JAXA TODAY

Japan Aerospace Exploration Agency
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Special Features

JAXA Astronaut AKIHIKO HOSHIDE

Talks about his long-term mission aboard the ISS and passes on his message to children who dream of becoming an astronaut

Deploying Small Satellites from JEM Kibo

First-ever attempt at deploying small satellites from the ISS using robotic arm

JAXA
Japan Aerospace Exploration Agency

Letter from Vienna

A New Serial, for JAXA TODAY (No.1)

Warm greetings from Vienna, Austria! I am Toshiro Ozawa, the Ambassador Extraordinary and Plenipotentiary of the Permanent Mission of Japan to the International Organizations in Vienna.

In early June, COPUOS (Committee on the Peaceful Uses of Outer Space), during its 55th session, elected Dr. Yasushi Horikawa, Technical Counsellor of JAXA, as the chairman of COPUOS for a tenure of two years. I write this *'Message from Vienna' to commemorate Dr. Horikawa's assumption of the Chair of COPUOS.*

COPUOS is one of the Standing Committees of the UN General Assembly with a long history, having celebrated its 50th anniversary last year. From its inception, COPUOS promoted international cooperation on the peaceful uses of outer space and is known for establishing international norms such as the Outer Space Treaty. In recent years, it's Scientific and Technical Sub-committee has been working to establish guidelines for the long term sustainability of space activities. This year, as a reflection of the increased attention for the practical activities of COPUOS, the European Union held a multi-lateral meeting on the 'Code of Conduct', which includes matters relating to national security. This meeting was held on the margins of COPUOS, one day prior to the 55th session of COPUOS.

On June 6th, the first day of the 55th session of COPUOS, my Mission hosted a reception to celebrate Chairman Horikawa's assumption of Office. On this memorable occasion, Dr.Tachikawa, the President of JAXA, graced us with his presence and we were delighted to welcome about 170 guests from various countries. The next day, on June 7th, I hosted a dinner for the newly appointed Bureau of COPUOS, the executives of OOSA (UN Office for Outer Space Affairs), and the Japanese delegation, including Dr. Tachikawa. This occasion turned out to be quite informative and meaningful as the guests were able to exchange views freely on the future activities of COPUOS in a relaxed atmosphere.

Dr. Horikawa had been participating actively in all COPUOS sessions, including it's Sub-committee discussions, since 2010. His abundant experience and knowledge of space development, together with his sincere personality, are well known in COPUOS circles. It goes without saying that the assumption of the Chair of COPUOS by Dr. Horikawa was welcomed by all, with many congratulatory remarks from numerous countries. This was encouraging, and I also felt that expectations are rising.

Chairman Horikawa took the initiative to circulate a paper through which he expressed his hopes and plans for enhancing the activities of COPUOS. The paper was warmly welcomed by many countries with expectations for deeper discussions in the future.

As mentioned before, the activities of COPUOS are attracting wider attention, and I do feel that all countries have expectations for further enhancement of its activities. Needless to say, Chairman Horikawa's leadership will be noticed. My Mission, with much pride and joy, is determined to provide full support to Chairman Horikawa.

Cover Story

Interview with

Akihiko Hoshide

Dialogue between JAXA Astronaut Akihiko Hoshide and Midori Nishiura, Executive Advisor for JAXA Public Affairs & International Relations

JAXA Astronaut Akihiko Hoshide is a member of International Space Station (ISS) Expedition 32/33, serving as a flight engineer on the long-term mission. In this dialogue he provides insights on his main assignments during the mission, his thoughts on Japan's manned space flight and offers a message for children whose dream is to one day become an astronaut.

Photo by Hiro Arakawa

Profiles

Photo by Hiro Arakawa

Akihiko Hoshide

JAXA Astronaut

Akihiko Hoshide was born in Tokyo, Japan, in 1968. In June 2008, he flew to the ISS aboard the Space Shuttle Discovery as a member of the STS-124/1J mission. Aboard the ISS, he conducted such tasks as berthing and activating the "Kibo" Japan Experiment Module Pressurized Module to the ISS, and also activating Kibo's robotic arm. Since July 2012, he has been serving on a four-month, long-term mission aboard the ISS. His planned activities in JEM Kibo include the technical verification mission for a small-satellite deployment system and a life science experiment using *medaka* (small freshwater fish).

Midori Nishiura

Midori Nishiura, an opinion leader, is the president of consulting firm Amadeus Inc., JAXA's Executive Advisor for Public Affairs & International Relations. Also, a Visiting Professor of International Relations & Communications at Yamaguchi University. Among many other important roles, Ms. Nishiura has served on the Advisory Board of various major companies and also sits on committees organized by government ministries and agencies. The author of many books as well as articles in leading publications, Ms. Nishiura, having conducted her own interview programs on television, is often called upon to commentate on the news.

Note: This interview was conducted on April 25, 2012, prior to Astronaut Hoshide's long-term mission aboard the ISS.

Theme 1 | Trying for a World-First on the ISS

Nishiura: You will soon embark on your second space flight. During this long-term mission aboard the ISS, you are set to carry out a world-first—the technical verification mission for the JEM-Small Satellite Orbital Deployer (J-SSOD). It's a small satellite deployment system. Would you care to elaborate?

Hoshide: An H-II Transfer Vehicle (HTV)—JAXA's resupply spacecraft for the ISS—is scheduled for launch in July this year, so it is planned to arrive at the ISS soon after us. The HTV's payload will include several small satellites, which we will unpack. The satellites will be brought outside through the JEM Airlock, moved to the deploy position using the Kibo robotic arm, and then released towards the aft/nadir direction of the ISS. One of the main advantages of this method is that the astronauts can check a satellite before its release into space.

Nishiura: That sounds exciting! Until now, small satellites have used the spare capacity available on large rockets, piggybacking, as it were, on larger satellite missions, haven't they?

Hoshide: Yes, that's right. It has meant that these small satellites had to endure quite extreme conditions during launch—vibrations, shocks and other things. But if we send them into space aboard "Kounotori" (the Japanese nickname for HTV), it is possible to pack them up very safely, so they get a much smoother ride. It also eases many of the design constraints small satellites have faced previously.

Nishiura: If the various launch conditions become less onerous, they will be a lot more attractive for potential industrial users.

Hoshide: Something I only found out when I began preparing for this mission is that there is a great deal of interest among industry in using small satellites. Whereas up until recently small satellites tended to have this image of only being built for university projects by graduate students, it is now starting to evolve into an important business area.

Nishiura: You will also be undertaking Earth observation tasks, and working on experiments in fields such as life science, medicine and materials, won't you?

Hoshide: Yes, we're going to do a long-term experiment that involves raising small *medaka* fish in a special aquarium in JEM Kibo called Aquatic Habitat (AQH). It is hoped that this aquatic animal experiment to analyze bone metabolism will help to elucidate the mechanism leading to loss of bone density among astronauts serving long-term missions aboard the ISS and contribute to therapies for osteoporosis on Earth.

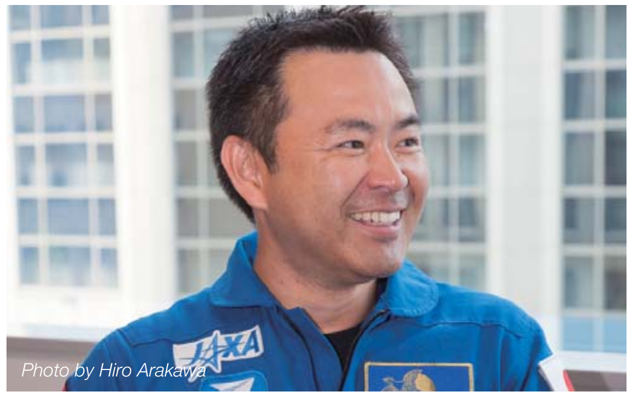
Photo by Hiro Arakawa

Theme 2 | Never Giving Up the Challenge of Becoming an Astronaut

Photo by Hiro Arakawa

Nishiura: My goodness, that is tremendous! Now, let me ask about how it all began for you. I read that when you were a university student you heard that astronauts were being recruited in Japan, so you called the National Space Development Agency of Japan (NASDA; currently JAXA) directly to try and get an interview, even though you didn't meet their applicant prerequisites.

Hoshide: Yes, I did, but naturally I got turned down. However, I still had a real desire to be involved with the space program. Later I joined NASDA, first working in the rocket development field, and then transferring to the NASDA Astronaut Office. I was assigned as a support engineer for Astronaut Koichi Wakata at the NASA Johnson Space Center in Houston, Texas, for his first mission.

Nishiura: I'm told that you once again applied for astronaut candidate selection in 1996, and that you reached as far as the final selection round. You came awfully close, didn't you?

Hoshide: That's right. After that I went to graduate school at the University of Houston while staying on as an employee of NASDA. Looking back on it now, that time I spent at the Johnson Space Center—working in areas like astronaut basic training and experiment payloads—was really useful and valuable experience for my career later on.

Nishiura: You had the courage to try again for astronaut selection in 1998, and this time you passed with flying colours! April 1999 was when you began your training as an astronaut candidate for the ISS, wasn't it?

Hoshide: That's correct. After being selected as an astronaut candidate, I got to see the training program from the opposite perspective—from the receiving side. The experience and understanding I had gained up to that point, working on the development of astronaut training, proved to be a huge help to me.


The crew of Expedition 32: From left, Akihiko Hoshide, Yuri Malenchenko and Sunita Williams


Astronaut Hoshide conducts checks of equipment to be used during his flight on Soyuz TMA-05M


Astronaut Hoshide (right) during a press display of the small-satellite deployment system


Hoshide visiting the Smithsonian Institution in the United States in 1983


Hoshide at university: Together with friends in his sports club (second from right)


Hoshide in Houston in 1995 after joining NASDA

Theme 3 | Aiming for the Ultimate Goal of Manned Space Flight

Photo by Hiro Arakawa

Nishiura: Although Japan has its own launch vehicle system and the HTV, which means it is now able to deliver supplies and equipment to the ISS, Japan doesn't have any means to carry people into space. In the near future, I think it would be wonderful, and really a must, for Japan to establish its own capability for human space transportation.

