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J-SBRO Annual Report 2010

JAXA Space Biomedical Reseach Office (J-SBRO)

Design : Maki Niihori

JAXA-SP-11-003E

J-SBRO
Annual Report 2010

JAXA Space Biomedical Research Office
(J-SBRO)

Office Logo Mark

Contents

Message from Head of J-SBRO 1
Topics, Press 2
Management 6
J-SBRO All members 7
J-SBRO Research Themes 9
○Experiments on Orbit (International Space Station utilization) 9
○Ground-based Research Themes 10
○Outreach/Education 11
○Externally Funded Reserch 11
○Collaborations 12
Physiological Countermeasures 13
○Countermeasures for Bone Loss 13
○Countermeasures for Physical Strength 14
○Team MED 15
○Hair 17
○Nutrition 18
Space Radiation Protection 19
○Biological effects 19
Medical Technology on Orbit 20
○Biological Rhythms 20
Environment Assessment 21
○Team Myco 21
Biomedical Research Utilizaing the Antarctica Station 22
○Antarctic Research Team 22
Frontier Medicine on the Lunar Surface 24
○Bipedal Walking on the Moon 24
○Research of Health and Medical Examintion on Lunar Surface 25
○Lunar Radiation 26
Outreach/Education 28
○Education 28
○Mission X in Japan 29
Loading Preparation/Operation of on-Orbit Experiments 30
○ Loading Preparation/Operation of on-Orbit Experiments 30
Our Activities 31
Publications 42
Links 50
The Organization of JAXA (March, 2011) 51
Tsukuba Space Center Access 52

Message from Head of J-SBRO

The International Space Station (ISS) is a permanent on-orbit research facility regularly inhabited by six international astronauts. Japanese astronauts Wakata (in the ISS for 4 months in 2009), Noguchi (in the ISS for 6 months in 2010), and Yamazaki (shuttle mission in 2010) have succeeded in their missions, and Astronaut Furukawa, a medical doctor, is scheduled to fly in May 2011 and stay in the ISS for 6 months. After Astronaut Furukawa's mission, astronauts Hoshide and Wakata are scheduled to stay in the ISS for 6 months each. It is the age of Japanese astronauts staying in space regularly every one or one and a half years.

The Space Biomedical Research Office in JAXA conducts studies in five fields (physiological countermeasures, psychological support, space radiation protection, on-orbit medical care, and the onboard environment assessment) to improve the medical technology required in long-duration missions in space. Moreover, we promote research on model creatures (medaka, mice, cell culture, etc.), as well as research using the Antarctic as a simulated space environment.

NASA/JAXA

Head of J-SBRO, Astronaut, Chiaki Mukai, MD, PhD

The office was established in April 2007 and is fairly new. However, in the second annual report, we were able to publish part of a research outcome. We will push on forward with mottos such as "Space medicine useful to society" and "Space medicine is the ultimate preventive medicine". We would be happy to receive comments and suggestions from people who read this progress report as we move forward with our research.

Topics

International Home Care & Rehabilitation Exhibition 2010

Special event "Forefront of the development of home care & rehabilitation equipment"

Mission X, Train Like An Astronaut.

J-SBRO partially participated in the Mission X, train like an astronaut.

Astronaut Furukawa attending a lecture on medical device.
He comfirmed ths manual of ISS medical device, stethoscope, at the Tsukuba Space Center.

Ibaraki Shimbun (Web version), Feb. 25, 2011

Tomomi Watanabe-Asaka, aerospace project research associate, won the award for excellent presentation at Japanese Society for Biological Sciences in Space.

APR

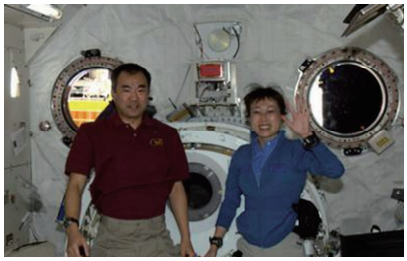
●Launch equipment for Biological Rhythms, Hair, Myco to ISS (STS-131)
●Return of Myco samples from ISS (STS-131)
● Acquisition of Myco samples on-orbit
●Special open-house event in J-SBRO facility

MAY

●Return of Hair and Myco samples from ISS (STS-132)
●Acquisition of Biological Rhythms data and Myco samples on-orbit

JUN

● Astronaut Noguchi returned to Earth from ISS



JUL

●Workshop on Antarctic medical research and medicine
●Subcommitte on Space Biomedical Research
● Acquisition of Biological Rhythms data and Hair samples on-orbit

AUG

● Acquisition of Biological Rhythms data and Myco samples on-orbit

SEP

●Subcommitte on Space Biomedical Research
● Acquisition of Biological Rhythms data on-orbit

OCT

●J-SBRO's seminar "Brain Science for Space Medicine"
● Special open-house event in J-SBRO facility

NOV

● J-SBRO's seminar "Using Hair for Medical Check on-orbit"
● J-SBRO's seminar "High-intensity Interval Aerobic Training"
● Acquisition of Biological Rhythms data Hair and Myco samples on-orbit

DEC

●J-SBRO's lanch on seminar "The Lunar Hole"
●Workshop on space biomedical research "Space Biomedical Research using fish -Next strategy-"
●Mission X event at Tsukuba Space Center
● Launch equipment for Biological Rhythms, Hair to ISS (HTV2 "KONOTORI2")

JAN

●Workshop on space biomedical research "Effort of Health Promotion and Space"
● Acquisition of Biological Rhythms data and Hair samples on-orbit

FEB

●Launch equipment for Biological Rhythms, Hair to ISS (STS-133)
●J-SBRO's seminar "Nutrition Challenge"
● Acquisition of Biological Rhythms data on-orbit
●Astronaut Furukawa attending a lecture on medical device.

MAR

● Return of Hair, Myco samples from ISS (STS-133)
●Subcommitte on Space Biomedical Research
●Workshop on space biomedical research "Public Relation of Science and Education"
● Acquisition of Myco samples on-orbit

Press

JAXA Industrial Collaboration and Coordination Center
Space Industry of Japan, Vol.2

Ibaraki Shimbun, Sep. 15, 2010
Chaki Mukai introduced JAXA facility to Princes

Tokyo Shimbun, Oct. 13, 2010
36th International Home Care and Rehabilitation Exhibition 2010

Ibaraki Shimbun, Sep. 15, 2010
Mission-X in Japan

Management

Masafumi Yamamoto, J-SBRO Manager

JAXA Space Biomedical Research Office (J-SBRO) conducts various space biological research which is categorized into five discipline fields below, from the viewpoint of both basic and clinical space medicine, for the purpose of reducing medical risks to astronauts on long-duration missions and promoting healthy, safe, and comfortable human space activities.

1. Physiological countermeasures

Bone loss, urinary calculi, myofunction decline, exercise prescription, metabolism and nutrition, effects of long-duration missions on the human body, immune function decline, etc.

2. Psychological support

Effects of a long-term stay in an isolated environment, effects of sleep and biological rhythm disorders, etc.

3. Radiation exposure control

The stochastic effect of space radiation exposure (physical measurement, ecological effect and biological measurement, etc.)

4. On-orbit medical care

Diagnosis/biomonitoring (simple self-diagnosis function) by Holter electrocardiograph, on-orbit diagnostic systems, etc.

5. The onboard environment

Monitoring of onboard air environment pollution, microbial flora in the body, etc.

Actual research is implemented utilizing various environments, including research on astronauts on a long-duration mission in the ISS which began with Japanese astronaut Koichi Wakata in 2009, with research on the 50th and 51st Antarctic research expeditions using Antarctic as a simulated space environment, with research on Medaka (small teleost) as a human model, and with others. Using the five research fields as the warps and the various experimental environments as the wefts, we efficiently utilize a few experimental opportunities to the maximum to promote the research.

Moreover, we have named basic medical research necessary for future human space activities on the lunar surface, "Lunar Surface Frontier Medicine." We promote research on lunar walking and fall prevention, medical treatment of harmful substances, such as lunar dust, medicine on the moon, and space radiation measurements for human lunar actovities. To promote such a wide range of research with limited staffs in J-SBRO office, collaboration with other JAXA and external researchers is needed. Thus far, we have performed joint research and research collaboration with more than ten research institutes and universities. We are also planning to equip and strengthen the efficient implementation system of space biomedical research .

The space biomedical research is not only for the health of astronauts, but also expected to contribute to improving medical care and health services on Earth as "ultimate preventive medicine." We continue to keep our activities to promote the health of all generations, with a motto:"Space medicine useful to society."

J-SBRO All Members

J-SBRO Members (17)	
・Chiaki Mukai	Head of J-SBRO
・Masafumi Yamamoto	Manager
・Hiroshi Ohshima	Senior Researcher
・Kazunari Tanaka	Senior Engineer
・Hidetoshi Tsuchiya	Senior Engineer
・Shin Yamada	Associate Senior Researcher
・Hajime Takeoka	Associate Senior Researcher
・Satoru Ishida	Engineer
・Tatsuya Aiba	Engineer
・Riyo Yamanaka	Engineer
・Tomomi Watanabe-Asaka	Aerospace Project Research Associate
・Masahiro Terada	Aerospace Project Research Associate
・Maki Niihori	Aerospace Project Research Associate
・Tomoaki Matsuo	Aerospace Project Research Associate
・Reiko Nakao	Aerospace Project Research Associate
・Yumi Kanno	Partner
・Miyuki Hiratsuka	Partner
Concurrent Members (7)	
・Kazuhito Shimada	Chief Physician, Astronaut Medical Operations Group
・Takahiro Abe	Senior Engineer, Astronaut Medical Operations Group
・Akiko Matsumoto	Chief Physician, Astronaut Medical Operations Group
・Takeo Miki	Chief Physician, Astronaut Medical Operations Group
・Aiko Nagamatsu	Associate Senior Engineer, Space Environment Utilization Center
・Mitsuyo Masukawa	Engineer, Space Environment Utilization Center
・Tamotsu Nakano	Space Education Center
Advisor, Invited Members (10)	
・Toshiko Ohta	Advisor, Emeritus Professor, PhD, University of Tsukuba
・Ken-ichi Iwasaki	Invited Researcher, Professor, MD, PhD, Nihon University
・Masamichi Sudoh	Invited Researcher, Associate Professor, PhD, Jikei UniversitySchool of Medicine
・Hideo Tatsuzaki	Invited Researcher, Laboratory Head, MD, PhD, National Institute of Radiological Sciences
・Kazuhiro Terasawa	Invited Researcher, Assistant Professor, PhD, Keio University
・Naomune Yamamoto	Associate Senior Researcher, Lecturer, MD, PhD, Tokyo Women’s Medical University
・Shoji Oda	Invited Researcher, Associate Professor, PhD, Universtiy of Tokyo
・Koh Mizuno	Invited Researcher, Associate Professor, PhD, Tohoku Fukushi University
・Shigeru Aoki	Invited Researcher, Associate Senior Researcher, Shimizu Corporation
・Ichiro Tayama	Inited Engineer, Chiyoda Advanced Solutions Corporation

J-SBRO All members















J-SBRO Research Themes

（１） Experiments on Orbit (International Space Station utilization)

