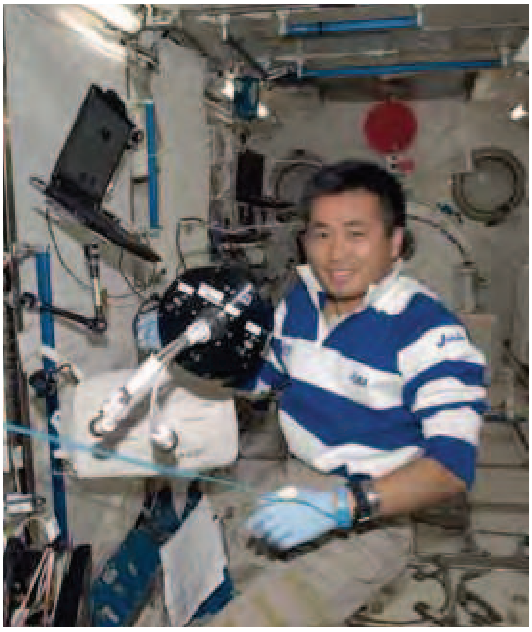
January 2010 No.01

JAXA TODAY



JAXA
Japan Aerospace Exploration Agency

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Cover Images
Clockwise from above left, Mare Moscoviense on the lunar farside, launch of H-IIB, Astronaut Koichi Wakata, HTV in preparation for its release from the ISS, President Keiji Tachikawa.

Space:Contributing to the future of mankind

What do JAXA's activities aim for?

JAXA has been engaged in a wide range of activities, including the launch of satellites, participation in the International Space Station (ISS) program, promotion of space science, and R&D in the aviation field. All these activities are performed based on a will to contribute to the future of mankind through space activities.

Keiji TACHIKAWA
President of JAXA

Midori NISHIURA
Advisor to JAXA Public Affairs

Launch of IBUKI(GOSAT) on January 23, 2008

Midori Nishiura with JAXA Astronaut, Soichi Noguchi, who is staying in the ISS as a crew member of Expedition 22/23.

Nishiura: May I start by saying that I am thrilled to observe the recent years of JAXA's space development activities, which have been successful, and contributed greatly to the future of mankind. I must say it makes my job all the more pleasurable. Dr. Tachikawa, perhaps you would like to begin by elaborating on these activities.

Tachikawa: In JAXA, year 2004 was started with the deliberation of how we could resume the launch of H-IIA launch vehicle, as the launch of the vehicle No. 6 failed in November of the previous year. Launch was resumed in February 2005. Since then, 10 vehicles have been successfully launched until last November. Advanced Land Observing Satellite DAICHI (ALOS), which was also very useful for disaster countermeasures, lunar explorer KAGUYA (SELENE) that observed the moon and took the image of "earthrise," and IBUKI (GOSAT) to observe greenhouse gases are included in them. We have launched not only JAXA's satellites, but also the geostationary meteorological satellite Himawari of the Meteorological Agency and information-gathering satellites. I'm very happy that all these satellites have achieved excellent results.

We offer observation data

Nishiura: It was exciting to watch the actual launch at Tanegashima Space Center, and the experience made me aware of the difficulty involved in launching a satellite. JAXA's satellites that have been launched over the years are diversified, and quite essential to our daily lives in many ways.

Tachikawa: The utilization of satellites has been significantly promoted from communications, broadcasting, and weather observation to positioning satellites often used for car navigation systems recently. Also, I see that JAXA's another important role is to use the results of observation from space for industry through, for example, support for agriculture, forestry and fishery, and resource exploration.

Nishiura: I also bring to attention the important fact that JAXA can play a big role in combating global warming, thus reducing it. This worldwide problem must be tackled with force and speed in order to secure the survival of mankind.

Tachikawa: The use of satellites for environmental problems, such as greenhouse gases and climate changes, and disaster countermeasures will increasingly be important in the future. So, JAXA makes considerable efforts to promote the use in these new areas. To cope with environmental problems, we need to research the situations, and observation from space is one of most effective means for it. For example, IBUKI is a satellite to measure CO_2 based on the concentration distribution from space. Previously the measurement has been performed at about 280 observation points on the land, which were hardly set on the ocean. Meanwhile, observation from space can be performed at 56,000 points all over the world, improving the accuracy of measurement greatly compared to the conventional one. IBUKI was launched last January and the distribution of data started in October. We expect all countries in the world use these data.

Nishiura: This is a tremendous contribution to the world. Governments of countries all over the world can draw appropriate measures using these data. IBUKI's observation data will continue to be useful in further advancement of measures to be taken whenever necessary.

Tachikawa: I have mentioned about global warming countermeasures above, and the same can be said for problems like climate changes and global circulation of water. We can offer observation data for these areas, too, and I believe the utilization of these data for policies through careful analysis will be more important in the future.

We can see the universe at all wavelengths

Nishiura: Another purpose of space utilization is to develop the field of space science. Would you enlighten the readers with JAXA's activities on astronomy, and solar system exploration fields?

Tachikawa: I think space science was started by people's demand to observe celestial bodies in space, or outside of the atmosphere, as the atmosphere hinders astronomical observation on the ground. In space, we can observe the universe at all wavelengths, and X-ray and radio waves are particularly focused in Japan. Five X-ray astronomical satellites have been launched in the last 30 years, producing many scientific outcomes such as the detection of black holes. We are now planning the No.6 satellite. I think we have offered advanced contributions with a small budget.

Nishiura: I couldn't agree with you more. I must say it was a remarkable effort on everyone at JAXA.

Tachikawa: In addition to observation from the Earth's orbit, we have also sent space probes to planets, including the Moon, for on-site exploration. Nozomi (PLANET-C) tried to explore Mars in the past, and HAYABUSA (MUSES-C) recently arrived at asteroid Itokawa. It is now on the way to the earth with samples collected from Itokawa. KAGUYA went to the Moon and brought many results. This year saw the launch of a Venus probe called AKATSUKI (PLANET-C). We also plan to launch a probe for Mercury in cooperation with Europe, and are considering successors of HAYABUSA and KAGUYA. These solar system explorations are too expensive for countries to work on solely. So it is sure that international cooperation will be actively pursued.

The outcome of experiments in space must be useful

Nishiura: International cooperation will need to increase, and strengthen. Japan can also continue to supply with up to date useful data for the benefit of other nations, enabling all of us in the world for new challenges, and research. It is important to accumulate such data, and experiences, so that they can be shared globally. We have the good example of the recent HTV project. The mission was a huge success.

Tachikawa: It has been around 11 years since the construction of ISS started. It will be finally completed this year. Then, the biggest challenge will be how to offer excellent fruits to humans

Dr. Keiji Tachikawa has been the President of JAXA since November 2004, driving for further advancement of aerospace exploration in Japan.

by using this ISS. Since six astronauts stay in the ISS, we have to transport food, water, daily necessities, and experimental equipment to them. HTV performs this role. The United States and Russia have already performed the shipment of supplies to the ISS. European transfer vehicle succeeded in shipment in 2008, and Japan also participates in this mission.