Hoshide: Oh, I agree. Despite Japan having its own Kibo module as part of the ISS, to get there we have to rely on other countries. It would be great if international competition were spurred on by Japan developing its own manned space transportation system.

Nishiura: At present, only astronauts who have undergone special training are able to go into space, but if there were many types of manned spacecraft, I am sure more people could go into space for various purposes.

Hoshide: People would be able to do all kinds of experiments themselves, or they could enjoy going into space as a travel experience. Looking from a long-term perspective, these kinds of capabilities are part of the ultimate goal of manned space flight. As a step toward that, Japan too needs to develop its own manned spacecraft.

Nishiura: I couldn't agree with you more. There should be a debate about how far Japan can take the development of a human space flight system under the country's present economic circumstances. Nevertheless, if we don't get started, we'll never arrive!

Hoshide: The heartfelt opinion of all Japanese astronauts, including myself, is "we want to go into space from Tanegashima, aboard Japan's own spacecraft." It might not be ready in time for our generation, but we could realize this goal in the next generation. But we have to start soon if we want to build that future.

Theme 4 | To Young People Who Want to be Astronauts

Nishiura: An astronaut is definitely an iconic role model for children. My wish is for more youngsters to be interested, drawn into the world of science and technology, and these children can grow up to contribute to the advancement of humankind, wouldn't you say? Would you like to send a message of encouragement for all the children, who carry the future hopes of humankind?

Hoshide: I want them not to be afraid of a challenge. Even if they come up against an obstacle, they shouldn't give up easily. During all the time I had the goal of becoming an astronaut, I was determined not to give up. It is because I kept my sights set on becoming an astronaut without ever giving up that I got to where I am today.

Nishiura: It's marvellous that you persevered! We can say the same about Japan's rocket as well as space development. They haven't been an easy ride either. Yet, all those people never gave up—on the contrary, they kept striving to meet the challenge. As the result, we have the H-IIB rocket and "Kounotori" thanks to their total commitment.

Hoshide: When Japan first joined the ISS program, it had only very limited experience compared with the United States or Russia. But since then, through development projects, such as Kibo and HTV, Japan has dramatically bolstered its technical capabilities.

Nishiura: On the ISS, an international project spanning 15 countries, with every country fulfilling different roles, Japan's role in the ISS program is now expanding more than ever.

Hoshide: On Kibo, we can do experiments in both pressurized and exposed environments, and we have the robotic arm. Only Kibo has an airlock specifically designed for handling equipment. And of course we have "Kounotori" too, so Japan's involvement in the ISS is very diverse. While it takes a huge amount of hard work to develop these kinds of new technology, you get a fantastic feeling when all that hard work pays off. It is something that you won't know until you experience it. I want young people to set their sights on becoming astronauts—I want them to experience the joy of making their dreams come true, and not be afraid of a challenge!

Nishiura: That is indeed the key message! We can all remind ourselves of this, too! Thank you so much for sharing your wonderful thoughts.

Photo by Hiro Arakawa

Hoshide (center) undertakes training related to the HTV with fellow astronauts

Launch of the H-IIB rocket carrying HTV3 (July 21, 2012)

HTV3

Hoshide wearing his Extravehicular Mobility Unit (EMU)

Hoshide undergoes extra-vehicular activity (EVA) training

The crew of Expedition 32 arrives at Baikonur Cosmodrome, Kazakhstan

Reaching for the Skies, Exploring Space

JAXA pursues the great potential of space with the aim of contributing to humanity's peace and happiness. Hence, JAXA undertakes a diverse array of research and development, exploration and space utilization activities.

JAXA's Long-Term Vision

In April 2005, JAXA proposed its ideal for the future of the aerospace field. This "Long-Term Vision" reinforces the organization's awareness of its responsibilities to society, and provides a vision of the aerospace field in Japan in 2025, which JAXA is striving to realize. Since then, JAXA has promoted a broad range of programs in line with its goal of turning this vision into reality.

Long-Term Vision		Applicable contents
1. **To build a secure and prosperous society through utilization of aerospace technology**	• Establishing a system for natural disaster management • Establishing a system for addressing global environmental issues	**C4** Deployment of the Advanced Microwave Scanning Radiometer 2 (AMSR2) Antenna—SHIZUKU's "Eyes" for Observing the Earth's Water Cycle
2. **To help uncover answers to mysteries of the natural universe and prepare for lunar utilization as a means of elucidating the origins of the Earth and humankind**	• Making Japan the world's leading science center through experience gained in space observation and planetary exploration • Establishing technologies for future lunar utilization	**P14–15** Hayabusa2—Setting Sights on a New Sample-Return Challenge **P18–21** The JAXA International Top Young Fellowship (ITYF) Program
3. **To realize world-class space transportation and Japan's home-grown space program**	• Establishing space transportation systems, including launch vehicles and orbital transfer vehicles, with the world's best reliability and competitiveness • Establishing technologies that will make possible manned space activities	**P16–17** "Space is the ideal workplace. I would love to do another long-term mission." **P22–23** Successful Execution of Controlled Re-entry of Launch Vehicle Upper Stage
4. **To develop aerospace as Japan's next key industry**	• Promoting the space industry as an important part of Japan's future industrial base	**P8–11** Deploying Small Satellites from JEM Kibo
5. **To establish Japan's aircraft manufacturing industry and develop supersonic aircraft**	• Revitalizing aircraft manufacturing as a key industry in Japan • Demonstrating technologies for hypersonic aircraft capable of Mach 5 speed that will be able to cross the Pacific in two hours	**P12–13** Flying Test Bed (FTB) "Hisho" Pioneers Advanced Aircraft Technology

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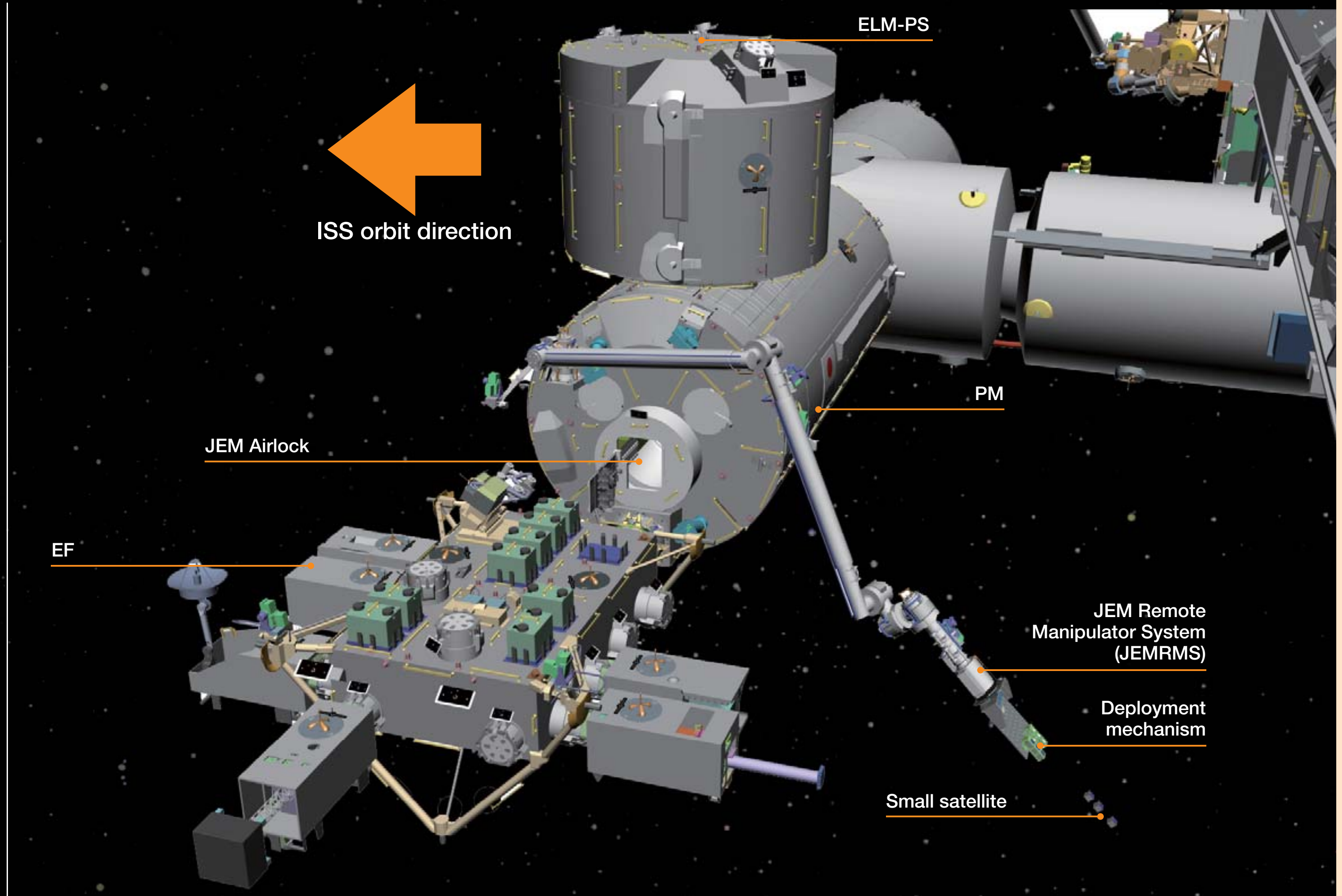