Research Field	Theme	Researcher	Status
Physiological Countermeasures	Prophylactic use of Bisphosphonate as a counter measure for space flight induced bone loss and rnal stone (International Proposal)	PI:Toshio Matsumoto (Tokushima University) Toshitaka Nakamura (University of Occupational and Enironment Health), Kenjiro Koori (Nagoya-City University), Hiroshi Ohshima NASA’s PI:Adrian LeBlanc (Uniersities Space Research Association)	on going
Physiological Countermeasures	Biomedical analyses of human hair exposed to long-term space flight (Hair)	Masahiro Terada, Shin Yamada, Riyo Yamanaka, Reiko Nakao, Satoru Ishida, Tatsuya Aiba, Hiroshi Ohshima, Noriaki Ishioka, Akira Higashibata, Takashi Yamazaki, Chiaki Mukai (PI) Collaboration: Kagoshima University	on going
Physiological Countermeasures	Changes of Nutrients in Spacefood after Long Duration Spaceflight	Akiko Matsumoto, Ichiro Tayama, Chiaki Mukai (PI)	on going
Medical Technology on Orbit	Research related to autonomic nerve activity of the heart during a long-duration mission	Hiroshi Ohshima, Koh Mizuno, Shin Yamada, Ichiro Tayama, Satoru Ishida, Tatsuya Aiba, Naomune Yamamoto, Chiaki Mukai (PI) Collaboration: Tokyo Women’s Medical University	on going
Environment Assessment	Mycological Evaluation of Crew Exposure to ISS Ambient Air(Myco)	Shin Yamada, Tatsuya Aiba, Satoru Ishida, Riyo Yamanaka, Toshiko Ohta, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai (PI) Collaboration: Teikyo University and Meiji Pharmaceutical University	on going
Physiological Countermeasures	Evaluations of physiological responses to space environmental stresses using medaka live imaging	Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Reiko Nakao, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Hiroshi Ohshima, Chiaki Mukai (PI)	in preparation
Physiological Countermeasures	Effect of the Hybrid Training Method on the disuse atrophy of the musculoskeletal system of the astronauts staying in the International Space Station for a long term. (International Proposal)	PI:Naoto Shiba (Kurume University) Hiroshi Ohshima, Shin Yamada	in preparation
Medical Technology on Orbit	The effect of long-term microgravity exposure on cardic autonomic function by analyzing 48-hours electrocardiogram	Hiroshi Ohshima, Koh Mizuno, Shin Yamada, Ichiro Tayama, Satoru Ishida, Tatsuya Aiba, Naomune Yamamoto, Chiaki Mukai (PI) Collaboration: Tokyo Women’s Medical University	in preparation

（2）Ground-based Research Themes

Research Field	Theme	Researcher	Status
Physiological Countermeasure	An exercise program to prevent deterioration of cardiac function during long-term space flight (HIAT)	Tomoaki Matsuo, Hiroshi Ohshima, Shin Yamada, Chiaki Mukai (PI)	on going
Physiological Countermeasure	Research on the disposition to space environmental stresses by *in vivo* imaging using medaka intestines	Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Reiko Nakao, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Hiroshi Ohshima, Chaiki Mukai (PI)	on going
Physiological Countermeasure	Swinming behavior and muscle activities under microgravity environment using medaka	Maki Niihori, Tomomi Watanabe-Asaka, Masahiro Terada, Reiko Nakao, Shoji Oda, Masamichi Sudoh, Hiroshi Ohshima, Chaiki Mukai (PI)	on going
Physiological Countermeasure	The research for the development of nutritional therapy based on the oscillation of muscle atrophy-related genes	Reiko Nakao, Toshiko Ohta, Chiaki Mukai (PI)	in preparation
Space Radiation Protection	Biological effects on low dose rate and long-term exposure to space radiation	Aiko Nagamatsu, Tomomi Watanabe-Asaka, Riyo Yamanaka, Chiaki Mukai (PI)	on going
Space Radiation Protection	Research on Biodosoimetry	Takahiro Abe, Riyo Yamanaka, Hideo Tatsuzaki, Chiaki Mukai (PI)	in preparation
Biomedical Research Utilizing the Antarctica Station	Biomedical Research Utilizing the Antarctica Station	Hiroshi Ohshima, Hidetoshi Tsuchiya, Shin Yamada, Masahiro Terada, Riyo Yamanaka, Hajime Takeoka, Toshiko Ohta, Koh Mizuno, Naomune Yamamoto, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai (PI)	on going
Frontier Medicine on the Lunar Surface	Bipedal Walking on the Moon: Simulation Studies on How to Prevent Falling	Shin Yamada, Hiroshi Ohshima, Tomoaki Matsuo, Chiaki Mukai (PI)	on going
Frontier Medicine on the Lunar Surface	Medical Treatment for Health on the Moon	Hidetoshi Tsuchiya, Hajime Takeoka, Hiroshi Ohshima, Shigeru Aoki, Chiaki Mukai (PI)	on going
Frontier Medicine on the Lunar Surface	Research related to the effects of space radiation on manned space activities on the Moon	Aiko Nagamatsu, Kazuhiro Terasawa, Chiaki Mukai (PI)	on going

（３）Outreach/Education

Research Field	Theme	Researcher	Status
Outreach/ Education	Research related to creating teaching materials from space biomedical research outcomes, JAXA Medical Education (J-Med)	Maki Niihori, Shin Yamada, Masamichi Sudoh, Toshiko Ohta, Shoji Oda, Chiaki Mukai (PI)	on going
Outreach/ Education	Misson-X in Japan	Maki Niihori, Shin Yamada, Tomoaki Matsuo, Reiko Nakao, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima, Chiaki Mukai (PI)	on going

（４）Externally Funded Research

Research Field	Theme	Researcher	Status
Physiological Countermeasure	The effects on skeletal muscles in medaka of the various muscle activities; Can medaka be a model organism for human skeletal muscle researches?	Masahiro Terada (PI)	on going

Collaborations

Theme	Institution and Collage
Prophylactic use of Bisphosphonate as a counter measure for space flight induced bone loss and rnal stone	University of Tokushima, University of Occupational and Environmental Health
Effect of the Hybrid Training Method on the disuse atrophy of the musculoskeletal system of the astronauts staying in the International Space Station for a long term.	Kurume University
An exercise program to prevent deterioration of cardiac function during long-term space flight (HIAT)	University of Tsukuba
Research on the disposition to space environmental stresses by in vivo imaging using medaka intestines	University of Tokyo, Yamaguchi University
Evaluations of physiological responses to space environmental stresses using medaka live imaging	University of Tokyo, Ochanomizu University, Yamaguchi University
Biomedical analyses of human hair exposed to long-term space flight (Hair)	Kagoshima University
Biological effect research on low dose rate and long-term exposure to space radiation	National Institute of Radiological Sciences
Biological Rhythms	Tokyo Women's Medical University
Mycological Evaluation of Crew Exposure to ISS Ambient Air (Myco)	Teikyo University, Meiji Pharmaceutical University
Utilizing the Antarctica Station	National Institute of Polar Research, Tokyo Women's Medical University, SleepWell Co.,Ltd., Teikyo University, Meiji Pharmaceutical University, Kagoshima University
Bipedal Walking on the Moon: Simulation Studies on How to Prevent Falling	Keio University
Research related to lunar dust	National Institute of Occupational Safety and Health, University of Occupational and Environmental Health

Physiological Countermeasures

Countermesures for Bone Loss

Hiroshi Ohshima, Toshio Matsumoto, Toshitaka Nakamura, Kenjiro Koori

Prophylactic use of bisphosphonate to prevent bone loss and renal stone in astronauts

Under the microgravity environment, bone resorption is enhanced and bone mass is reduced ten times faster than that of a patient with osteoporosis on the ground. During a long-duration space flight, an astronaut exercises 6 days a week for 2 hours each day. However, this does not prevent bone loss. Therefore, we have suggested the prophylactic use of bisphosphonate, which has been used to treat osteoporosis for 10 years and has shown evidence of increasing bone mass and decreasing fracture incidence. We have validated its usefulness through 90-day bed rest study. With the outcome of this research, our proposal was selected as one of the "space life sciences flight experiments." JAXA is now conducting this space flight experiment, using bisphosphonate to reduce bone loss and renal stone in astronauts, as joint research between JAXA and NASA.

We have obtained the consent of participants in this research (those taking medicine) from seven astronauts so far. From March 2011, four astronauts have taken bisphosphonate every week during their missions on the ISS and we have obtained their pre-, in-, and post-flight medical data. We plan to obtain the flight data, including intravenous injections data, from up to ten astronauts in the near future, and to analyze the data. We will develop the results at academic conferences. (Collaboration: The University of Tokushima, and The University of Occupational and Environmental Health, and Nagoya-city University)

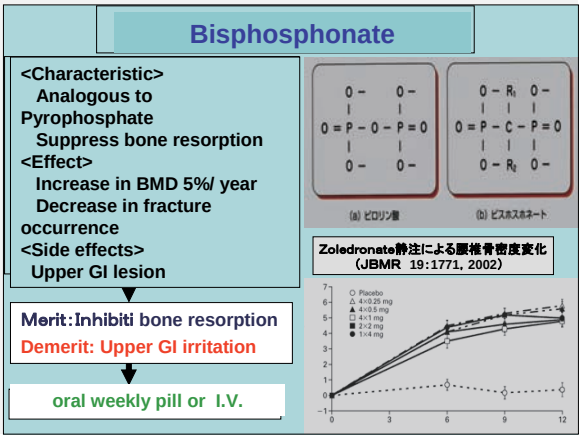
Bisphosphonate as a Countermeasure to Space Flight Induced Bone Loss (JAXA/ NASA)

1.Purpose
To determine the effectiveness of Prophylactic use of bisphosphonate in preventing space flight induced bone loss and renal stones

2.Method
Medication: In flight weekly Alendronate(70mg) or Pre flight Zoledronate(4mg)
Measurements: BMD, qCT, Bone marker, Renal stone parameter, ultrasound

3. Scientists
Toshio Matsumoto, JAXA PI (Tokushima Univ.)
Toshitaka Nakamura(UOEH)
Kenjiro Kohri (Nagoya City U.)
Hiroshi Ohshima (JAXA)

Adrian LeBlanc, NASA PI (USRA)
Jeff Jones (NASA), et al.



Countermeasures for Physical Strength

Hiroshi Ohshima, Shin Yamada, Tomoaki Matsuo, Chiaki Mukai

Remarkable muscle atrophy and decrease of physical strength are major medical problems during a long-duration space flight. It is necessary to develop effective and short time training methods with appropriate exercise equipment and nutrient intake to reduce the declination of physical strength in astronauts.

1. Hybrid training method

Hiroshi Oshima, Shin Yamada

Hybrid training is a new countermeasure method that produce contraction force by electrical stimulation of antagonist to resist the volitional contracture of agonist. The electrical muscle stimulation method is the same as that used in a rehabilitation facility. By use of Hybrid training method, the slow muscle fiber of agonist contracts afferently, and the fast muscle of antagonist contracts efferently. This approach makes axial load on the bone. Hybrid training is expected to provide useful muscle training method under microgravity,

In addition to the operational studies at university and hospitals, we conducted operational verification study by an expedition team in the Antarctic. Hybrid training was selected as one of the “space life sciences flight experiments” and we are presently preparing for the on-orbit experiment. (Collaboration: Kurume University/Professor Naoto Shiba)

2. An exercise program to prevent deterioration of cardiac function during long-term space flight (HIAT)

Tomoaki Matsuo, Hiroshi Ohshima, Shin Yamada

An effective and short exercise program to prevent cardiac hypofunction is required in a long-duration mission. The exercise such as using a bicycle ergometer shoud be a useful countermeasure under the microgravity environment. Yet, many astronauts lose weight during a space mission. This research focuses on High-intensity Interval Aerobic Training (HIAT) as an exercise that can control the increase of energy consumption and prevent the deterioration of cardiac function. The purpose of this research is to develop JAXA’s HIAT (J-HIAT) and to verify its effectiveness and appropriateness through ground-based experiments. (Collaboration: The University of Tsukuba/Professor Kiyoji Tanaka)

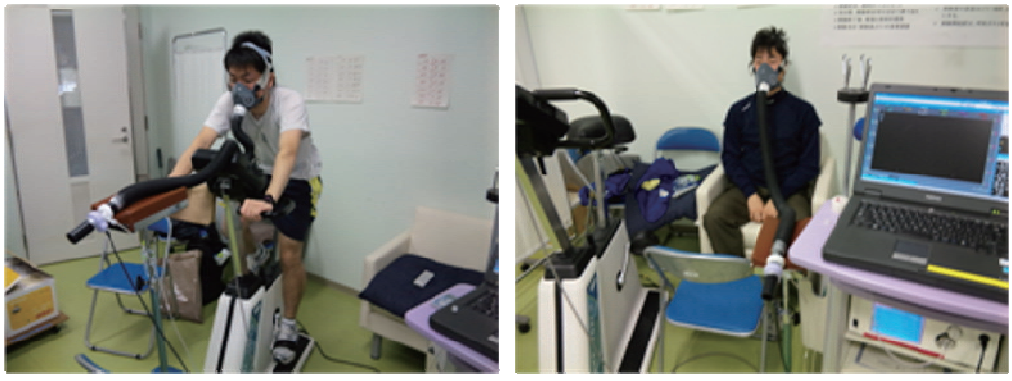


Fig.1 HIAT Measurement (Right：Load, Left：Rest)

Team MED

Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Reiko Nakao, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Chiaki Mukai

Medaka is an indigenous model vertebrate of Japan with its various strains, transparency during embryogenesis, and research history since the 1940's. Dramatic improvements in live imaging technology enable observations of not only individual movement, but also the molecular activity in a single cell. Our purpose is to evaluate the influence of the space environment on the human body using medaka and biological methods.