Nishiura: Japan's experiment module, Kibo is in ISS. We all share such high hopes and expectations for it to produce useful data and results.
Tachikawa: Experiments in the ISS have just started. But, we hope to contribute to humans by producing excellent results as soon as possible, because the outcomes of experiments in space must be useful for human life in future.

Two-hour flight between Japan and the United States

Nishiura: Please tell us about JAXA's research development of aircrafts.
Tachikawa: JAXA is engaged in R&D for not only space, but also aviation. We used to have YS-11, a regional airplane, but we have never had aircrafts made in Japan after it. That's why various R&D efforts have been made to produce regional jets. JAXA also researches the basic part of the development. Mitsubishi Heavy Industries decided to commercialize Mitsubishi Regional Jet (MRJ) last year, and the past outcome of JAXA's research was used for this. For MRJ, it is necessary to obtain type approval certificate in Japan, and JAXA will help the government's tasks for this.

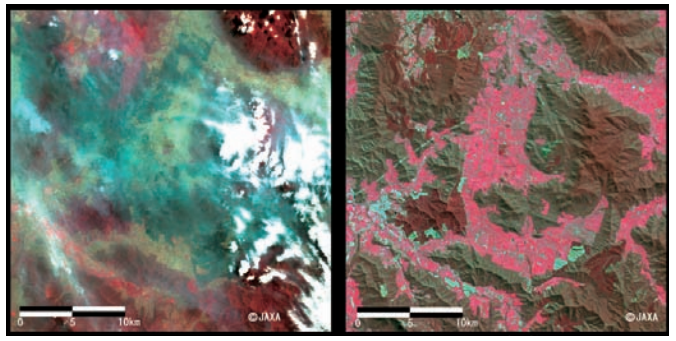
We eagerly hope to realize supersonic aircrafts in the future. But, for Mach 2 level aircrafts, considering the environment is needed, concretely speaking, quietness and measures against sonic boom. Moreover, we have worked on the development of ultra supersonic aircrafts flying at about Mach 5, which can shuttle between Japan and the United States in 2 hours.

Nishiura: Wouldn't it be marvellous? No more jet lags!
Tachikawa: You would also like to try this airplane, wouldn't you? But for this, we have to develop an engine for high-speed flight. The United States, Europe, and Japan now research this jointly. Mach 5 level supersonic aircrafts may be produced through international cooperation in the future.

Cooperation with Asian countries

Nishiura: I emphasize once again the importance of international cooperation in space field.
Tachikawa: Efforts for the ISS have been made through international cooperation, and I think it is really great for humans. Fortunately, conflicts have never broken out between participating countries during these projects.

Nishiura: That indeed is an immensely important factor. World peace achieved through sharing and participating in space projects are no longer just a dream.
Tachikawa: For example, if considering the future manned exploration of the moon, it must be hard for a country to realize it. So, several countries will have to cooperate. I assume the same can be said for the manned exploration of Mars.



The Extent of damage caused by mountain fire in Australia as observed by DAICHI (above). The right hand image shows the site before fire (Sept. 15, 2006) and the left shows the site after fire (Feb. 10, 2009).

Nishiura: What cooperative relationship does JAXA have with countries in Asia?
Tachikawa: JAXA developed what is called "Sentinel Asia" in the field of disaster measures in 2007 in which 21 countries in Asia participate. We have so many natural disasters in the Asian region, such as typhoons, floods, earthquakes, tsunami, and mountain fires. If a disaster occurs, we need to know the circumstances as soon as possible. Observations from space are best suited to this. That's why we offer a service to use DAICHI launched in 2006 to take images of the disaster site as soon as possible if required when a disaster occurs. This service has already produced results, offering various data. In this "Sentinel Asia," not only Japanese DAICHI, but also Indian, Korean, and Thai satellites have participated, allowing more prompt action to take the images of disaster sites by using the closest satellite when the provision of information is requested.

We consider if we can apply this cooperative relationship to the environmental area, too. While we already have IBUKI in Japan, we also plan to launch new satellites. India, Korea, and China may also launch satellites for similar purposes. If we can use these satellites, we will be able to cope with the environmental problems of Asian countries. We aim to build such cooperative relationships in Asia first, and then apply them globally.

Contributing to the future of mankind

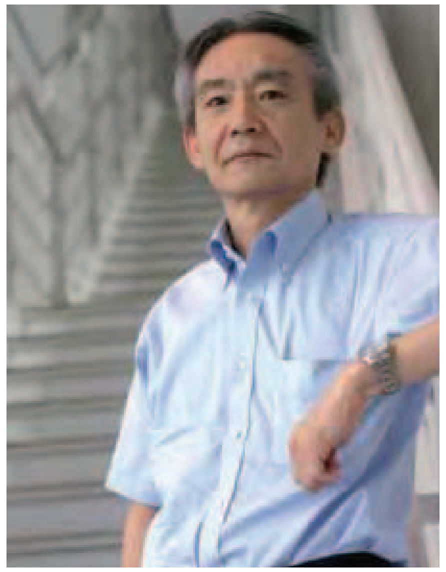
Nishiura: With the increasing number of problems facing the mankind today, space research and development are essential part of our lives to tackle these problems. It encourages us to see some nations have deep understanding about this fact, and focus on space as a national policy as well as launching full-scale efforts to advance the space projects. Here in Japan, the Basic Space Law was established in 2008.
Tachikawa: The Basic Plan for Space Policy was made based on the Basic Space Law and Japanese space policy to be implemented for the next 5 years was shown. I think it is wonderful, because space is highlighted as a theme for national strategy.

Nishiura: Japan is blessed with talented professionals, as well as excellent technologies, etc. I believe we have a lot to offer, and contribute to the world, and it's peace.
Tachikawa: I totally agree with you. Japan is now one of the top five countries in terms of space development and has made economical and global contributions. But, we are also eager to contribute to space utilization with human resources. JAXA tries to achieve it as a member of the world.

Midori Nishiura, an Opinion Leader, and President of a consulting firm, Amadeus Inc., Advisor to JAXA's Public Affairs, Visiting Professor at Yamaguchi University, amongst many other important roles she fills, has been on the Advisory Board of various major companies, and also sits on committees organized by Government Ministries and Agencies. Author of many books as well as articles in leading publications, Ms. Nishiura, having had her own interview programmes on television is often called upon to commentate on the news.

"Perseverance is the key to the success" of the H-IIB Launch Vehicle

The H-IIB Launch Vehicle Test Flight (H-IIB TF1) took off at its scheduled time on September 10, 2009 from the Tanegashima Space Center and delivered the H-II Transfer Vehicle (HTV) Demonstration Flight to the specified orbit. This new launch vehicle with launch performance greatly improved compared with that of the H-IIA is said to be the key to Japanese space transportation. But what kind of philosophy is its design base? And, what kind of potential does it have for the future? Mamoru Endo, one of JAXA's six chief engineers, who has been engaged in the development and operation of the H-II and H-IIA launch vehicles since the days when he was a member of the former National Space Development Agency of Japan (NASDA), talked about a view into something further away from the success of the H-IIB.



