Microbiology of methanogenes and of hyperthermophiles;

Head of fermentation facility (11 fermenters - Archaecenter Regensburg)

Space Related Activities:

Cultivation of chemolithotrophic microorganisms which are only dependent upon the presence of water and volcanic gases like hydrogen, CO_2 and H_2S

Selected Publications:

Liu W, Vierke G, Wenke A-K, Thomm M, Ladenstein R (2007) Crystal structure of the archaeal heat shock regulator from *Pyrococcus furiosus*: A molecular chimera representing eukaryal and bacterial features. J Mol Bio. 369: 474-488.

Lee SJ, Surma M, Seitz S, Hausner W, Thomm M, Boos W (2007) Differential signal transduction via TrmB, a sugar sensing transcriptional repressor of *Pyrococcus furiosus*. Mol Microbiol 64(6): 1499-1505.

Etzel K, Huber H, Rachel R, Schmalz G, Thomm M, Depmeier W (2007) Pyrite surface alteration of synthetic single crystals as effect of microbial activity and crystallographic orientation. Advanced Materials Research, 20-21: 350-353.

Lee SJ, Surma M, Seitz S, Hausner W, Thomm M, Boos W (2007) Characterization of the TrmB-like protein, PF0124, a TGM-recognizing global transcriptional regulator of the hyperthermophilic archaeon *Pyrococcus furiosus*. Mol Microbiol 65(2): 305-318.

Grünberg S, Bartlett MS, Naji S, Thomm M (2007) Transcription factor E is a part of transcription elongation complexes. J Biol Chem 282(49): 35482-35490.

Micorescu M, Grünberg S, Franke A, Cramer P, Thomm M, Bartlett M (2008) Archaeal transcription: function of an alternative transcription factor B from *Pyrococcus furiosus*. J Bacteriol 190(1): 157-167.

Prof. Dr. Robert F. Wimmer-Schweingruber

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Website: http://www.ieap.uni-kiel.de/et/ag-wimmer/index.php

Scientific Career

1983	Studies in Physics,
1991	University of Bern, Switzerland
1991	Diploma in Theoretical Physics
1994	PhD in Experimental Physics
2001	Habilitation in Experimental Physics

Professional Experience

1995-1996	Postdoc, University of Maryland, College Park, MD, USA
1996-2001	Research Fellow, University of Bern, Switzerland
2001-2002	Senior Scientist (Oberassistent), University of Bern, Switzerland, teaching at university level
Since 2002	University professor at the IEAP, University of Kiel, Germany
2004-2006	2-year term as executive director of the IEAP

Research Topics

Solar and heliospheric physics, planetology, radiation detection

Space Related Activities

Co-Investigator of instruments on numerous space missions

Co-Principal Investigator for Solar Orbiter / EPD

Principal Investigator for LEO/RadMo

Selected Publications

Wimmer-Schweingruber RF (2005) Interplanetary Disturbances. In Space Weather: The Physics Behind a Slogan. Scherer K et al. (eds), Springer, Berlin, Lect Notes Phys 656: 71-129.

Bochsler P, Moebius E, Wimmer-Schweingruber R F (2006), On the velocity distributions of dust-related inner-source pickup ions , Geophys. Res. Lett., 33, L06102, doi:10.1029/2005GL025178.

Wimmer-Schweingruber RF (2006) Coronal Mass Ejections. Space Sci Rev 123: 471-480.

Wimmer-Schweingruber RF, Crooker NU, Balogh A, Bothmer V, Forsyth RJ, Gazis P, Gosling JT, Horbury T, Kilchenmann A, Richardson I, Richardson J, Riley P, Rodriguez L, von Steiger R, Wurz P, Zurbuchen TH (2006) Understanding Interplanetary Coronal Mass Ejections Signatures. Space Sci Rev 123: 177-216.

DOSTEL on EuTEFF in STS-122 Cargo Bay

Prof. Dr. Reinhard Wirth

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Scientific Career

1976 Dipl.-Biol., University of Regensburg
1980 Dr. rer. nat., University of Regensburg
1989 Dr. rer. nat. habil., University of Munich

Professional Experience

1980-1983 Postdoctoral fellow at the University of Munich, Germany
1983-1985 Postdoctoral fellow at the University of Michigan, Ann Arbor, USA, Prof. Don Clewell
1985-1994 Research assistant at the University of Munich, Germany
Since-1994 Professor (C3) at the University of Regensburg, Germany

Research Topics

Cell surface appendages (flagellae, fimbriae and pili) of Archeae and their role in adhesion, motility, biofilm formation, etc.