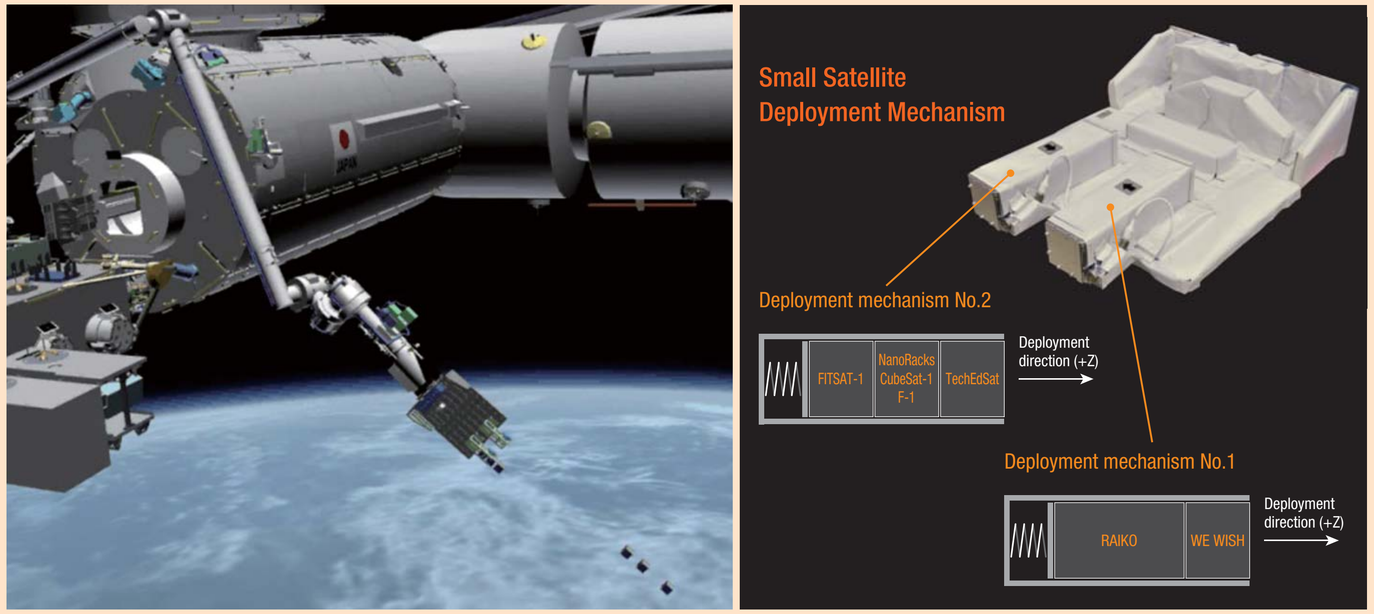
Deploying Small Satellites from JEM Kibo

"CubeSat" is a category of small satellites that began as a standard for satellites built by university students, and whose dimensions are a 10cm cube. At JAXA, staff who were among the first generation of students to work on CubeSat projects are starting to put this experience to use in actual missions. In this article, two of the principal engineers involved in the small-satellite deployment mission provide an overview of the demonstration mission for the JEM-Small Satellite Orbital Deployer (J-SSOD), which will be performed by Astronaut Akihiko Hoshide during his long-term mission aboard the ISS.

Kazuyoshi Kawasaki
Manager
Lunar and Planetary Exploration Program Group

* Position at the time of the project was Deputy Manager, Space Environment Utilization Center

Yusuke Matsumura
Manager, Senior Engineer
JEM Mission Operations and Integration Center
Human Space Systems and Utilization Mission Directorate



To ensure that the small satellites do not touch or collide with the ISS after deployment, the satellites are deployed in the direction opposite to the ISS' orbit and diagonally below the ISS. For this reason, the satellites orbit the Earth at a lower altitude than the ISS, burning up upon re-entry into the atmosphere after approximately 100 days in space. Hence, they do not become space debris.

Small Satellite Deployment from the ISS Using Robotic Arm

JEM Kibo comprises three modules—the Pressurized Module (PM), Experiment Logistics Module Pressurized Section (ELM-PS) and Exposed Facility (EF). The PM has two large windows, below which is a small door used for transferring equipment and materials between the PM and EF. This door is part of an airlock that enables experiment apparatus and samples to be moved onto the EF while maintaining the air pressure inside the PM. The JEM Airlock is a vital facility for the effective utilization of the EF while astronauts remain inside the PM.

JAXA considered various novel applications for the airlock, and this led to the birth of an innovative mission for sending into orbit small satellites that conform to the CubeSat standard* by using a spring mechanism and robotic arm.

* A 10cm cube, referred to as "1U," is the basic CubeSat unit. The size may be increased along one axis. Hence, "2U" is 10cm×10cm×20cm.

Crew Able to Check Satellites Immediately Before Deployment

Until now, small satellites have been put into orbit using large launch vehicles, meaning they were subject to severe constraints, including conditions relating to vibrations during launch and the reliability of the separation mechanism. However, the new method employed for this mission eases many of the previous constraints. Since the satellites are wrapped in shock-absorbing materials and stored in special-purpose bags and transported to the ISS aboard the HTV, as long as they are robust enough to be carried to the launch complex on an aircraft, they will most likely be able to go into space without further modification.

The most significant advantage of this method is that the crew can check the satellites immediately before deployment into orbit. Since the astronauts unpack the satellites by hand and place them in the deployment mechanism, the crew can manually switch on the satellites' power, check functions and if necessary perform simple repairs.

Under conventional launch methods, once the satellite is placed into the launch vehicle's payload fairing, it cannot be touched. This means special measures must be taken in such areas as battery power and start-up method. In contrast, a method that allows the crew to handle the satellite immediately prior to deployment is highly advantageous. Owing to such merits, this novel method opens up a range of new possibilities in the future. For example, small satellites may take on many new forms and missions, including non-rigid structures and so on.

The three satellites chosen from Japan for this first demonstration mission are shown on pages 10–11, with deployment from the ISS scheduled for early August.

Small-Satellite Development Brings the Challenges of Space Close to Home

For this mission, five satellites were chosen for deployment from JEM Kibo through public calls for proposals—three satellites from Japan selected by JAXA and two satellites selected by NASA. In this article, the leaders of each of the three Japanese satellite development teams offer their thoughts on the project.

FITSAT-1

Institution: Fukuoka Institute of Technology
Principal missions: 5.8GHz band high-speed communication, LED-based visible light communication experiment

Takushi Tanaka, Professor
Department of Communication and Computer Engineering, Fukuoka Institute of Technology

A particularly challenging mission for small satellites is high-speed communication. Using the high frequency band of 5.8GHz, we employ a flat patch antenna on the satellite's magnetic-north-facing side for transmitting and receiving. If it is successful, our calculations indicate that it will be possible to transmit one VGA image (640×480 pixels) in 5–6 seconds, which is approximately 100 times faster than conventional CubeSat communication speed.

We also plan to make the light-emitting diodes (LEDs) installed around the circumference of the patch antenna flash on and off, thereby creating an "artificial star that really shines." Anyone with a pair of binoculars can participate in this optical communication experiment. I have long been involved in robot artificial intelligence (AI) research, and I was not at all familiar with the space field. However, both Astro Boy and HAL9000 (the artificial intelligence in the movie "2001: A Space Odyssey") appear in stories set in space. Robots and space have a very high affinity. I believe the project has a very high educational value.

FITSAT-1
Size: 1U

Professor Takushi Tanaka (front row, second from right) and the development team

RAIKO

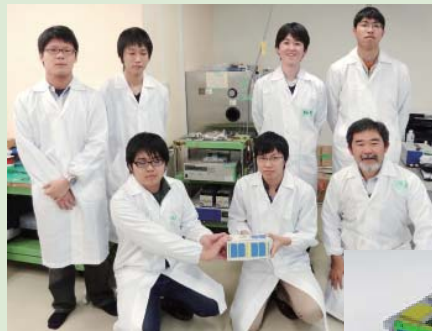
Institution: Wakayama University / Tohoku University
Principal missions: Orbit descent using membrane deployment, Earth imaging using a camera with a fish-eye lens, Ku-band communication experiment

Hiroaki Akiyama, Specially Appointed Professor
Director of the Institute for Education on Space
Wakayama University

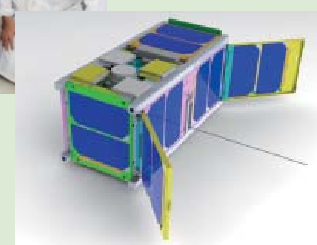
The environment for CubeSats is changing rapidly and in a favorable direction. In 2003, a paradigm shift occurred driven by the CubeSat launch by the University of Tokyo and the Tokyo Institute of Technology using a Russian launch vehicle. Thanks to the opportunity to be involved in a Japan-based launch, we have entered an era in which the uniqueness of missions and originality of ideas vie with one another. The CubeSat itself is now on the verge of becoming a practical educational tool. By opening up the chance for ordinary students to think about the space environment as something familiar, we are definitely increasing our pool of engineers and researchers.

Meanwhile, Japan has established its own space transportation system, has a laboratory aboard the ISS and sends astronauts into space. This makes Japan the envy of countries with strong space development aspirations. I think that these kinds of launch opportunities can surely be utilized as part of Japan's diplomacy.

While being aware of the great impact and responsibility carried by RAIKO within the space education field, I observed the reliable efforts of students working on the project.



Professor Kazuya Yoshida (front row, right) of Tohoku University with the joint university development team



RAIKO
Size: 2U

WE WISH

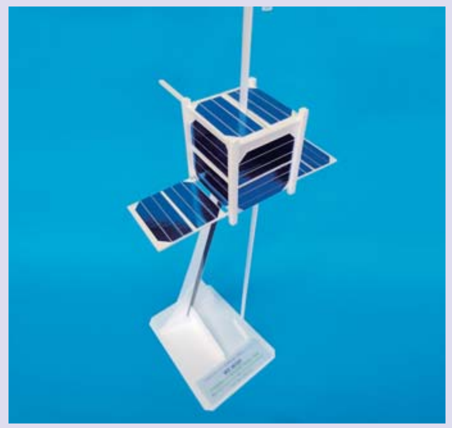
Institution: Meisei Electric Co., Ltd.
Principal mission: Earth imaging using an ultra-small infrared camera

Isao Tanaka
Equipment Development Division
Meisei Electric Co., Ltd.