Mamoru ENDO

Chief Engineer, Space Transportation Program Systems Engineering Office joined NASDA (the former National Space Development Agency of Japan and the current JAXA) and worked for projects such as the development of the H-II and LE-7 and the concept design of the H-IIA. Focused on the preparation for the operation start of H-IIA as the deputy manager after the launch failure of the H-II No.8 (1999). Worked to rebuild the H-II family as a project manager after the launch failure of the H-IIA No.6 (2003), being involved in the development of the H-IIB at the same time. Retired from the project manager position after helping on the H-IIA No.11 project (2006) and was assigned to the current position.

Basic concept: No major change

My very first experience of witnessing a launch of the H-IIA Launch Vehicle at the launch site was immediately after I stepped down from the position of the H-IIA project manager. It was a launch of the H-IIA Flight 12, and I can still vividly recall my strong impression of the dynamic liftoff scene. It was awesome! Unfortunately, I was at the Tokyo office watching a live report of the H-IIB launch that time. I thought I would remain calm and cool for the launch this time, but I actually found myself shouting, "Good! Well done!" to myself in my mind every time some major events, such as SRB-A separation and first-stage engine cutoff, successfully took place.

We now have a new launch vehicle with a new name, H-IIB. It is larger with improved launch capability. However, our basic concept of its development was "no major change." Engineers who were engaged in the H-IIB development must have been less interested in it owing to such a concept. However, thanks to the concept, we were able to maintain the steady and sound development of H-IIB from the beginning to the end by minimizing challenges to new technologies. I now felt relieved to have fulfilled my responsibility rather than moved by the successful launch. Also, I was overwhelmed by deep emotion and satisfaction to see that we had finally reached the level of discussing manned space transportation.

A "space transportation system" is a service to prepare a launch vehicle (transportation means) required by a customer payload (satellite side) and take a payload to its orbit. In order to inject an HTV, which is 16.5 tons, to its orbit, we made a new launch vehicle, H-IIB, with minimal risks and costs. Accumulated experiences and technologies of the H-IIA were fully utilized for this purpose.

Step-by-step progress based on 204 type

For example, a solid launch vehicle booster (SRB-A) for the H-IIB is exactly the same as that for the H-IIA. The core vehicle needed to be strengthened to bear with the power of four SRB-As, but its design strength has already been verified by the H-IIA Flight 11 (204 type of the H-IIA series) with the KIKU No. 8 (ETS-VIII: Engineering Test Satellite-III) onboard. From the very early stage of the H-IIB development,

H-IIB launch vehicle moving to the launch pad No.2 of the Tanegashima Space Center on September 10, 2009

we strategically verified some technological issues through the H-IIA 204 type to smoothly step up from H-IIA to H-IIB. In that sense, the H-IIA 204 type was a very important step as it satisfied the requirements of a very heavy payload, "KIKU No.8," while realizing "minimum risks and costs."

The diameter of the H-IIB first stage is 5.2 meters, which is larger than the H-IIA diameter. It is true that a bigger diameter is one of the "unknown factors" in view of design. Still, it is not very difficult to predict its impact through simulation based on calculation. Some new technologies such as friction stir welding (FSW), which was used for joining core vehicles and dorm parts, greatly contributed to reducing costs including inspection expenses. An upgraded avionics system (an electronic system for guidance control) can also be applied to the H-IIA series. As a result of our tireless efforts, the development cost of the H-IIB was much less than that of H-II, which was about 270 billion yen, or that of H-IIA, about 120 billion yen. Although we exceeded our original budget of 20 billion yen, which included the development costs of Mitsubishi Heavy Industries (MHI), we were able to complete the development of H-IIB with the total amount of about 27 billion yen (19.6 billion yen for JAXA and 7.5 billion yen for MHI). I think our achievement was more than "incredible." It should be "unrealistic" (or even "crazy!") if you compare it with the global launch vehicle development standard. Our successful development was owing to our "power of continuation" as we have been persistently striving to develop H-II, H-IIA, and H-IIB.

Necessity of new challenges

The H-IIB development project gave its first cry when JAXA (then NASDA) was busy investigating the cause of the H-IIA Flight 6 launch failure and studying countermeasures. In other words, at that time, we were in one of the worst situations in our history; thus, even some people within our organization opposed the idea of developing a new launch vehicle under such circumstances. They commented, "Even though we can use quite a few already established technologies, don't we still have to build a new system?" or "You can't achieve the development in such a low budget." Even some of them explicitly said, "The project should be cancelled." Their opposition was rational because the "development of a new launch vehicle" was proposed by a person who was the project manager of the launch vehicle that caused a failure. By incorporating those candid opinions, we have repeatedly studied and verified the possibility of a new launch vehicle development, and I now believe that such careful consideration also contributed to our successful development.

Meanwhile, I also hear some comments like, "We've already had a launch vehicle that has enough launch capability, thus we do not need to pursue further development," or "Are our development activities not for an achievement but for inducing further development?" However, as athletes continue their daily training to maintain their ability, we also need to update our technological level by continuously challenging new things. If we merely continue our launch activities with existing launch vehicles, I can clearly predict that they will become obsolete in the near future. In ten years or so, some manufacturers may stop making a certain component. Therefore, I strongly feel the necessity of always setting a new goal and investing in it.

We have already accumulated a lot of knowledge and technology. We have enough data in our computers. However, only human beings can extract and fully understand these, and create a new thing . In the case of large systems such as a launch vehicle, we cannot make any progress if we start something from scratch every time. Currently, the same engineers are in charge of maintenance, operation, and new technical development of both H-IIA and H-IIB, and I believe that that is the way it should be.

Safety is determined by "how much we have considered"

This launch was successfully achieved, but it does not mean that we have acquired a space transportation system that can be used for manned space transportation. It is true that we have acquired a potential, but just having the capability and actually carrying human beings to space are two completely different things. In the case of an unmanned mission, we can continue the flight of a launch vehicle until it reaches an extreme situation even if we detect some abnormality in flight data. Then, if we find that the mission cannot be achieved, we can send a destruct command to terminate the flight with a loss of vehicle (LOV) or a loss of mission (LOM). For a manned mission, however, things are very different. We may have to give up a vehicle or a mission, but we have to avoid a loss of the crew (LOC). In that sense, the same data abnormality has different meanings for a manned and an unmanned mission; hence, a very critical decision must be made for a manned mission. In the United States and Russia, enough data must have been accumulated to make such a grave decision by actually manufacturing hardware and testing it repeatedly.

