ISSN 1349-113X
JAXA-SP-12-006E
JAXA Special Publication

J-SBRO Annual Report 2011

JAXA Space Biomedical Research Office

(J-SBRO)

JAXA-SP-12-006E

J-SBRO
Annual Report 2011

JAXA Space Biomedical Research Office
(J-SBRO)

Office Logo Mark

Contents

Message from Mukai Chiaki , JAXA Astronaut

NASA/JAXA

JAXA Astronaut, Chiaki Mukai, MD, PhD

More than fifty years have passed since Russian cosmonaut Yuri Gagarin made the world's first successful human spaceflight in 1961. Humans in the meantime have made tremendous progress in the human space technologies behind the launching of rockets beyond Earth's gravity for space flights, long stays in low Earth orbit (LEO), and the safe return of spacecraft to Earth. In 1985, Japanese candidates began their initial training to become future astronauts. To date, nine Japanese (including a journalist aboard a commercialized Soyuz rocket) have participated in 15 total space flight missions, extending the zone of human activities into space. Today, some astronauts now live and work in space.

National prestage initially provided the impetus for space development activities, but nowadays, international cooperation is indispensable. This situation is symbolized by the International Space Station (ISS) project involving the participation of individuals from 15 countries. Orbiting around the Earth in LEO, the ISS is a unique multi-purpose facility where a microgravity environment is used for scientific research (materials science and life sciences), technical developments, and observation of the Earth and space. In addition it has hosted education and cultural activities.

Recent years have seen one or two Japanese astronauts participate in six-month space missions. In 2011, astronaut Satoshi Furukawa contributed to the possibilities of using the space environment for medicine during his stay in space lasting 167 consecutive days. This marked the record longest stay among Japanese astronauts. In 2012, astronaut Akihiko Hoshide will also embark on a long duration stay in the ISS.

Medical sciences play a very important role in ensuring healthy and safe space flight. Medical technologies should not only support the development of human exploration activities in remote environments on the Moon and Mars, but should also allow the general public to enjoy space travel in the future. Thus, related scientific research is being specifically conducted to better understand the effects of gravity and spatial disorientation on humans and other living things.

The Japan Aerospace Exploration Agency (JAXA) established a new internal organization in April 2007– the JAXA Space Biomedical Research Office (J-SBRO)– to improve the health management of Japanese astronauts. J-SBRO is engaged in various missions for reducing medical risks during space flight, improving health management, and conducting basic medical study. Through intensive coordination with different research communities, J-SBRO is providing feedback to society on the development of physiological measures, provision of mental/psychological assistance, management of exposure to cosmic radiation, creation of a suitable spacecraft environment, and development of telemedicine technologies. J-SBRO is currently conducting in-orbit research, e.g. prophylactic administration of medication against bone loss, the effects of microgravity/cosmic radiation on hair cells, measurement of biological rhythm, collection of body bacterial flora, and development of autonomous in-orbit diagnostic devices. Furthermore, supporting research continues on-ground as well as making preparations for future space medical and biological research.

J-SBRO also conducts parabolic flight experiments and medical research on the continent of Antarctica to simulate space conditions. Its scope of research also covers medicine for exploitation of the Moon's surface, including the development of health management technologies on the Moon and medical and biological research in variable gravity. With the slogans "space medicine is

the ultimate preventive medicine" and "space medicine is useful for society" in mind, J-SBRO conducts scientific activities for both astronauts and the general public.

During the next 50 years, space development will promote the commercial utilization of space and make it feasible for members of the general public to venture into space on holidays aboard spacecraft. Moreover, making space travel possible for the general public will certainly accelerate the process of "space development for humanity." In this age, space medicine and space biology will play important roles. The following presents some of J-SBRO's achievements for 2011. We hope that many people will take the time to read these reports and give us their opinions, so as to help us make progress in these activities.

Mukai Chiaki, JAXA Astronaut, Vice Director for Human Space Systems and Utilization Mission Directorate

May19-22, Dr. Mukai in International Space Medicine Summit 2011, Houston. The purpose of this summit is to bring together leading physicians, space biomedical scientists, engineers, astronauts, cosmonauts and educators from spacefaring nations for high-level discussions about the research needed to prevent and/or mitigate the medical, psychological and biomedical challenges of long-duration spaceflight.

Jun. 1-2, Dr. Mukai and other foerign astronauts participated in Committee on the Peaceful Uses of Outer Space (COPUOS) at Wien.

Sep. 4-11, Dr. Mukai lectured in the 24th Congress of Association of Space Explorers at Moscow.

Nov. 30, Dr. Mukai gave JAXA's memontus to Dr. Igor A Gorlinsky, Vice president of Saint Petersburg State University

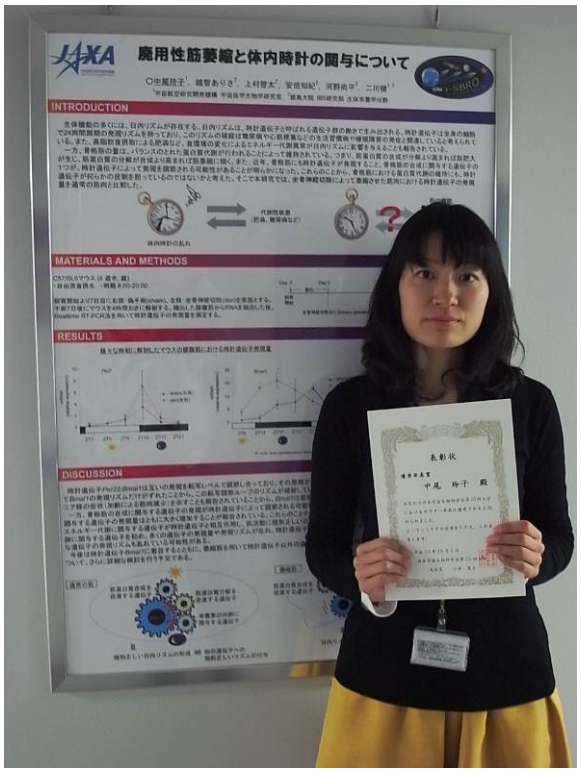
Topics

Health Promoting Event “Living in Garavity”

J-SBRO Member’s Lectures

The 57th Japanese Society of Aerospace and Environmental Medicine

Reiko Nakao, aerospace project reserach associate, won the award for excellent presentation at Japanese Society for Biological Sciences in Space.



APR

- Subcommitte on Space Biomedical Research

MAY

- Acquisition of Biological Rhythms data , Myco and Hair samples on-orbit
- Workshop on space biomedical research "How to save you from decline of immune functions"
- Launch equipment for Myco to ISS (STS-134)

JUN

- Return of Myco and Hair samples from ISS (STS-134)
- ISTS 28th
- Astronaut Furukawa Starts ISS Expedition Mission
- Mssion X in JAPAN
- Acquisition of Biological Rhythms data on-orbit

JUL

- Acquisition of Myco and Hair samples on-orbit
- Launch equipment for Myco to ISS, and return of Myco and Hair samples (STS-135)
- Subcommitte on Space Biomedical Research
- Workshop on Antarctic medical research and medicine

AUG

- Acquisition of Biological Rhythms data and Hair samples on-orbit
- Astronaut Furukawa EPO Event "Challenge for Space medicine on-orbit !"

SEP

- Acquisition of Myco samples on-orbit
- Astronaut Furukawa EPO Event "Living in Gravity"

OCT

- Acquisition of Biological Rhythms data on-orbit
- Special open-house event in J-SBRO facility

NOV

- Astronaut Furukawa returned to Earth from ISS
- 57th JSASEM

DEC

JAN

- Acquisition of Hair samples on-orbit

FEB

- Workshop on space biomedical research "Health promotion"
- Subcommitte on Space Biomedical Research
- Workshop on space biomedical research "Sleep cycle, biological rhythms"
- J-SBRO's seminar "Nutrition and Risk in Space Environment"

MAR

- Launch equipment for Biological Rhythms 48hrs to ISS (ATV3)

Press

宇宙開発 日本は重責を

向井千秋さんに聞く

日本人初の女性宇宙飛行士としてスペースシャトルに2度乗った向井千秋さんは、シャトル退役が科学技術の進歩を滞らせると懸念する一方、今後は国際協力の下で日本が重責を担うことを求める。

「何度も宇宙を往復できるシャトルは大量輸送時代を築いた。搭乗当時は『宇宙利用の黄金時代』。宇宙に大量の実験機材を運び、多くの成果を持ち帰る。ロシア宇宙船ソユーズは3人乗りで搭載量が多くない」

「コロンビア号への思い入れが強い。他のシャトルが新幹線ならコロンビア号は蒸気機関車。重厚な感じで、品格の高い女性の印象だ。打ち上げ時は『この程度の振動で済むの？』と意外だった。不気味だったのは地球帰還直前。空気の分子がぶつかり合い、ネジ1本までびりびりと揺れているかのようだった」

むかい・ちあき　77年慶大医卒。85年宇宙飛行士候補に選出。94、98年スペースシャトル搭乗。07年宇宙航空研究開発機構宇宙医学生物学研究室室長に就任。11年宇宙機構特任参与。

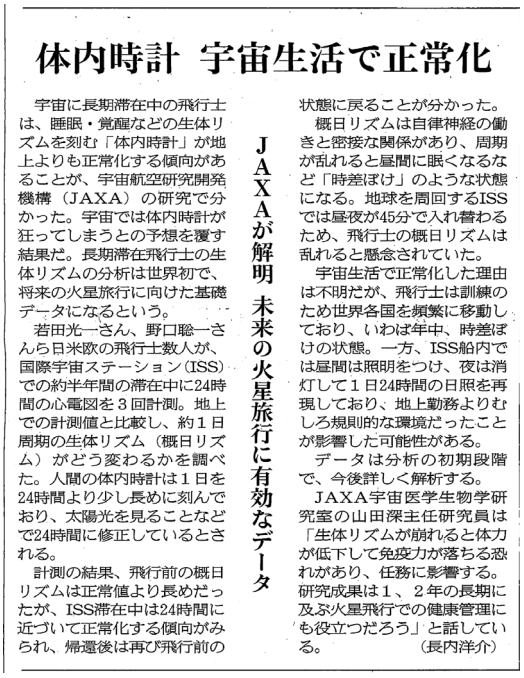
「コロンビア号の残骸には涙した。宇宙実験を地上から支援する立場だった。望んでいた3度目の飛行も白紙になった。86年にはチャレンジャー号が爆発。科学技術の粋を集めたシャトルの爆発は誰も考えなかった。86年はチェルノブイリ原発事故も起きた。科学技術の進歩におごり高ぶっていた人間が、ひっぱたかれたような感じがした」

「宇宙開発は米国と旧ソ連を中心に国威発揚が原動力だった。今や国際協力は当たり前。他国と協力しつつ、日本は重要な役目を担う努力が必要だ。企業などが健全な競争をしながら参加する仕組みを政府は作るべきだ。中国やインドが存在感を高めている。日本は無人の宇宙輸送機を持つ。人が乗れる宇宙船への改良も選択肢だ」

（聞き手は山本優）

全文を電子版テクノロジーに

Nikkei Shimbun, Jul. 3, 2011



体内時計 宇宙生活で正常化

JAXAが解明 未来の火星旅行に有効なデータ

宇宙に長期滞在中の飛行士は、睡眠・覚醒などの生体リズムを刻む「体内時計」が地上よりも正常化する傾向があることが、宇宙航空研究開発機構（JAXA）の研究で分かった。宇宙では体内時計が狂ってしまうとの予想を覆す結果だ。長期滞在飛行士の生体リズムの分析は世界初で、将来の火星旅行に向けた基礎データになるという。

若田光一さん、野口聡一さんら日米欧の飛行士数人が、国際宇宙ステーション（ISS）での約半年間の滞在中に24時間の心電図を３回計測。地上での計測値と比較し、約１日周期の生体リズム（概日リズム）がどう変わるかを調べた。人間の体内時計は１日を24時間より少し長めに刻んでおり、太陽光を見ることなどで24時間に修正しているとされる。

計測の結果、飛行前の概日リズムは正常値より長めだったが、ISS滞在中は24時間に近づいて正常化する傾向がみられ、帰還後は再び飛行前の状態に戻ることが分かった。

概日リズムは自律神経の働きと密接な関係があり、周期が乱れると昼間に眠くなるなど「時差ぼけ」のような状態になる。地球を周回するISSでは昼夜が45分で入れ替わるため、飛行士の概日リズムは乱れると懸念されていた。

宇宙生活で正常化した理由は不明だが、飛行士は訓練のため世界各国を頻繁に移動しており、いわば年中、時差ぼけの状態。一方、ISS船内では昼間は照明をつけ、夜は消灯して１日24時間の日照を再現しており、地上勤務よりむしろ規則的な環境だったことが影響した可能性がある。

データは分析の初期段階で、今後詳しく解析する。

JAXA宇宙医学生物学研究室の山田深主任研究員は「生体リズムが崩れると体力が低下して免疫力が落ちる恐れがあり、任務に影響する。研究成果は１、２年の長期に及ぶ火星飛行での健康管理にも役立つだろう」と話している。

（長内洋介）

Sankei Shimbun, Oct. 10, 2011

骨粗しょう症

防止薬 宇宙でも有効

徳大・松本教授ら発見

飛行士が服用し実証

地球上で、骨は重力による負荷を受けることで古い骨の破壊と新しい骨の形成のバランスを保っている。しかし、無重力状態では、バランスを崩して腰や脚の骨が破壊されやすくなる。