Meisei Electric has extensive experience in satellite equipment, including development of the HDTV camera used on the lunar explorer Selenological and Engineering Explorer (SELENE), which was launched in September 2007. Hence, within the company we have such testing facilities as a vacuum chamber and a vibration tester. Since the satellite developed on this occasion is small, we were able to utilize all of our facilities. However, this is our first experience with producing an entire satellite ourselves. The project was mainly driven by our younger staff members, with veteran employees occasionally offering advice. The team certainly enjoyed producing this satellite.

With regard to methods of utilizing satellite imagery, we appealed to local junior high and high school students and teachers, and thought about this issue together. Since we are also utilizing the capabilities of ham radio operators, the company exhibited at the local ham radio fair in Isesaki, Gunma Prefecture, and appealed for enthusiasts to receive data from the satellite.

Even for such a small satellite, the ability to use high-precision mission equipment may be attributed to the equipment-friendly launch method of wrapping the satellite in shock-absorbing materials and placing it in a special-purpose bag for transportation as payload on the HTV.



WE WISH
Size: 1U

Flying Test Bed (FTB) “Hisho” Pioneers Advanced Aircraft Technology

“Hisho” is the Japanese nickname for Japan’s latest FTB, which JAXA has introduced with the objective of enhancing flight demonstration technology.

Based on a Cessna Aircraft Company twin-engine, medium-sized business jet, Hisho’s fuselage has been modified and additional instruments and equipment have been installed to make the aircraft suitable for experiments and technology demonstrations. After adding modifications to enable installed testing equipment to be operated inside the aircraft cabin, various sensors were also installed and internal electrical wiring changed. On the aircraft exterior, JAXA added pylons for affixing antennae and instrument pods, and installed a camera recess for photographing directly underneath the aircraft.

Hisho may be used in a diverse variety of testing fields. It is set to play a vital role in advancing Japan’s aviation and aeronautical science and technology to a new level, having commenced operations in July 2012.

Testing equipment has been installed in the cockpit

Seats were removed from the cabin, which was modified so that testing equipment could be installed

These are examples of Hisho’s practical application. As well as helping to fulfill JAXA’s mission, Hisho will meet the needs of industry, academia and other users.

Space
- Flight testing of observation instruments to be installed on satellites
- Synchronized observations with satellites
- Micro-gravity experiments
- Launch vehicle and atmospheric launch support
- Flight testing related to launch vehicle tracking and control system

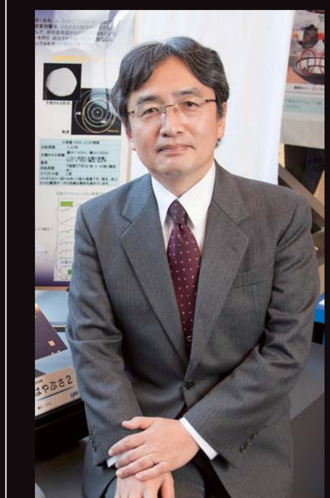
Aeronautics / Aviation
- Flight testing related to advanced technology for passenger aircraft
- Flight testing related to silent supersonic aircraft technology
- Flight testing related to advanced jet aircraft component technology
- Flight testing related to next-generation flight operation systems

An artist's rendition of Hayabusa2 exploring 1999 JU3. Two high-gain antennae can be seen on the spacecraft's body.

Hayabusa2

Setting Sights on a New Sample-Return Challenge

Discussions regarding a potential Hayabusa2 mission commenced in 2006, while Hayabusa was still on its return journey back to Earth. While capitalizing on the sample-return experience achieved by its predecessor, Hayabusa2 will set its sights on several new space exploration challenges. The target asteroid is called "1999 JU3,"which is thought to contain large amounts of organic matter and water. We asked Project Manager Makoto Yoshikawa and Project Scientist Masanao Abe to give us an overview of the Hayabusa2 project, which is expected to further elucidate the origins and evolution of the Solar System.



Makoto Yoshikawa
Hayabusa2 Project Manager
Associate Professor
Department of Space Engineering
Institute of Space and Astronautical Science (ISAS)

Striving for Further Progress in Deep Space Exploration Technology

Hayabusa2 will explore the asteroid 1999 JU3, whose length is estimated to be approximately 920 meters. That is bigger than Itokawa, which is around 540 meters long. One of the main reasons for selecting this target is that in contrast with Itokawa—an S-type asteroid of rocky composition—1999 JU3 is a C-type asteroid. Although it has a similar rocky composition, its surface is believed to contain organic matter and water. By carrying out a sample return from 1999 JU3, we hope to gain new information relating to the origin and evolution of the Solar System.

One of the most difficult aspects of the Hayabusa mission was the extremely busy schedule during the spacecraft's rendezvous with Itokawa. Hayabusa could only stay with Itokawa for two-and-a-half months, and during that time we needed to carry out scientific observations and obtain a sample. This meant that there was a very heavy operational workload. For the Hayabusa2 mission, we plan to have the spacecraft stay with 1999 JU3 for approximately one-and-a-half years, thereby allowing ample time for observation and careful sample collection.

In its external appearance, Hayabusa2 differs from its predecessor by having two flat high-gain antennae. In addition to the X-band frequency range conventionally used in deep space probe communications, for Hayabusa2 we want to try using the much higher Ka-band frequencies, which offer four times faster communication speeds.

During the Hayabusa mission, the MINERVA mini-rover robot failed to reach the surface of Itokawa, so for Hayabusa2 we have even greater motivation to succeed with our new version of the robot, MINERVA2. We also plan to increase the propulsion power of the ion engines, with the aim of realizing greater stability in the spacecraft's operation.

Another World First: Creating an Artificial Crater on the Surface of an Asteroid

In another world-first challenge, Hayabusa2 will carry a new piece of equipment called an "impactor," which will use explosives to fire a projectile at the surface of 1999 JU3 to create an artificial crater. To avoid being hit by fragments forced up by the explosion, the spacecraft will perform a complex maneuver—temporarily relocating to a position on the opposite side of the asteroid and then returning to the area above the crater. However, some members of our project team argued that it was important to record the crater impact moment. To achieve this, we are studying the potential for using a small deployable camera (DCAM), similar to the camera used to photograph the sail of the Small Solar Power Sail Demonstrator IKAROS.

Hayabusa2 will once again involve a significant level of international cooperation. For example, similar to Hayabusa, NASA's Deep Space Network (DSN) of antennae will help track the spacecraft and we will receive the cooperation of Australia in the return-capsule landing scheme. Furthermore, we are considering the possibility of carrying the Mobile Asteroid Surface Scout (MASCOT) mini-lander being developed through a consortium led by the German Aerospace Center (DLR).

Orbital positions mean that there are good opportunities in 2012 for observing 1999 JU3 from Earth. Prior to the launch of Hayabusa2, we intend to harness these opportunities to learn as much as possible about the mission's target asteroid.

Remaining at the Forefront of Sample-Return Technology

Masanao Abe
Hayabusa2 Project Scientist
Associate Professor
Department of Solar System Sciences
ISAS

An artist's rendition of Hayabusa2 touching down on the artificial crater made by the "impactor"

Through the analyses carried out so far on the samples from Itokawa, the thing that has reinforced our view that such S-type asteroids are generally not the source of meteorites is the fact that on the surface of the sample grains there are even smaller particles present. We believe that such samples hold a myriad of information about the history of the asteroid's surface as well as the evolution of matter and celestial bodies. If it were possible, I would break open an asteroid and look at everything inside. Realistically, that is not possible, so we will instead try to make a crater on the asteroid surface.

We hope that these efforts will enable us to recreate an "impact agglomeration" from the early stages in the formation of the Solar System. In these very early stages, gases formed dust particles, which in turn accreted into "planetesimal"—modest formations of 1–10 kilometers in diameter. However there are many unanswered questions regarding the details of this process and how these planetesimal led to the formation of asteroids and planets. We hope that this project will provide hints to help elucidate such processes.

We anticipate obtaining close-up photographs of the asteroid surface up to the order of centimeter-level resolution, something that Hayabusa was unable to capture. The experience we gained from Hayabusa in terms of sample collection and analysis technologies is also proving very useful. Japan is at the forefront of sample-return technology and execution, and we are constantly thinking about how we can maintain our position and steadily working on things that will keep us at the leading edge.

JAXA Astronaut Satoshi Furukawa

"Space is the ideal workplace. I would love to do another long-term mission."

Astronaut Satoshi Furukawa looks back on his long-term mission aboard the ISS.

From June to November 2011, Astronaut Furukawa completed a long-term mission aboard the ISS. In an interview conducted with him during a return to Japan in January 2012 to present his mission report, he recalls some of the highlights of his 167 days in space.

167 days

Following Return from the ISS, 45 Days for Re-adaptation to the Earth's Environment

First off, can we talk about the period immediately after your landing back on the ground? After completing a long-term mission in space, what was your condition like when you returned to Earth on November 22, 2011?

I couldn't stand up at all, and it was quite scary trying to move my head. Although I retained a comparatively good level of muscle strength, I had lost all my ability to balance. However, my balance recovered rapidly in about 24 hours, and thanks to the NASA rehabilitation program, my body returned to its pre-flight condition.

Please share with us your experiences during the Soyuz launch on June 8, 2011.

We boarded the Soyuz spacecraft about two hours before liftoff, working on the final flight preparations. After liftoff, during rocket ignition we could only monitor the status, but later on, when the spacecraft thrusters were used to change orbit and during rendezvous with the ISS, the crew had various tasks to complete.

After docking and entering the ISS, I got "space motion sickness," so when I moved my head I felt uncomfortable and nauseous. However, my body gradually adapted to the non-gravity environment and after about a week I was all right.

Contributing to the Practical Application of a Telemedicine System and New Drug Development

Based on research themes submitted by the general public, you worked on the "Try Zero-G" program, on experiments designed to help unravel the mysteries of space as well as experiments on how to best meet the challenges of space medicine.

For the program, we carried out experiments under approximately 10 themes. For example, we selected a "Nystagmus" experiment, which looked at back-and-forth eye movement, and even though I felt quite dizzy, we did not detect much nystagmus. In the "Blood Pressure Measurement" experiment, although leg blood pressure is somewhat higher than arm blood pressure when measured on the ground, in space the two measurements were the same. These experiments gave us a variety of interesting results.