However, in Japan, if we decide to engage in manned space transportation, it is not realistic that we follow the conventional method of the previous century that requires a lot of money and

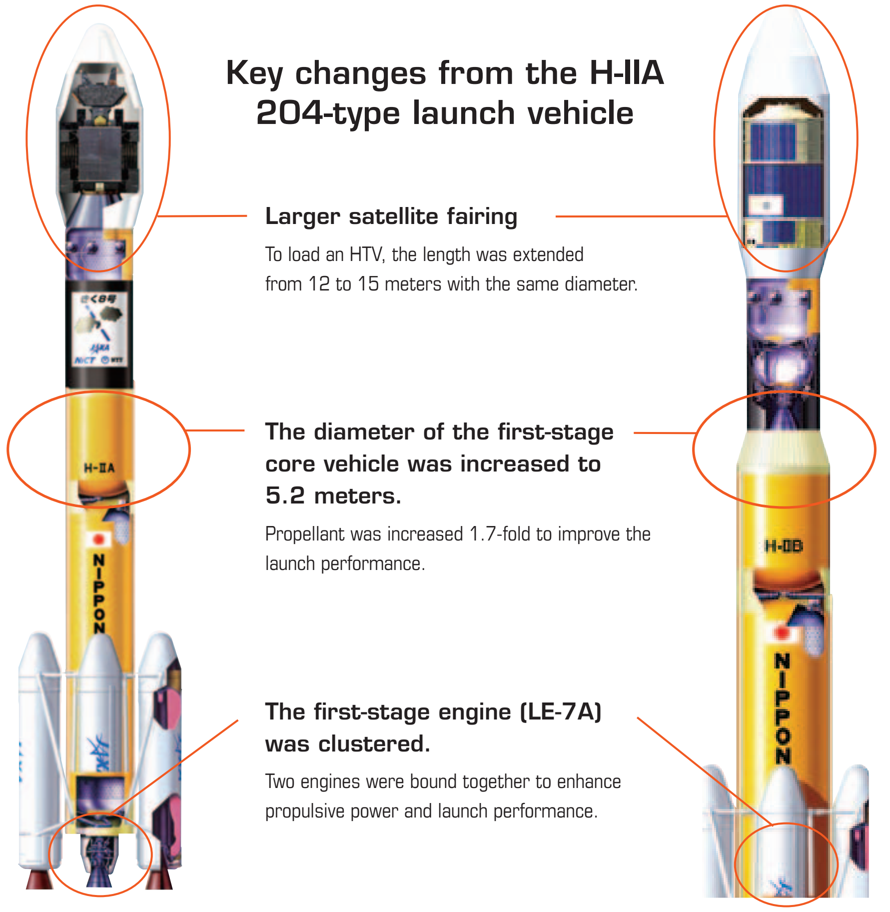
H-IIB TF1 carrying the H-II Transfer Vehicle (HTV) Demonstration Flight launched from the Tanegashima Space Center on September 11, 2009

time for repeated tests and data acquisition to set up some sort of decision-making criteria. We should come up with a space transportation system that does not require a critical judgment, or that does not induce two or more incidents that entail critical decisions simultaneously. It means that, for a manned mission, we will face challenges that are completely different from improving or renovating the H-IIA or H-IIB, which is not designed for a manned mission.

Having said the above, I believe that, technically, Japan's existing hardware itself is good enough for a manned mission. The point is that reliability and safety depend on how far we consider some issues and what problems are investigated in depth during the design phase.

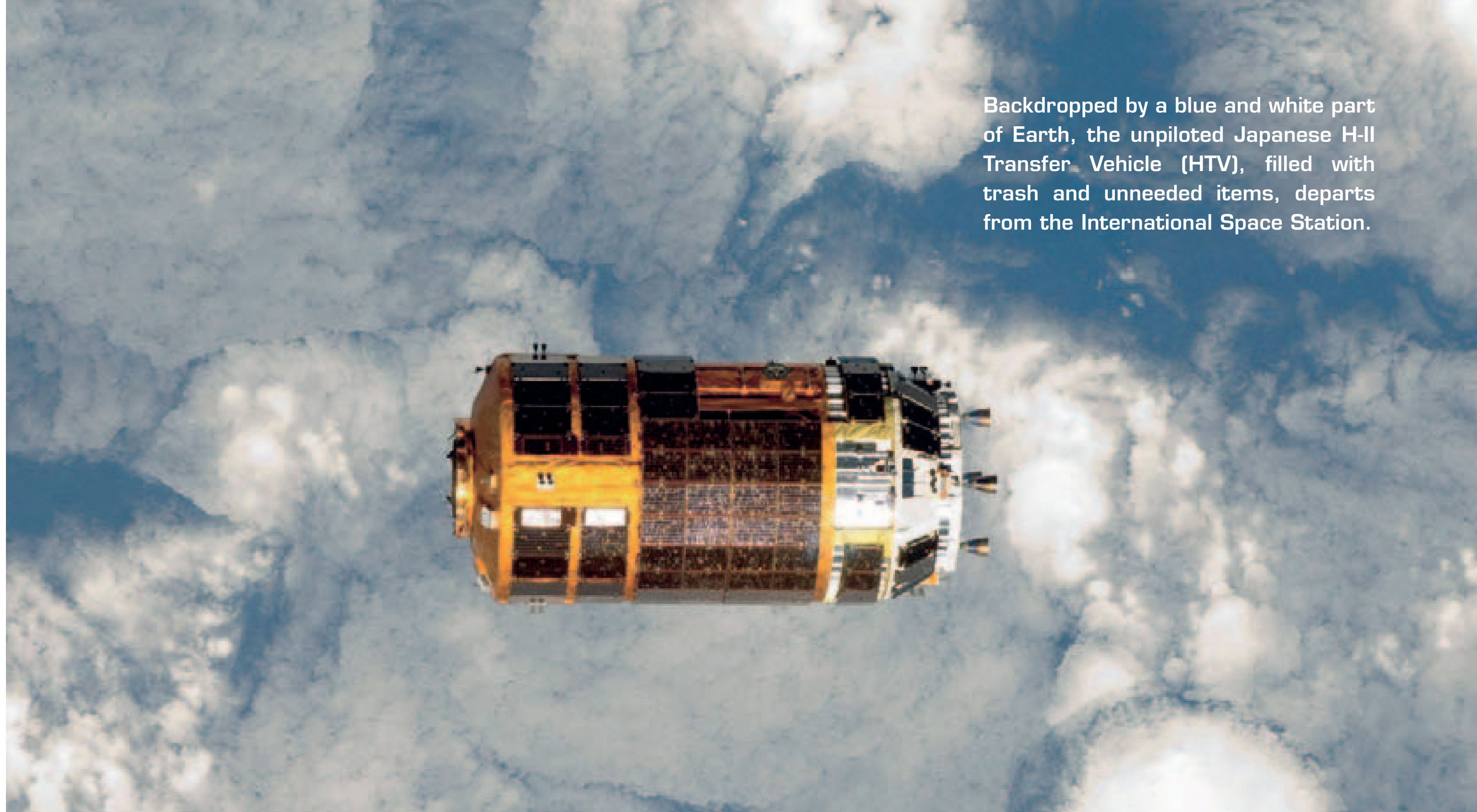
I always say, "A launch vehicle provider is like a palanquin carrier." I believe that the successful H-IIB launch this time has enabled us to move a step closer to a safer transportation system for men, but we have not achieved yet a fully comfortable level of providing a vehicle that people can safely ride.

As a person who has been working for an unmanned launch vehicle, I feel that it is an important task for me to provide next-generation engineers with the environment where they can meet the challenge to provide a vehicle in which people can safely ride. Most of all, if we decide to send people into space by our own space transportation system, those who will be on board will be JAXA astronauts, our fellow engineers.