Our goal for the future is to maintain and create a better space environment by answering behind problems.

1. Research on the disposition to space environmental stresses by *in vivo* imaging using medaka intestines

Intestines are internal organs with high sensitivity to stresses and are exposed to the external environment through food inside the body. We have focused on the biological influences of radiation, microgravity, and the enclosed environment and have verified of these influences on the gut and cardiac autonomic system in medaka.

We established an image acquisition method of the heart and the intestinal tract using a transparent medaka strain (SK2) and executed an analysis of the autonomic nervous function. Moreover, pathological analysis of the medaka intestines to compare the intestines with mammalian ones is underway. (Collaboration: The University of Tokyo/Professor Hiroshi Mitani, Yamaguchi University/Professor Kohsuke Sasaki, Associate Professor Shuji Terai)

2. Swimming behavior and muscle activities under microgravity environment using medaka

Microgravity and circadian rhythms influence skeletal muscle reduction and the activities of living organisms, respectively. We are attempting to evaluate the biological influence of a long-term stay in space using the analysis of activity patterns of medaka skeletal muscle, and of the circadian rhythm using biochemistry and live imaging techniques.

We are analyzing the circadian rhythm and the patterning of the behavior with our established calculation method with the medaka active mass.

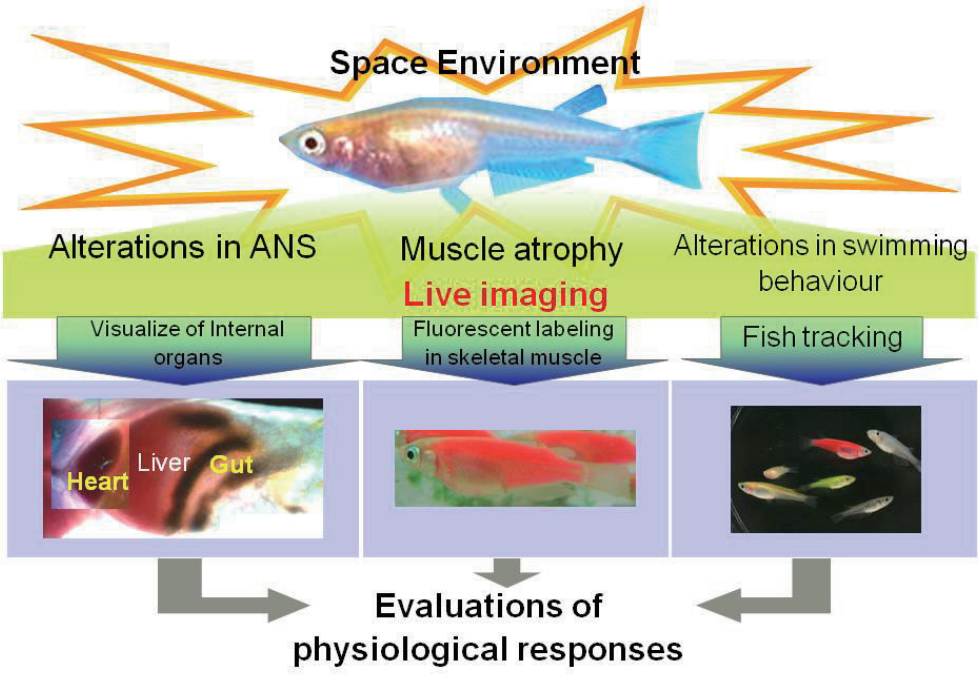
3. Mechanisms of slow muscle reduction using medaka skeletal muscle

Skeletal muscles, especially the soleus muscle, reduce when exposed under the microgravity environment for a long term due to the decrease in muscle activity. Our aim is to analyze and consider the mechanisms of skeletal muscle reduction using live imaging and the molecular biology of medaka. To reveal these mechanisms, we focus on three studies: 1) establishment of the medaka skeletal muscle atrophy and hypertrophy model, 2) establishment of the quantitative evaluation of muscle atrophy and hypertrophy, and 3) molecular biological analyses.

We have made a muscle atrophy model with mutant Medaka, executed a low temperature study, and evaluated the alteration using histology and gene expression.

4. Evaluations of physiological responses to space environmental stresses using medaka live imaging【expected experiment on orbit】

The aim of this study is to verify the physiological influences of the space environment, such as microgravity and space radiation, on living organisms from a basic biomedical point of view using medaka. To accomplish this, we will conduct three quantitative physiological evaluations under the space environment using the live imaging technique: 1) muscle atrophy by reduction of muscle activity, 2) alteration of the autonomic nervous system by digestive functions, and 3) heart rate and behavior analyses. This proposal will not require returned sample collections because it is completed using remote image acquisition on orbit, data transfer, and analysis of the image data on the ground. (Collaboration: The University of Tokyo/Professor Hiroshi Mitani, Ochanomizu University/Professor Shoji A. Baba, Yamaguchi University/Associate Professor Shuji Terai)



Hair

Masahiro Terada, Shin Yamada, Riyo Yamanaka, Reiko Nakao, Satoru Ishida, Tatsuya Aiba, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Hiroshi Ohshima, Hideyuki J. Majima (Kagoshima University), Chiaki Mukai

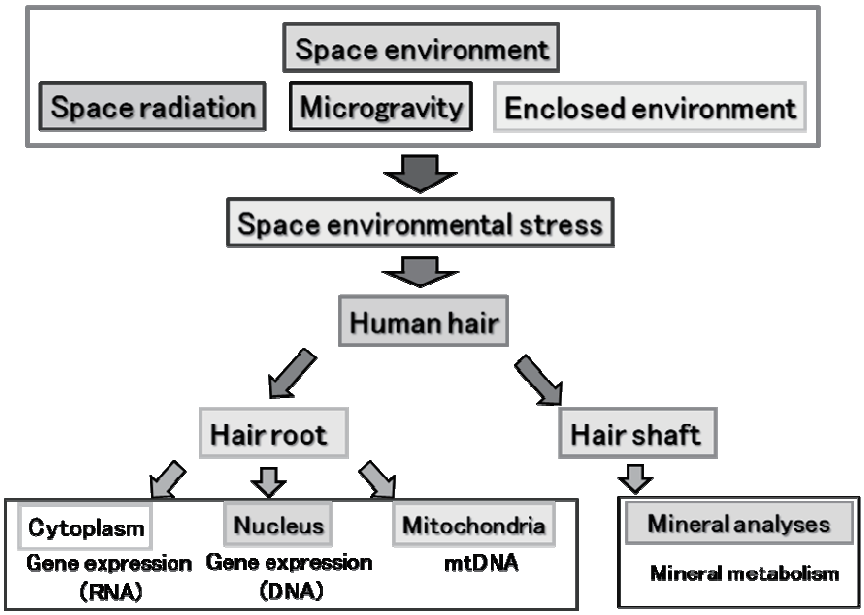
Biomedical analyses of human hair exposed to long-term space flight (Hair)

In space experiments, hair is one of the most suitable specimens, because there are neither special hardware nor handling necessary to collect and store samples. Within a hair follicle, active cell divisions take place, and the gene expressions sensitively reflect various environmental factors such as physical and psychological stressors. A hair shaft contains minerals and traces metals that have been metabolized in the body. By analyzing astronaut's hair, their gene conditions and mineral metabolism during long-term space flight will be revealed.

The purpose of this research is to study the effects of long-term space flight in human hair and to support the development of an effective and easy diagnostic measure for ISS crew.

For the hair roots, total RNA was extracted and used to DNA microarray analysis. For the hair shaft, the concentration of Calcium or other mineral elements on the cross-sectional analyses were quantitavely observed.

We could have an opportunity to analyze rodents samples by participating the tissue sharing program of 3-months space-flown mice organized by AGI (Italian Space Agency). It will reasonably complement human hair experiment because we able to conduct more detailed skin analysis which is enable in human experiment.



Nutrition

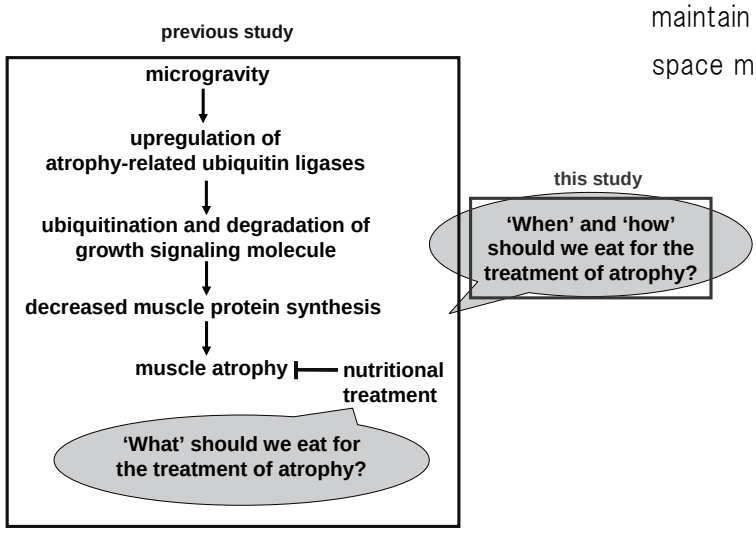
Reiko Nakao, Toshiko Ohta, Akiko Matsumoto, Ichiro Tayama, Chiaki Mukai

1. The research for the development of nutritional therapy based on the oscillation of muscle atrophy-related genes.

Reiko Nakao, Toshiko Ohta and Chiaki Mukai

Skeletal muscle atrophy caused by unloading is one of serious problem for astronauts staying in ISS. In unloading condition, skeletal muscle is decreased responsiveness to growth factors and increased proteolysis through the induction of some ubiquitin ligases, called muscle atropy-related genes (atrogenes).

Now, we are planning to development the nutritional therapy for muscle atrophy based on the oscillation of atrogenes. In previous study, it has been reported that skeletal muscle express clock genes and have endogenous molecular clock dissociated from the central molecular clock in brain. Thus we are going to analyse the oscillation and interaction between atrogenes and clock genes in cultured myotube. These results will be significant to determine 'when' we should have diet for the effective treatment of muscle atrophy.



2. Changes of Nutrients in Spacefood after Long Duration Spaceflight

Akiko Matsumoto, Ichiro Tayama and Chiaki Mukai

JAXA astronauts on long-duration missions on the ISS are able to eat certified Japanese space food. During a mission, the astronauts' diet is limited to space food and appropriate nutrient intakes are very important to the maintenance of their health.

The purpose of this study is to evaluate stability of nutrients in space food during storage on the ISS. We are analyzing changes in the food after exposure to the space environment for more than one year.

Japanese space food samples and JAXA Bio PADLES were launched in April 2010 and have been stored on the ISS. After retrieving samples of food from the ISS, the change of nutrients in the space foods will be analyzed. The analytes, including vitamins, lipoperoxide and amino acids, are susceptible to radiation damage. Therefore, Bio PADLES' s data are analyzed for dose of space radiation. The results of this study are to be used to improve the space food system and to help astronauts maintain optimal nutrient levels during future space missions.

Space Radiation Protection

Biological effects

Aiko Nagamatsu, Tomomi Watanabe-Asaka, Riyo Yamanaka, Chiaki Mukai

Biological effects on low dose rate and long-term exposure to space radiation

The influence of space radiation is a major health risk to astronauts on a long-duration mission in the ISS and an important research subject for space biomedical research. We have accumulated ground-based evaluations of the effects of radiation on the human body, such as an epidemiological survey on the long-term effects of high dose/acute exposure. However, the biological effects and risks of chronic irradiation from low dose rates and long-term exposure under the space environment have to be estimated based on extrapolated data of the high dose region. The purpose of this research is to reveal the fine mechanisms of the biological effects of space radiation that appears in all species. We are focusing on the gene and protein expressions using both human cultured cells and medaka, as the bridging to the research on mammals (mice) in the future.