The "Onboard Diagnostic Kit" developed by JAXA is an effective method that enables remote diagnosis by a doctor on the ground when there is no doctor onboard.

Using a USB camera, a doctor on the ground can undertake remote diagnosis by looking at comparatively high-quality images of an onboard astronaut's tongue, eyes, conjunctiva and facial expression, and listen to the astronaut's heartbeat. Based on the verification of the kit's functions carried out during this mission, improvements are currently being made to the software. For example, these improvements will enable even a user who is not a medical practitioner to determine whether the displayed data is within the normal range. In the future, I believe such a system will become essential for long-term space missions.

You monitored the growth of a cucumber plant and did an experiment to grow protein crystals. What was the objective of such experiments?

We closely studied the function of proteins in relation to a hormone that controls plant growth. These experiments were designed to elucidate such phenomena as plant response to gravity and growth control, and are related to the development of vegetable factories in space that may be used in future missions to Mars or other destinations.

From the experiment to grow protein crystals related to the development of an influenza therapeutic agent, we aim to yield samples that will give us detailed insights into the three-dimensional structure of the proteins. We have regular opportunities to conduct experiments, so we plan to try this with various types of protein and hope that we can contribute to new drug development.

Aiming to Return to the ISS after Further Training

While you were aboard the ISS, the cumulative number of days spent in space by Japanese astronauts became the third highest of all nationalities.

Yes, I think it is wonderful that Japanese people can make this contribution to the world by regularly participating as international crew.

Not long after that milestone was passed, in August the launch failure of the Russian Federal Space Agency (Roscosmos)'s Progress M-12M resupply spacecraft meant that the ISS was temporarily reduced to a crew of only three. How did you cope with that situation?

Normally, there is a two-week period during which the ISS has only three ISS crew members, but on this occasion we continued working for about eight weeks with just the three of us. Our expedition had to return to Earth in November, so we were worried that the ISS may be left unmanned. However, this served to increase the crew's level of motivation. Shortly after, Soyuz launches successfully resumed, and when our replacement crew arrived, it felt like being reunited with old friends.

What were some of the lasting impressions of your return to Earth?

When we separated from the ISS and began our journey back to Earth, just as we maneuvered the Soyuz craft into a rear-facing orientation and waited for the de-orbit engine burn, we passed right over Hokkaido. The islands of Hokkaido and Honshu both looked very beautiful.

The de-orbit burn is quite an intense experience. If the thrust is too strong, the re-entry angle will be too steep and there is the danger of burning up in the atmosphere. If the re-entry angle is too shallow, the spacecraft could bounce off the atmosphere and end up adrift in space. However, Soyuz is a very reliable spacecraft with many backup systems in place.

How do you feel now, and what are your future goals?

This mission was a very rewarding one for me. I think that space is the ideal workplace. I want to offer my long-term mission experience as feedback to Astronaut Akihiko Hoshide, who will fly to the ISS in July 2012, and Astronaut Koichi Wakata, who will serve as ISS commander from late 2013. I also hope my insights can be of use to the three new JAXA astronauts, Kimiya Yui, Takuya Ohnishi and Norishige Kanai. I want to continue my own training too, and if the opportunity arises I would like to return to work aboard the ISS. I would love to do another long-term mission.

As technical verification of the "Onboard Diagnostic Kit," Astronaut Furukawa undergoes diagnosis of his retina and tongue

©JAXA/NASA

The three ISS crew members work together during the period in which Soyuz launches were suspended. From left: Satoshi Furukawa, Michael Fossum (NASA) and Sergey Volkov (Roscosmos)

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The plant growth experiment using cell culture equipment

A meeting between the ISS and Kibo Mission Control Room

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An event for interaction with organizations involved in health promotion and preventive care for the elderly

©JAXA/GCTC

The JAXA International Top Young Fellowship (ITYF) Program

Inviting leading young researchers from around the world to contribute to the development of space science

The JAXA International Top Young Fellowship (ITYF) program was launched in fiscal 2009 as a program for inviting outstanding young researchers from Japan and abroad with the objectives of furthering the development of space science in Japan and promoting internationalization of Japan's research scene. After conducting an extensive international call for applications, four successful candidates were announced for fiscal 2009, followed by one additional participant selected in fiscal 2010. All of the research fellows in the program are based at the Institute of Space and Astronautical Science (ISAS) within JAXA's Sagamihara Campus in Kanagawa, Japan. We asked the five researchers to tell us about their research and share their impressions of the program.

Profiles of the ITYF researchers can be found on the following web site: http://www.isas.ac.jp/e/researchers/young-fellowship/fellows

* In addition to the original five fellows, two new researchers joined the program in fiscal 2011—Adam Master from the United Kingdom and Stefano Campagnola from Italy.

Research Theme:

Magnetospheric and auroral dynamics of Jupiter and Saturn

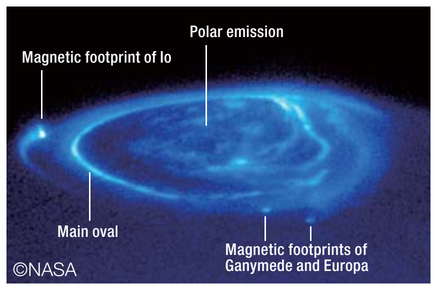
Sarah Badman

I studied physics and space science at the University of Leicester in the United Kingdom and am currently pursuing research in the area of planetary magnetospheres and aurorae. Aurorae are a phenomenon caused when particles released from the Sun or other bodies travel down a planet's magnetic field lines and impact on the atmosphere, causing it to emit light. My principal area of research is the aurorae of the outer planets, such as Jupiter and Saturn. With new observations of Saturn's auroral emissions being sent back by the Cassini orbiter, I am particularly interested in Saturn at the moment. The magnetosphere protects life on Earth from the Sun's energetic particles, hence when considering whether or not life exists on planets outside the Solar System, planetary magnetosphere research is extremely important.

The level and breadth of research activity carried out at ISAS is impressive. All aspects of space mission design and exploitation are carried out here: designing and building scientific instruments, gathering and analyzing data, and building theoretical models. The success of JAXA missions engages people's interest. When the asteroid explorer Hayabusa (MUSES-C) returned to Earth, thousands of people came to ISAS to see the sample-return capsule.

My general goal is to understand how the solar wind affects Saturn's magnetosphere and atmosphere by studying images of the aurorae, and through models of auroral emission developed by ISAS colleagues.

My next research target is to discover how energy is transferred through Jupiter's magnetosphere using observations of the plasma torus from JAXA's EXCEED mission and images of the aurorae.



An image of Jupiter's northern ultraviolet aurorae captured by the Hubble Space Telescope

Research Theme:

Modeling of cosmic ray acceleration and non-thermal emission

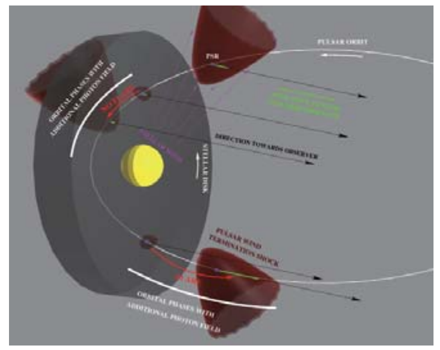
Dmitry Khangulyan

My specialist field is theoretical astrophysics. After studying theoretical physics in one of Russia's major technical universities (Moscow Engineering Physics Institute), I started my research in the field of high-energy astrophysics at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany. Since then, my research has been mainly focused on the interpretation of observations in gamma- and X-ray energy bands. Namely, I work on the modeling of high energy processes occurring in a broad range of astrophysical objects, e.g., binary systems harboring a compact companion (a black hole or pulsar), pulsar wind nebulae, and active galaxies. This large variety of sources sometimes prevents a very deep study of some specific processes, however, on the other hand it gives a very important, in my view, generality of the approach. In particular, when my collaborators and I were working on the interpretation of the recent gamma-ray data from the binary pulsar system PSR-B1259/LS2883 and the Crab Pulsar, we discovered that two apparently very different phenomena—a high energy flare detected from the binary system and a pulsed very high energy emission seen from the Crab Pulsar—may have a common origin. Namely, cold pulsar wind may lead to these phenomena. Our study of the pulsed very high energy emission from the Crab Pulsar was recognized as important enough to be published in the journal *Nature*.

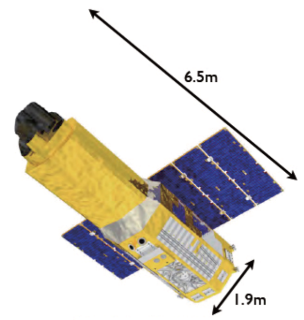
Although my research is primarily theoretical, it is very important for me to keep a close connection to the actual observation data. Even before coming to Japan, I used data from JAXA's X-ray astronomy satellite Suzaku (ASTRO-EII) and was involved in collaborative research with Japanese members of the Suzaku mission. At ISAS, a significant attraction for me is to be involved in the ASTRO-H project, which is currently in development, and in other astronomical observation projects. I have particularly high expectations for the ASTRO-H project, which I think will achieve breakthrough results for different astrophysical objects.

As an ITYF researcher, I greatly appreciate the level of research freedom that one has as a member of this program, which is most likely unprecedented for a position of this level. Also, it is interesting to see the internal structure of research institutes in different countries. For example, I see that young researchers in ISAS are involved in more projects than for example in Germany. While this has both positive and negative aspects, it definitely allows one to build up a lot of experience.

My general goal is to work on astrophysical radiation models, which include a detailed theoretical scenario, for example a hydrodynamical description of the astrophysical object. However, this kind of approach can be justified only in connection with high-quality observational data, thus I want to model the latest observational data obtained in gamma- and X-ray energy bands.