このため、長期間、宇宙に滞在した飛行士の骨密度は、寝たきりの高齢者と同じよう にもろく、折れやすくなる。破壊された骨は尿に溶け出し、宇宙飛行士は帰還後に尿路結石を起こしやすいという問題もあった。

古い骨の破壊を防ぐビスフォスネートは国内外で治療はおさなりになりがち。宇宙飛行士への効果が実証されたことで、治療に向けた利用を進めてほしい」と話した。（大塚康代）

徳島大学の松本俊夫教授（骨代謝学）が率いる宇宙航空研究開発機構（JAXA）と米航空宇宙局（NASA）との共同研究チームは、国際宇宙ステーションに長期滞在した宇宙飛行士の骨密度減少予防に、骨粗しょう症防止薬「ビスフォスフォネート」が有効であることを発見した。

実験には若田光一さん（48）、野口聡一さん（46）、古川聡さん（47）ら7人の宇宙飛行士が参加し、錠剤を週1回服用、帰還したばかりの古川さんらを除いた5人のデータを解析し、服用していない飛行士14人と骨密度を比較した。この結果、服用していない14人は飛行前に比べて6～7%低下したのに対し、服用した5人はほぼ変化がなかった。

松本教授は「寝たきり高齢者に対して、骨の破壊を防ぐ治療法が確立できる」と話している。

Tokushima Shimbun, Dec. 12, 2011

NASA提唱 体力トレーニング

月に向かってジャンプ

十一屋小、縄跳びに挑戦

国内初 18カ国参加

Hokkoku Shimbun, Feb. 9, 2012

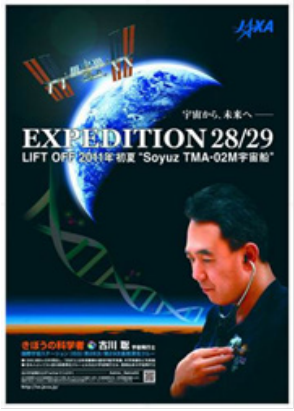
Interview with JAXA Astronaut, Satoshi Furukawa, crewmember of Expedition 28/29

JAXA astronaut, Satoshi Furukawa, stayed aboard the International Space Station from June 10, 2011, to November 22, 2011, as a crewmember of Expeditions 28/29.

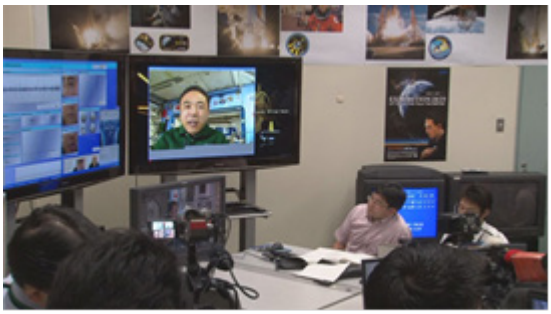
During his long duration stay, astronaut Furukawa conducted successful on-orbit experiments commissioned by several countries including Japan. As a medical doctor, he was particularly interested in the space biomedical experiments.

The JAXA Space Biomedical Research Office (J-SBRO) interviewed astronaut Furukawa on January 17, 2012, at the Tsukuba Space Center (TKSC), in order to ask him about the researches of space medicine and biology, and several topics regarding the on-orbit experiments as follows:

(1) On-orbit experiments in space medicine/biology
(2) Meaning of on-orbit experiments conducted by astronauts
(3) Ground-based experiments as parts of space biomedical research
(4) Outreach activities for space biomedical research
(5) Expectations for the Flight Crew Operations and Technology Department and J-SBRO.



Astronaut Furukawa commented on the precautions and measures taken to ensure the five on-orbit experiments as pertaining to J-SBRO, and his interest in the analysis results. He encouraged us to pursue ground-based research and outreach activities in order to obtain fruitful results, and gave his expectations for human space development activities in Japan. He also mentioned about low dose radiation exposure and vestibular adaptation upon returning from a microgravity environment to a gravitation environment. The interview brought about some suggestions on future space medical research.



Efforts of J-SBRO in Furukawa's long-term spaceflight

In coordination with astronaut Furukawa and the ISS press department, the JAXA Space Biomedical Research Office (J-SBRO) had provided several years of assistance in support of the astronaut's five commissioned space medical experiments during his long stay in space, and also conducted educational and public relation activities before the missions

were completed.

1. Space medical experiments

The on-orbit space medical experiments conducted include:

・Prophylactic use of Bisphosphonate as a countermeasure for space flight induced bone loss and runal stone

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

・Mycological evaluation of crew exposure to ISS ambient air

・Biomedical analyses of human hair exposed to long-term space flight

・Evaluation of Onboard Diagnostic Kit (for experiments led by the Space Environment Utilization Center)

2. "Challenge for Space Medicine!"

Ideas on studying physical changes in the human body under the space environment were solicited from the public. On the ten themes selected from among those proposed, pictures were taken in the KIBO experiment module. We assisted the ISS PR department in preparing the documented Procedures and a descriptive document of the pictures taken.

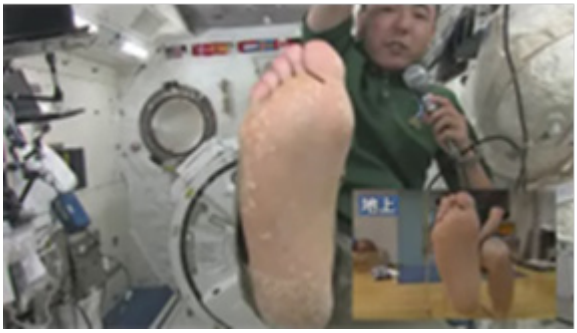
3. Recording of video data for educational use in space medicine

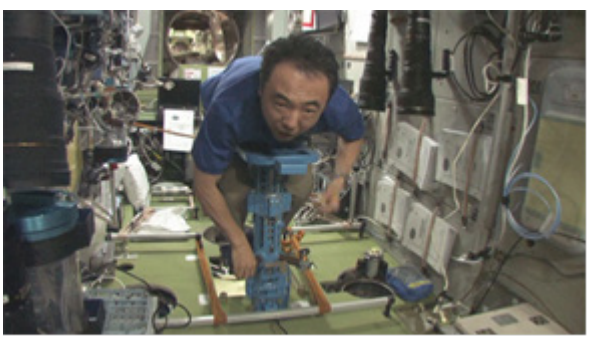
Simple and easy-to-understand video data on physical changes in the human body in space, equipment installed in the ISS, and space medical experiments were recorded, along with a narration in Japanese. We provide assistance in drafting, planning for scenarios, and capturing control images regarding the flight. It is expected that such video data will be used as educational material in schools and educational facilities.

4. Health promoting event: "Living in Gravity"

A telecommunications event with prevention care associations was organized as part of a new effort in telecommunications under the slogan, "Tips for a Healthy Long-Life Learned from Space Medicine.". A reduction in bone quantity and muscle atrophy are common medical issues for both astronauts and the elderly. This telecommunications event was organized because edification for effective prevention was deemed important and necessary. Ten associations committed to prevention care were chosen through public solicitation. A total of about 50 persons (five representatives of each association) participated in this event. They gathered at the Tsukuba Space Center (TKSC) on September 14, 2011, for two sessions. During the first session, J-SBRO officials gave lectures on space medicine, health, and longevity. The second session was devoted to live telecommunications with astronaut Furukawa and the presentation of the associations' activities.

J-SBRO was in charge of preparing and organizing the event, as well as preliminary seminars entitled "Tips for a Healthy Long-Life Learned from Space Medicine" for the associations. At the same time, the internal departments of JAXA assisted the ISS PR department. A brochure was prepared with assistance from the Japanese Society of Physical Fitness and Sports Medicine, the Japanese Orthopaedic Association, and the Japanese Association of Rehabilitation Medicine. A brochure in English was also prepared at NASA's request.





Report on meetings of scientific associations

In 2011, J-SBRO was involved in the administration of two meetings of scientific associations.

One was a meeting of the 57th Japanese Society of Aerospace and Environmental Medicine, held mainly at the Tsukuba Space Center (TKSC) on November 24 through 26, 2011. Astronaut Chiaki Mukai served as the meeting president. Its main theme was "Social Utility of Space Medicine." A total of 190 persons participated in the event, including 164 regular members, 12 postgraduate students, two university students, nine symposiasts, and three invited guests. Another 29 non-members also participated in lectures and symposiums opened to the public. The program included:

・ Seminar for certified physicians: "Deployment of Aeromedical Services in Devastated Northeastern Japan"
・Symposium organized by a group of young physicians: "Perspective of Space Medical Research"
・ Luncheon seminar: "Cosmic Rhythm and Human Rhythm - - 'Glocal' (a combination of global and local)"
・Meeting President's lecture: "What was learnt from Human Space Flight, and the Future"
JSASEM Symposium: "Japan's Human Space Flight: From the Past to the Future"
Open Symposium (1): "Utility of Space Medicine"
Special Lecture by Mr. Mamoru Mohri: "Why do humans challenge space?"
Open Symposium (2): "How are social issues related to the utilization of the KIBO module?"

The other meeting held in June 2011 was actually a session of the 28th biennial meeting of the International Symposium on Space Technology and Science (ISTS) held in the city of Ginowan, Okinawa. Our members were involved in the administration of the "Space Life Science" session. From the researcher and engineer of the inside and outside of space development of many countries presented the results and current status of their research and development activities in space and on the ground. This year's session was marked by many presentations on the theme of "radiation." Many members of the audience were captivated by the lectures, particularly in the wake of the disaster that struck northeastern Japan in March 2011.

At the symposium, our members also organized and administered a panel discussion on "Human exploration in space," presided over by astronaut Mukai. Several outside experts on space policy, space moral and culture, and earth observation, as well as astronaut Naoko Yamazaki, were featured as the panelists. They discussed human space flight from the viewpoints of philosophy, ideology and culture, while the audience had the opportunity to express their opinions. Thus, problem awareness was enhanced at the symposium.

Global Health Promotion – Improving health using space technology

From 2011 through early 2012, JAXA conducted a joint research with Keio University on "Collaboration with Keio University on the research of global health security using space technology". The purpose was to study what effects the global climate change and the population and economic growth in Asian region have on the public health, and also to do intensive studies of adaptation and mitigation plan to the transborder health problems by utilizing space technology like a remote sensing technology. These activities were expected to initiate new applications of the earth observation data to the field of public health. We set the research targets to identify the objects of utilization of space technology which were applicable to the public health and to adopt a policy of the study.

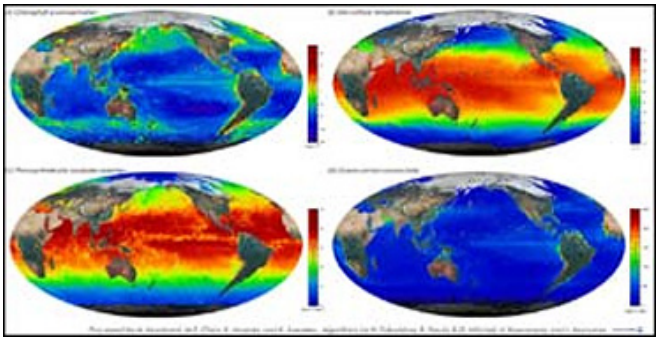
The JAXA study team consisted of key members from Earth Observation Research Center (JAXA lead and satellite team members), Space Biomedical Research Office (medical team members), and Legal Office (legal affairs team members). In Keio University, the Global Security Center (GSEC) played a major role as an anchor and a secretariat to coordinate and summarize the overall study in addition to the legal affairs study.

The research at the GHP was carried out from the view point of the two directions. First was (1) to select study themes which would contribute to improving both the quality of life in Japan and public health in the densely populated area in Asia.
Second was (2) to select the fields where it would be technically feasible to utilize space technologies to the study.

As a result of the discussion, following two promising fields have been selected which contains certain previous studies in early phase. We will proceed with the research to identify the study themes in these fields.
(1) Utilization of satellite remote sensing information to mitigate damage of pollinosis, some to call it as the "national malady" in Japan
(2) Feasibility of utilization of remote sensing technology to understand and predict the environment which is favorable to growth of vectors carrying infectious diseases.

In the future, we would like to promote the feasibility study in cooperation with external organizations both in Japan and International communities, including the World Health Organization (WHO), through which we should understand the requirement of the global health community for space technology utilization.

The picture from the ISS



The analysis picture of sea surface temperature

Messege from Head of J-SBRO

JAXA Space Biomedical Research Office (J-SBRO), established in 2007, has been conducting various space biomedical research for the purpose of reducing medical risks to astronauts on long-duration missions and promoting healthy, safe, and comfortable human space activities. The research area is categorized into five discipline fields below. Each of them covers both clinical space medicine research to improve health management of astronauts and basic research to elucidate fundamental mechanisms of the effects of space flight, In 2011, J-SBRO made a major contribution to develop a Scenario in the field of Space Medicine Research at the Working Group of the ISS and Kibo Utilization Promotion Committee. The scenario has been released in April 2012 and expected to advance Japan's space medical reseach.

1. Physiological countermeasures
Bone loss, urinary calculi, myofunction decline, exercise prescription, metabolism and nutrition, immune function decline, etc.
2. Psychological support
Effects of long-duration stay in an isolated environment, sleep and biological rhythm disorders, etc.
3. Radiation exposure control
The stochastic effect of space radiation exposure (physical measurement, biological measurement, etc.)
4. On-orbit medical care
Diagnosis/biomonitoring (simple self-diagnosis function), on-orbit diagnostic systems, etc.
5. The onboard environment
Monitoring of onboard environment, microbial flora in the body, etc.