We conducted irradiation experiments on human cultured cells and medaka using carbon ion radiation and a Cf-252 neutron source using HIMAC accelerator at the National Institute of Radiological Sciences and we established a low dose rate and long-term irradiation experimental system on these two biological samples. We are now in process of expressed gene/protein profiling. Bio PADLES dosimeters from JAXA's Space Environment Utilization Center were set near the biological sample and the doses for the sample during irradiation were obtained. (Collaboration: The National Institute of Radiological Sciences: Masao Suzuki Ph.D))

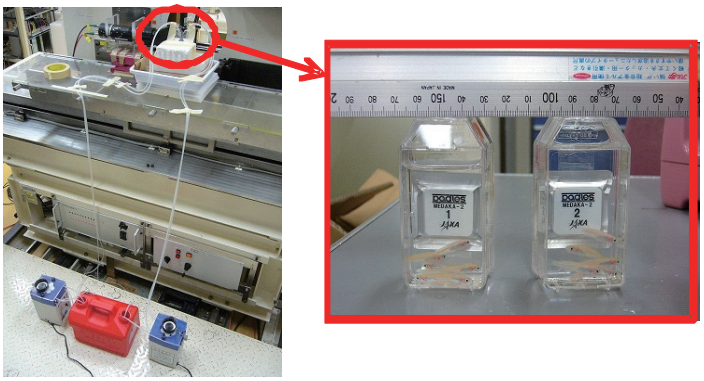


Fig.1 Irradiation to Medaka using HIMAC accelerator.

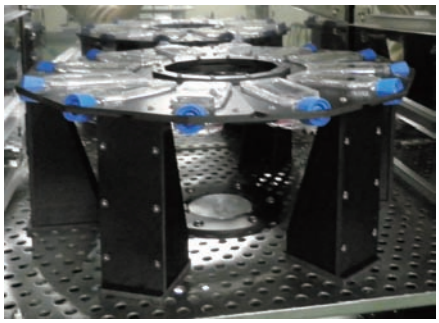


Fig.2 Irradiation to human cultured cells using Cf-252 neutron source

Medical Technology on Orbit

Biological Rhythms

Hiroshi Ohshima, Kou Mizuno, Shin Yamada, Ichiro Tayama, Satoru Ishida, Tatsuya Aiba, Naomune Yamamoto, Chiaki Mukai

Research related to autonomic nerve activity of the heart during a long-duration mission

Lack of high-illumination daylight under the microgravity environment of space is suggested as the possible cause of abnormal biological rhythms and sleep disorders. Those adverse consequences may induce deterioration in psychological mood, concentration and working efficiency, which are associated with increased risk of accident. Therefore, solving this problem is considered to be essential in JAXA's space medical research.

From the viewpoint to improve on-orbit remote medicine technology in monitoring human biological rhythms. JAXA has loaded a Japanese Holter electrocardiograph on ISS with an Expedition 18 flight and measured 24-hour electro cardiac waveforms. We have achieved data down linking from the Japanese experimental module, Kibo, to the Tsukuba Space Center, and sufficiently analyzed as medical data.

Based on this technical achievement, we obtained 24-hour Holter ECG data three times during the 6-month missions of ten astronauts on the ISS. Characteristic changes during long-term space flight were analyzed with pre-flight control data. We evaluated the changes in biological rhythms of cardiac autonomic nervous functions by nonlinear methods. The results will be used to improve the health care technology of long duration astronauts. (Collaboration: Tokyo Women's Medical University/Professor Kuniaki Otsuka)

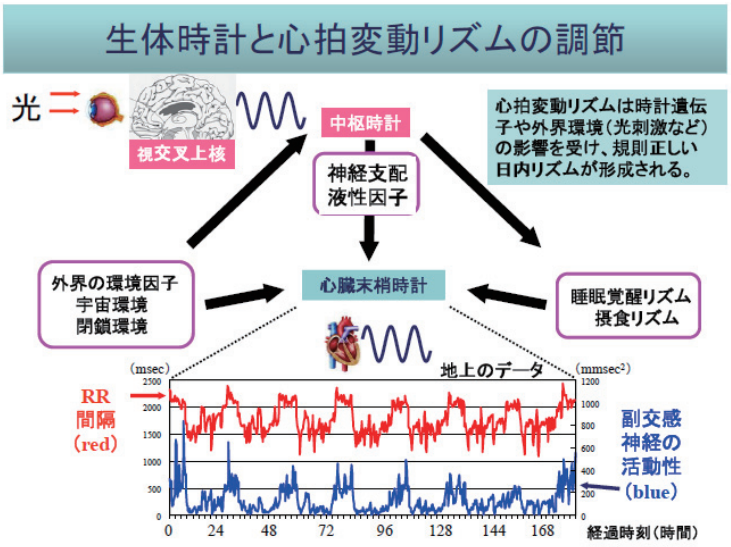


Fig.1 Regulation of biological clock and rhthms

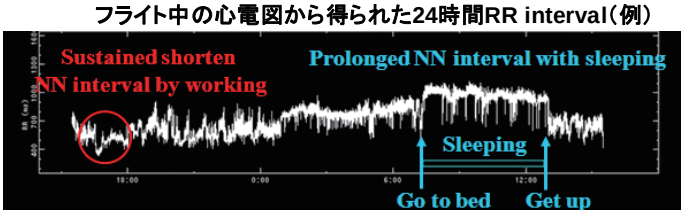


Fig.2 An example of 24-hour electric cardiac wave forms

Environment Assessment

Team Myco

Shin Yamada, Tatsuya Aiba, Satoru Ishida, Riyo Yamanaka, Toshiko Ohta, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai

Mycological Evaluation of Crew Exposure to ISS Ambient Air (Myco)

Microflora on crew members who stay aboard the ISS are thought to strongly reflect the ISS environment, which is a completely confined orbital living space in microgravity. Some microorganisms isolated from the living environment of manned spacecrafts are known as possible allergens in our living environment on the ground.

The objective of this study is to evaluate the risk of microorganism inhalation and adhesion to skin while exposed to ambient air during stays aboard the ISS. Using swabs, sampling sheets and a tube, crewmembers collect preflight, inflight and postflight samples of mucosal membranes from their nasal cavities and pharynx, skin samples from both cheeks and upper chests, and sputum.

Sample correction from 3 ISS crew and 6 shuttle crew members have been completed. We will perform detailed microbial analysis of these samples by both culture-based methods and the latest molecular-genetic methods.

Myco experiment is expected to support development of effective medical countermeasures to protect crewmembers against microbes. (Collaboration: Teikyo University/Associate Professor Koichi Makimura and Meiji Pharmaceutical University /Assosicate Professor Takashi Sugita)

Fig.1 Myco Sampling Kit

Biomedical Research Utilizing the Antarctica Station

Antarctic Research Team

Hiroshi Ohshima, Hidetoshi Tsuchiya, Shin Yamada, Hajime Takeoka, Masahiro Terada, Riyo Yamanaka, Toshiko Ohta, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai

There are several environmental similarities between space and Antarctica such as specific light environment and prolonged confinement in the isolated station.

JAXA and the National Institute of Polar Research have started joint medical research focusing on common features, such as insolation change and a long-term closed environment are common between space and Antarctica, and yet different from Japan. We obtained data from the 50th and 51st Antarctic expedition teams to analyze the influence of living in Antarctica on the human body. The outcome is applied to improving health management techniques on long-term missions in space and on wintering life in the Antarctic. (Collaboration: the National Institute of Polar Research/Professor Kentaro Watanabe)

We are promoting 4 projects as follows:

1. Research related to effects on biological rhythms

(1) Analysis of autonomic nerve activity of the heart

(2) Analysis by electroencephalogram in sleep (simple electroencephalograph)

(3) Analysis by active mass

A characteristic of living in the International Space Station (ISS) is same that of a few people living together in a closed/isolated space for a long time. Thus, the Antarctic provides a similar environment to ISS. These environments, are known to cause abnormalities in biological rhythms and sleep disorder. The purpose of this research is to improve medical management techniques on the ISS by using the Antarctic environment.

Following the 50th research expedition in the Antarctic, we obtained data from six members of the 51st expedition team staying at Showa Station from February 2010 until February 2011, every 3 months (March, June, September, and December). The measurement items were subjective evaluation of sleep, sleep/awakening rhythm evaluation by active mass measurement, 24-hour Holter electrocardiography, and sleep stage judgment by simple electroencephalograph. The main analytical point is that active mass decreases and the zone of sleeping hours moves back (nocturnal) between March and June (fall to winter). Moreover, the subjective evaluation and structure of sleep showed a nearly normal outcome, but analysis of the variable frequency of R-R interval electrocardiogram, showed a stable outcome with an almost 24-hour circadian rhythm. (Collaboration: Tokyo Women's Medical University/Professor Kuniaki Otsuka, Sleep Well Co., Ltd./Mr. Masaki Yoshida)

2. Research related to the improvement of muscle training

The Antarctic expedition loses exercise opportunities due to living in a closed environment especially during winter. This research uses hybrid training (which was

selected as a flight experiment study by announcement of opportunity for JAXA's Life Science Experiments in 2009) for a certain period: 1) to verify the training effects and 2) to check the operational validity in a remote location. Volunteers from the 50th Antarctic expedition team were tested for 16 weeks; the first 8 weeks involved a simple knee flexion/ extension exercise and the last 8 weeks involved a knee flexion/ extension exercise with hybrid training. We measured weight, body fat percentage, leg muscle strength, and thigh circumference for every 4 weeks. Then, we analyzed the data, to extract operational improvements.

(Collaboration: Kurume University/ Professor Naoto Shiba)

3. Mycological evaluation of human skin exposed to the Antarctic environment

(1) Fungous analysis of skin (feces)

(2) Microbial flora analysis of living environment

We collect scales of skin by tape stripping to evaluate the sanitary conditions of the skin microbiologically and try to amplify and quantify DNA of skin microorganisms directly. We focus especially on Malassezia, which is a fungus related to dermatitis and allergies.Additionally, we research changes of enteric bacteria and microorganisms in the environment as analysis subjects.

(Collaboration: Teikyo University/Associate Professor Koichi Makimura and Meiji Pharmaceutical University/Associate Professor Takashi Sugita)

4. Biomedical analyses of human hair exposed to the Antarctic environment

This research consists of hair root and hair shaft analysis. In hair root analysis, we investigate the gene expression of hair matrix cells that actively repeat cell division and react sensitively to various factors (ultraviolet rays, psychological stress, aging, hours of sunlight, etc.). In hair shaft analysis, we examine the changes of mineral metabolism. Moreover, we will compare the results of Antarctic expedition team with those of astronauts.

(Collaboration: Kagoshima University/Professor Hideyuki J. Majima)

Frontier Medicine on the Lunar Surface

Bipedal Walking on the Moon

Shin Yamada, Hiroshi Ohshima, Tomoaki Matsuo, Chiaki Mukai

Bipedal walking on the moon: Simulation studies on how to prevent falling

JAXA aims to send astronauts to the Moon or Mars, where the force of gravity for a given mass is different from that on Earth. To walk upright without falling under these altered gravitational conditions, optimized techniques need to be verified for future missions.

We have been studying changes in kinematics of walking at different gravitational loads using body weight suspension systems. Following three gravitational conditions are simulated: Earth, 1-G; Mars, 1/3-G; and the Moon, 1/6-G. Surface EMG is recorded from leg muscles while subjects walked on a treadmill. Cadence, duration of stance phase, and step length were calculated from walking velocity and steps. In addition, robot model and mathematical simulations are employed to identify ideal conditions of walking in variable gravities.