Sketch of interaction in binary pulsar system. Image credit: ApJL



X-ray astronomy satellite Suzaku (ASTRO-EII)

The Crab Pulsar and its surrounding nebula

Research Theme:

Black hole-related research using data from such sources as X-ray astronomy satellites and infrared observatories

Poshak Gandhi

After studying physics at the University of Delhi in India, I completed a doctorate in astrophysics at the University of Cambridge in the United Kingdom. Before coming to JAXA, I was at RIKEN in Japan. My specialty is high-energy astronomy and particularly the research of black holes. My main reasons for coming to Japan were to learn from the extensive expertise of researchers using data from JAXA's X-ray astronomy satellite Suzaku and the infrared astronomy satellite Akari (Astro-F), in addition to exploring Japan's fascinating culture and language. Suzaku is one of the best observation platforms for observing black holes. Japan has traditionally been strong in the field of high-energy astronomy, and there are many black hole specialists here.

Since matter that gets pulled towards black holes emits extraordinary amounts of light and heat, black holes may be observed using many bands, such as visible light, infrared, X-rays, and gamma rays. My work has uncovered a tight relationship between the brightness of X-ray and infrared emissions by growing supermassive black holes in many galaxies. This type of research is crucial for understanding the structure surrounding black holes. I have also studied the multi-band emission from ultra-fast streams of matter which are ejected from near black holes, helping us to probe extreme environments in the universe.

Upon arriving at ISAS, I was inspired by the broad range of research being conducted in many fields, including rocket development and space probes. I am pursuing collaborative research with the ISAS X-ray and infrared groups, but I also have the opportunity to speak with people from outside my specialist field, and this provides very good stimulus.

I am grateful for all the opportunities that I have received in Japan, and my general goal is that I hope to contribute to, and collaborate with, the growing Japanese astronomical community for many more years to come. Recent research has advanced our knowledge greatly, but we are only at the beginning of our quest to understand our place in the universe.

In front of the Subaru telescope in Hawaii

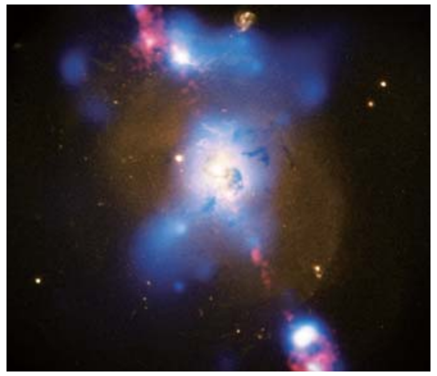
Research Theme:

Observational research of high-energy jet sources

Lukasz Stawarz

After studying physics at the Jagiellonian University in Poland, I majored in astrophysics and completed my doctorate degree. Next, I conducted post-doctoral training positions at the Harvard-Smithsonian Center for Astrophysics in the United States; the Max Planck Institute for Nuclear Physics in Heidelberg, Germany; and Stanford University in the United States. My scientific research is placed in a broad context of high-energy astrophysics, and regards in particular the physics of supermassive black holes and relativistic jets produced by them. At present, I am a full member of the two major international gamma-ray experiments, namely the space observatory Fermi-LAT, and the ground-based Cherenkov telescope H.E.S.S. In my research I am relying extensively on the X-ray data collected by modern X-ray observatories. One of the reasons that brought me to Japan was in fact the operation of the Suzaku X-ray astronomy satellite, as well as the ASTRO-H mission, which is currently under development in ISAS. I am happy to be involved in the ASTRO-H project as a science team member, and I have high expectations for the performance of the mission and the scientific discoveries it will deliver very soon.

Astrophysical black holes can be roughly divided into two classes. One class consists of stellar-mass black holes, formed at the end of the life of a massive star as a result of the direct collapse of the stellar interior. The other class is constituted by supermassive black holes present in the centers of galaxies. These latter objects, reaching enormous masses of millions and billions of solar mass, form by a gradual growth of smaller mass black holes merging and accreting matter from their surroundings throughout the whole history of the Universe. Many supermassive black holes produce spectacular streams of magnetized hot plasma outflowing with relativistic bulk velocities from the galactic centers. Broadband emission of such jets can be now studied in detail using modern gamma- and X-ray telescopes. My main research objective is to utilize this rich but previously hardly available dataset to better understand jet physics.



A multi-wavelength image of the active galaxy 4C+29.30 showing the X-ray emission of the hot plasma in blue; radio emission associated with the jets outflowing from the galactic center in red; and the starlight of the host galaxy in yellow (image taken from "Siemiginowska, Stawarz et al. 2012, the Astrophysical Journal 750, p.124")

To understand relativistic jets and their engines, i.e. supermassive black holes, as well as their cosmological evolution in general, is a difficult task because of the complexity of the systems and limited observational data. What is in particular lacking is a complete theory on how exactly jet particles are accelerated to energies high enough to produce the observed gamma- and X-ray emission. My goal is to combine the most recent observational results on high-energy emission of relativistic jets with phenomenological models of the energy dissipation in magnetized plasma to constrain a general theory of the particle acceleration in the astrophysical environment.

Research Theme:

Flow physics and computation in space science and aerospace engineering

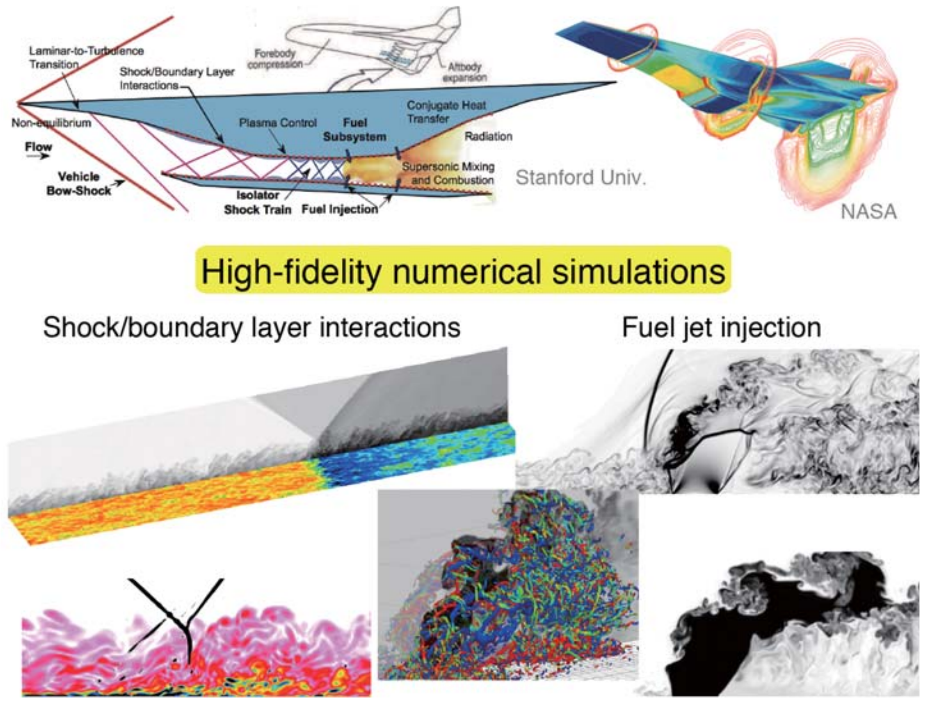
Soshi Kawai

Prior to joining the ITYF program, I was a Postdoctoral Fellow at the Center for Turbulence Research at Stanford University in the United States working on research projects concerning high-fidelity numerical simulations of high-speed turbulent flows, flow-physics analyses, and physics-based modeling. This ITYF fellowship allows me to further pursue my research, and, since it includes research funding, I believe that it is a great research environment in which I can establish myself as an independent researcher.

My broad research area includes the fields of fluid mechanics, thermodynamics, applied mathematics, and computational science. My research combines numerical simulations with physical modeling and theory to study fundamental unsteady flow physics, turbulence, shock waves, aeroacoustics, interfacial instabilities, and multi-material mixing. For example, as airplanes and spacecraft can fly at very high speeds, the flows around these vehicles have a high Reynolds number (i.e., there is a wide range of flow scales in both space and time) and become turbulent, often generating shock waves. Hence, the understanding of these complex phenomena (interactions between the turbulence and the shock waves) and their physics-based modeling is a crucial issue when designing such vehicles.

In the course of our recent research, we have proposed a numerical method for accurately simulating the interaction between turbulence and shock waves, and a physical model for accurately simulating high Reynolds number flows, something that existing numerical methods and physical models fail to do robustly. We believe that these breakthroughs may not only have impact on the aerospace engineering of rockets and airplanes but also on many other fields, e.g., understanding the hydrodynamics in space science that we have already started to work on here at ISAS.

In Japan, there are relatively few places in which young researchers can establish their independent research projects. The ITYF program, however, makes this possible. I am really grateful for the opportunities that I have received, and I hope that I can use this opportunity to extend my research, including into the broad area of high-speed turbulent flows and the emerging discipline of quantification of uncertainties in numerical predictions. My general goal is that I hope to contribute to both space science and aerospace engineering activities through my research on flow physics and computational science.



Successful Execution of Controlled Re-entry of Launch Vehicle Upper Stage

In January 2011, JAXA performed a controlled re-entry of the H-IIB launch vehicle upper stage, successfully bringing it down in a target impact zone. In this article, three of the JAXA engineers who worked on this project discuss the challenges they faced as they strove to enhance safety and minimize debris generation associated with launch vehicles.

Shigeru Mori (right)
Engineer*
H-IIB Project Team
Space Transportation Mission Directorate
* Position at the time of the project. Currently on temporary transfer.

Kaoru Sakamoto (center)
Engineer
Space Transportation Program Safety and Mission Assurance Office
Space Transportation Mission Directorate

Kyotaro Ida (left)
Engineer*
Space Transportation Program Safety and Mission Assurance Office
Space Transportation Mission Directorate
* Position at the time of the project. Currently works at the JEM Mission Operations and Integration Center.