At the end of JFY2011, five flight experiments were conducted in ISS, including four on-board experiments with Japanese astronaut Koichi Wakata in 2009, Soichi Noguchi in 2009 - 2010 and Satoshi Furukawa in 2011. Following them, new medical experiments selected through International Life Science Research Announcement in 2009 and other experiments using MEDAKA fish are in preparation. In parallel, we are promoting ground-based research toward future space experiments and "Lunar Surface Frontier Medicine" for future human space activities on the lunar surface.

In order to promote such a wide range of research with limited staffs in J-SBRO, collaboration with other JAXA and external researchers is needed. Thus far, we have performed joint researches and collaborations with 25 of research institutes and universities. With such collaboration, we plan to strengthen the efficient implementation system of space biomedical research for the future.

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 the 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."

Masafumi Yamamoto, Head of J-SBRO

J-SBRO All Members

J-SBRO Members (18)	
・Chiaki Mukai	JAXA Astronaut, Vice Director for Human Space Systems and Utilization Mission Directorate
・Masafumi Yamamoto	Head of J-SBRO
・Hiroshi Ohshima	Senior Researcher
・Hidetoshi Tsuchiya	Senior Engineer
・Yoshiyuki Honma	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
・Nguyen Minh Hue	Aerospace Project Research Associate
・Yumi Kanno	Partner
・Miyuki Hiratsuka	Partner
Concurrent Members (7)	
・Kazuhito Shimada	Chief Physician, 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
・Tomoko Ogasawara	Chief Physician, Astronaut Medical Operations Group
・Tagayasu Anzai	Physician, Astronaut Medical Operations Group
・Tamotsu Nakano	Space Education Center
Advisor, Invited Members (10)	
・Toshiko Ohta	Advisor, Emeritus Professor, PhD, University of Tsukuba
・Masamichi Sudoh	Invited Researcher, Professor, PhD, Jikei UniversitySchool of Medicine
・Hideo Tatsuzaki	Invited Researcher, Laboratory Head, MD, PhD, National Institute of Radiological Sciences
・Ken-ichi Iwasaki	Invited Researcher, Professor, MD, PhD, Nihon University
・Takeshi Nikawa	Invited Researcher, Professor, MD, PhD, University of Tokushima
・Koh Mizuno	Invited Researcher, Associate Professor, PhD, Tohoku Fukushi University
・Shoji Oda	Invited Researcher, Associate Professor, PhD, Universtiy of Tokyo
・Kazuhiro Terasawa	Invited Researcher, Assistant Professor, PhD, Keio University
・Naomune Yamamoto	Associate Senior Researcher, Lecturer, MD, PhD, Tokyo Women’s Medical University
・Ichiro Tayama	Inivited Engineer, Chiyoda Advanced Solutions Corporation
・Shigeru Aoki	Invited Researcher, Associate Senior Researcher, Shimizu 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 renal stone (International Proposal)	Toshio Matsumoto (Tokushima University) (PI) Toshitaka Nakamura (University of Occupational and Enironment Health), Kenjiro Koori (Nagoya-City University), Hiroshi Ohshima NASA's PI:Adrian LeBlanc (Universities Space Research Association)	on going
Physiological countermeasures	Biomedical analyses of human hair exposed to long-term space flight (Hair)	Shin Yamada, Reiko Nakao, Satoru Ishida, Tatsuya Aiba, Hiroshi Ohshima, Terada Masahiro, Noriaki Ishioka, Akira Higashibata, 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 (Biological Rhythms)	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, Toshiko Ohta, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai (PI) Collaboration: Teikyo University and Meiji Pharmaceutical University	on going
Medical technology on orbit	The effect of long-term microgravity exposure on cardiac autonomic function by analyzing 48-hours electrocardiogram (Biological Rhythms 48hrs)	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
Physiological countermeasures	Evaluations of physiological responses to space environmental stresses using medaka live imaging	Tomomi Watanabe-Asaka, Maki Niihori, Reiko Nakao, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Hiroshi Ohshima, Chiaki Mukai (PI) Collaboration: University of Tokyo, Ochanomizu University, Yamaguchi University	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)	Naoto Shiba (Kurume University) (PI) Hiroshi Ohshima, Shin Yamada	in preparation

（2）Ground-based Research Themes

Research field	Theme	Researcher	Status
Physiological countermeasures	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 countermeasures	Research on the disposition to space environmental stresses by *in vivo* imaging using medaka intestines	Tomomi Watanabe-Asaka, Maki Niihori, Reiko Nakao, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Hiroshi Ohshima, Chaiki Mukai (PI)	on going
Physiological countermeasures	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) Collaboration: University of Tokyo, Ochanomizu University, Yamaguchi University	on going
Physiological countermeasures	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
Physiological countermeasures	Investigation on the mechanisms of immune dysfunction in space environment	Nguyen Minh Hue, Toshiko Ohta, Chiaki Mukai(PI) Collaboration: RIKEN	
Space Radiation Protection	Biological effects on low dose rate and long-term exposure to space radiation	Aiko Nagamatsu, Tomomi Watanabe-Asaka, Nguyen Minh Hue, Chiaki Mukai (PI) Collaboration: National Institute of Radiological Sciences	on going
Space radiation protection	Research on biodosoimetry	Masaru Sato, Hideo Tatsuzaki, Chiaki Mukai (PI)	in preparation
Biomedical research utilizing the Antarctica Station	Biomedical research utilizing the Antarctica Station	Hiroshi Ohshima, Shin Yamada, Hajime Takeoka, Toshiko Ohta, Koh Mizuno, Naomune Yamamoto, Masahiro Terada , 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) Collaboration: Keio University	on going
Frontier medicine on the lunar surface	Medical treatment for health on the Moon	Yoshiyuki Honma, Hajime Takeoka, Hiroshi Ohshima, Shigeru Aoki, Chiaki Mukai (PI) Collaboration: University of Occupational and Environmental Health	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, Yoshito Kamiyama, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima, Chiaki Mukai (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, Nagoya City University , 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
The research for the development of nutritional therapy based on the oscillation of muscle atrophy-related genes	The National Institute of Advanced Industrial Science and Technology
Investigation on the mechanisms of immune dysfunction in space environment	RIKEN
Biological effect research on low dose rate and long-term exposure to space radiation	University of Tokushima , National Institute of Radiological Sciences
Biological rhythms & Biological rhythms 48hrs.	Tokyo Women's Medical University
Mycological evaluation of crew exposure to ISS ambient air (Myco)	Teikyo University, Meiji Pharmaceutical University
Research 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

Ⅰ. 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

Bone Loss and renal stones are well known as essential problems for astronauts during extended stays in space. The proximal femoral bone loses 1.5 percent of its mass per month or roughly 10 percent over a six-month stay in space. Bisphosphonate is one of therapeutic agents used for osteoporosis and it has been used for treating osteoporosis patients for more than a decade. Through 90-day bed rest research on Earth, we confirmed that this agent has a preventive effect in the loss of bone mass. Based on these results as well studies conducted by others, JAXA and NASA decided to collaborate on a space biomedical experiment on preventive bone loss during space flight. Dr. Leblanc, USRA and Dr. Matsumoto, Tokushima University are the two principal investigators of this study. Some JAXA and NASA crew members are participating this study by taking this agent once a week while in space. Our study is still ongoing, however, it dose appear that astronauts can reduce the risk of bone loss and renal stone risk by proper intake of appropriate nutrients, such as calcium and vitamin D, incorporating an effective exercise program, and taking minimum amounts of medication.

(Collaboration: The University of Tokushima, and The University of Occupational and Environmental Health, and Nagoya-city University)

Countermeasures for Physical Strength

Hiroshi Ohshima, Shin Yamada, Tomoaki Matsuo, Chiaki Mukai

1. Hybrid training method

Hiroshi Oshima, Shin Yamada

Hybrid training is a method of exercise that entails electrically stimulating antagonist muscles during movement, thereby giving motion resistance against the voluntary contraction of agonist muscles. This method is expected to be effective for strengthening muscles and countering reductions in bone mass under a load in the longitudinal direction. The method was adopted as one of the themes of life science research in the 2009 public offer for life science proposal applications. Ever since last year, this team has been committed to making preparations for on-orbit experiments, providing assistance braces for attaching electrodes, stimulating devices and a muscle strength dynamometer in a spacecraft, and examining a feasible exercise protocol during operation. Oxygen consumption during movement was also studied as part of an ground-based preliminary 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

In a microgravity environment, the volume load on the left ventricle is reduced and cardiac function deteriorates. Then, human's physical working capacity certainly decreases during spaceflight. In this situation, exercising using a bicycle ergometer can be a useful countermeasure. Many astronauts, however, experience controversial weight loss during spaceflight due to energy imbalances. It is logical to assume that excessive exercise can

promote an energy deficit and impact negatively on astronauts' weight management during long-term spaceflight. The purpose of this study is to develop JAXA's original exercise protocol that can control the increase of energy expenditure and prevent the deterioration of cardiac function and to verify its effectiveness through ground-based experiments. So far, our study revealed that our original exercise protocol controled increased energy expenditure and had a significant positive impact on subjects' cardiorespiratory fitness capacity. For future space missions, the results should be confirmed through actual spaceflight or simulated experiments (e.g., bed rest study). (Joint research with the University of Tsukuba/Professor Kiyoji Tanaka)

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 from Japan with its various strains, transparency and research history since the 1940's. Our purpose is to evaluate the influence of the space environment such as microgravity and space radiation on the human body using medaka and biological methods and create a better space environment by answering existing problems.

1. Live image evaluations of physiological responses to space environment using medaka 【an expected experiment on orbit】

To accomplish our purpose, we focus on alterations muscle activity, behavior and cardiac autonomic nervous system, and plan the experiment completed using remote image acquisition on orbit and analysis on the ground after data transfer.

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

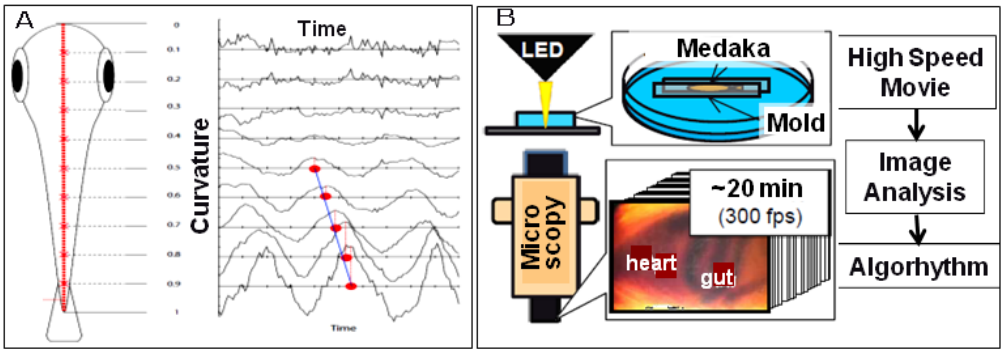
Microgravity and circadian rhythms influence skeletal muscle reduction and the activities of living organisms, respectively.

We are analyzing the pattern of the body axis movement and the behavior with our established calculation method (Fig. A).

3. Disposition of medaka intestines to space environment by *in vivo* imaging

We focus on the biological influences of radiation and microgravity, and have verified of these influences on the gut and cardiac autonomic system in medaka.

We executed the autonomic nervous function by our novel method and power spectral density analysis using a transparent medaka strain (Fig. B). Pathological analysis of medaka intestines after γ-ray irradiation is ongoing. (Collaborations with The University of Tokyo and Yamaguchi University)



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)

This study is being conducted to evaluate the effects of long duration stays in space on the human body, by analyzing the genes extracted from hair roots and the fluctuations in trace element distribution. Ten astronauts are participating as subjects in this experimental project. As of the end of 2011, the specified samples were collected from a total of eight subjects.

For hair root analysis, we have completed validation studies of a technique to extract efficiently genes from a limited quantity of samples and have already begun analyzing the gene expression level in the DNA microarray process. For the hair shaft, we have initiated quantitative analyses using an electron probe micro-analyzer (EPMA). The study focuse on the dynamics of gene expressions and calcium distribution that have some relationship with loss, in order to clarify the mechanism of body adaptation during a long stay in space. (Collaboration with professor Hideyuki Majima of Kagoshima University)

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, the skeletal muscle is decreased response to growth factors and increased proteolysis through the induction of some ubiquitin ligases, called muscle atropy-related genes (atrogenes). Some nutrients have been known to inhibit the expression of atrogenes during unloading condition, but thier effects are still controvertial. To develop into the nutritional therapy for muscle atrophy, we are planning to examine the appropriate time to intake the nutrients for inhibiting atrogenes based on the oscillation of them. To detect the time, when atrogenes express abundantly, we analysed the mRNA level of atrogenes in muscle of denervated mice. In our preliminary data, expression of the atrogenes at night phase was higher than that at light phase. This result may be significant to determine 'when' we should have diet for the effective treatment of muscle atrophy.

2. Changes of nutrients in space food after long duration space flight

Akiko Matsumoto, Ichiro Tayama and Chiaki Mukai

Certified JAXA space foods are now provided for JAXA astronauts on long-duration missions on the ISS. 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 have analyzed changes in the food after exposure to the space environment.