Subsequent studies have revealed that muscle activities and duration of the double support phase decreased according to the reduction of simulated gravities. These changes seems to be caused not only by direct effects of unloading but also by kinematic adaptations to them. It can be said that a human walks slowly with a shortened stride length and elongated stance phase to adjust to low gravitational conditions. We are currently carrying out the second phase of the study. In this phase, a newer movable body weight suspension system is used to achieve more realistic simulations.(Collaboration: Keio University/ Professor Meigen Liu)

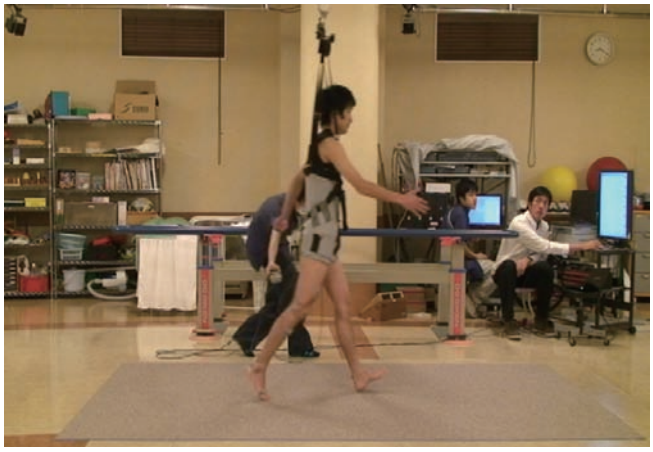


Fig.1 A movable body weight suspension system

Research of Health and Medical Examination on Lunar Surface

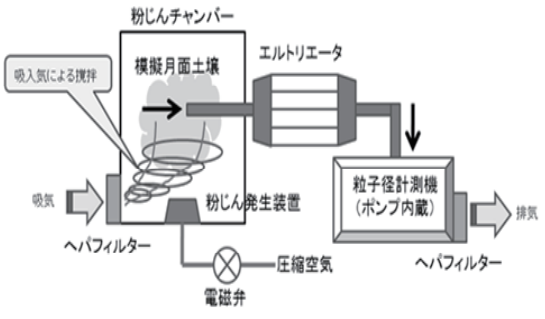
Hidetoshi Tsuchiya, Hajime Takeoka, Hiroshi Ohshima, Shigeru Aoki, Chiaki Mukai

1. Research on lunar dust

Lunar dust, like sand, falls slower under microgravity such as 1/6G than 1G(gravity on the earth). Therefore, lunar dust tends to float in the ISS and to be inhaled easily into human respiratory organs. This increases the possibility of health impairment. We conducted an aircraft flight experiment to perceive the movement of lunar dust under microgravity. Simulant particles inside a chamber were used as a simulated lunar dusts. The particles were then absorbed through an elutriator (air classification used to trap particles with a bigger constant rate of sedimentation), and the diameter of the particles that came through the elutriator was measured to verify the relationship between sedimentation velocity and gravity. We found that the sedimentation velocity of particles showed to be according to the predicted sedimentation formula under a one-sixth gravity environment.

Moreover, under microgravity, we consider to develop the methods of preventing health impairment due to fine particles. (Collaboration; The National Institute of Occupational Safety and Health, Japan/Yasutaka Ogawa, director; Shou Maki, researcher, and The University of Occupational and Environmental Health, Japan/ Professor Yasuo Morimoto)

Outline of lunar dust examination



2. Research of Medical Examination on Lunar Surface

Medical appliances that do not require specific equipment to diagnose illness of astronauts and to detect microorganisms in the environment are necessary to a lunar mission. Therefore, we study the necessity of independent examination texhniques on lunar surface, and develop small high-precision appliances. In developing examination techniques for manned space activities on lunar surface, their devices require such as; (1) quick and easy operation, (2) the ability of judge isually, (3) no influence of the diagnostics results from various graitational enironments, (4) protection from leakage or emission of samples and reagents under micrograbity and (5) lighten workload astronauts. We now consider the possibility of application on examination techniques established on the earth, such as the gene amplification test.

Lunar Radiation

Aiko Nagamatsu, Kazuhiro Terasawa, Chiaki Mukai

Research related to the effects of space radiation on manned space activities on the Moon

Investigation of manned space missions on the Moon and Mars after 2020 has started. The space radiation environment outside the terrestrial magnetosphere is much different from that of LEO and the influence on humans/creatures is estimated to be bigger, which will have an impact on the scenario of manned space missions. A manned research promotion committee selected prior research titled "Research related to space radiation effect for manned space activities on the moon" as JAXA's in-house research in 2009 and 2010 to understand the radiation environment on the lunar surface, to evaluate the effects of radiation on humans and creatures, and to develop technologies needed to manage the exposure on the Moon. The research subjects are as follows:

Subject 1: Understanding space radiation effects on the Moon

Subject 2: Biological effect research for lunar radiation

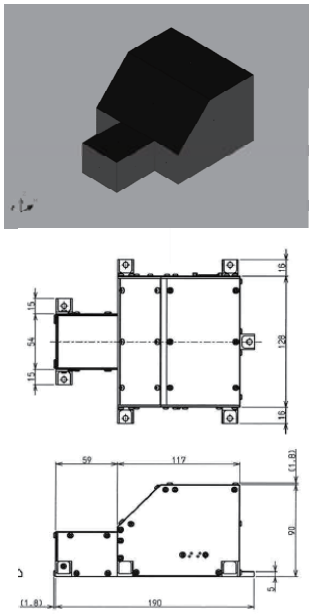
Subject 3: Investigation of skills technologies needed to manage radiation exposure on the Moon

This year, based on the outcome of Subject 1, and in cooperation with JAXA's Space Environment Utilization Center, the Aerospace Research and Development Directorate's Space Environment Group, and JSPEC, we arranged developmental implementation of space radiation measurements, drew up an operational demand, and evaluated the characteristics of onboard measuring instruments for next-generation manned space activities. The following three projects are to be used:

(1) RRMD-V (Real-time radiation monitoring device-V) for SELENE-2

A RRMD-V silicon detector telescope suggested by the Space Biomedical Research Office has been selected as SELENE-2 pre-project utilization mission equipment to measure the space radiation environment on the Moon for lunar manned activities (September 2009).

We studied program refinement of RRMD-V's operational demand (data acquisition of satellite flight phase, flight altitude of regular operation, measurement period during regular operation based on scientific demand, electric power, telemetry, and radiating surface) and received SELENE-2's Delta MDR (Mission Demand Definition Review) in November 2010. We are preparing to receive the SDR (System Definition Review) for the 2015 launch (Image 1) through a monthly development coordination conference.



Schematic view of RRMD-V

(2) Small silicon detector on board MUSES-C2

The Lagrangian points are considered as a candidate of a base for next-generation manned activities. Investigation is underway of measuring space radiation under the terrestrial magnetosphere and deep space using a loading opportunity on MUSES-C2. We study energy measurements of protons when solar flares arise and the basic specifications of equipment (loading weight, electric power, independent thermal control, data packet, etc.) and advance the design investigation consistent with the standard for MUSES-C2.

(3) Active detector on board the ISS (PS-TEPC)

The Position Sensitive Tissue Equivalent Proportional Counter (PS-TPEC) is designed to detect the position of incident particles and improve the energy measurement compared with TEPC. It uses a Micro-Pixel Chamber (μ-PIC) strip electrode and tissue equivalent materials and obtains a three-dimensional flight path while aiming to measure heavy charged particles and neutrons (by measuring the recoil proton from the target) with one detector. This year, we obtained data by the detector, HIMAC heavy particle accelerator in four machine times at the National Institute of Radiological Sciences.

-November 12, 2010 Ar 650 MeV/n
-November 13, 2010 H (proton) 230 MeV
-January 31, 2011 C 400 MeV/n
-February 1, 2011 Fe 500 MeV/n

A ground verification test to improve the accuracy of determination for installation on the ISS in 2014 is ongoing.

Outreach/Education

Education

Maki Niihori, Shin Yamada, Masamichi Sudoh, Toshiko Ohta, Shoji Oda, Chiaki Mukai

Research for producing teaching materials from space biomedical research, JAXA Medical Education (J-MEd)

"Outreach" includes various activities aiming at promoting public understanding of science, such as publishing books and giving public talks, lectures and discussions etc., to provide information to the public.

Recently, the public outreach has been becoming important in the science fields. Because, it is one of the ways to contribute to the society through the science education using technologies and knowledges of sciences, and it can provide an important link between the scientists and society. Space science is expected to raise awareness of people's advanced sciences and here is the consistency between people's demand and the characteristic of outreach: providing information to the public.

We, JAXA Biomedical Research Office, have been starting the outreach activities for promoting awareness of importance of space biomedical research and improve space biomedical education.

(1) Publication of space biomedical research outcomes

We organized an exhibition room, in order to show our research results and how physiological alterations occur in space to the visitors. The exhibition room will be open for visitors from 2011. In addition, we give lectures to the public and students to present the results of our research, to give visibility to scientific success stories, and to support science education.

(2) Collection of space medical science video content

We plan to obtain video content with the theme of "Space Medical Science" on orbit. That will be recorded by a Japanese astronaut staying in Internatuional Space Station. We have been developing scenarios with teachers, in order to provide appropriate and effective education materials using the video. This project is collaborated with JAXA Space Education Center.

Physiological Space risks and their application to science education

Mission X in Japan

Maki Niihori, Shin Yamada, Tomoaki Matsuo, Reiko Nakao, Takashi Nakazawa, Yoshito Kamiyama, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima, Chiaki Mukai

"Physical strength" plays an important role for supporting humans' development and growth, and to do a creative activity. Therefore, the improvement of physical strength of children is important for better future also for the development of our country. Moreover, it is indispensable to formation of a well-rounded character for all the people to consider health from the infant stage, and to acquire the custom of achieving the improvement of basic physical strength, because it is also improve children's mental health.

In 2010, we launched an education program, Mission X in Japan, which came from "Mission X: Train Like an Astronaut" (hereinafter called "Mission X") led by mainly NASA and ESA. Mission X is an international public outreach program designed to encourage proper nutrition and exercise teaching young people to live and eat like astronauts. We went along with Mission X's standpoint, and we modified the program based on the original ones to suite Japanese culture and students' grade. Using astronauts as examples, the mission can motivate and educate students to instill and adopt good nutrition and physical fitness as life-long practice.

Mission X in Japan was held in early 2011. We are continuing the education/public outreach to promote public understanding of science and making contributions to science education through lectures on astronautical specialties and knowledges.

Title	Contents	Note
＜Exercise＞ Agility Training	Zig-zag run etc.	Astronauts go through vigorous physical fitness training before each mission to prepare their bodies for space flight.
＜Exercise＞ Muscle training	Push-up, squat, etc.	
＜Nutrition Lacture / Experiment＞ What a Sweet Soda!	How much sugar is contained in soda? Lecture and experiment.	"Space food" can contribute to not only the proper nutrition intake but also the reducing stress and communication in space.

Fig.1 Examples of Contents of Mission X in Japan

Loading Preparation/Operation of On-orbit Experiments

Loading Preparation/Operation of On-orbit Experiments

Satoru Ishida, Tatsuya Aiba, Ichiro Tayama, Chiaki Mukai

In collaboration with technical experts, the JAXA Space Biomedical Research Office conducts on-orbit experiments related to medical research on astronauts scheduled for long-duration missions on the ISS.

We coordinate constantly with all concerned parties inside and outside the country in preparation of the on-orbit experiment, which includes arrangement of loading preparation for the experimental equipment (including return recovery preparation), advance preparation/plan arrangement of on-orbit experiment operation, training of the astronauts, and acquisition of pre-flight baseline data.

Loading preparation of experimental equipment: It includes arrangement of the launch/launching site plan, loading in the rocket, ground tests required before operation on the ISS, a safety inspection based on the test results, downlink to the ground of obtained data and samples after the on-orbit experiment, and the adjustment plan for return recovery.

Advanced preparation and the adjustment plan for on-orbit experimental operation:

It includes schedule arrangement of on-orbit experiments, guarantee of on-orbit work hours for the astronauts, creation/arrangement of the operation process, the utilization plan of the infrastructure inside the ISS, and adjustment of the presupposition/ restriction for experiment operation including the support plan of the ground-based operation team.

Actual operation of the on-orbit experiment: It means to confirm the work process inside the experiment operations control room, to support astronauts from the ground. It is able to confirm the success of the experiment, to provide technical support, and to communicate any defects of experimental equipment.

After the on-orbit experiment, we support the preparation for transportation of samples returned/recovered and post- flight baseline data acquisition of the astronaut. Moreover, we review technical problems that should be considered in future on-orbit experiments through post-flight technical debriefing. We now provide the loading preparation and operation on three projects as follows:

(1) Research related to autonomic nerve activity of the heart during a long-duration mission (Biological Rhythms)

(2) Biomedical analyses of human hair exposed to long-term space flight (Hair)

(3) Mycological Evaluation of Crew Exposure to ISS Ambient Air (Myco)

The obtained data is down-linked via satellite circuit at all times in the project (1). Hair and Myco from an astronaut are collected and stored in a freezer to protect them until genetic analysis is performed on the ground in the projects (2) and (3).