H-IIA 204-type launch

H-IIB launch vehicle

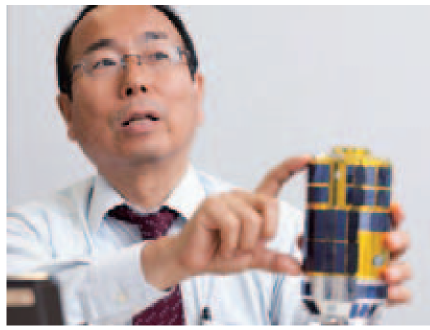


Backdropped by a blue and white part of Earth, the unpiloted Japanese H-II Transfer Vehicle (HTV), filled with trash and unneeded items, departs from the International Space Station.

H-II Transfer Vehicle (HTV) completed the 53-day mission.

The HTV was launched from the Tanegashima Space Center by the H-IIB Launch Vehicle on September 10, 2009 and docked with the International Space Station (ISS) on September 17. After being moored to the ISS for almost one and half months, it was released from the ISS on October 30, 2009 and completed the 53-day mission when reentering the atmosphere over New Zealand on November 1, 2009.

This was the first mission for the HTV, a cargo vehicle developed by Japan. What kind of system is the HTV? How was it developed? And, how will it be operated in the future? We asked these questions to Yoshihiko Torano, a project manager controlling the HTV Project.



Yoshihiko TORANO
Project Manager
HTV Project Team
Human Space System and Utilization Mission Directorate

Transporting everyday goods and experiment devices to ISS

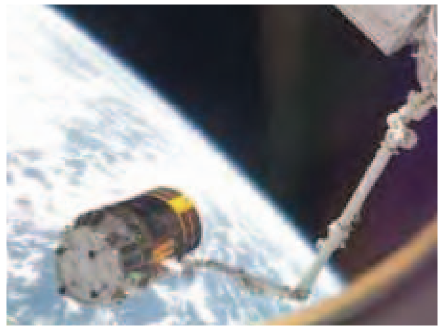
Q. What kind of a cargo vehicle is the HTV?

Torano: The HTV is to transport everyday goods, various experiment devices, and parts used for the maintenance of the ISS to the ISS from the ground. The total length is approximately 10 meters, the diameter is 4.4 meters, and the mass excluding the cargo is 10.5t. It can deliver a cargo of 6t or more to the ISS. The HTV is mainly composed of two major sections: space to load cargos and to house PCs, electronics, propellants, engines, and others. The former is also composed of two sections: the Pressurized Carrier in which 1 atmosphere is always kept and the Un-pressurized Carrier exposed to space to transport goods in a vacuum.

Next pages The HTV Mission Control Room in the Tsukuba Space Center. The staff members celebrating the success of mission after the HTV reentered the atmosphere on November 2, 2009.


JAXA
HTV PLANNER

The HTV is launched by the H-IIB Launch Vehicle.



The HTV approaching the ISS

Crew members enter the HTV docked to the ISS.

ISS Canadarm2 grapples the HTV in preparation for its release from the station.

Backdropped by a blue and white part of Earth, the HTV, filled with trash and unneeded items, departs from the ISS.

Q. Which points of the HTV are unique?
Torano: First of all, I think the Unpressurized Carrier is unique because the HTV will be the only vehicle that can transport experimental devices and parts to be mounted on outside the ISS after the scheduled retirement of Space Shuttle in 2010. In addition, the Pressurized Carrier is also unique because it allows the HTV to transport a large-size cargo with its large 1.2-meter-wide opening on the docking side.

Q. How is the HTV docked with the ISS after being launched by the H-IIB Launch Vehicle?
Torano: The HTV recognizes its own position by using the data of GPS after being separated from the launch vehicle's second stage and reaches the same altitude as the ISS by the main engine fired. Then it moves to the position 5 km from the ISS and confirms to the controller if it can proceed with the next step. If the controller on the ground approves, the HTV will fly down to move just under the ISS. Then it checks all the functions and awaits instructions from the controller on the ground, hovering at the points of 300 m and 30 m from the ISS when moving up close to the ISS. Finally, it stops at 10 m from Harmony module (the node 2) on the bottom of the ISS, and then the robotic arm of the ISS grasps the HTV to let it dock with the Harmony.

Excellent safety is required to dock HTV with the manned ISS

Q. What did the HTV transport to the ISS in this mission?
Torano: This HTV, the first demonstration flight, had the HREP, an experiment device of NASA, and the SMILES, Japanese experiment equipment (loaded on a special platform called a exposure pallet) in the Un-pressurized Carrier, and food, drinking water, and everyday goods for astronauts in the Pressurized Carrier. It is planned to launch the HTV almost once a year, i.e., 6 more HTVs, in the future.

Q. Is the unmanned HTV in danger of clashing into the ISS by mistake when approaching the ISS?
Torano: If it happens, it will be a serious problem, as the ISS is with astronauts onboard. That's why very high safety is required for the HTV and its operating process is designed not to allow to proceed to the next step without receiving an approval command from the controller on the ground at each key point.

Q. Which point was difficult in the development process of the HTV?
Torano: The most difficult point was to let the HTV follow the ISS at exactly the same speed as the ISS flying at a speed of 7.7 km a second as if it hovered around the ISS. To achieve this, elaborate calculations were needed to keep ultra-precision, and double and triple systems were used for security purposes. So, we had to struggle to conduct too many tests with too many items. For example, for tests between two devices, 2 tests for each device for the double system and 3 tests for each device for the triple system were required.

The International Space Station's Canadarm2 grapples the unpiloted Japanese H-II Transfer Vehicle (HTV) in preparation for its release from the station.

Q. Had the JAXA experienced rendezvous and docking in space?
Torano: We had an experiment of the rendezvous and docking. The Engineering Test Satellite VII Kiku No. 7 (ETS-VII) "Orihime (Chaser) & Hikoboshi (Target)" launched in 1997. In fact, the outcomes of these experiments were utilized for the HTV.

Q. Where is a command to the HTV sent from?
Torano: It is sent from the mission control room for the HTV in the Tsukuba Space Center where a 20-member team works on a three-shift system.

Q. You must have trained a lot for the operations of the HTV from the launch, and docking to the ISS to subsequent operations.
Torano: Yes, I have already done training 100 or more times, including joint training with the United States I sometimes do it three times a week, and must sometimes start from 4 A.M. or from evening till dawn due to time difference with the United States.