Space Related Activities

ESA project „Communities of archeae and specific bacterial communities on spacecrafts and in their clean room environment"

Selected Publications

Francia MV, Haas W, Wirth R, Samberger E, Muscholl-Silberhorn A, Gilmore MS, Ike Y, Weaver KE, An FY, Clewell DB (2001) Completion of the Nucleotide Sequence of the *Enterococcus faecalis* Conjugative Virulence Plasmid pAD1 and Identification of a Second Transfer Origin. Plasmid 46: 112-117.

Siebert K, Busl M, Asmus I, Freund J, Muscholl-Silberhorn A, Wirth R (2004) Evaluation of Methods for Storage of Marine Macroorganisms with Optimal Recovery of Bacteria. Appl Environ Microbiol 70: 5912-5915.

Schopf S, Wanner G, Rachel R, Wirth R (2008) An Archaeal Bi-species Biofilm Formed by Pyrococcus furiosus and Methanopyrus kandleri. Arch Microbiol submitted.

Thoma C, Frank M, Rachel R, Schmid S, Näther D, Wanner G, Wirth R (2008) Fimbriae of *Methanothermobacter thermoautotrophicus* are encoded by mth60: first characterization of an archaeal fimbrium. Mol Microbiol submitted.

Pyrococcus furiosus binds by flagella to grains of sand in its biotop

PD Dr. Jochen Zange

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Space Physiology

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Scientific Career

1985	Diploma in Biology
1990	PhD in Natural Sciences (Biology)
2006	Habilitation in Human Physiology

Professional Experience

1988-1990	Postdoc, Max-Planck-Institute for System Physiology, Dortmund, Germany
1990-1991	Postdoc, Institute of Animal Physiology, Heinrich-Heine-Universität Düsseldorf, Germany
Since 1991	Researcher at the Institute of Aerospace Medicine, Cologne, current position: Head of subdivision 'Integrative Muscle Physiology'

Research Topics

Physiology and pathophysiology of human skeletal muscle. Development and testing of countermeasures and therapies against muscle weakness. Development of non invasive methods for research in applied human physiology and for diagnosis of muscle diseases.

Space Related Activities

PI: EuroMir '94, '95, ´95E, and MIR '97, '97E.
CoI ESA-MAP-Med30
ESA Topical Team Member: "Skeletal Muscle" and "Artificial Gravity"

Selected Publications

Zange J, Beisteiner M, Müller K, Shushakov V, Maassen N (2008) Energy metabolism in intensively exercising calf muscle under a simulated orthostasis. Pflügers Arch. 455(6): 1153-1163.

Zange J, Grehl T, Disselhorst-Klug C, Rau G, Müller K, Schröder R, Tegenthoff M, Malin JP, Vorgerd M (2003) Breakdown of adenine nucleotide pool in fatiguing skeletal muscle in McArdle's disease: a non-invasive 31P MRS and EMG study. Muscle Nerve 27(6): 728-736.

Vorgerd M, Zange J (2002) Carbohydrate oxidation disorders of skeletal muscle. Curr. Opin. Clin. Nutr Metab Care 5 (6): 611-617.

Zange J, Kornblum C, Müller K, Kurtscheid S, Heck H, Schröder R, Grehl T, Vorgerd M (2002). Creatine supplementation results in elevated phosphocreatine /adenosine triphosphate (ATP) ratios in the calf muscle of athletes but not in patients with myopathies. Ann Neurol 52 (1): 126-127.

Zange J, Müller K, Schuber M, Wackerhage H, Hoffmann U, Günther RW, Adam G, Neuerburg JM, Sinitsyn VE, Bacharev AO, Belichenko OI (1997) Changes in calf muscle performance, energy metabolism, and muscle volume caused by long term stay on space station Mir. Int J Sports Med 18: S308-S309.

SpaceLife

Profiles of the Associated Partners

Univ.-Prof. Dr. Leo Brunnberg

Fachbereich Veterinärmedizin
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Research Topics

Pathogenesis and Therapy of Osteoarthritis in Dogs

Experimental Surgery

Neurosurgery: Herniated Vertebral Disc

Orthopedics: New methods of fracture care

Selected Publications

Nordhoff M, Rühe B, Kellermeier C, Moter A, Schmitz R, Brunnberg L, Wieler LH (2008) Association of Treponema spp. with canine periodontitis. Veterinary Microbiology 127(3-4): 334-342.