Our Activities

Chiaki Mukai

○Symposiums

1. Chiaki Mukai, Biomedical Analyses of Mice Body Hair Exposed to Long-term Space Flight as a Compliment of Human Research, 38th COSPAR Scientific Assembly, Jul. 23, 2010, Germany
2. Chiaki Mukai, Climate Change and Health, Symposium on Greenhouse Gas Measurements from Space, Aug. 25, 2010, Tokyo (in Japanese)
3. Chaiki Mukai, University of Tokyo Executive Management Program, Aug. 27, 2010, Tokyo (in Japanese)
4. Chiaki Mukai, Space medical technology innovation and its global applications, WHO ; First Global Forum on Medical Devices, Sep. 10, 2010, Thailand
5. Chiaki Mukai, The Future of Humans in space／Space Medicine Applications : New concepts on Gravity, Hypogravity and Microgravity effects on Humans, 6th International Conference of Aerospace medicine, Sep. 24, 2010, Greece
6. Chiaki Mukai, The Impact of Climate Change on Human Welfare – the Space Travelers' Perspective, XXIII Plenetary Congress of the Association of Space Explorers, Oct. 6, 2010, Malaysia
7. Chiaki Mukai, Japanese International School in Dusseldorf, Oct. 28, 2010, German
8. Chiaki Mukai, 60 anniversary of the establishment of Keio Girls Senior High School, Nov. 13, 2010, Tokyo (in Japanese)
9. Chiaki Mukai, Climate Change and Health, Space Utilization Symposium, Feb. 17, 2010, Tokyo
10. Chiaki Mukai, Meaning of the life science experiment in space, Japanese Experiment Module "Kibo" Utilization Symposium; Experiment of Life Science on Orbit, Feb. 28, 2011. Tokyo (in Japanese)

○ Mass Media

1. Chiaki Mukai, Nishinippon Shimbun, May 31, 2010 (in Japanese)
2. Chiaki Mukai, NHK Publishing, Jul. 12, 2010 (in Japanese)
3. Chiaki Mukai, Space Industy of Japan, Sep. 30, 2010 (in Japanese)
4. Chiaki Mukai, Asahi Shimbun, Jan. 5, 2011 (in Japanese)
5. Chiaki Mukai, Sunday Mainichi, Jan. 9, 2011 (in Japanese)

J-SBRO Meetings

Subcomitte on Space Biomedical Research

	Date		Agenda
27th	Jul. 30, 2010	Tokyo	・Biomedical Research Utilizing the Antarctica Station ・Biological effects on low dose rate and long-term exposure to space radiation
28th	Sep. 14, 2010	Tokyo	・An exercise program to prevent deterioration of cardiac function during long-term space flight (HIAT) ・Swinming behavior and muscle activities under microgravity environment using medaka ・Mission X in Japan
29th	Jun. 26, 2010	Tokyo	・Technologies and Analyses Using Medaka to Ealuate Nutrition ・Medical Treatment for Health on the Moon ・Bipedal Walking on the Moon: Simulation Studies on How to Prevent Falling ・Research related to autonomic nerve actiity of the heart during a long-duration mission ・The research for the development of nutritional therapy based on the oscillation of muscle atrophy-related genes.
30th	Mar. 11, 2011	Tokyo	・The research for the development of nutritional therapy based on the oscillation of muscle atrophy-related genes. ・Research on the disposition to space environmental stresses by in vivo imaging using medaka intestines ・An exercise program to prevent deterioration of cardiac function during long-term space flight (HIAT) ・Prophylactic use of Bisphosphonate as a counter measure for space flight induced bone loss and rnal stone ・Biomedical Research Utilizing the Antarctica Station ・Research related to autonomic nerve actiity of the heart during a long-duration mission ・Biomedical analyses of human hair exposed to long-term space flight (Hair) ・Mycological Evaluation of Crew Exposure to ISS Ambient Air(Myco)

Members of Subcomitte on Space Biomedical Research

	Name	Institution
Chairman	Meigen Liu	Professor, Keio University, School of Medicine
Member	Yoshiharu Aizawa	Professor, Kitasato University, School of Medicine
Member	Akihiko Ishihara	Professor, Kyoto University, Graduate School of Human and Environmental Studies
Member	Tomio Inoue	Professor, Yokohama City University, Graduate School of Medicine
Member	Toshio Ohhashi	Professor, Shinshu Uniersity, Graduate School of Medicine
Member	Masayuki Omori	Profesor, Chuo University, Faculty of Science and Engineering
Member	Toshihiro Kawamoto	Professor, University of Occupational and Environmental Health, Japan School of Medicine
Member	Kazuhiro Sakai	President, The Institute for Science of Labour
Member	Norio Suzuki	Professor emeritus, University of Tokyo, Faculty of Medicine
Member	Yoshiki Seino	Honorary president, Osaka Koseinenkin Hospital
Member	Chiharu Sekiguchi	Vice president, Nakahara Hospital
Member	Hiroyuki Takeda	Professor, University of Tokyo, Graduate School of Science
Member	Hiroshi Tanaka	Professor, Tokyo Medical and Dental University, Graduate School of Biomedical Science
Member	Fumitaka Noda	Professor, Taisho University, Faculty of Human Studies

Workshops

Theme	Date		Speaker
Space Biomedical Research using Fish-Next Strategy	Jan. 13, 2011	Tokyo	Hiroshi Mitani, Professor, University of Tokyo, Graduate School of Frontier Sciences Atsuko Sehara, Professor, Kyoto University Institute for Frontier Medical Sciences Yoshiro Takano, Professor, Tokyo Medical and Dental University Graduate School of Medical and Dental Sciences Tomomi Watanabe-Asaka, Aerospace Project Research Associate, JAXA Tomoko Uchida, Associate Senior Engineer, JAXA
Effort of Health Promotion and Space	Jan. 31, 2011	Tokyo	Hiroshi Ohshima, Senior Researcher, JAXA Toshitada Yoshiok, President, Hirosaki Gakuin University Kozo Nakamura, Professor, University of Tokyo, raduate School of Medicine Meigen Liu, Professor, Keio University, School of Medicine
Public Relation of Science and Education	Mar. 4, 2011	Tokyo	Amane Koizumi, Associate Professor, National Institute for Physiological Sciences Fuji Nagami, Contract Associate Professor, Tohoku University, Tohoku Neuroscience Global COE Yuichi Takayanagi, President, Tamarokuto Science Center Shin Yamada, Associate Senior Researcher, JAXA

Seminars

Theme	Date		Lecturer
Russian Course	Jul. 2010 - Jan. 2011	Tsukuba	Toshinobu Usuyama, Associate Professor, University of Tsukuba, Graduate School of Humanities and Social Sciences
Brain Science for Space Medicine	Oct. 13, 2010	Tsukuba	Kotaro Takeda, Researcher, Advanced Telecommunications Research Institute International Junichi Ushiba, Assistant Professor, Keio University, Faculty of Science and Technology
High-intensity Interal Aerobic Training	Nov. 9, 2010	Tsukuba	Kiyoji Tanaka, Professor, Graduate School of Comprehensive Human Sciences, University of Tsukuba Kazunori Ohkawara, Postdoctoral Fellow, Japan Society for the Promotion of Science Nobutake Shimojo, Assistant Professor, Graduate School of Comprehensive Human Sciences, University of Tsukuba Akira Matsushita, Researcher, Global COE Program: Cybernics, University of Tsukuba Kousaku Saotome, Tsukuba Medical Center Tomoaki Matsuo, Aerospace Project Research Associate, JAXA
Using Hair for Medical Check on-orbit	Nov. 22, 2010	Tsukuba	Makoto Akashi, Professor, Research Institute for Time Studies, Yamaguchi University Takashi Matsuzaki, Associate Professor, Faculty of Life and Environmental Science, Shimane University Hajime Sato, President, National Research Institute of Police Science Masahiro Terada, Aerospace Project Research Associate, JAXA
Nutrition Challenge	Feb. 8, 2011	Tsukuba	Noriko Sato, Part-time Lecturer, Ochanomizu University, Science & Education Center

J-SBRO Facility Tours

1. Jikei University School of Medicine
2. Koganeibashi Sakura Clinic
3. Okayama University Faculty of Medicine
4. Jikei College of Nursing
5. Juntendo University
6. Yokohama City University, School of Medicine,
7. University of Tsukuba
7. Aichi Science & Technology Foundation
8. Shinshu University School of Medicine

Physiological Countermeasures

Bone Loss

○Reiews/Books

1. Hiroshi Ohshima, Microgravity and bone metabolism, THE BONE, 24(2) , 125-130, 2010 (in Japanese)
2. Hiroshi Ohshima, Musculoskeletal rehabilitation and bone. Musculoskeletal response to human space flight and physical countermeasures, CLINICAL CALCIUM, 20 (4) , 537-542, 2010 (in Japanese)
3. Madarame H, Kurano M, Takano H, Iida H, Sato Y, Ohshima H, Abe T, Ishii N, Morita T, Nakajima T., Effects of low-intensity resistance exercise with blood flow restriction on coagulation system in healthy subjects., Clin Physiol Funct Imaging, 30, 210-213, 2010
4. Hiroshi Ohshima, Secondary Osteoporosis UPDATE. Bone loss due to bed rest and human space flight study, CLINICAL CALCIUM, 20 (5) , 709-716, 2010 (in Japanese)
5. Hiroshi Ohshima: Bone mineral loss under bed rest and space flight , Lecture report of the 54th Educational Seminar of Japan Osteoporosis Foundation, 2010 (in Japanese)

○Symposiums

1. Hiroshi Ohshima, Bone loss due to long term bed rest and human space flight, The 54th Educational Seminor, Japan Osteoporosis Foundation, Jul. 2, 2010, Tokyo (in Japanese)
2. Hiroshi Ohshima, Bone loss in space flight and countermeasure, Tsukuba Science Casting Workshop, Aug. 10, 2010, Tsukuba (in Japanese)
3. Hiroshi Ohshima, Musculoskeletal response and countermeasure program for space flight, Effects of mechanical stress and nutrition on bone and muscle: Latest progress, The 25th International Science Forum, Dec. 4, 2010, Tokyo (in Japanese)
4. Hiroshi Ohshima, JAXA's space medicine and outreach, Countermeasure program for bone loss and muscle atrophy in space flight, The 2nd Space Biomedical Research Work Shop, Mar. 4, 2011, Tokyo (in Japanese)
5. Hiroshi Ohshima, Effects of long duration space flight on bone loss, The 88th annual meeting of Physiological Society of Japan, Mar. 28, 2011, Yokohama (in Japanese)

Physical Strength

○Reviews/Books

1. Hiroshi Ohshima, Shoichi Tachibana, Koichi Wakata, Human space flight and rehabilitation, Advanced medical series 40, Rehabilitation medicine for rehabilitation doctors and co medical staffs, Institute of advanced medical technology, 18-21, 2010 (in Japanese)
2. Hiroshi Ohshima, Koh Mizuno, Effect of microgravity on physical ability, Ed. DT. Kirkendall, Dictionary of exercise and sport science, Biomechanics and Physiology, 390-399, 2010 (in Japanese)
3. Shin Yamada, Anti-aging and Space Medicine, Monthly Book of Rehabilitation, 123; 147-152. 2010 (in Japanese)
4. Hiroshi Ohshima, Rehabilitation medicine and human space flight, Lecture report of the Society for Advanced rehabilitaionn Medicine, 2010 (in Japanese)

○Meetings

1. Hiroshi Ohshima, Current Operational exercise support for Japanese astronauts, International Countermeasure Workshop, Jun. 19. 2010, Italy
2. Hiroshi Ohshima, JAXA's Countermeasure Technology Research and Development, International Countermeasure Workshop, Jun. 19, 2010, Italy
3. Tomoaki Matsuo, Shin Yamada, Hiroshi Ohshima, Chiaki Mukai, An exercise program to prevent deterioration of cardiac function during long-term space flight (HIAT), 56th JSASEM, Nov. 13 ,2010

○Symposiums

1. Hiroshi Ohshima, Space medicine and welfare apparatus, The 36th Home Care and Rehabilitation Exhibition, Sep. 30, 2010, Tokyo (in Japanese)
2. Shin Yamada, Space Medicine and Musculoskeletal Rehabilitation, 36th International Home Care and Rehabilitation Exhibition, Sep. 30, 2010, Tokyo (in Japanese)