Technology leading to the future manned space system

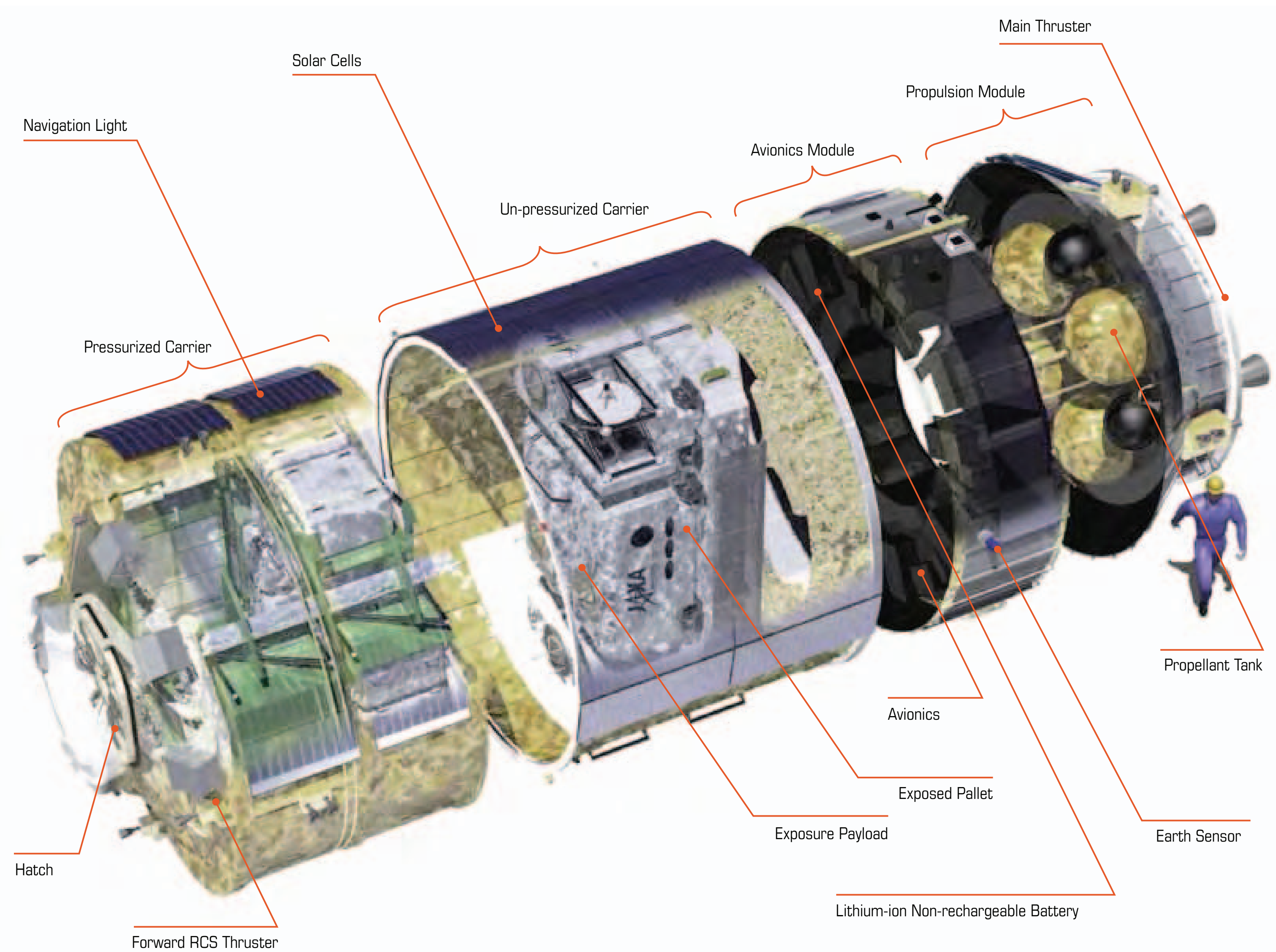
Q. Do international partners have great expectations from the HTV?
Torano: At the beginning of the HTV development, some people may have said that we did not have to develop such a transporter because we could pay money to ask the transportation of goods to the Space Shuttle or Progress. But, our predecessors kept the development saying, "No, we do not give it up, because the HTV must be needed for the Japanese space development in the future." Consequently, the HTV now attracts a lot of attention from the world, since Space Shuttle will retire from service soon.

Q. What does the HTV mean to the future of Japanese space development?
Torano: In the Pressurized Carrier of the HTV, people can breath because 1 atmosphere is always kept inside. So we can turn the HTV into a manned spaceship by mounting life-supporting equipment. In other words, we can make any time a system for manned space flights. By enhancing the propulsion system a little, we can even go to the Moon. So I believe that the significance of the HTV is not only in the safe transportation of cargo to the ISS, but also in the realization of manned space flights by Japan.

Q. Many people may think it costs a great deal of money for Japan to achieve a manned space flight capability, and we have to develop the technology from scratch. But what do you think of it?
Torano: That's not the case. It may cost much, but we do not have to develop from scratch.

Q. Finally, tell us about your hopes for the future.
Torano: I believe the HTV is a very excellent cargo transporter as well as the culmination of the past space development of Japan, as the technologies of rocket, satellites, and manned space system are concentrated in it. My hope or desire for the future is to use these outcomes as a means to develop not only manned space flight, but also the Moon and the other planets.

H-II Transfer Vehicle (HTV)



Six-person crew is a very important milestone in the ISS program

Astronaut Koichi Wakata told about the long stay in space.

On July 31, 2009, JAXA astronaut Koichi Wakata, who stayed in the International Space Station (ISS) as a member of the Expeditions 18, 19, and 20 crew, safely returned to Earth aboard space shuttle Endeavour. He completed the final assembly of the Japanese Kibo Experiment modules with the crew of STS-127/2JA mission. His stay in space was as long as about 138 days. During his stay in space, the crew size of the ISS Expedition expanded from 3 to 6.

The time flew by quickly

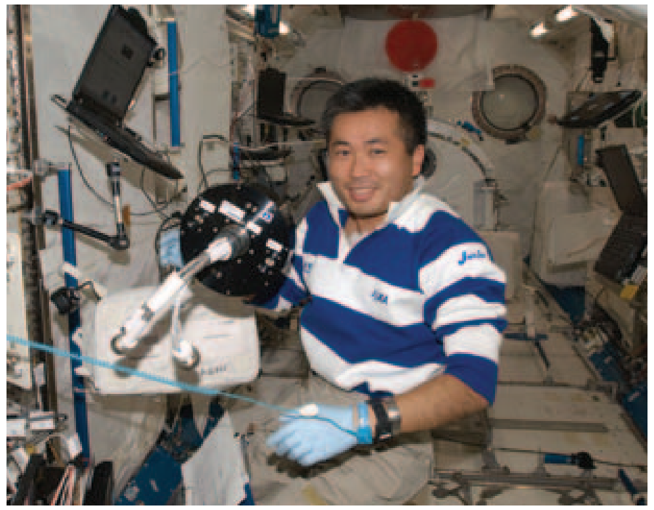
Q. How did you feel right after returning from the long stay in the International Space Station (ISS)?

Wakata: I felt the gravity and realized that I really came back to the earth. The time flew by quickly because I was busy with my work and in daily life in space. I felt like coming back from one-week or two-week business trip. Since I worked in a special and, in a way, demanding environment that was different from the life on the earth, the four and a half months of stay in space was like a dream.

Q. When you were assigned as an Expedition crew, you told us that the flight would be like a marathon after sprint with another sprint at the end, because you had shuttle missions in the outward and return trips. How was it actually?

Wakata: As I expected, I felt like I was doing a 100-meter dash every day during the docking of space shuttle on the way to and from ISS. Usually in the returning shuttle flight, a complicated task like assembling of the Japanese Experiment Module Kibo is not assigned to an Expedition crew. However this time, the returning flight included the mission of final assembly of Kibo modules and my participation, as a JAXA astronaut, was assigned from the beginning. Since I had a huge pile of tasks just before returning to the earth, I kept having a sense of tension all the way. In the outward flight STS-119, I installed a base segment of solar array panel called S6 truss to the ISS.