Ottenjann M, Lübke-Becker A, Linzmann H, Brunnberg L, Kohn B (2008) Pyothorax bei 26 Katzen Klinik, Labordiagnostik und Therapie (2000-2007) Berliner und Münchener Tierärztliche Wochenschrift 121 (9/10): 365-373.

Walther B, Wieler LH, Friedrich AW, Hanssen AM, Kohn B, Brunnberg L, Lübke-Becker A (2008), Methicillin-resistant Staphylococcus aureus (MRSA) isolated from small and exotic animals at a university hospital during routine microbiological examinations. Veterinary Microbiology 127(1-2): 171-178.

Brunnberg L (2007), Experimentelle interdisziplinäre Chirurgie in der klinischen Forschung für Tier und Mensch. Nova Acta Leopoldina NF 95 (353): 183-191.

Forterre F, Fritsch G, Kaiser S, Matiasek K, Brunnberg L (2006) Surgical approach for tentorial meningiomas in cats: a review of six cases. Journal of feline medicine and surgery 8 (4): 227 – 233.

Forterre F, Kaiser S, Garner M, Stadie B, Matiasek K, Schmahl W, Brunnberg L (2006)Synovial cysts associated with cauda equina syndrome in two dogs. Veterinary Surgery 35(1): 30-33.

Forterre S, Raila J, Forterre F, Brunnberg L, Schweigert FJ (2006) Characterisation of transthyretin and retinol-binding protein in plasma and cerebrospinal fluid of dogs. Veterinary Journal 171 (3) : 451-455.

Forterre S, Raila J, Kohn B, Brunnberg L, Schweigert FJ (2006)Protein profiling of organic stone matrix and urine from dogs with urolithiasis. Journal of Animal Physiology and Animal Nutrition 90: 192-199.

Prof. Hanns-Christian Gunga

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Scientific Career

1980	Diploma in Geology-Palaeontology
1987	State examen in Medicine
1989	Dissertation Dr. med. (Berlin)
1997	Habilitation/PhD (Physiology), Free University Berlin, Berlin
2004	Professorship, Charité University Medicine Berlin, Berlin

Professional Experience

1980 1987	Scientific Assistant, Department of Physiology, Free University Berlin Germany
1996	Visiting Researcher, Santiago de Chile
2000	Speaker of the Center of Space Medicine
Since 2008	Vice Director of the Department of Physiology, Charite University Medicine Berlin, Campus Benjamin Franklin
1995 2002	Group Leader, Max-Delbrück-Laboratory, Cologne, Germany
Since 2002	Group Leader, Professor, Institute for Biology II, University of Freiburg, Germany

Research Topics

Space medicine, blood physiology, cardiovascular physiology, renal physiology, comparative physiology in extreme environments

Space Related Activities

PI:
EUROMIR'94 (Principal Investigator, CVP-Erythropoietin)
ESA-CNES L-TBR'94 (Principal Investigator, Erythropoietin)
MIR'97 (Principal Investigator, Erythropoietin-Serum Transferrin Receptor)
Neurolab 2000 (Principal Investigator, Psycho-Physiology)
Co-I: ISEMSI'90, EXEMSI'92, MIR'92, D-2, ALTAIR, EUROMIR'94, HUBES'94

Several Parabolic Flight Campaigns and Bed Rest Studies

Selected Publications

Gunga HC, Sandsund M, Reinertsen RE, Sattler F, K Koch KJ (2008) A non-invasive device to continuously determine heat strain in humans. J Therm Biol 33: 297-307.

Boldt LH, Fraszl W, Röcker L, Steinach M, Noack T, Gunga HC (2008) Changes in the haemostatic system during after thermoneutral and hyperthermic water. Eur J Appl Physiol 102: 547-554.

Gunga HC, Suthau T, Bellman A, Stoinski S, Friedrich A,Trippel T, Kirsch K, Hellwich O (2008) A new body mass estimation of Brachiosaurus brancai Janensch, 1914 mounted and exhibited at the Museum of Natural History (Berlin, Germany). Fossil Record 11: 28-33.