Team MED

○Reviews/Books

1. Tomomi Watanabe-Asaka, Chiaki Mukai and Hiroshi Mitani "Technologies and analyses using medaka to evaluate effecs of space on health", Biological Sciences in Space, 24(1): 3-9, 2010
2. Shoji Oda, Yusuke Urushihara, Yukie Higa, Toyoko Kuno, Yasuhiro Kamei, Tomoko Ishikawa, Chiaki Mukai, Takeshi Todo and Hiroshi Mitani. "Long-Term Rearing of Medaka aboard ISS to Clarify the Trans-Generation Effects in Vertebrates Induced by Cosmic Ray Irradiation", ISTS

○Meetings

1. Masahiro Terada. Thespecuation of evaluation method on medaka skeletal muscle, 18th Annual Meeting of Japan Society of Exercise and Sports Physiology, Jul. 31, 2010, Kagoshima (in Japanese)
2. Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Shoji Oda, Ken-ichi Iwasaki, Hiroshi Mitani and Chiaki Mukai. Establishment of the method of the heart rate variability analysis using medaka live imaging, 24th Annual meeting of JSBSS, Sep. 17, 2010, Miyagi (in Japanese)
3. Masahiro Terada, Tomomi Watanabe-Asaka, Maki Niihori, Fuminori Kawano, Yoshinobu Ohira, Chiaki Mukai. Thespecuation of evaluation method on medaka skeletal muscle; Is medaka skeletal muscle atropy in space? 24th Annual meeting of JSBSS, Sep. 17, 2010, Miyagi (in Japanese)

4. Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Hiroshi Mitani, and Chiaki Mukai. "Analyses of heart rate variability using hi-speed images" 16th Small fish Conference. Sep. 19, 2010, Saitama (in Japanese)
5. Tomomi Watanabe-Asaka, Masamichi Sudoh, Maki Niihori, Masahiro Terada, Shoji Oda, Ken-ichi Iwasaki, Shuji Terai, Chiaki Mukai and Satoshi Kurihara. "Analyses using medaka to rvaluate effects of space on health", 127th Seiikai, Oct. 7, 2010, Tokyo (in Japanese)
6. Tomomi Watanabe-Asaka, Maki Niihori, masahiro Terada, Ken-ichi Iwasaki, Masamichi Sudoh and Chiaki Mukai. "Heart rate analysis in Medaka via live-imaging technique" 56th JSASEM, Nov. 13, 2010, Saitama (in Japanese)
7. Masahiro Terada, Tomomi Watanabe-Asaka, Maki Niihori, Fuminori Kawano, Reiko Nakao, Ken-ichi Iwasaki, Masamichi Sudoh, Chiaki Mukai, Yoshinobu Ohira. The analysis of medaka skeletal muscle and electrocardiogram on medaka, 56th JSASEM, Nov. 13, 2010, Saitama (in Japanese)

○Symposiums

1. Tomomi Watanabe-Asaka, "Space biomedical research in manned space development – Evaluation of space environment using medaka," Invited speech in JAXA, Jul. 21, 2010, Tsukuba (in Japanese)
2. Tomomi Watanabe-Asaka, "Space Biomedical Researches using Medaka as a Model Animal", the 81st Annual Meeting of the Japanese Society for Hygene, Mar. 27, 2010, Tokyo (in Japanese)

Hair

○Meetings

1. Masahiro Terada, Reiko Nakao, Hideyuki J. Majima, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Masamichi Sudoh, Yoshinobu Ohira, Chiaki Mukai, Biomedical Analyses of Mice Body Hair Roots as a Complement of Human Research, The 88th Annual Meeting of the Physiological Society of Japan, Mar. 28, 2010, Yokohama (in Japanese)
2. Masahiro Terada, Masaya Seki, Reiko Nakao, Toko Hashizume, Hideyuki J. Majima, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai. The performance of microarray analyses on one hair root from human single strand of hair, The 88th Annual Meeting of the Physiological Society of Japan, Mar. 28, 2010, Yokohama (in Japanese)

○Symposiums

1. Masahiro terada, The Research Fields of JAXA Space Biomedical Research Ohhice:Physiological Countermeasures、The 81st Annual Meeting of the Japanese Society for Hygiene, Mar. 27, 2010, Tokyo (in Japanese)

Nutrition

○Original Paper

1. Akiko Matsumoto, Kenneth J. Storch, Adrienne Stolfi, Stanley R. Mohler, Mary Anne Frey, T. Peter Stein, Weight Loss in Humans in Space., Aviation, Space, and Environmental Medicine (in press)

Space Radiation Protection

Biological Effect

○Meetings

1. Masao Suzuki, Chizuru Tsuruoka, Yukio Uchihori, Hsashi Kitamura, Aiko Nagamatsu, Tomomi Watanabe-Asaka, Riyo Yamanaka, Yoshiya Furusawa: Biological effects in normal human fibroblasts induced by low fluence irradiations of high-LET iron ions , 24th JSBSS, 2010 Sep. Sendai.

○Symposiums

1. Aiko Nagamatsu : Human Space Technology for Supporting the ISS and Future human Missions, Japan Woman Engineers Forum , 2010 Sep. Tokyo

○Ohters

1. Tomomi Watanabe-Asaka, Aiko Nagamatsu, Riyo Yamanaka, Masao Suzuki, Cui Hua Liu, Yukio Uchihori, Hisahi Kitamurra, Biological Effects Induced by Low-Density Heavy Ions of Space radiation in Medaka. （22B-273）, NIRS HIMAC-report 2010, 2011(in press)
2. Masao Suzuki, Cui Hua Liu, Aiko Nagamatsu, Tomomi Watanabe-Asaka, Riyo Yamanaka, Hisashi Kitamura, Yumiko Kaneko, Narongchai Autsavapromporn, Yukio Uchihori, Mechanism(s) of bystander effects induced by low-fluence heavy ions (22B-328), NIRS HIMAC-report 2010, 2011(in press)

Utilizing the Antarctica Station

○Symposiums

1. Mizuno K. Human biological rhythms in Antarctica - Study outline and subjective and objective sleep evaluation -, Workshop on Antarctic Medical Research and Medicine 2010, Jul. 2010, Tokyo (in Japanese)
2. Yamamoto N, Otsuka K, Ishikawa M, Kubo Y, Ohsima H, Mukai C. Annual change of heart rate variability analysis of volunteer in Antarctica. Workshop on Antarctic Medical Research and Medicine 2010, Jul. 2010, Tokyo (in Japanese)
3. Yoshida M, Urade Y, Tanaka K. Sleep monitoring at the South Pole. 2 Workshop on Antarctic Medical Research and Medicine 2010, Jul. 2010, Tokyo (in Japanese)

Frontier Medicine on the Lunar Surface

Bipedal Walking on the Moon: Simulation Studies on How to Prevent Falling

○Symposiums

1. Hiroshi Ohshima, Kimitaka Hase, Masaki Takahashi, Terumasa Narukawa, Meigen Liu, Shin Yamada, Chiaki Mukai, Electromyographic activities during simulated moonwalks using a treadmill and body suspension system, The 31st annual meeting of the International Society of Gravitational Physiology, Jun. 18, 2010, Italy
2. Shin Yamada, Kimitaka Hase, Meigen Liu, Hiroshi Ohshima, Chiaki Mukai, Bipedal Walking on the Moon and Mars : A Simulation Study Using a Treadmill with a Body Weight Suspension System、5th International Congress of Medicine in Space and Extreme Environments, 21 Oct, 2010, Germany

Research related to the effects of space radiation on manned space activities on the Moon

○Original Papers

1. H. Koshiishi, H. Matsumoto, K. Terasawa, K. Koga and T. Goka, Neutron Dosimetry inside theInternational Space Station, In "Space Exploration Research", 531-544 (2010).

○Meetings

1. Kazuhiro Terasawa, Tadayoshi Doke, Kentaro Miuchi, Toru Tanimori, Shinichi Sasaki, Hiroko Tawara, Kiwamu Saito, Kazutoshi Takahashi, Haruhisa Matsumoto, Tatsuto Komiyama, Nana Higashio, Tetsuhito Fuse, Yukio Uchihori, Hisashi Kitamura, Development of a space dosimeter with a gas time projection chamber (TPC), The Japan Society of Applied Physics, Sep. 14, 2010, Nagasaki (in Japanese)
2. Kazuhiro Terasawa, Tadayoshi Doke, Kentaro Miuchi, Toru Tanimori, Shinichi Sasaki, Hiroko Tawara, Kiwamu Saito, Kazutoshi Takahashi, Haruhisa Matsumoto, Tatsuto Komiyama, Nana Higashio, Yukio Uchihori, Hisashi Kitamura, Development of a space dosimeter for an extended stay in space, The Japan Society of Applied Physics, Mar. 17, 2010, Hiratsuka (in Japanese)

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1. Kazuhiro Terasawa, Tadayoshi Doke, Kentaro Miuchi, Toru Tanimori, Shinichi Sasaki, Hiroko Tawara, Kiwamu Saito, Kazutoshi Takahashi, Haruhisa Matsumoto, Tatsuto Komiyama, Nana Higashio, Tetsuhito Fuse, Yukio Uchihori, Hisashi Kitamura, Active space dosimeter PS-TEPC onboard the ISS, JAXA space environment symposium, Oct. 19, 2010, Tokyo (in Japanese)
2. Kazuhiro Terasawa, Space radiation exposure limiting the duration of stay in space, Science cafe in a contribution course of kyokuto Securities Co., Ltd, Oct. 2, 2010, Tokyo (in Japanese)
3. Aiko Nagamatsu, Chiali Mukai, Kazuhiro Terasawa, Haruhisa Matsumoto : Measurement of lunar radiation environments using RRMD (Real-time Radiation Monitoring Device)-Ⅲ, The11th Space Science Symposium, 2011 Jan. Sagamihara (in Japanese)

○Others

1. Kazuhiro Terasawa, Tadayoshi Doke, Shinichi Sasaki, Toru Tanimori, Haruhisa Matsumoto, Hiroko Tawara, Kiwamu Saito, Kazutoshi Takahashi, Yukio Uchihori, Hidetoshi Kubo, Tatsuto Komiyama, Kentaro Miuchi, Hisashi Kitamura,Response of a position-sensitive tissue equivalent proportional counter to heavy ions, Report of Research Project with Heavy Ions at NIRS-HIMAC 2010, 2010 (in Japanese)
2. K. Terasawa, T. Doke, N. Higashio, H. Kitamura, T. Komiyama, H. Kubo, H. Matsumoto, K. Miuchi, K. Saito, S. Sasaki, K. Takahashi, T. Tanimori, H. Tawara and Y. Uchihori, Development of Position Sensitive Tissue Equivalent Proportional Counter (PS-TEPC) and establishment of a technique for space dosimetry on the International Space Station (2009WG report), Space Utilization Research 26 ,236-238, 2010. (in Japanese)

Outreach/Education

Education

○Review/Books

1. Maki Niihori, Report of Japan-Canada WISET Exchange Lectureship, See you in Space! – Message to the "Universal Universe" Next Generations -, Trends in the Sciences, Vol 15, pp 75-81, October, 2010 (in Japanese)

○Meetings

1. Maki Niihori, Masamichi Sudoh, Ken-ichi Iwasaki, Tomomi Watanabe-Asaka, Chiaki Mukai, Space Biomedical Research Education/Outreach - The Effect of the Education Materials Using Space Biomedical Research Outcomes -, Society of Japan Science Teaching 60th Annual Meeting, Aug. 7, 2010, Yamanashi (in Japanese)
2. Maki Niihori, Reiko Nakao, Tomoaki Matsuo, Masamichi Sudoh, Ken-ichi Iwasaki, Tomomi Watanabe-Asaka, Chiaki Mukai, Space Biomedical Research Outreach, The 24th Annumal Meeting of Japanese Society for Biological Science in Space, Sep. 17, 2010, Miyagi (in Japanese)
3. Maki Niihori, Masamichi Sudoh, Shin Yamada, Chiaki Mukai, Biomedical Research Outreach with Education Materials focusing on the Space Biomedical Research, The 56the Annual Meeting of Japan Society of Aerospace and Environmental Medicine, Nov. 13, 2010, Saitama (in Japanese)