After the space shuttle Discovery for the STS-119 left and the two of expedition 18 crew returned to Earth by Soyuz TMA-13, I conducted various experiments pertaining to system operation and maintenance in ISS for two months with cosmonaut Gennady Padalka and NASA astronaut Michael Barratt. We were very busy every day during this period, as it was a flight in space shuttle. At the end of May, three crews newly arrived in Soyuz TMA-15 and a six-person team was formed for the first time in ISS. After that, I had a day off on Sundays and we had some spare time in life.



Astronaut Koichi WAKATA works in the Kibo laboratory of the International Space Station. He is a veteran of three space flights. He flew as the first Japanese Mission Specialist on the STS-72 mission in 1996. In 2000, he became the first Japanese astronaut to work on the ISS assembly on the STS-92 mission. On March 15, 2009, Koichi Wakata flew aboard Discovery on the STS-119 mission during which the seven-member crew installed the final starboard truss segment S6 to the ISS and performed three space walks. During 4-1/2 months aboard the ISS, he served as a Flight Engineer and the JAXA Science Officer on the crew of Expeditions 18, 19, and 20. He became the first Japanese astronaut to serve as a resident ISS crew member. Expedition 20 marked the first ISS expedition to expand the crew size from 3 to 6 members with representative crew members from all the ISS partner agencies. With the arrival of STS-127, the crew expanded from 6 to 13, the largest ever to live and work aboard the ISS. The seven-member crew of STS-127 completed the final assembly of the Japanese Kibo modules of the ISS and performed five space walks. Koichi Wakata returned to Earth aboard Endeavour with the crew of STS-127 on July 31, 2009.

Well-lighted, quiet, and comfortable Kibo

Q. You had a big job to complete Kibo modules at the very end of the Expedition. How did you feel when you finished it?

Wakata: Seventeen years have passed since I was selected as an astronaut candidate, and I have worked with people who joined the development team of "Kibo" and members of operation and control team of JAXA who operate Kibo from Tsukuba Space Center, Japan. I am very happy to have joined the mission to finish assembling Kibo. During the final work to move the experimental package using Kibo's robotic arm, I remembered all of those people I have worked with and I felt that I was really fortunate to be involved in Kibo project.

Q. What did you think of Kibo after you actually worked in space?

Wakata: I felt strongly that "Kibo" is a great experimental facility that Japan could be proud of. The Pressurized Module is well-lighted and quiet, making a comfortable environment. I also felt that the perfection level of ergonomic design is very high. I did various tasks including life science experiment, material experiment, and art experiment, as well as PR activities and educational/promotional activities. I hope that the Kibo's great capability is used in various ways.

The six-person Expedition 20 crew poses in the Harmony node of the International Space Station. Pictured clockwise from right (center) are cosmonaut Gennady Padalka, commander; Canadian Space Agency astronaut Robert Thirsk, Japan Aerospace Exploration Agency (JAXA) astronaut Koichi Wakata, NASA astronaut Michael Barratt, cosmonaut Roman Romanenko, and European Space Agency astronaut Frank De Winne, all flight engineers.

Six-person crew as a key milestone in ISS project

Q. In this long stay in space, you yourself became an examinee for an experiment. I believe the outcomes of the experiment will be important for the future manned activities. And what is your idea?

Wakata: If a man stays in space over a long period, the density of bone will be reduced. In this mission, I became the first examinee among astronauts for testing bisphosphonate, a drug used to control the reduction of bone density. I took this drug, which is normally used for patients with osteoporosis on Earth, to check its effects on the reduction of bone density under the microgravity environment. As a result, we had positive outcomes of bone density between before and after the flight. This is one of the ongoing collaborative researches between Japan and the United States, and I believe we could get valuable data through this experiment to resolve the reduction of bone density, a physiological problem, during a long stay in space.

Q. The first six persons of Expedition crew were astronauts from the United States, Russia, Europe, Canada, and Japan. What did you feel about the life in space with people from various countries?

Wakata: Astronauts from five space agencies participating in the ISS program gathered in orbit by chance during this Expedition. I think six-person crew is a very important milestone in the ISS program. International cooperation is essential for human beings to

The Japanese Experiment Module Kibo laboratory and Exposed Facility are featured in this image photographed by a crew member on the International Space Station.

The members of the STS-127/2JA ISS Orbit 2 flight control team pose for a group portrait in the space station flight control room in the Mission Control Center at NASA's Johnson Space Center.

develop new frontiers. So I believe this gathering of astronauts from five space agencies in the ISS was an event representing the significance of international cooperation.

Q. What did you do in your free time?
Wakata: After six-person crew was formed, I could have time to read books, enjoy the beautiful view of the earth through an unshuttered window of Kibo, and listen to music in my free time or holiday. For me, viewing Earth, our home, seemed to be the most relaxing time.

My dream is to allow Japanese to go into space from Tanegashima

Q. What do you think about the manned space activities of Japan in the future?
Wakata: For one thing, I think it is important to advance the Kibo operation soundly to achieve the success of ISS program. In fact, it is a very challenging endeavor to operate manned facilities in space, a harsh environment, although people may feel it is rather easy after launching the vehicle into space. A wrong operation may lead to fatal damages such as fire and sudden depressurization. All staff members of the operation control team in Tsukuba handle hard tasks to operate Kibo around the clock in cooperation with control teams all over the world and astronauts in orbit. In my opinion, manned space activities are an effort of crisis management for human beings to survive as "species" in the long view. So I believe it is necessary to utilize new technologies and know-how of operation obtained through the development and operation of Kibo in the post-ISS manned space activities of Japan. In addition, I expect that Japan will further contribute to the world's manned space activities as a leader in technology by promoting the area of specialty such as robotics.

Q. What is your dream in the future?
Wakata: I want to contribute to the success of the entire ISS program, emphasizing that I am a Japanese astronaut, by using what I have learned through the training and space-flight missions and widely promote Japan as a nation contributing greatly to the world's space programs in a variety of areas, including the ISS, especially in terms of human resources. And, my big dream is to construct a Japanese manned space-ship that can shuttle between the ground and low earth orbit in order to allow a lot of astronauts from Japan and the rest of the world to go into space from Tanegashima Space Center in the future.

Q. Finally, please offer any comment for the readers.
Wakata: I am very glad to have completed the mission safely. I could get through the long stay in space for four and half months, thanks to support by many people. In addition to me, JAXA astronaut Soichi Noguchi started a long stay last December, and astronaut Naoko Yamazaki will board the space shuttle in March next year. Moreover, astronauts Satoshi Furukawa and Akihiko Hoshide plan to participate in a 6-month long stay in the ISS in the near future. Thus an increasing number of Japanese astronauts will play an active role. So I wish many people continue to cheer for us.