A package of Japanese space food samples was launched in April 2010 by the space shuttle and stored on the ISS. Space food samples were exposed to space environment for more than a year. After retrieving space food samples from the ISS in June 2011, changes of nutrients in the space foods were

analyzed. The analytes, including vitamins, lipoperoxide and amino acids, are susceptible to radiation damage. Therefore, JAXA Bio PADLES's data were 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.

Immunity

Nguyen Minh Hue, Toshiko Ohta, Chiaki Mukai

Investigation on the mechanisms of immune dysfunction in space environment

At the specific space environment, which is characterized by various aspects such as microgravity, isolated and closed ISS, and space radiation. Under such a circumstances, these can cause to human body risks like an aging process such as decreasing bone mass, muscle atrophy, sleep disorders and so on. Dysfunction of the immune response which directly render an astronaut's health such as infections after space flight mission is an urgent issue.

In previous studies, the decreased immune function due to space flight has the potential immune cell-mediated dysfunction, and gives risks of infection, carcinogenesis, allergic disease. However, these details of the effective mechanisms and immune disordered markers have not yet been clear.

We hypothesize that the environmental stress and/or exercise decreasing in space environment might cause into the immune dysfunction. Therefore, we are going to analyze the dynamics of immune-related genes expression and its phenotype appeared by lymphocyte subpopulation variation, using a simulated space environmental mouse model. In addition, identify the biomarkers for immune function evaluation by investigation of the cytokines target molecules dynamics in serum.

Analysing of these series experiments, we elucidate the mechanism of the immune response of the simulated space environment mouse model to obtain the data base for on-orbit experiment in the future.

(Collaboration with Research Center for Allergy and Immunology; Laboratory for Epithelial Immunobiology Team Leader, Dr. Hiroshi Ohno)

Ⅱ. Psychological Support

Sleep research

Akiko Matsumoto, Koh Mizuno, Tatsuya Aiba

Many aspects of human physiology, metabolism and behavior are dominated by 24-hour cycles including the sleep-wake cycle, alertness and performance patterns, and other physiological events. The 24-hour light-dark cycle is the primary environmental time cue that resets the internal circadian pacemaker.

Symptoms of shift-work include sleep disruption, excessive sleepness while awake, irritability, and a decrease in performance. In addition, night work is known to increase the risk of accidents and injuries. Several studies have shown that shift-work is also associated with increased risk of developing various disorders.

In the japanese experimental module "KIBO" control room of the JAXA Tsukuba Space Center, "Kibo" flight control team members have been working with 3 shift- cycle per day including a night shift, since non-stop 24-hr/7-day ISS KIBO operations started in June 2008. We believe that it is important to secure a safe and stable KIBO operations by improving health and sleep conditions of the

flight controllers. In 2011, we measured luminous intensities in several areas of the JEM flight control room, because alertness levels are affected by illumination. We further plan to investigate sleep condition of shift workers of JEM flight controllers and to develop countermeasures for sleep-related problems.

Ⅲ. Space Radiation Protection

Biological effects

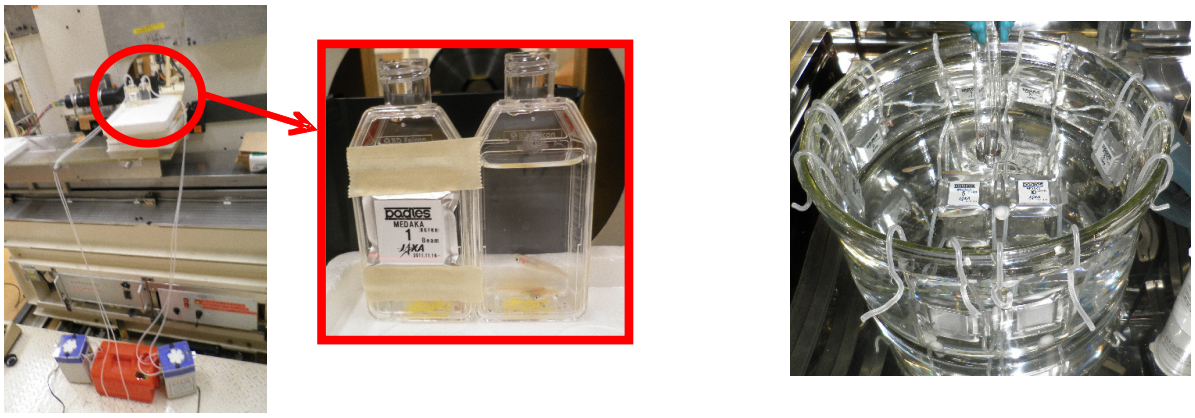
Aiko Nagamatsu, Tomomi Watanabe-Asaka, Riyo Yamanaka, Chiaki Mukai

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

Space radiation effects for crew member is one of the important risks during a long duration stay in the International Space Station (ISS) and expected future human space flights to the moon and Mars. We have analyzed the gene and protein expression based on microarray and TOF_mass spectrometry method induced by low-dose rate and low-fluence chronic irradiation with single source composing space radiation particles.

This study aims to evaluate RBE for the results of gamma ray sources Cs-137 and radiation effects obtained by irradiation tests with different LETs heavy charged particles and neutrons for human cultured cell and Medaka.

(Collaboration with The National Institute of Radiological Sciences: Masao Suzuki Ph.D)



Biodosimetry

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

In the management of astronaut exposure to cosmic radiation during a long stay in the ISS, measurements of physical dose taken with a passive personal dosimeter (JaCPD) based on thermoluminescent dosimetry (TLD-MSO) and a solid track detector (CR-39) are used. However, this technique does not allow us to distinguish between individual differences in sensitivity relative to an identical dose. In order to evaluate risk more precisely, a dose estimation technique should be used in combination with biodosimetry as the method of analyzing chromosomal aberration.

This study aims at verifying the applicability of a proven cytogenetic technique (analytical karyotyping) for estimating radiation dose, along with change of the abnormal chromosome numbers in peripheral blood lymphocytes. The estimation of radiation dose in space can apply to manage the exposure of

Japanese astronauts to cosmic radiation.

The methods of evaluation and analysis have been verified to date, with the problems encountered during analytical sampling having been identified, and applicability of this technique to Japanese astronauts now being verified. Findings in the research will be used to apply biodosimetry to the health management of astronauts during long stays in the ISS and also conduct further analyses.

Ⅳ. 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

Disruption of circadian rhythm are not only associated with an enhanced risk of cardiac disease, but also induce variety of other disease, such as metabolic disorder. Biological clocks are known to be affected by external stimulation, such as light and darkness cycle and micro gravity. However, previous data suggested that diminished circadian pacemaker rhythm and lead to eventual sleep problems in astronauts during short duration flight (less than 4 month), no data existed during long flight about the change of circadian rhythms. Therefore, we evaluated the change of circadian rhythms during long space flight (more than 6 month). Measurement RR-intervals variability for 24 hours can reflect the circadian rhythm on cardiac autonomic nerve function. Therefore, we conducted continuous 24-hour RR intervals measurement in six crews for preliminary data of this project. At first, most major RR interval cycle rhythm of the astronauts were extended to more than 24 hours on day 30 after the launch, however, RR interval cycle rhythm were gradually approaching 24hour and the power of circadian rhythm of the RR intervals of the astronauts was observed most clearly on day 180 after the launch. Especially, the power of parasympathetic nerve function tended to recover as a longer flight. In conclusion, these data suggested that the circadian rhythm of astronauts were enhanced during long space flight. (Collaboration: Tokyo Women's Medical University/Professor Kuniaki Otsuka)

Ⅴ. 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)

This study aims at analyzing the microorganisms that are adhered on, or inhaled into a crewmember's body in the ISS over time, in order to describe their formation and change processes. The study particularly focuses on an dermal fungal flora *Malassezia* which can cause skin inflammation and allergy.

All planned samplings including those for on-orbit experiments (from 10 shuttle crewmembers and 10 ISS crewmembers) were

completed this year. Most of the samples have already been returned to the ground are now being analyzed. The analyses conducted to date show that samples from airway mucosa tend to allow the culturing of fewer bacterial colonies in orbit, while the amount of *Malassezia* settled on skin (cheek and anterior chest) in orbit increases up to several times that on the ground, and then drops after returning to the ground to lower than that prior to launch.

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

Ⅵ. 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

1. Research related to effects on biological rhythms

The situation of overwintering Antarctic expedition is considered to be partially analogous with long duration space mission, which is characterized by long duration sojourn in an isolated environment with small number of members executing specialized missions. From this viewpoint, J-SBRO conducted data collection of human circadian rhythms in the wintering members of the 50th (2009-2010) and 51th (2010-2011) parties of Japanese Antarctic Research Expedition (JARE). In each of the parties, 6 members participated in the study, and a series of measurements comprised of a standardized questionnaire to answer past one month of sleep, 1-week actigraphy to assess sleep/wake rhythm, and 24-hours holter ECG monitoring with nocturnal EEG measurement, were performed in March, June, September and December. Whereas the findings in subjective and objective evaluation of nocturnal sleep showed almost normal throughout the sojourn, delayed sleep phase with decreased daily activity was observed in winter (June). At this time, circadian rhythm of cardiac parasympathetic index revealed significantly prolonged cycle length, although the cycle length of cardiac sympathovagal balance was within the normal range of circadian rhythm. Further analyses have been ongoing to examine the effect of activity rhythm and sleep quality on cardiac autonomic nervous activity.

2. Research related to the improvement of muscle training

JARE party have extended stays in extreme isolated environments, and their physical activities are reduced during the Antarctic winter. We performed an experiment to evaluate the hybrid training system (HTS) for 1) training effect and 2) operational feasibility in this isolated environment. This system has been selected as a flight theme of International Life Science Research Announcement - ILSRA 2009 utilizing the ISS. Ten subjects were recruited from the 50th JARE. Knee extension and flexion training was performed for 19-minutes. The training was performed three times a week for 16 weeks during the Antarctic winter. Simple knee exercises were performed for the first half (8 weeks), and HTS for the latter 8 weeks. Strength of knee flexion and extension etc. were measured, and operative problems were also evaluated. Six of the ten subjects accomplished the experiment, and there were no adverse effects observed. Knee flexion force increased approximately 45% after the hybrid training, though the changes were not observed in other evaluations. Several pointers were obtained for

developing a more user-friendly electrical stimulation control box and improving the wearable electrode attachments. We are now preparing a flight experiment for the japanese space station astronaut using the upgraded HTS, which has been modified from the knowledge obtained from this analogue simulation study in Antarctica. (Collaboration project with professor Naoto Shiba of Kurume University)

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

This study is being conducted to analyze the gene expressions in hair roots and the distribution of trace elements in hair shafts. The sampling of hair specimens was conducted four times, every three months, with the cooperation of members of the 51st wintering team staying in the Antarctic. The elements involved in bone metabolism were analyzed with ICP-MS. Ca, Zn, and Mn were able to be detected, and thus these elements were deemed as being useful for examining the effects under microgravity. In addition to hair samples obtained in the on-orbit operation, those extracted from hair roots were subjected to microarray analysis to compare both in terms of gene expression.
(Collaboration: Kagoshima University/Professor Hideyuki J. Majima)

4. Mycological evaluation of human skin exposed to the antarctic environment

(1) Analysis of bacteria on skin and enterobacterial flora

(2) Analysis of bacterial flora in a human living environment

Human skin scales were sampled by using a tape-stripping method to evaluate the microbiological conditions of the human skin. Skin microbe DNA was extracted from these scales in order to attempt amplification and quantification. *Malassezia* (a fungus that can cause skin inflammation and allergy) showed its tendency to increase on the human body (especially on the scalp) during a stay in the Antarctica. The distribution of bacteria in the intestines also showed some variation. A questionnaire survey is being conducted on related symptoms and living conditions to obtain supportive evidence. (Collaboration with professor Koichi Makimura of Teikyo University, and associate professor Takashi Sugita of Meiji Pharmaceutical University)

Ⅶ. 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

During a stay on the Moon and a human exploration mission to Mars, crewmembers must adapt to a changing gravitational environment that largely differs from that on Earth. This study aims at describing the requirements for walking without falling in a variable gravitational environments.

We used suspending devices to simulate walking actions on the Moon (1/6 G) and on Mars (1/3 G). In 2010, a new mobile suspending device was introduced to make analyses sufficiently sophisticated to consider the shift in horizontal body weight. The ground reaction force was found reduced in the damping direction under the 1/6 G weight condition, thus increasing the risk of falling. We also examined reliability of the suspending device focusing on fluctuation of the traction force during the unloading of weight. We hope that the results of these experiments and

analyses can be utilized for designing spacesuits and configuring training conditions for future human exploration of Mars. This joint research was conducted with professor Meigen Liu of Keio University.
(Collaboration: Keio University/ Professor Meigen Liu)

Research of Health and Medical Examination on Lunar Surface

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

1. Research on lunar dust

Under the low gravity environment of the Moon where the falling velocities of objects are much lower, there could be a risk of inhaling lunar dust suspended in pressurized areas of the base on the lunar surface. The dust deposited on the spacesuit of an astronaut could be brought into these areas. The inhaled dust could also eventually cause health disorders.

We conducted experiments using simulated moon dust onboard an aircraft and verified the relationship between gravity and the precipitating velocity according to the size of dust particles. Results of the experiments were used to examine preventive measures against health disorders that may be caused by inhaled moon dust, with a view toward establishing the management of health, operational environment, and operation, while considering the physicochemical properties of moon dust. The following guidelines have thus been drafted on preventing health disorders caused by lunar dust.