Gunga HC, Kirsch KA, Roecker L, Kohlberg E, Tiedemann J, Steinach M, Schobersberger W (2007): Erythropoietin regulations in humans under different environmental and experimental conditions. Respir Physiol Neurobiol158: 287-297.

Gunga HC, Suthaus T, Bellmann A, Friedrich A, Schwanebeck T, Stoinski S, Trippel T, Kirsch K, Hellwich O (2007) Body Mass estimations for Plateosaurus engelhardti using laser scanning and 3D reconstruction methods. Naturwissenschaften 94: 623-630.

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Research Topics

Basic neurobiological adaptation mechanisms of fish to altered gravity conditions

Artificial ecosystems

Space biology

Selected Publications

Shcherbakov D, Winklhofer, M, Petersen N, Steidle J, Hilbig R, Blum M (2005) Magnetosensation in zebrafish. Current Biology 15(5): 161-162.

Hilbig, R, Anken, R, Rahmann H, (2003): On the origin of susceptibility to kinetotic swimming behaviour in fish: A parabolic aircraft flight study. J Vest Res 12: 185-189.

PD Dr. Michael Lebert

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Scientific Career

1987 Diploma in Biology
1991 PhD in Natural Sciences (Biochemistry)
1999 Habilitation (Botany)

Professional Experience

1991 – 1993 Postdoc, Pullman, Wa., USA
Since 1993 Senior scientist, University of Erlangen, Germany

Research Topics

Euglena gracilis ('beast')

Environmentally controlled signal perception and signal transduction in microorganisms

Artificial ecosystems

Space biology

Selected Publications

Richter, PR, Schuste, M, Meyer I, Lebert M, Häder, D-P (2006) Indications for acceleration-dependent changes of membrane potential in the flagellate *Euglena gracilis*. Protoplasma 229: 101-108.

Häder D-P, Richter P, Lebert M (2006) Signal transduction in gravisensing of flagellates. Signal Transduct. 6: 422-431.

Häder D-P, Lebert M (2006) ELDONET – European Light DOsimeter NETwork. Environmental UV radiation: Impact on Ecosystems and Human Health and Predictive Models. NATO Science Series, IV. Earth and Environmental Sciences, Vol. 57, Ghetti, F., Checcucci, G., Bornman, J.F. (Eds.), Springer, The Netherlands, pp. 95-10.

Häder D-P, Richter P, Ntefidou M, Lebert M (2005) Gravitational sensory transduction chain in flagellates. Adv Space Res 36: 1182-1188.

Streb C, Richter, P, Ntefidou M, Lebert M, Häder D-P (2002) EXOTOX-biomonitoring based on real time movement analysis of unicellular organisms. J Gravit Physiol 9: 345-346. Reprint of ESA SP-501.

Richter P, Ntefidou M, Streb C, Lebert M, Häder D-P (2002) Physiological characterization of gravitaxis in *Euglena gracilis*. J Gravit Physiol. 9: 279-280 Reprint of ESA SP-501.

Sinha RP, Barbieri ES, Lebert M, Helbling EW, Häder D-P (2003) Effects of solar radiation on phycobiliproteins of marine red algae. Trends Photochem. Photobiol 10: 149-157.

Ntefidou M, Richter PR, Streb C, Lebert M, Häder D-P (2002) High light exposure leads to a sign change in gravitaxis of the flagellate *Euglena gracilis*. J Gravit Physiol 9: 277-278.

Prof. Klaus Palme

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Scientific Career

1977 Diploma in Chemistry
1981 PhD in Natural Sciences (Chemistry)
1993 Habilitation (Botany), University of Cologne
2001 Professorship, University of Freiburg

Professional Experience

1978 – 1981 Scientific Employee, Biochemistry Institute, University of Ulm, Germany
1982 – 1983 Visiting Researcher, Salk Institute for Biological Studies in San Diego (USA)
1984 – 1985 SFB Scholarship, Cologne, Germany
1986 – 1995 Scientific Employee, Max-Planck-Institut für Züchtungsforschung, Cologne, Germany
1995 – 2002 Group Leader, Max-Delbrück-Laboratory, Cologne, Germany
Since 2002 Group Leader, Professor, Institute for Biology II, University of Freiburg, Germany

Research Topics

Physiology, genetics and metabolism of Arabidopsis thaliana

Awards

1995 G-Prize (for "longterm application oriented research; Intospace, Paris)
2002 Max-Planck-Forschungspreis für internationale Kooperation

Selected Publications

Vandenbussche F, Smalle J, Le J, Saibo NJM, De Paepe A, Chaerle L, Tietz O, Smet A, Laarhove LJ, Harren FJM, Verbelen H-P, Van Onckelen H, Palme K, Van Der Straeten D (2002) The Arabidopsis thaliana mutant mar1 illustrates a cross-talk between ethylene and auxin. Plant Physiol 131:1228-1238.