Method for Minimizing the Generation of Space Debris from a Launch Vehicle Final Stage

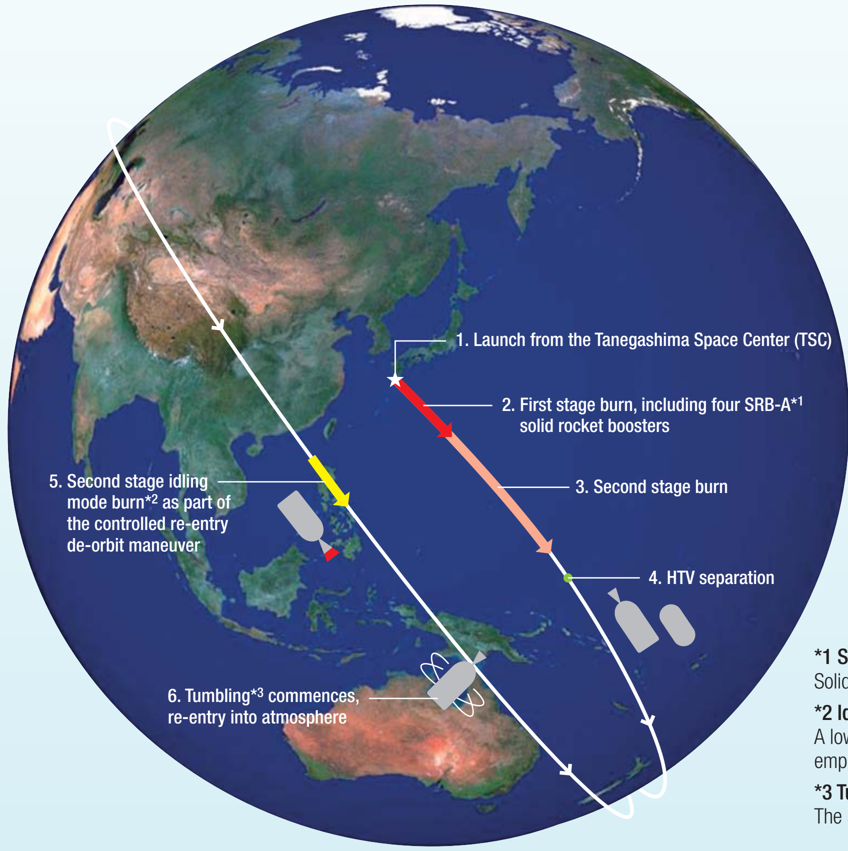
Incidents of uncontrolled re-entry of satellites have featured prominently in the news recently. Although solid rockets and fuel tanks are designed to fall into the sea during a satellite launch sequence, the final stage of a launch vehicle remains on orbit after separating from its satellite payload. Consequently, a rocket final stage is generally destined to become space debris, which will at some future point re-enter the Earth's atmosphere due to orbital decay.

The H-II Transfer Vehicle (HTV; nicknamed "Kounotori" from its second mission) is launched on an H-IIB rocket. Since the HTV has its own engines for making its approach to the International Space Station (ISS), the spacecraft separates from the launch vehicle at a lower altitude than would be the case with an ordinary satellite. The H-IIB rocket upper stage—weighing approximately 3 tons—is left in a low orbit, becoming debris that re-enters the atmosphere at a comparatively early point. For this reason, JAXA decided to embark on the development of Japan's first controlled re-entry system for the H-IIB upper stage.

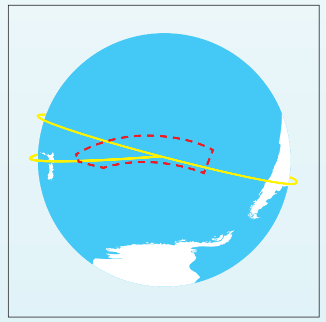
A Mere 80-Second Window for the Rocket to Receive Radio Command Signals

To execute a de-orbit maneuver and controlled re-entry, the H-IIB upper stage must be re-oriented to face the opposite direction to the one in which it is moving, and an engine burn is made to decrease velocity. A high-latitude area of the South Pacific Ocean was chosen as the target impact zone since it is far from land and very few vessels pass through the area. We developed a plan in which a thrust of the H-IIB upper stage engine could be made with certainty after one orbit of the Earth and while visible from the Tanegashima Ground Station.

To execute the controlled re-entry, a radio link must be established between ground control and the rocket. The horizon angle of the tracking and control antenna is less than one degree. Furthermore, since the upper stage power batteries would not maintain operable charge from the second orbit onward, it was imperative to execute a successful re-entry maneuver during the first orbit. The upper stage remains visible from the Tanegashima Ground Station for approximately 300 seconds, and once the time necessary for transmission of the reverse-thrust command is subtracted, the window for the rocket to receive radio command signals is a mere 80 seconds at the most. We developed a program to automatically determine timing of the approval command for re-entry using a predetermined threshold. Based on this, we also held training drills using more than 30 sudden malfunction scenarios.



Target Impact Zone



***1 SRB-A:**
Solid rocket boosters used in the H-IIA and H-IIB launch vehicles

***2 Idling mode burn:**
A low-propulsion-power burn mode for which the turbo pump is not employed. In this case, the longer burn time makes control easier.

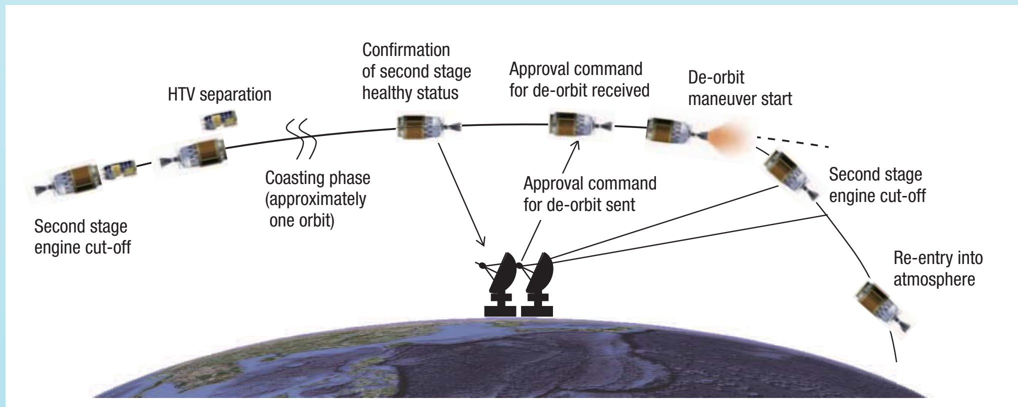
***3 Tumbling:**
The second stage tumbles end-over-end as it begins re-entry

Successful Controlled Re-entry Above South Pacific Ocean

On January 22, 2011, after confirmation of separation of HTV2, the team responsible for executing the controlled re-entry carried out the re-orientation maneuver of the H-IIB upper stage while the rocket was within visibility of the Guam Ground Station. The upper stage then passed over the Pacific, South America, the Atlantic, and the Mediterranean as it headed toward Russia. The Tanegashima Ground Station antenna quickly picked up radio signals from the H-IIB upper stage as it rose above the horizon, and confirmed that the rocket was on a normal flight path and its status was healthy. The command was then sent to commence the engine reverse thrust, and the operation proceeded smoothly.

During the engine burn, the estimated impact area of the upper stage tracked across the control room screen, and when it stopped exactly on the target impact zone, we knew that we no longer had to worry about a possible failure. The second stage then moved beyond the visibility of the Tanegashima Ground Station, passing over New Zealand and making atmospheric re-entry above the South Pacific Ocean. Although most of the rocket burned up during re-entry, some components are thought to have fallen into the ocean. Hence, Japan's first attempt at controlled re-entry was successfully completed. JAXA plans to continue utilizing this system for subsequent launches, beginning with HTV3.

Note: HTV3 had its controlled re-entry on July 21, 2012.

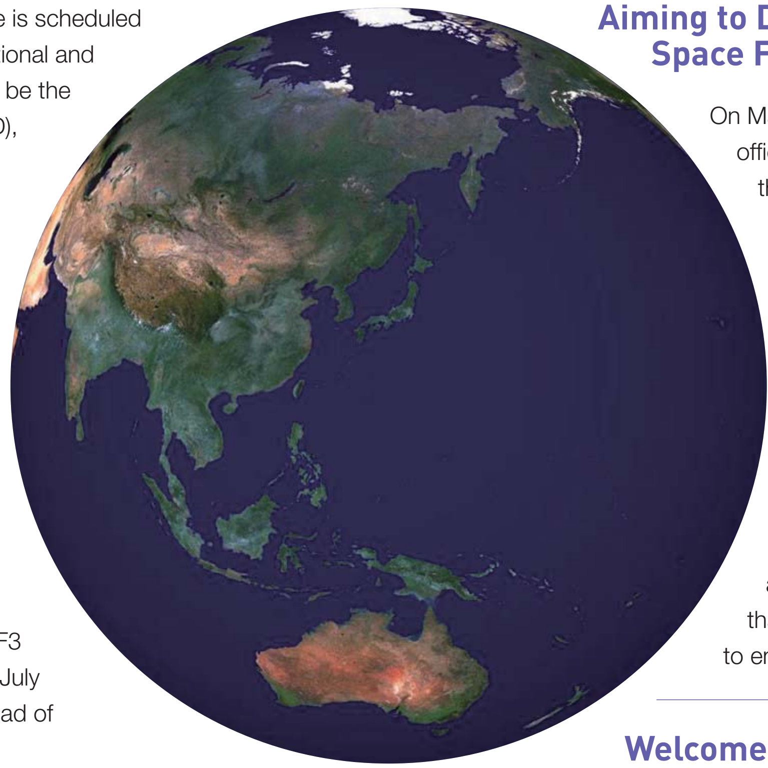


JAXA's Frontier

On July 17, Soyuz completed a successful rendezvous and docking maneuver with the ISS.