■ Health management: medical examinations and health guidance/education before, during and after a flight by a team of experts led by a flight surgeon capable of judging respiratory diseases.

■ Operational environment management: measurement of moon dust density, elimination of dust sources, improvement of operation processes, ventilation adapted to current contamination in an environment containing moondust, in order to improve the operational environment.

■ Operation management: use of anti-dust masks and other respiratory protectors in locations whose safety has not been verified, periodic examination of protector performance, and periodic replacement of filters

(Collaboration with 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)

2. Research of medical examination on lunar surface

Compact, universal, high-precision autonomous examination devices are needed to diagnose diseases during missions involving a stay on the lunar surface, and to detect

bacteria in the environment.

We have examined freeze-dried reagents for use in the ISS and during stays on the Moon. Our examinations focused on the use of Loop-Mediated Isothermal Amplification (LAMP) applicable to DNA amplification at normal temperatures without using a thermal cycler.

This year, the results of research conducted to date were gathered and reviewed, and our study on lunar surface medicine was closed. LAMP technology will be studied in the next phase (downsizing of equipment), along with other proposed themes during the second-phase use of the KIBO module.

Lunar Radiation

Aiko Nagamatsu, Kazuhiro Terasawa, Chiaki Mukai

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

Manned space mission on the Moon or Mars will be expected after ISS operation. The space radiation environment beyond the low earth orbit (LEO) is extremely different from the LEO's one, and the influence of space radiation upon human activity is estimated to be grater. Manned mission success will be affected remarkably by the doses beyond the LEO.

We also have strategies for space radiation measurement with following two activities:

■ Development of the real-time radiation monitoring device-V (RRMD-V) onboard the lunar satellite SELENE-2 Lander; we will evaluate lunar radiation environments with RRMD-Ⅴ to research of biological effects on the moon, and administration for radiation protection of astronauts before human lunar mission starts .

■Development of the position sensitive tissue equivalent proportional chamber for ISS 'Kibo' ;

we obtained the response data by ground performance test using the HIMAC heavy particle accelerator at the National Institute of Radiological Sciences (NIRS). It will be expected the measurement start from 2014 onboard the ISS 'Kibo'.

Ⅷ. 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)

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 was opened to the public on May, 2011, and over 20,000 people visited our exhibition room during 8 months.

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.

<Reference:
http://www.jaxa.jp/visit/tsukuba/tour_e.html >

2. Space medical science video content

We have developed scenarios with teachers, in order to provide appropriate and effective

education materials using the video. We filmed the video content with the theme of ″Space Medical Science″ on orbit with Japanese astronaut, Satoshi Furukawa, who stayed in ISS.

And we will continue to produce effective education materials for educators. This project is collaborated with JAXA Space Education Center.

<Reference:
http://iss.jaxa.jp/iss/jaxa_exp/furukawa/exp2/igaku/
(in Japanese) >

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, named after “Mission X: Train Like an Astronaut” (hereinafter called simply “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, and we believe that Mission X is worth continuing in order to help educate students on instilling and adopting good nutrition and physical fitness as life-long practices. In October, 2011, we had an event, which was named ″Mission X in Koriyama, Fukushima″, in order to cheer up the people who are earthquake victims. This event was collaborating with JAXA space education center and student volunteers.

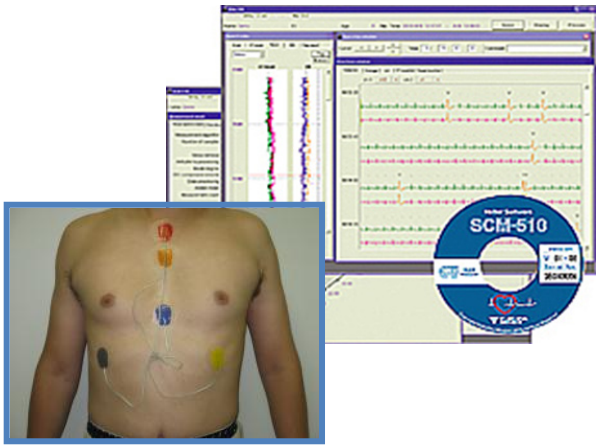
We are continuing the public outreach to promote public understanding of science and making contributions to science education through lectures on astronautical specialties and knowledges.

Ⅸ. Loading Preparation/Operation of On-orbit Experiments

Loading Preparation/Operation of On-orbit Experiments

Satoru Ishida, Tatsuya Aiba, Ichiro Tayama, Chiaki Mukai

We are conducting on-orbit experiments and preparing for others in order to acquire medical research data on ISS astronauts. Our activities include preparatory work for mounting experimental equipment on the rocket, establishing experimental procedures, providing preflight astronaut training, acquiring baseline data before and after a flight, making adjustments to experimental resources, conducting on-orbit experiments, and recovering acquired data and samples. In 2011, the three-year-old missions involving "experiments for identifying biological rhythm" and "collection of bacteria in the ISS," in which astronaut Satoshi Furukawa also participated, were successfully completed.



Our Activities

J-SBRO Meetings

Advisory committee on Human Space Technology
Subcomitte on Space Biomedical Research

	Date		Agenda
31th	Apr. 25, 2011	Tokyo	・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)
32th	Jul. 13, 2011	Tokyo	・Biological effects on low dose rate and long-term exposure to space radiation ・Swinming behavior and muscle activities under microgravity environment using medaka ・Investigation on the mechanisms of immune dysfunction in space environment
33th	Feb. 8, 2012	Tokyo	・Bipedal walking on the Moon: simulation studies on how to prevent falling ・Medical treatment for health on the Moon
34th	Feb. 29, 2012	Tokyo	・Research on the disposition to space environmental stresses by in vivo imaging using medaka intestines ・Swinming behavior and muscle activities under microgravity environment using medaka ・The research for the development of nutritional therapy based on the oscillation of muscle atrophy-related genes. ・Investigation on the mechanisms of immune dysfunction in space environment

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
How to save you from decline of immune functions	May. 24, 2011	Tokyo	Shimada, Kazuhito, Chief Physician, JAXA Hiroshi Kiyono, Prof., University of Tokyo Kiyoshi Takeda, Prof., Osaka University Hiroshi Ohno, Team Leader, RIKEN Masanobu Nanno, General Manager, Yakult Central Institute Kazunhiro Kondo, Prof., Jikei UniversitySchool of Medicine
Health promotion	Feb. 1, 2012	Tokyo	Hiroshi Ohshima, Senior Researcher, JAXA Toshio Matsumoto, Prof., Tokushima University) Kenjiro Koori, Prof., Nagoya-City University Hitoshi Shimano, Prof., University of Tsukuba Kiyoji Tanaka, Prof., University of Tsukuba
Sleep cycle, biological rhythms	Feb. 20, 2012	Tokyo	Koh Mizuno, Invited researcher, JAXA Kuniaki Ohtsuka, Prof., Tokyo Women's Medical University Masaya Takahashi, Senior fellow, National Institute of Occupational Safety and Health Kazuo Mishima, Director, National Institute of Mental Health

Seminars

Theme	Date		Lecturer
Nutrition and risk in space environment	Feb. 28, 2012	Tsukuba	Kotaro Doyama, Associate Senior Engineer, JAXA Akiko Matsumoto, Chief Physician, JAXA Yasuo Kagawa, Vice President, Kagawa Nutrition University Tohru Kikuchi, Radio Isotope Center, Jichi Medical University Takahiro Inakuma, Kagome Research Institute

Kibo Utilization Promotion Committee

	Date		Agenda
3rd	Apr. 28, 2011	Tokyo	・Space medical research activities in the world.
4th	Jan. 11, 2012	Tokyo	・ISS & "Kibo" utilization aiming in space medicine area

Chiaki Mukai and Hiroshi Ohshima were the members of the Kibo Utilization Promotion Committe.

J-SBRO Facility Tours

1. University of Tsukuba
2. Nihon University
3. Kitasato University
4. Sacience Summer Camp
5. Tstukuba Science Casting Workshop
6. Shinshu University
7. Keio University
8. Tokai University Boyo Senior High School
9. Japan Society of Aerospace and Environmental Medicine
10. Jikei University School of Medicine
11. Toneyama National Hospital
12. Oita University

Chiaki Mukai

○Symposiums
1. Chiaki Mukai, 20th anniversary lecture, Chiaki Mukai Children's Science Museum, May 5, 2011, Tatebayashi (in Japanese)
2. Chiaki Mukai, Why do human beings go to ousterspace?, Yonsei University, May 12, 2011, Wonju
3. Chaiki Mukai, Space Life science for helping people on earth, 2nd Annual Meeting of the Korean Microgravity Society, May. 13, 2011, Wonju
4. Chiaki Mukai, Outreach programs in Japan., The 1st international:envihab Symposium, May 24, 2011, Cologne
5. Chiaki Mukai, Space for Humanity ～ Towards the Next Stage of Exploration ～, The 28th International Symposium on Space Technology and Science, Jun. 6, 2011, Ginowan
6. Chiaki Mukai, Human Exploration in Space, The 28th International Symposium on Space Technology and Science, Jun. 7, 2011, Ginowan
7. Chiaki Mukai, Global Health Security Using Space-Based Assets -Technical Session: Forecasting Natural Disasters Using Space-Based Assets-, Association of Space Exolorers XXIV Congress, Sep. 8, 2011, Moscow
8. Chiaki Mukai, Expectation for the Space supporting a life, Earth Obsavation Symposium, Sep. 21, 2011, Tokyo (in Japanese)
9. Chiaki Mukai, The importance of reaching out to society - Education enables us to envision and pursue our dreams-, International Astronautical Congress, Oct. 7, 2011, Cape town
10. Chiaki Mukai, Space for Humanity-Towards the Next Stage of Space Exploration-, Delft University of Technology, Oct. 26, 2011, Delft
11. Chiaki Mukai, The JapaneseSchool of Amsterdam, Oct. 27, 2011, Amsterdam
12. Chiaki Mukai, Dutch & Japanese Trade Federatin Symposium, Oct. 27, 2011, Amsterdam
13. Chiaki Mukai, Congress President Lecture, 57th Japanese Society of Aerospace and Environmental Medicine, Nov. 25, 2011, Tsukuba (in Japanese)
14. Chiaki Mukai, Fifty Years of Human Space Flight-from Gagarin to the Next Stage of Exploration-, Saint Petersburg State University, Nov. 30, 2011, Saint Petersburg

○Mass Media
1. Chiaki Mukai, 30 years of the space shuttle program, Takarajimasha Inc., 2011 (in Japanese)
2. Chiaki Mukai, JAXA's No.039, Japan Aerospace Exploration Agency, 2011 (in Japanese)
3. Chiaki Mukai, NHK, 2011 (in Japanese)
4. Chiaki Mukai, Jomo-Shinbun, 2011 (in Japanese)
5. Chiaki Mukai, Nikkei Shinbun, 2011 (in Japanese)
6. Chiaki Mukai, The welfare/care machinery TECHNO PLUS, Japan Industrial Publishing co., ltd., 2011 (in Japanese)
7. Chiaki Mukai, Asahi Shinbun, 2011 (in Japanese)
8. Chiaki Mukai, Manyo-sya Inc., 2011 (in Japanese)
9. Chiaki Mukai, NHK Radio, 2011 (in Japanese)
10. Chiaki Mukai, Japanese Psychiatric Nurses Association, 2011 (in Japanese)
11. Chiaki Mukai, NHK Gunma, 2012 (in Japanese)

Physiological Countermeasures

Bone Loss

○Reviews/Books
1. Hiroshi Ohshima, Peventing Bone Loss in Space Flight with Prophylactic Use of Bisphosphonate: Health Promotion of the Elderly by Space Medicine Technologies. *in Benefits of ISS Research, NASA HP* (http://www.nasa.gov/mission_pages/station/research/benefits/bone_loss.html).

○Symposiums
1. Hiroshi Ohshima, Countermeasure in trhe 90 d Toulouse long term male bed rst syudy and the lumbar spine, 18th IAA Human in Space Symposium, Apr. 13, 2011, Houston.
2. Adrian LeBlanc, Toshio Matsumoto, Jeffrey A. Jones, Jay Shapiro, Thomas F. Lang, Linda C. Shackelford, Scott M. Smith, Harlan Evans, Elisabeth Spector, Robert Ploutz-Snyder, Jean Sibonga, Toshitaka Nakamura, Kenjiro Kohri, Hiroshi Ohshima, Antiresorptive treatment for spaceflight Induced bone atrophy-preliminary results, 18th IAA Human in Space Symposium, Apr. 13, 2011, Houston.
3. Daniel L.Belavy, Hiroshi Ohshima, Marie-PierreBareille, J¨orn Rittweger, Dieter Felsenberg, Countermeasures in the 90d Toulouse long-term male bed-rest (LTBR) study and the lumbar spine., 18th IAA Human in Space Symposium, Apr. 13, 2011, Houston.
4. Adrian LeBlanc, Toshio Matsumoto, Jeffrey A. Jones, Jay Shapiro, Thomas F. Lang, Linda C. Shackelford, Scott M. Smith, Harlan Evans, Elisabeth Spector, Robert Ploutz-Snyder, Jean Sibonga, Toshitaka Nakamura, Kenjiro Kohri, Hiroshi Ohshima, Antiresorptive treatment for spaceflight Induced bone atrophy-preliminary results. Sep. 16, 2011, San Diego.