Willemsen V, Frim, J, Grebe, M, Van Den Toorn, A, Palme, K, Scheres B (2003) The Arabidopsis ORC/Sterol methyltransferase1 gene is required for cell polarity, and correct localization of putative auxin efflux carriers. Plant Cell 15: 612-625.

Ottenschläger I, Wolff P, Wolverton C, Bhalerao R, Sandberg G, Ishikawa H, Evans M, Palme K (2003) Gravity induced auxin transport from Arabidopsis columella to lateral root cap cells. Proc Natl Acad Sci USA 100: 2987-2991.

Frim lJ, Benkova E, Mayer U, Palme K, Muster G (2003) Automated whole mount localisation techniques for plant seedlings. Plant J 34: 115-124

Hejátko J, Pernisová M, Eneva T, Palme K, Brzobohaty B (2003) The putative sensor histidine kinase CKI1 is involved in Arabidopsis female gametophyte development. Mol Gen Genet 269: 443-453.

PD Dr. Franz Rödel

Universitätsklinikum
Klinik für Strahlentherapie und Onkologie
Strahlenbiologie

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E-mail: Franz.Roedel@kgu.de
Website:
http://www.strahlentherapie.kgu.de/Ueber-Uns

Scientific Career

1991 Diploma in Biology
1995 PhD in Natural Sciences, University of Erlangen-Nürnberg
2004 Habilitation (Molecular Radiation Biology)

Professional Experience

1991 – 1995 Scientific Employee, Institute for Microbiology, University of Erlangen-Nürnberg, Germany
1995 – 1996 Scientific Project Leader, Medicon Publisher, Munich, Germany
1997 Seminar Project Management, Grundig Academy Nürnberg, Germany
1997 – 2007 Scientific Employee, Radiotherapy Clinic , University of Erlangen-Nürnberg, Germany
Since 2007 Group Leader, Radiotherapy Clinic , University of Frankfurt, Germany

Awards

2000 Günther-von-Pannewitz-Award
2004 Hermann-Holthusen-Award

Research Topics

Molecular radiation biology: key processes and molecules in radiation-induced cell inactivation andtheir modulation in radiotherapy. Development of novel therapeutic targets for cancer treatment. Mechanisms of the anti-inflammatory properties of low-dose X-irradiation.

Development of new vectors with Selected Publications

Rödel F, Frey B, Leitmann W, Capalbo G, Weiss C, Rödel C (2008). Survivin antisense oligonucleotides effectively radio sensitize colorectal cancer cells in both tissue culture and murine xenograft models. Int J Radiat Oncol Biol Phys 71: 247-55.

Rödel F, Hofmann D, Auer J, Keilholz L, Herrmann M, Röllinghoff M, Sauer R, Beuscher HU (2008). The anti-inflammatory effect of low dose radiation therapy involves a diminished CCL20 chemokine expression and granulocyte/ endothelial cell adhesion. Strahlenther Onkol 184: 41-47.

Rödel F, Keilholz L, Herrmann M, Sauer R, Hildebrandt G (2007). Radiobiological mechanisms in inflammatory diseases of low-dose radiation therapy. Int J Radiat Biol, 83: 57-66.

Capalbo G, Rödel C, Stauber RH, Knauer SK, Bache M, Kappler M, Rödel F (2007). The role of survivin for radiation therapy: prognostic and predictive factor and therapeutic target. Strahlenther Onkol, 183: 593-599.

Rödel F, Keilholz L, Herrmann M.; Sauer R, Hildebrandt G (2007). Radiobiological mechanisms in inflammatory diseases of low dose radiation therapy. Int J Radiat Biol, 83: 357-66

Knauer S, Krämer O, Knösel T, Engels K, Rödel F, Kovács A, Brieger J, Habtemichael N, Hambeck M, Klein-Hitpass L, Rödel C, Mann W, Knecht R, Petersen I, Heinzel T, Stauber R (2007). Nuclear export is essential for the biological activity of survivin – novel aspects to target the survivin pathway in cancer. FASEB Journal, 21: 207-216.