Astronaut Akihiko Hoshide Begins Long-Term Mission Aboard the ISS

Astronaut Akihiko Hoshide lifted off from the Baikonur Cosmodrome, Kazakhstan, on July 15, 2012 (JST), aboard the Soyuz TMA-05M (31S) spacecraft bound for the ISS. On July 17, Soyuz completed a successful rendezvous and docking maneuver with the ISS. As a flight engineer of the Expedition 32/33 crew, Astronaut Hoshide will spend approximately four months aboard the ISS. During his stay, he is scheduled to conduct experiments on JEM Kibo and perform ISS operational and maintenance duties. One of his main tasks during his stay will be the operation of the JEM-Small Satellite Orbital Deployer (J-SSOD), which has been transported to the ISS as payload on JAXA's HTV3 re-supply spacecraft. This will be the demonstration mission of J-SSOD, during which Astronaut Hoshide and his fellow astronauts will operate the JEM Remote Manipulator System (JEMRMS)—the robotic arm—to send small satellites into orbit.




HTV3 completed a successful docking with the ISS

HTV3 (KOUNOTORI 3) Arrives at the ISS

The H-II Transfer Vehicle (HTV; Japanese nickname: "Kounotori") was developed by Japan as a re-supply spacecraft for transporting goods and equipment to the ISS. The third spacecraft in this series was launched aboard the H-IIB F3 launch vehicle from the Tanegashima Space Center (TSC) on July 21, 2012 (JST). For this mission, the HTV carried a total payload of approximately 4.6 tons to the ISS.

Principal payload items included the Aquatic Habitat (AQH) experimental aquarium, the JEM-Small Satellite Orbital Deployer (J-SSOD) and the five small satellites to be deployed using J-SSOD. In addition to the Re-entry Breakup Recorder (REBR) that was also carried on HTV2, this mission will carry the Re-entry Data Recorder (i-Ball), which was developed through a partnership between JAXA and the private sector. i-Ball will collect data during re-entry into the atmosphere, with the aim of acquiring data useful for the design and development of future re-entry vehicles.


Color composite image of the Earth as observed with the AMSR2 from 9 a.m. of July 3 to 9 a.m. of July 4 (JST). Areas shown in black were not observed.

Successful Launch of GCOM-W1 and SDS-4

On May 18, 2012, at 1:39 a.m. (JST), JAXA satellite Global Change Observation Mission 1st–Water "SHIZUKU" (GCOM-W1) and Korean Multi-purpose Satellite 3 (KOMPSAT-3) of the Korea Aerospace Research Institute (KARI), along with secondary payloads Small Demonstration Satellite-4 (SDS-4) and HORYU-2 of Kyushu Institute of Technology were launched from the Tanegashima Space Center (TSC) aboard H-IIA Launch Vehicle No. 21 (H-IIA F21). Each of the satellites successfully entered their planned orbits.

After being inserted into its A-Train* orbit on June 29, GCOM-W1 commenced Earth observations and data acquisition on July 3 using the Advanced Microwave Scanning Radiometer 2 (AMSR2). GCOM-W1 is scheduled to continue initial functional verification, followed by initial calibration and inspection operations, including data accuracy confirmation and data calibration.

SDS-4 is also undergoing operations according to its original plan.

* A-Train—a constellation of Earth observing satellites—is an international project led by NASA, under which several satellites closely follow one after another along the same orbital "track." By combining the different sets of nearly simultaneous observations, scientists are able to gain a better understanding of important parameters related to climate change. GCOM-W1 is Japan's first contribution to the A-Train.


From right, astronauts Furukawa, Wakata, Prime Minister Noda, Administrator Bolden, Leland D. Melvin and John M. Grunsfeld

Aiming to Deepen Japan–United States Ties in the Space Field

On May 1, 2012 (JST), at Blair House in Washington, D.C.—the official state guesthouse of the President of the United States—the Prime Minister of Japan, Mr. Yoshihiko Noda, along with JAXA astronauts Koichi Wakata and Satoshi Furukawa, met Charles F. Bolden, the Administrator of NASA. Prime Minister Noda commented, "We wish to deepen Japan–United States ties in the space field." Astronaut Wakata mentioned the significance of his three Space Shuttle flights culminating in his completing the installation of JEM Kibo's components aboard the ISS. Astronaut Furukawa spoke about his participation in experiments to grow protein crystals in micro-gravity conditions, which will contribute to research relating to the development of a therapeutic agent to inhibit the proliferation of influenza viruses. He said that as a physician, he is determined to exert his utmost efforts to ensure the project leads to breakthrough results.

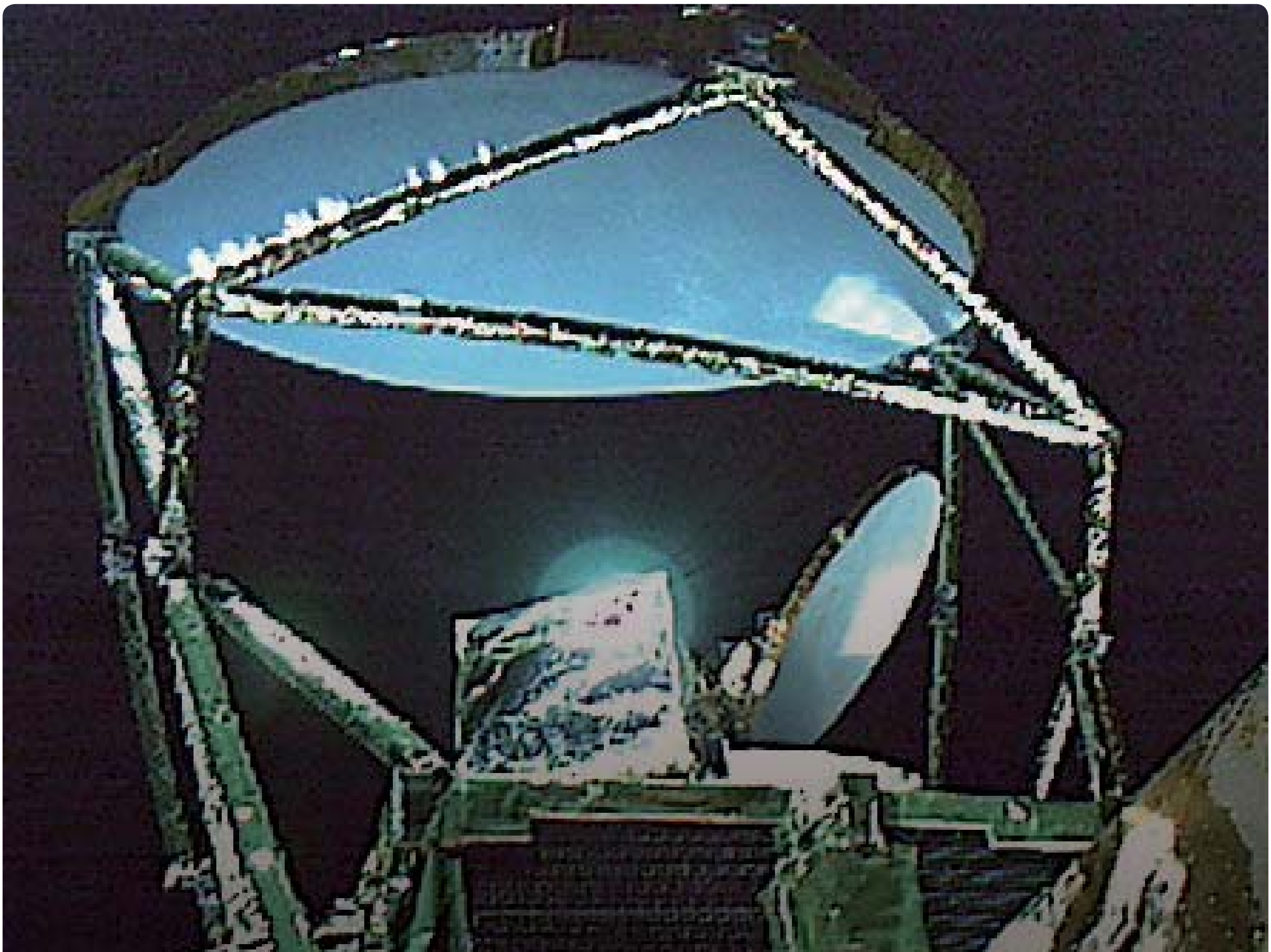
Asia-Pacific Regional Space Agency Forum (APRSAF-19) will be held December 11–14, 2012, in Kuala Lumpur

Welcome to APRSAF-19!

The nineteenth session of the Asia-Pacific Regional Space Agency Forum (APRSAF-19) will be held December 11–14, 2012, in Kuala Lumpur, Malaysia, under the theme of "Enriching the quality of life through innovative space programs." APRSAF-19 will be jointly organized by the Ministry of Science, Technology and Innovation (MOSTI) and the National Space Agency (ANGKASA) of Malaysia, as well as the Ministry of Education, Culture, Sports, Science and Technology (MEXT) of Japan and the Japan Aerospace Exploration Agency (JAXA).

Attended by around 300 participants from approximately 30 countries and international organizations—including those from space agencies, governmental entities, the academic community and the private sector—APRSAF is fast growing into the largest, and action-oriented, international space forum in the Asia-Pacific. Through presentations and discussions in the plenary and working group sessions, participants are able to explore possibilities for joint projects and collaborative activities in the areas of Earth observation, communications satellite applications, space education as well as utilization of space. Additional information regarding APRSAF can be found on its web site, www.aprsaf.org.

Anyone interested in space activities and the utilization of space science and technology and its applications to address issues of importance to the Asia-Pacific region is welcome to participate. Registration is expected to start in late August.



SHIZUKU's Awakening

Deployment of the Advanced Microwave Scanning Radiometer 2 (AMSR2) Antenna—SHIZUKU's "Eyes" for Observing the Earth's Water Cycle

JAXA satellite Global Change Observation Mission 1st–Water "SHIZUKU" [GCOM-W1, Project Manager: Keizo Nakagawa] was launched from the Tanegashima Space Center (TSC) aboard H-IIA Launch Vehicle No. 21 (H-IIA F21) on May 18, 2012 (JST). Approximately 11 hours after the launch, JAXA confirmed via image data received at the Katsuura Tracking and Communication Station (Chiba, Japan) that the antenna of AMSR2, which is carried by SHIZUKU, had successfully deployed.

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