Physical Strength

○Original Papers

1. Tomoaki Matsuo, Satoshi Seino, Kazunori Ohkawara, Kiyoji Tanaka, Shin Yamada, Hiroshi Ohshima, Chiaki Mukai, A preliminary exercise study of japanese version of high-intensity Interval aerobic training (J-HIAT), *Transactions of JSASS, Aerospace Technology Japan*, ***in press.***
2. Daniel L.Belavy, Hiroshi Ohshima, Marie-PierreBareille, J¨orn Rittweger, Dieter Felsenberg: Limited effect of fly-wheel and spinal mobilization exercise countermeasures on lumbar spine deconditioning during 90 d bed-rest in the Toulouse LTBR study, *Acta Astronautica*, 69, 406-419, 2011.

○Reviews/Books

1. Hiroshi Ohshima, Health care for astronauts and rehabilitation for senor citizen -countermeasure program of bone loss and muscle atrophy for astronauts-, *Fukushi-Kaigo Technoplus*, 4(9), 11-14, 2011. (in Japanese)
2. Hiroshi Ohshima, Bone loss countermeasure program for astronauts and health promotion for eldery people, *Journal of Clinical Rehabilitation*, 20(10), 922-928, 2011. (in Japanese)
3. Shin Yamada, Space medicine and rehabilitation medicine, *Journal of Clinical Rehabilitation*, 20(10), 904-913, 2011. (in Japanese)
4. Ken Aoki, Yojiro Ogawa, Ken-ichi Iwasaki, Chiaki Mukai, Approach to elucidating the influences and factors affecting circulation system in humans in space environment, *Environmental Health and Preventive Medicine*, 66(3), 568-572, 2011. (in Japanese)

○Meetings

1. Hiroshi Ohshima, Shin Yamada, Yoshito Kamiyama, Shino Kawashima, Physical training program for Japanese space station astronauts, The 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.
2. Tomoaki Matsuo, Satoshi Seino, Kazunori Ohkawara, Kiyoji Tanaka, Shin Yamada, Hiroshi Ohsima, Chiaki Mukai, An effective and efficient exercise protocol to prevent deterioration of cardiac function during long-term space flight: A preliminary study, The 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.
3. Hiroshi Ohshima, Human Space flight and rehabilitation, The 21st Cerebral Vascular Symposium, Sep. 10, 2011, Osaka. (in Japanese)
4. Tomoaki Matsuo, Kazunori Ohkawara, Satoshi Seino, Shin Yamada, Hiroshi Ohshima, Kiyoji Tanaka, Chiaki Mukai, Effects of cycling protocols on excess post-exercise energy expenditure. The 66th Japanese Society of phsical fitness and Sports Medicine, Sep. 16, 2011, Shimonoseki, Yamaguchi. (in Japanese)
5. Tomoaki Matsuo, Masamichi Sudoh, Shin Yamada, Hiroshi Ohshima, Satoshi Kurihara, Chiaki Mukai, An exercise protocol to prevent deterioration of cardiac function during long-term space flight (A Preliminary Study), The 128th Seiikai, Oct. 6, 2011, Tokyo. (in Japanese)
6. Tomoaki Matsuo, Shin Yamada, Hiroshi Ohshima, Ken-ichi Iwasaki, Masamichi Sudoh, Chiaki Mukai, An exercise program to prevent deterioration of cardiac function during long-term space flight, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)
7. Yoshito Kamiyama, Hiroshi Ohshima, Shin Yamada, Shino Kawashima, Countermeasure systems onboard the international space station, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)
8. Hiroo Matsuse, Naoto Shiba, Takashi Nago, Yoshiro Takano, Shin Yamada, Hiroshi Ohshima, Yoshihiko Tagawa, Oxygen comsumption during ergometer exercise with hybrid training system, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)
9. Naoto Shiba, Hiroo Matsuse, Takashi Nago, Masayuki Omoto, Hiroshi Ohshima, Shin Yamada, Development of the hybrid training system for the disuse atrophy of the musc uloskeletal system of the astronauts staying in the international space station for a long term, The 89th Annual Meeting of the Physiological Society of Japan, Mar. 31, 2012, Matsumoto. (in Japanese)

○Symposiums

1. Shin Yamada, Effect of long-term space flight on human body and its countermeasures, Teikyo University Space Environmental Medicine 5th Open Lecture, Sep. 3, 2011, Tokyo. (in Japanese)
2. Tomoaki Matsuo, Workshop ″Variable factors of total daily energy expenditure in humans″ The 66th Japanese Society of phsical fitness and Sports Medicine, Sep. 17, 2011, Shimonoseki, Yamaguchi. (in Japanese)
3. Tomoaki Matsuo, Exercise trainings for astronauts. The 1st Tsukuba Space Frontier Forum Oct. 29, 2011, Tsukuba. (in Japanese)
4. Tomoaki Matsuo, Young Researchers' Symposium "Exercise sciences and microgravity environment" The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)
5. Tomoaki Matsuo, Exercise sciences and microgravity environment, The 82nd Annual Meeting of the Japanese Society for Hygiene, Mar. 26, 2012, Kyoto. (in Japanese)

Team MED

○Original Papers

1. Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Shoji Oda, Ken-ichi Iwasaki, Masamichi Sudoh, Shin Yamada, Hiroshi Ohshima and Chiaki Mukai, Technologies to analyze the movement of internal organs by high-speed movies using medaka, *Transactions of JSASS, Aerospace Technology Japan*, ***in press*** .

○Reviews/Books

1. Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Ken-ichi Iwasaki, Shoji Oda, Shoji A. Baba, Shuji Terai, Katsuhiko Ohmori , Hirosih Mitani and Chiaki Mukai, Evaluations of Physiological Responses to Space Environmental Stresses Using Medaka Live Imaging, *Journal of The Japan Society of Microgravity Application*, 28(3), 55-61, 2011. (in Japanese)

○Meetings

1. Tomomi Watanabe-Asaka, Maki Niihori, Masahiro Terada, Shoji Oda and Chiaki Mukai, "Technologies to analyze the movement of internal organs by high-speed movies using medaka" The 28th International Symposium on Space Technology and Science, Jun. 5, 2011, Ginowan, Okinawa.
2. Tomomi Watanabe-Asaka, Maki Niihor, Shoji Oda, Ken-ich Iwasaki, Chiaki Mukai, Analysis of the heart rate fluctuations by high-speed movies using medaka, The 7th European Zebrafish Meeting, Jul. 5, 2011, Edinburgh.
3. Tomomi Watanabe-Asaka, Maki Niihori, Shoji Oda, Ken-ichi Iwasaki, Shuji Terai, Hiroshi Mitani and Chiaki Mukai, Analysis of autonomic nervous activities from the movement of internal organas by high-speed movies using medaka, The 17th Japanese Medaka and Zebrafish Meeting, Sep. 8, 2011, Mishima, Shizuoka.
4. Maki Niihori, Tomomi Watanabe-Asaka, Shoji A. Baba, Shoji Oda, , Establishment of the swiming analysis technique by high-speed movies using medaka, The 17th Japanese Medaka and Zebrafish Meeting, Sep. 8, 2011, Mishima, Shizuoka.
5. Tohko Takeyama, Shoji Oda, Tomomi Watanabe-Asaka, Maki Niihori, Behavioral analysis of the impact on heard behavior of aged medaka, The 82nd Annual Meeting of the Zoological Society of Japan, Sep. 21, 2011, Asahikawa. (in Japanese)
6. Shoji Oda, Yoshihiko Katada, Tohko Takeyama, Tomomi Watanabe-Asaka, Maki Niihori, Hiroshi Mitani, 24 hours monitoring of medaka behavior, The 82nd Annual Meeting of the Zoological Society of Japan, Sep. 21, 2011, Asahikawa. (in Japanese)
7. Tomomi Watanabe-Asaka, Maki Niihori, Shoji Oda, Ken-ichi Iwasaki, Shuji Terai, Hiroshi Mitani and Chiaki Mukai, Analysis of autonomic nervous activities in internal organs using high-speed movies in medaka, The 25th Annual Meeting of Japanese Society for Biological Sciences in Space, Sep. 30, 2011, Yokohama. (in Japanese)
8. Maki Niihori, Tomomi Watanabe-Asaka, Masahiro Terada, Reiko Nakao, Shoji A. Baba, Shoji Oda, Analysis and evaluation of swimming behavior using images in medaka, The 25th Annual Meeting of Japanese Society for Biological Sciences in Space, Sep. 30, 2011, Yokohama. (in Japanese)
9. Tomomi Watanabe-Asaka, Maki Niihori, Shoji Oda, Kenichi Iwasaki, Tatsuya Aiba, Chiaki Mukai, Development of a method of measuring cardiac autonomic nervous activity using medaka high-speed movie, TX technology showcase in Tsukuba 2012, Jan. 13, 2012, Tsukuba. (in Japanese)
10. Shoji Oda, Yoshihiko Katada, Toshikazu Yamashita, Tomomi Watanabe-Asaka, Maki Niihori, Shoji A. Baba, Study of movement in medaka symposium on image science and bio-imaging forum, Mar. 5, 2012, Okazaki, Aichi. (in Japanese)
11. Shoji Oda, Tomomi Watanabe-Asaka, Maki Niihori, Ken-ichi Iwasaki, Masahiro Terada, Masamichi Sudoh, Hiroshi Mitani, Chiaki Mukai, Medaka as an experimental model system for vertebrate autonomous nervous system study, The 89th Annual Meeting of the Physiological Society of Japan, Mar. 29, 2012, Matsumoto. (in Japanese)

○Symposiums

1. Tomomi Watanabe-Asaka, Space medicine and analysis autonomic nervous activity in medaka, 3rd "Using small fish promoting network to use small fish models for medicine and drug discovery", Feb. 2, 2012, Okazaki. (in Japanese)
2. Tomomi Watanabe-Asaka, Aiming for medaka space experiments to evaluate physiological impacts in space, The 82nd Annual Meeting of the Japanese Society for Hygiene, Mar. 26, 2012, Kyoto. (in Japanese)

Hair

○Original Papers

1. Masahiro Terada, Fuminori Kawano, Noriaki Ishioka, Akira Higashibata, Hideyuki J Majima, Takashi Yamazaki, Tomomi Watanabe-Asaka, Maki Niihori, Reiko Nakao, Shin Yamada, Chiaki Mukai, Yoshinobu Ohira, Biomedical analysis of rat body hair after hindlimb suspension for 14 days, *Acta Astronautica*, 73, 23-29, 2011.
2. Riyo Yamanaka, Shin Yamada, Masahiro Terada, Tatsuya Aiba, Satoru Ishida, Hiroshi Ohshima, Yoshinobu Ohira, Hideyuki Majima, Chiaki Mukai, Peliminary studies for "Biomedical analysis of human hair exposed to a long-term Space Flight (Hair)" Project: An analysis of trace elements in the hair, *Transactions of JSASS, Aerospace Technology Japan*, *in press*

○Meetings

1. Masahiro Terada, Reiko Nakao, Shin Yamada, Riyo Yamanaka, Hideyuki Majima, Takashi Yamazaki, Akira Higashibata, Noriaki Ishioka, Hiroshi Ohshima, Chiaki Mukai, The genetic analysis on the hair roots from one or five strands of human hair, 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.
2. Riyo Yamanaka, Shin Yamada, Masahiro Terada, Tatsuya Aiba, Satoru Ishida, Hiroshi Ohshima, Yoshinobu Ohira, Hideyuki Majima, Chiaki Mukai, Peliminary studies for "Biomedical analysis of human hair exposed to a long-term space flight (Hair)" Project: An analysis of trace elements in the hair, The 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.

Nutrition

○Original Papers

1. Akiko Matsumoto, Kenneth J. Storch, Adrienne Stolfi, Stanley R. Mohler, Mary Anne Frey, T. Peter Stein, Weight loss in humans in space. *Aviat Space Environ Med*, 82, 615 - 621, 2011.

○Meetings

1. Reiko Nakao, Arisa Ochi, Keita Kanmura, Tomoki Abe, Shohei Kohno, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai, Takeshi Nikawa, The Relationship of circadian rhythm and muscle atrophy, The 25th Annual Meeting of Japanese Society for Biological Sciences in Space, Sep. 30, 2011, Yokohama. (in Japanese)
2. Akiko Matsumoto, Effects on nutrients in space food after long duration spaceflight. Vol. 1, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)
3. Reiko Nakao, Arisa Ochi, Keita Kanmura, Tomoki Abe, Shohei Kohno, Takeshi Nikawa, The relationship of circadian rhythm and muscle atrophy, The 18th Annual Meeting of Japanese Society for Chronobiology, Nov. 24, 2011, Nagoya. (in Japanese)

○Symposiums

1. Reiko Nakao, The development of new therapeutic strategy for unloading-induced skeletal muscle atrophy, The 82nd Annual Meeting of the Japanese Society for Hygiene, Mar. 26, 2012, Kyoto. (in Japanese)

Immunity

○Meetings

1. Minh-Hue Nguyen, Toshiko Ohta, Chiaki Mukai, Investigation of the mechanisms of immune dysfunction in space environment, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)

Space Radiation Protection

Biological Effect

○Meetings

1. Aiko Nagamatsu, Hiroko Tawara, Keiji Murakami, Keiichi Kitajo, Ken Shimada, Hidenori Kumagai, Estimation and experimental studies for Radiobiology experiments using Phits, The 7th Particle and Heavy ions transportation workshop, Aug. 24, 2011, Tokaimura, Ibaraki.