Rödel F, Hoffmann J, Distel L, Herrmann M, Noisternig T, Papadopoulos T, Sauer R, Rödel C (2005). Survivin As a Radio-Resistance Factor, and Prognostic and Therapeutic Target for Radiotherapy in Rectal Cancer. Cancer Res, 65: 4881-4887.

Univ.-Prof. Dr. Michael F.G. Schmidt

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Website: http://www.vetmed.fu-berlin.de/einrichtungen/institute/we06/index.html

Scientific Career

1973 Diploma in Biology
1975 Dr. rer. nat. in Biochemistry, Virology, Genetics
1987 Habilitation (Biochemistry and Virology)
1986 Professorship

Professional Experience

1972 – 1973 Teaching Assistant, Faculty of Vet. Med., Giessen, Germany
1973 – 1974 Research Assistant, Faculty of Vet. Med., Giessen University, Germany
1974 – 1977 Post Doc, Faculty of Vet. Med., Giessen University
1977 – 1980 Research Fellow, Dept. of Microbiology & Immunology, Washington University, School of Medicine, USA
1980 – 1982 Senior Researcher, Faculty of Vet. Med., Giessen University
1982 – 1986 Research Assosiate (C1), Virology Department, Faculty of Vet. Med., Giessen
1986 – 1990 Associate Professor, Dept. of Biochemistry, Faculty of Medicine, Kuwait University
1990 – 1993 Full Professor, Dept. of Virology, Faculty of Vet. Med., FU Berlin, Germany
Since 1993 Full Professor and Chairman, Dept. of Immunology and Molecular Biology, Faculty of Veterinary Medicine, FU Berlin, Germany

Research Topics

Enveloped viruses (emphasis influenza virus); membrane biochemistry (vesicular transport, secretion); protein modifications (glyosylation, fatty acylation); intestinal immunity; osteoarthritis, gene therapy; inflammation

Selected Publications

Rachakonda PS, Rai MF, Manning K, Schmidt MFG (2008) Expression of canine interleukin-4 in canine chondrocytes inhibits inflammatory cascade through STAT6. Cytokine 44: 179-184.

Rachakonda PS, Rai MF, Schmidt MFG (2008) Application of inflammation-responsive promoter for an in vitro arthritis model. Arthritis Rheum 58: 2088-2097.

Veit M, Ponimaskin E, Schmidt MFG (2008) Analysis of S-acylation of proteins. Methods Mol Biol 446: 163-182.

Rai MF, Rachakonda PS, Manning K, Vorwerk B, Brunnberg L, Kohn B, Schmidt MFG (2008) Quantification of cytokines and inflammatory mediators in a three-dimensional model of inflammatory arthritis. Cytokine 42: 8-17.

Scharek L, Guth J, Filter M, Schmidt MFG (2007) Impact of the probiotic bacteria Enterococcus faecium NCIMB 10415 (SF68) and Bacillus cereus var. toyoi NCIMB 40112 on the development of serum IgG and faecal IgA of sows and their piglets. Arch Anim Nutr 61: 223-234.

Schierack P, Wieler LH, Taras D, Herwig V, Tachu B, Hlinak A, Schmidt MFG, Scharek L (2007) Bacillus cereus var. toyoi enhanced systemic immune response in piglets. Vet Immunol Immunopathol 118: 1-11.

Rachakonda PS, Veit M, Korte T, Ludwig K, Böttcher C, Huang Q, Schmidt MFG, Herrmann A (2007) The relevance of salt bridges for the stability of the influenza virus hemagglutinin. FASEB J 21(4): 995-1002.

Prof. Fengyuan Zhuang

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Scientific Career

1962 Diploma in Physics

Professional Experience

1962 Teaching Assistant
1980 Lecturer, Physics Dept. Beijing University
1980 Visiting Scholar,
1983 Applied Mechanics & Engineering/Bioengineering, Biomachanics, University of California, San Diego, USA
1983 Lecturer Physics Dept.,
1984 Beijing University
1984 Associate Prof.
2001 Prof. Director, Dept. of Biomechanics & Biorheology, Research Institute, China-Japan Friendship Hospital
1985 Director of Hemorheology
1989 Dept. Beijing Heart Lung, & Blood Vascular Center
2001 Director, Founder of Bioen-
2005 gineering Dept., (now School of Biological Science & Medical Engineering), Beijing University of Aeronautics & Astronautics (BUAA)
2001 Director of Bioscience
2008 & Bioengineering Institute
Since Prof. School of Biological
2001 Science and Medical Engineering, BUAA

Research Topics

Effects of gravity on the cardio-vascular system, remoldeling of cardiovescular vessels.