○Symposiums

1. Maki Niihori, Shin Yamada, Tatsuya Aiba, Tomoaki Matsuo, Reiko Nakao, Hiroshi Ohshima, Chiaki Mukai, Space medicine useful to society, JAXA Symposium on Aerospace Researches JAXA, Nov. 25, 2011, Tokyo (in Japanese)
2. Shin Yamada, Outreach of Space Biomedical Research, 3rd Space Biomedical Research Work Shop, Mar. 4, 2011, Tokyo (in Japanese)
3. Maki Niihori, Space Biomedical Outreach for the Benefit of All People, The 81st Annual Meeting of the Japanese Society for Hygiene, Mar. 25, 2010, Tokyo (in Japanese)

○Others

1. Maki Niihori, Invited Lecture at Kurashiki-Amaki Junior High School, Oct. 27, 2010, Okayama (in Japanese)
2. Maki Niihori, Invited Lecture at Msduda Junior High School, Mar. 2, 2011, Shimane (in Japanese)

Preparation and Operation

Preparation and Operation on Orbit

○Meetings

1. Satoru Ishida, Operation of Experiments on Orbit, The 56the Annual Meeting of Japan Society of Aerospace and Environmental Medicine, Nov. 13, 2010, Saitama (in Japanese)

○Symposiums

1. Satoru Ishida, Living in International Space Station, Lecture of Seki board of education, Oct. 24, 2010. Seki (in Japanese)

Others

○Reviews/Books

1. Hiroshi Ohshima, Chiaki Mukai, JAXA Space Medicine Experiments in Japanese Experiment Module "Kibo", Report of Technical Committee on Space Aeronautical and Navigational Electronics, IEICE, 110(92) : 95-98、2010 (in Japanese)

○Meetings

1. Hiroshi Ohshima, Shin Yamada, Maki Niihori, Hajime Takeoka, Masafumi Yamamoto, Toshiko Ohta, Chiaki Mukai, JAXA space medicine activities to improve human life on the ground, The 56th Annual Meeting of Japan Society of the Aerospace and Environmental Medicine, Nov. 13, 2010 (in Japanese)

○Symposiums

1. Hiroshi Ohshima, Space medicine research in Japanese experiment module "Kibo", TSUKUKYO lunch meeting, May 14, 2010, Tsukuba (in Japanese)
2. Hiroshi Ohshima, Development of health care technology and space medicine research, Advanced course of space medicine, University of Tsukuba, Jun. 29, 2010, Tsukuba (in Japanese)
3. Hiroshi Ohshima, Human space flight and space medicine research, Graduate school of comrehensive human science, Oct. 6, 2010, Tsukuba (in Japanese)
4. Shin Yamada, The Most Important Issues of the Space Medicine, Kick-off Seminar of the Society for Acupuncture Science in Space, Oct. 15, 2010, Kyoto (in Japanese)
5. Hiroshi Ohshima, Space biomedical research for human space flight and future perspective, The 27th Annual Meeting of the Japanese Society of Disability and Oral Health, Oct. 24, 2010, Tokyo (in Japanese)
6. Hiroshi Ohshima, Space Biomedical research for long duration human space flight, Joint Meeting of Four wards of Medical Association in Yokohama. Dec. 9, 2010, Yokohama (in Japanese)

○Others

1. Hiroshi Ohshima, Space Medicine: Ultimate Preventive Medicine for Human Space Flight JAXA Home page, http://www.jaxa.jp/article/special/experiment/ohshima01_e.html, 2010 (in Japanese)
2. Hiroshi Ohshima, Front line of advanced research, Serialized report, Effects of space flight on human body, Healthiest 205, 2010 (in Japanese)
3. Shin Yamada, Theories and Practices of Rehabilitation Medicine (Interview), Medical Practice 27(10): 1645-1662, 2010 (in Japanese)

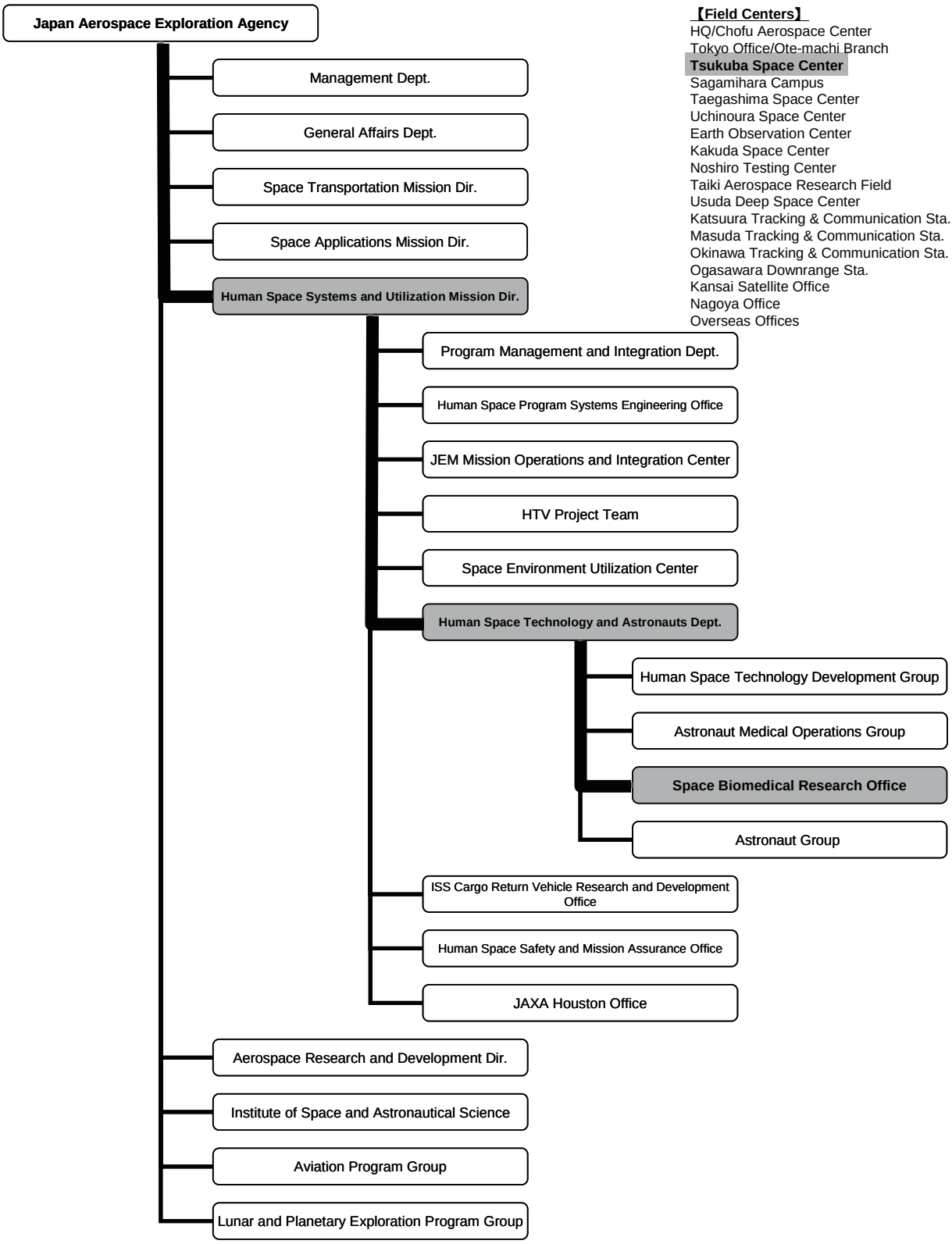
Publications

1. Tomomi Watanabe-Asaka, Chiaki Mukai and Hiroshi Mitani “Technologies and analyses using medaka to evaluate effecs of space on health”, Biological Sciences in Space, 24(1): 3-9, 2010

Links

	URL
JAXA Space Medicine	http://iss.jaxa.jp/med/index_e.html
JAXA repository	http://repository.tksc.jaxa.jp/en
Aerospace Information Reference External Version	http://airex.tksc.jaxa.jp/en
Experiment on Japanese Experiment Module “KIBO”	http://kibo.jaxa.jp/en/experiment/
NASA Human Research Program	http://humanresearch.jsc.nasa.gov/
ESA reserch human spaceflight and exploration	http://www.esa.int/esaHS/research.html

The Organization of JAXA (March, 2011)



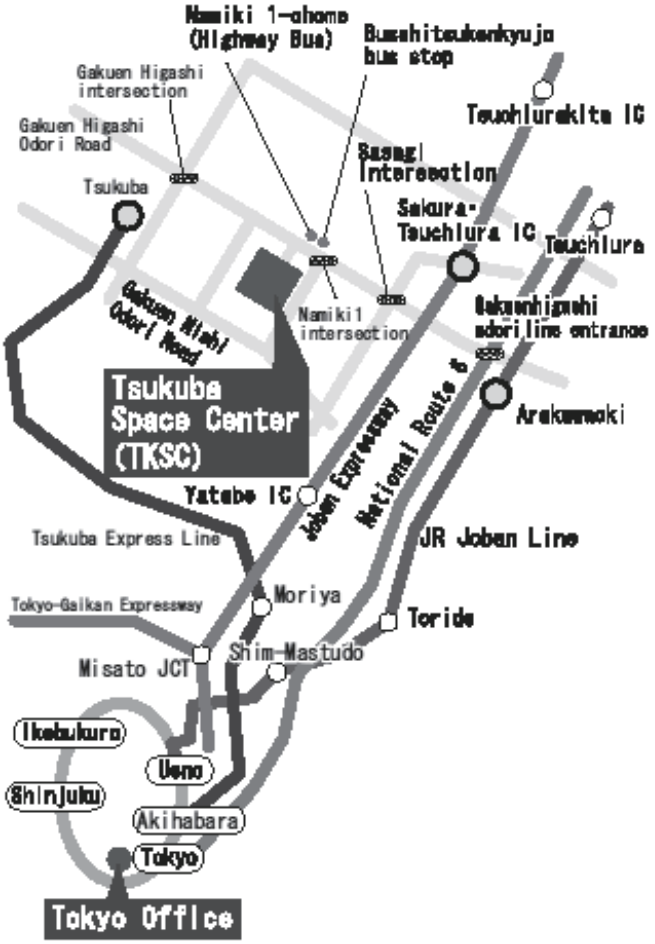
Tsukuba Space Center (TKSC) ACCESS

BY TRAIN

Get off the train at "ARAKAWAOKI" station (JR Joban Line). Take a Kantetsu Bus for Tsukuba University Chuo, then get off the bus at the "BUSSHITSUKENKYUJO MAE" bus stop. It is 1-minute walk from the bus stop. Or you can use a taxi from "ARAKAWAOKI" station (JR Joban Line). It takes about 15 minutes.

Get off the train at "TSUCHIURA" station (JR Joban Line). Take a taxi. It takes about 20 minutes.

Get off the train at "TSUKUBA" station (Tsukuba Express Line). Take a Kantetsu Bus for "ARAKAWAOKI" station, then get off the but at the "BUSSHITSU-KENKYUJO MAE" bus stop. It is 1-minute walk from the bus stop.
Or you can use a taxi from "TSUKUBA" station (Tsukuba Express Line). It takes about 10 minutes



BY HIGHTWAY BUS

At JR Tokyo Station Yaesu South Exit, take a Highway Bus for Tsukuba Center, and get off the bus at "NAMIKI 1-CHOME" bus stop. It is 1-minute walk from the bus stop.

From Narita Airport, take the Airport Liner NATT's, which connects "TSUCHIURA" station to the Narita Airport via the Tsukuba Center Bus Terminal. It takes about 1 hour 40 minutes.

BY TAXI

About 10 minutes from "TSUKUBA" station
About 15 minutes from "ARAKAWA OKI" station
About 20 minutes from "TSUCHIURA" station

BY CAR

Using Joban Expressway
From "SAKURA TSUCHIURA" Interchange, it takes 7 minutes (3.5km).
Using National Route 6
From Gakuen-higashi-odori line entrance, it takes 10 minutes (5km).

Editors note

Japan had the Tohoku earthquake and the Tsunami in this March. We hope that many researchers are interested in the activity of J-SBRO by reading the annual report. And, we wish this report becomes the symbol of the revival from the disaster. Don't give up, Japan !

(Editional member, Tatsuya Aiba)

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