○Symposiums

1. Aiko Nagamatsu, Space radiation measurement and foundation research onboard the ISS KIBO for future human space development ISS-radiation dosimetry using PADLES and PS-TEPC on board the Kibo, The 18th "KIBO" Utilization Seminar, Jun. 24, 2011, Tokyo. (in Japanese)
2. Aiko Nagamatsu, Strategy of space radiation measurement and foundation research onboard the KIBO, Multi-lateral medical operations panel, The 16th Radiation Health Working Group, Sep. 26, 2011, Moscow.
3. Kazuhiro Terasawa, Ionizing radiation in space and on the ground and the invisible safety tether for astronauts, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 26, 2011, Tsukuba. (in Japanese)
4. Kazuhiro Terasawa, Difference in the radiation measurements between space and ground and the front line of space dosimetry, TX Thechnology Showcase in Tsukuba 2012, Jan. 13, 2012, Tsukuba. (in Japanese)

○Others

1. Tomomi Watanabe-Asaka, Aiko Nagamatsu, Riyo Yamanaka, Masao Suzuki, Cui Hua Liu, Yukio Uchihori, Hisashi Kitamura, Biological effects induced by low-density heavy Ions of space radiation in medaka (22B-273), *NIRS HIMAX-reports 2011*, 2012. (in Japanese)
2. Suzuki Masao, Cui Hua Liu, Aiko Nagamatsu, Tomomi Watanabe-Asaka, Riyo Yamanaka, Hisashi Kitamura, Yumiko Kaneko, Narongchai Autdavapromporn, Yukik Uchihori, Mechanism(s) of bystander effects induced by low-fluence heavy ions (22B-328), *NIRS HIMAX-reports 2011*, 2012. (in Japanese)

Medical Technology on Orbit

○Symposiums

1. Koh Mizuno, Sleep and biological rhythms in space, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 26, 2011, Tsukuba. (in Japanese)

Environment Assessment

○Meetings

1. Takashi Yamazaki, Ichiro Satoh, Shin Yamada, Takashi Sugita, Koichi Makimura, Mycological evaluation of crew exposure to ISS ambient air (Myco): Interim Report, The 55th Annual Meeting of the Japanese Society for Medical Mycology, Oct. 21, 2011, Tokyo. (in Japanese)
2. Takashi Yamazaki, Koichi Makimura, Shin Yamada, Chiaki Mukai, Mycological evaluation of crew exposure to ISS ambient air (Myco): Interim Report, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)

Uttilizing the Antarctica Station

○Symposiums

1. Hajime Takeoka, Shin Yamada, Hidetoshi Tsuchiya, Hiroshi Ohshima, Masafumi Yamamoto, Chiaki Mukai, Giichiro Ohno, Kentaro Watanabe, Space analogue studies in antarctica, Workshop on Antarctic Medical Research and Medicine 2011, Jul. 30, 2011, Tokyo.
2. Koh Mizuno, Human biological rhythms in antarctica-study outline and subjective and objective sleep evaluation-, Workshop on Antarctic Medical Research and Medicine 2011, Jul. 30, 2011, Tokyo.
3. Masaki Yoshida, Yoshihiro Urade, Hidetoshi Tsuchiya, Sleep monitoring at the south pole, Workshop on Antarctic Medical Research and Medicine 2011, Jul. 30, 2011, Tokyo.
4. Naomune Yamamoto, Otsuka Kuniaki, Motonao ishikawa, Yutaka Kubo, Satoru Ishida, Tatsuya Aiba, Ichiro Tayama, Chiaki Mukai, The change of heart rate variability analysis in antarctica, Workshop on Antarctic Medical Research and Medicine 2011, Jul. 30, 2011, Tokyo.
5. Shin Yamada, Hajime Takeoka, Takashi Yamazaki, Takashi Sugita, Koichi Makimura, Mycological evaluation of member of antarctic expedition., Workshop on Antarctic Medical Research and Medicine 2011, Jul. 30, 2011, Tokyo.
6. Masahiro Terada, Hideyuki Majima, Shin Yamada, Akira Higashibata, Noriaki Ishioka, Chiaki Mukai, Biomedical analyses of human hair exposed to the antarctic environment, Workshop on Antarctic Medical Research and Medicine 2011, Jul. 30, 2011, Tokyo.
7. Koh Mizuno, Naomune Yamamoto, Masaki Yoshida, Mari Inokuchi, Kentaro Morikawa, Tsuginori Yoshida, Yutaka Okada, Kuniaki Otsuka, Yoshihiro Urade, Kentaro Watanabe, Giichiro Ohno, Hiroshi Ohshima, Chiaki Mukai, Sleep in wintering expedition members in antarctica, Worldsleep2011, Oct. 19, 2011, Kyoto.
8. Naomune Yamamoto, Koh Mizuno, Masaki Yoshida, Mari Inokuchi, Kentaro Morikawa, Tsuginori Yoshida, Yutaka Okada, Kuniaki Otsuka, Yoshihiro Urade, Kentaro Watanabe, Giichiro Ohno, Hiroshi Ohshima, Chiaki Mukai, Annual change of circadian rhythm in wintering expedition members in antarctica, Worldsleep2011, Oct. 19, 2011, Kyoto.
9. Masaki Yoshida, Koh Mizuno, Naomune Yamamoto, Mari Inokuchi, Kentaro Morikawa, Tsuginori Yoshida, Yutaka Okada, Kuniaki Otsuka, Yoshihiro Urade, Kentaro Watanabe, Giichiro Ohno, Hiroshi Ohshima, Chiaki Mukai, Sleep EEG monitoring in wintering expedition members in antarctica, Worldsleep2011, Oct. 19, 2011, Kyoto.

Frontier Medicine on the Lunar Surface

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

○Original Papers

1. Shin Yamada, Hiroshi Ohshima, Tomofumi Yamaguchi, Terumasa Narukawa, Masaki Takahashi, Kimitaka Hase, Meigen Liu, Chiaki Mukai, Simulation studies of bipedal walking on the Moon and Mars, *Transactions of JSASS, Aerospace Technology Japan*, *in press.*

○Meetings

1. Naoko Kawamoto, Kazuaki Oyake, Tomofumi Yamaguchi, Mariko Mutoh, Shigeo Tanabe, Shin Yamada, Hiroshi Ohshima, Kimitaka Hase, Yohei Otaka, Meigen Liu, Muscle activation patterns simulated for space walk – effects of walking speed, The 46th Congress of the JPTA in Miyazaki, May 28, 2011, Miyazaki. (in Japanese)
2. Shin Yamada, Hiroshi Ohshima, Tomofumi Yamaguchi, Terumasa Narukawa, Masaki Takahashi, Kimitaka Hase, Meigen Liu, Chiaki Mukai, Simulation studies of bipedal walking on the Moon and Mars, The 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.
3. Tatsuhiko Ikeda, Terumasa Narukawa, Masaki Takahashi, Meigen Liu, Hiroshi Ohshima, Development and analysis of reduced gravity simulator following the horizontal displacement of a suspended body on the treadmill, The 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.
4. Yusuke Matsumoto, Tatsuhiko Ikeda, Terumasa Narukawa, Masaki Takahashi, Shin Yamada, Hiroshi Ohshima, MeigenLiu, Proposal of experimental reproduction method of variable gravity and gait analysis of biped robot, The Japan Society of Mechanical Engineers MOVIC 2011, Jul. 1, 2011, Nagano. (in Japanese)

5. Tatsuhiko Ikeda, Terumasa Narukawa, Masaki Takahashi, Meigen Liu, Hiroshi Ohshima, Shin Yamada, Analysis of walking under microgravity using passive walking rimless wheel. International Astronautical Congress 2011 (IAC2011), Oct. 6, 2011, Cape Town.
6. Yusuke Matsumoto, Tatsuhiko Ikeda, Terumasa Narukawa, Masaki Takahashi, Hiroshi Ohshima, Shin Yamada, Meigen Liu, Proposal of experimental reproduction method of variable gravity and gait analysis. International Astronautical Congress 2011 (IAC2011), Oct. 6, 2011, Cape Town. . .
7. Shin Yamada, Hiroshi Ohshima, Tomofumi Yamaguchi, Terumasa Narukawa, Masaki Takahashi, Kimitaka Hase, Meigen Liu and Chiaki Mukai, A simulator for bipedal walking on the Moon and Mars, Space Forum 2011, Oct. 19, 2011, Star City, Russia.
8. Tomofumi Yamaguchi, Kimitaka Hase, Yohei Otaka, Shin Yamada, Hiroshi Ohshima, Chiaki Mukai, Meigen Liu, Simulation studies for lunar and Mars walking using a suspension system, The 41st Congress of Japanese Society of Clinical Neurophysiology, Nov. 12 2011, Shizuoka. (in Japanese)

○Symposiums
1. Shin Yamada, Walking simulations for lunar exploration by JAXA, Seminar of Space Nutrition, Aug. 11, 2011, Tokushima. (in Japanese)

Research of Health and Medical Examination on Lunar Surface

○Reviews/Books
1. Tatsunori Kambara, Masanori Horie, Yasuo Morimoto, Shigeru Aoki, Takeo Miki, Influences of Moon dust on human, *Journal of Japan Air Cleaning Association*, 49(4), 54-59, 2011. (in Japanese)

○Meetings
1. Tatsunori Kambara, Masanori Horie, Yasuo Morimoto, Takeo Miki, Yoshiyuki Honma, Shigeru Aoki, Evaluation of pulmonary influences of Moon dust by intratracheal Instillation, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)

Lunar Radiation

○Original Papers
1. Kazuhiro Terasawa, Tadayoshi Doke, Kentaro Miuchi, Toru Tanimori, Shinichi Sasaki, Kiwamu Saito, Kazutoshi Takahashi, Hiroko Tawara, Haruhisa Matsumoto, Tetsuhito Fuse, Tatsuto Komiyama, Aiko Nagamatsu, Yukio Uchihori and Hisashi Kitamura, Response of a prototype position-sensitive tissue-equivalent proportional chamber to heavy ions with energies of several hundreds of MeV/n, *KEK Proceedings,* 2011-8, 189-195, 2011.

○Meetings
1. Yuji Kishimoto, Shinichi Sasaki, Kazutoshi Takahashi, Hiroko Tawara, Kiwamu Saito, Kazuhiro Terasawa, Tetsuhito Fuse, Aiko Nagamatsu, Yuichi Itoh, Kentaro Miuchi, Toru Tanimori, Hidetoshi Kubo, Yukio Uchihori, Hisashi Kitamura, Tadayoshi Doke, Present status of development for the version 2 of the position-sensitive tissue-equivalent proportional chamber (PS-TEPC), The Japan Society of Applied Physics, Sep., 1, 2011, Yamagata. (in Japanese)

○Symposiums
1. Yuji Kishimoto, Tetsuhito Fuse, Shinichi Sasaki, Tadayoshi Doke, Tatsuto Komiyama, Kazuhiro Terasawa, HirokoTawara, Kiwamu Saito, Kazutoshi Takahashi, Kentaro Miuchi, Haruhisa Matsumoto, Hironobu Nishimura, Hidetoshi Kubo, Toru Tanimori, Tsutomu Nagayoshi, Yasunobu Fujita, Koji Takeuchi, Jun Kikuchi, Yukio Uchihori, Hisashi Kitamura, Development of the position-sensitive tissue-equivalent proportional chamber, The 26th Workshop on Radiation Detectors and Their Uses, KEK, Jan. 24, 2012, Tsukuba. (in Japanese)
2. Kazuhiro Terasawa, Shinichi Sasaki, Hiroko Tawara, Kiwamu Saito, Kazutoshi Takahashi, Yuji Kishimoto, TadayoshiDoke, Toru Tanimori, Hidetoshi Kubo, Kentaro Miuchi, Haruhisa Matsumoto, Tatsuto Komiyama, Tetsuhito Fuse, Aiko Nagamatsu, Yuichi Itoh, Yukio Uchihori, Hisashi Kitamura, Development of position sensitive tissue equivalent proportional chamber (PS-TEPC) and establishment of a technique for space dosimetry on the International Space Station (2011WG report), Space Utilization Research, Vol.28, Jan. 23, 2012, Tokyo. (in Japanese)
3. Aiko Nagamatsu, Lunar radiation environment for human space flight, The Science and Utilization Workshop Towards human Exploration, Mar. 8, 201, Sagamihara. (in Japanese)

Outreach/Education

Education

○Original Papers
1. Maki Niihori, Shin Yamada, Tomoaki Matsuo, Reiko Nakao, Takashi Nakazawa, Yoshito Kamiyama, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima and Chiaki Mukai, Mission X in Japan: An education outreach program featuring astronautical specialties and knowledge, *Transactions of JSASS, Aerospace Technology Japan, in press.*

○Mettings

1. Maki Niihori, Shin Yamada, Tomoaki Matsuo, Reiko Nakao, Takashi Nakazawa, Yoshito Kamiyama, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima, Chiaki Mukai, Mission X-Japan ～Education outreach program featuring astronautical specialties and knowledges ～, 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.
2. Maki Niihori, Shin Yamada, Masamichi Sudoh, Tomoaki Matsuo, Reiko Nakao, Takashi Nakazawa, Yoshito Kamiyama, Hiroshi Ohshima, Chiaki Mukai, Practices of space science education using space medicine and space biological materials, Society of Japan Science Teaching 61th Annual Meeting, Aug. 20, 2011, Matsue, Shimane. (in Japanese)
3. Reiko Nakao, Shin Yamada, Maki Niihori, Tomoaki Matsuo, Takashi Nakazawa, Yoshito Kamiyama, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima, Chiaki Mukai, The effect of education outreach program featuring astronautical specialties and knowledges for lifestyle of children., The 66th Japanese Society of phsical fitness and Sports Medicine, Sep. 17, 2011, Shimonoseki, Yamaguchi. (in Japanese)
4. Maki Niihori, Shin Yamada, Tomoaki Matsuo, Reiko Nakao, Yoshito Kamiyama, Hajime Takeoka, Akiko Matsumoto, Hiroshi Ohshima, Chiaki Mukai, An education outreach program using space biomedical knowledge in JAXA: astronaut can be a good model for life habit improvement promotion in the field of physical activity and nutrition, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 24, 2011, Tsukuba. (in Japanese)

○Symposiums

1. Maki Niihori, Shin Yamada, and Chiaki Mukai, Space Education Exploration; Mission X Program in Japan, 2011 International lunar Research Park Leaders Summit, Nov. 14, 2011, Hawaii.
2. Shin Yamada, Maki Niihori, Tomoaki Matsuo, Reiko Nakao, Hiroshi Ohshima, Chiaki Mukai, MISSION X CHALLENGES IN JAPAN, NASA Human Research Program Investigatpr's Work shop, Feb. 15, 2012, Houston.
3. Shin Yamada, Mission X in Japan, Space Education Sympodium, Feb. 26, 2012, Tokyo. (in Japanese)
4. Maki Niihori, Contribution to the society:space biomedical research education/outreach, The 82nd Annual Meeting of the Japanese Society for Hygiene, Mar. 24, 2012, Kyoto.