Effects of microgravity on immune cells and endothelial cells.

Mechanobiology studies on gravisensing of mammalian cells

Cell biomechanics

Space Related Activities

General Secretary for the 16th IAA Humans in Space Symposium, May 21-24, 2007 Beijing

Co-Chair of 2nd Sino-German Symposium on Space Life Sciences, Oct. 13-18, 2008, Beijing

Principle investigator - muscle atrophy of *C. elegance* - on Chinese Biosatellite SHIJIAN 8 (2006)

Co-investigator - 10th DLR parabolic flight campaign (effects of microgravity on migration- and adhesion-regulating signal pathways in cells of the immune system, Cologne, Germany (2007)

Selected Publications

Wang C, Sang C, Higashibata A, Ishioka N, Rong L, Yang C, Sun Y, Yi ZC, Zhuang FY (2008) Changes of muscle-related genes and proteins after spaceflight in Caenorhabditis elegans. Progress in Biochemistry and Biophysics 35(10): 1195-1201.

Gao ZY, Liu F, Yu ZQ, Bai X, Yang C, Zhuang FY, Ruan CG (2008) Effects of von Willebrand Factor Concentration and Platelet Collision on Shear-induced Platelet Activation, Thrombosis and Haemostasis, 100: 60-68.

Yang C, Wei D, Zhuang FY (2008) The force induced by organelles' gravity in the microfilament is in the range of 0.1-1pN, Acta Astronautica, 63: 923-928.

SpaceLife

Member Group Locations

SpaceLife

Application

SpaceLife is open to highly qualified and motivated applicants from all countries, and it is committed to an equal opportunity policy. Applicants should hold a Master's or other degree with excellent grades comparable to a German University Diploma in psychology, biology, physics, and nutrition or sports sciences.

SpaceLife gives the opportunity to carry out a full-time doctoral thesis at the end of which the doctoral students will receive a Dr. rer. nat., Dr. hum. biol., Dr. oec. troph., Dr. med. vet. Dr. rer. medic. or Dr. Sports Sciences. Per age-group, up to 13 doctoral students at the DLR and up to 12 from the partner universities can participate in the program. Furthermore, doctoral students who have already started their thesis at the DLR or the partner universities can apply for admission to SpaceLife and are also subjected to the selection process described below.

Applicants are invited to send

- their curriculum vitae,
- list of publications,
- copy of their diploma/master theses,
- past and present research interests,
- copies of masters/diploma certificates (with translation if not in German, English or French) and
- contact addresses of two referees.

The two referees will be asked by the SpaceLife coordinator to submit confidential letters of recommendation. Linguistic proficiency in English can be demonstrated by taking a standardized test (e.g., the TOEFL). Selected applicants will be invited for an interview with faculty members. The partners of SpaceLife jointly conduct the central selection procedure. The applications will be subjected to a competitive multi-step evaluation procedure.

Evaluation of applications

The first evaluation takes into account the applicants' national education system, and is carried out by experts on the respective educational system. Applicants will be contacted by phone for assessment of proficiency in English.

Applications of candidates which meet the requirements of SpaceLife are recommended for further assessment by the faculty members, who jointly short-list the candidates to be invited for the interview days in Cologne. Invitations are sent approximately six weeks in advance.

During the interview days, each candidate conducts several interviews with faculty members to discuss research experience, motivation and interests. The interviews with group leaders result in a first assessment of candidates. All applicants proceed to a final interview with a Selection Committee, which consists of five faculty members. Taking the assessment of the interviewing faculty members into account, the Selection Committee evaluates the overall qualification of the candidate, and recommends to the spokesperson and the coordinator of SpaceLife whom to admit to the program.

Offers of admission

Offers of admission to SpaceLife are made by the end of the selection week. The offers include in general the affiliation to the SpaceLife program and to a research group. The individual starting date will be agreed with the primary Supervisor.

SpaceLife

Contact

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Dr. Christine Hellweg

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Radiation Biology
Cellular Biodiagnostics

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Secretary

Anna-Maria Trautmann

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Radiation Biology

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