Preparation and Operation

Preparation and Operation on Orbit

○Meetings

1. Satoru Ishida, Hiroshi Ohshima, Tatsuya Aiba, Takashi Yamazaki, Masahiro Terada, Hajime Takeoka, Shin Yamada, Riyo Yamanaka, Chiaki Mukai, Outline of experiment operation on the orbit of JAXA space medicine research, The 28th International Symposium on Space Technology and Science, Jun. 8, 2011, Ginowan, Okinawa.

○Symposiums

1. Satoru Ishida, Medical technology on orbit, The57th Japanese Society of Aerospace and Environmental Medicine, Nov. 26, 2011, Tsukuba. (in Japanese)

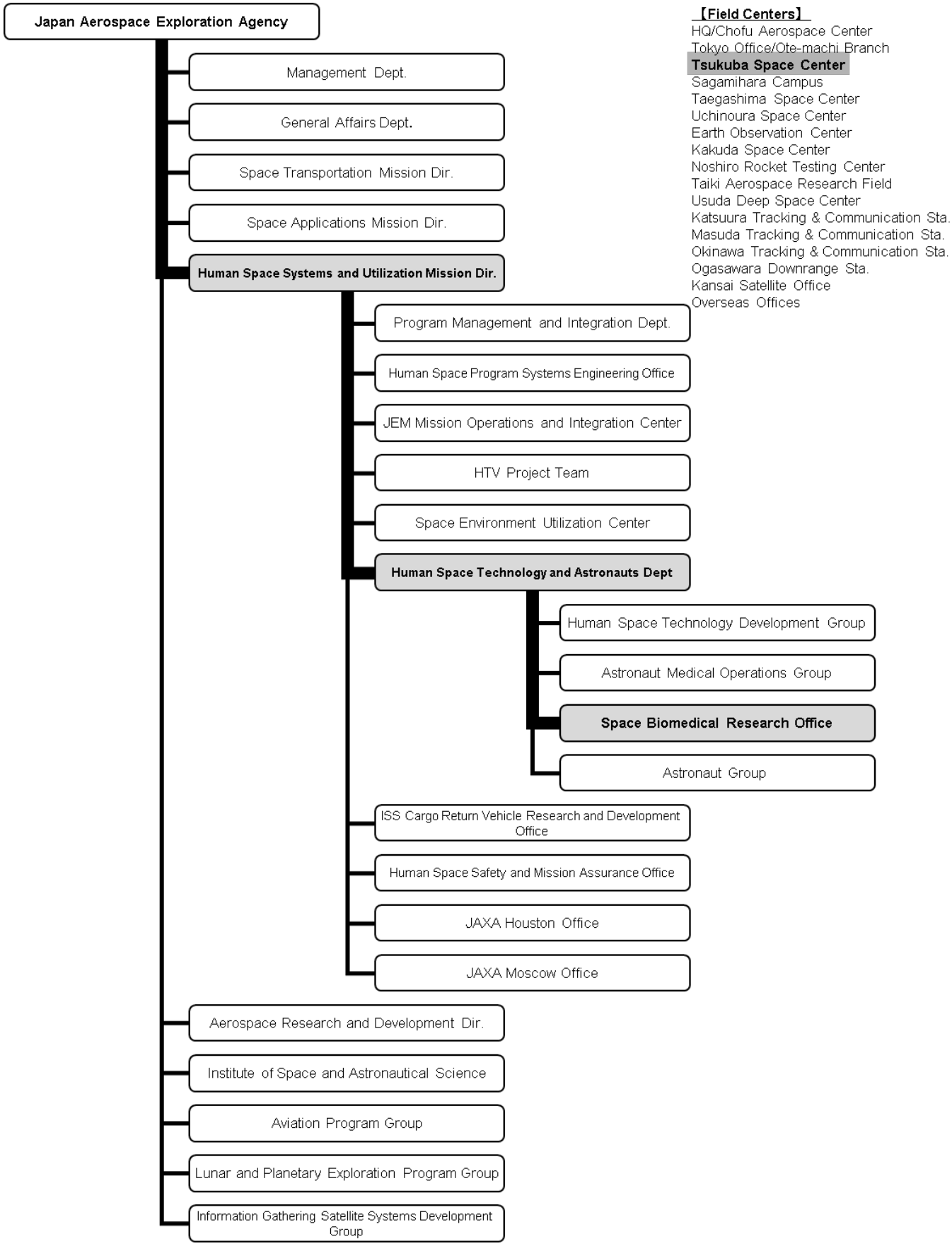
Others

And many other activities had approximately seventy outreaches.

Links

Title	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
Tours and Exhibits Tsukuba Space Center	http://www.jaxa.jp/visit/tsukuba/index_e.html
JAXA Deigital Archives	http://jda.jaxa.jp/en/
Tips for a Healthy Long-Life Learned from Space Medicine	http://iss.jaxa.jp/med/0220jaxa_kenkotyojyu_english.pdf
Mission X: Train Like an An Astronauts	http://trainlikeanastronaut.org/
NASA Human Research Program	http://humanresearch.jsc.nasa.gov/
ESA reserch human spaceflight and exploration	http://www.esa.int/esaHS/research.html
ISS Benefits for Humanity	http://iss.jaxa.jp/en/iss/benefits/index.html

The Organization of JAXA (March, 2012)



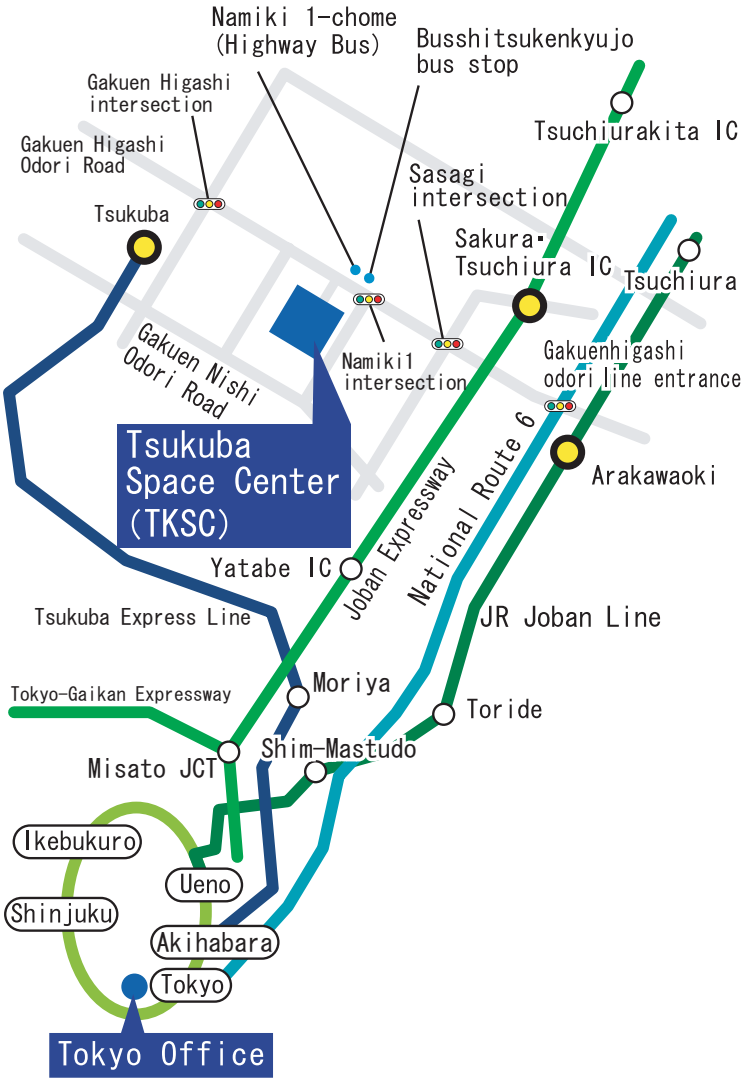
Tsukuba Space Center（TKSC） ACCESS

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.

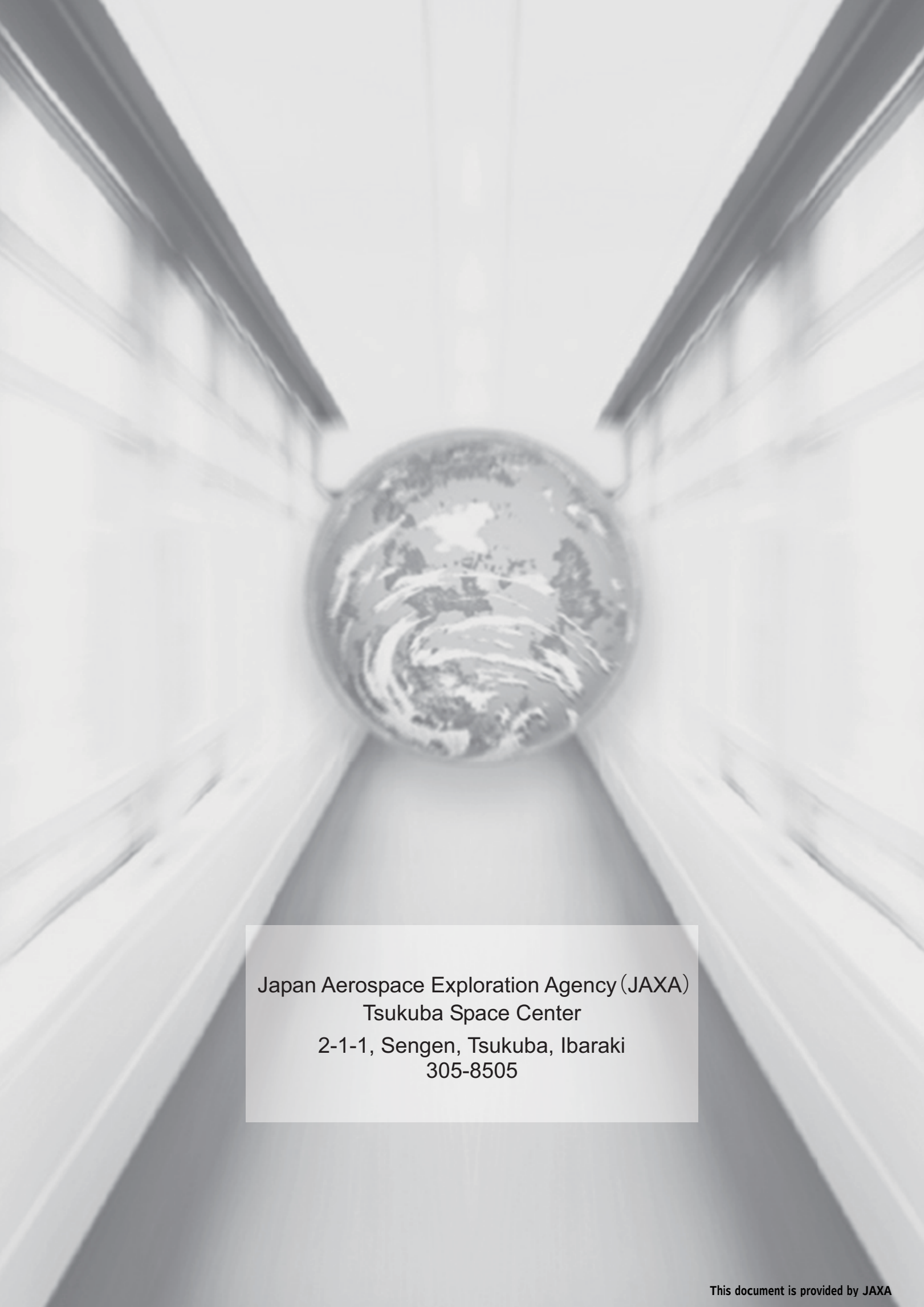
From Narita Airport, take the Airport Liner NATT's, which connects "TSUCHIURA" station to the Narita Airport via the Tsukuba Center Bus Terminal. It takes about 1 hour 40 minutes.

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).



Japan Aerospace Exploration Agency（JAXA）
Tsukuba Space Center
2-1-1, Sengen, Tsukuba, Ibaraki
305-8505