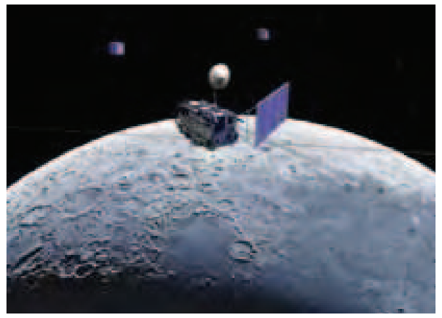
Deepening Mysteries of the Moon

Scientific Results of Lunar Explorer KAGUYA

The SELenological and ENgineering Explorer KAGUYA (SELENE), Japan's first large lunar explorer, was launched on September 14, 2007, and was controlled to be dropped onto the Moon on June 11, 2009, as its mission was completed. KAGUYA had been using 14 onboard scientific instruments to observe the entire surface of the Moon. Although it is still in the data analysis stage, new discoveries have been published in scientific journals. We interviewed Professor Manabu Kato, Science Manager of SELENE Project, about the scientific results of KAGUYA.

Magma oceans right after the Moon's formation

Q. Will you tell us about the scientific results of KAGUYA?
Kato: First, the Terrain Camera (TC) is a high-resolution stereo camera, and a lot of interesting data have been already acquired, including 3D flythrough movie of Tycho Crater. We used TC data to determine the age of lunar region using a method called cater counting; the greater the number and density of craters, the older we assume the region to be. Since the chronology of the nearside of the Moon is already determined rightly, we analyzed the chronology of the maria, the "ocean" on the farside of the Moon. As a result, we found that the farside had been volcanically active until 2.5 billion years ago, i.e., they may be about 1 billion years younger than previously estimated because it was thought that the maria had become inactive about 3.5 billion years ago. The nearside had been active until about 1 billion years ago. The fact that the farside had been active until 2.5 billion years ago shows that the Moon had enough heat source and was not completely cold until that time.



Japan's Lunar Explorer KAGUYA with 14 scientific instruments onboard was launched on September 14, 2007. The major objectives of the mission are to understand the Moon's origin and evolution, and to observe the moon in various ways in order to utilize it in the future. On June 11, 2009 its mission was completed.

Q. Then, is the history of the Moon different from that was previously thought?
Kato: It is thought that the lunar surface was once completely molten right after the Moon's formation; the so-called magma ocean existed. The quantity of heat source of the Moon was basically determined during this period, and it seems that more heat was reserved than previously thought.

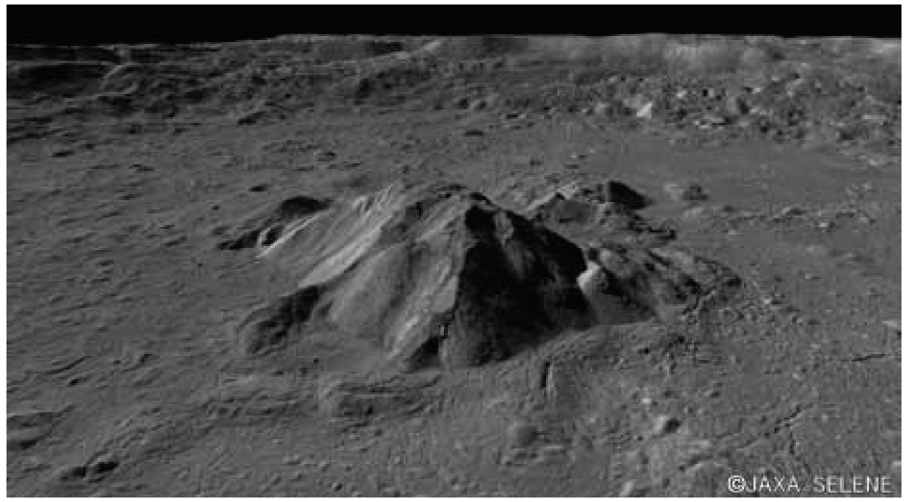
Manabu KATO, "Kaguya" Science Manager, SELENE Project Team, JAXA Space Exploration Center

Global topographic map was completed with laser altimeter

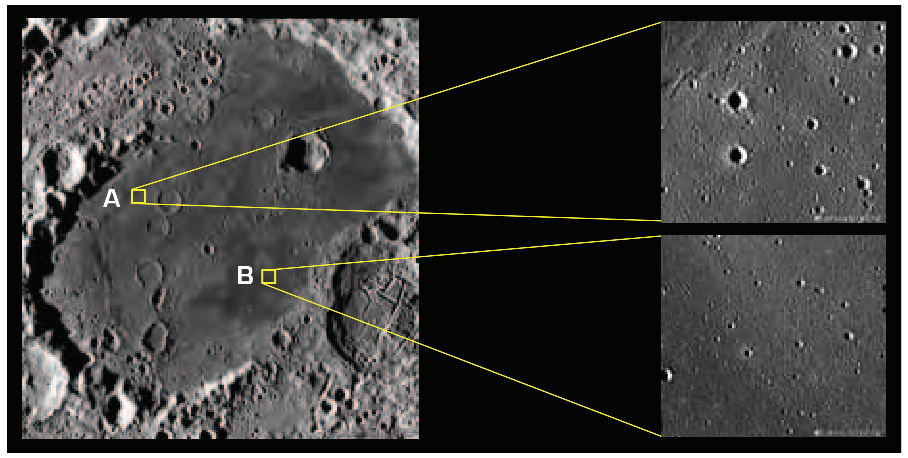
Q. How was the result of scientific instruments used to observe the distribution of minerals on the lunar surface?
Kato: Two instruments are onboard KAGUYA to observe rocks that comprise

the surface of the Moon and their mineral composition. One is a Multi-band Imager (MI) and the other is Spectral Profiler (SP). We observed central peaks of craters with these two instruments. In violent impact that may create a crater of 100 km diameter, the central part of the crater is uplifted due to the gravitational effect. This is the central peak where we can find materials deep underground, because these materials were exposed by the collision. We observed several central peaks and found that the major component was the rock called anorthosite consisting of mineral that was rich in calcium and aluminum. The composition was almost the same everywhere. This means that the layer of anorthosite exists underground. This also shows that the existing magma ocean hypothesis may be somewhat different.

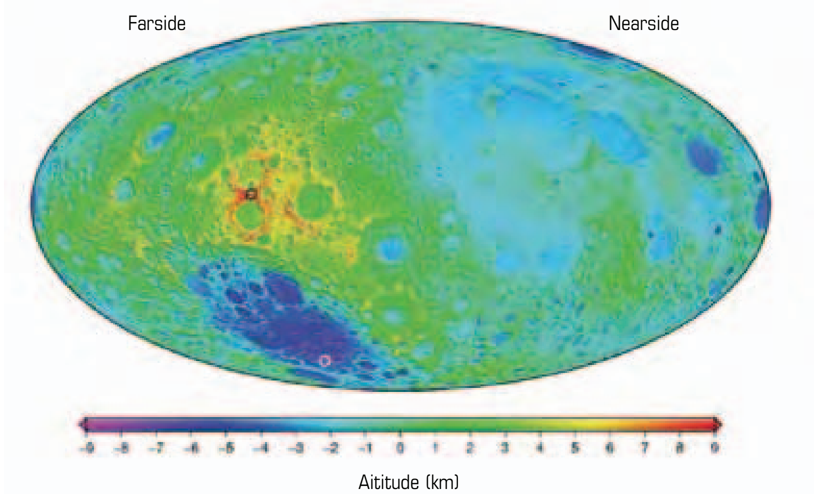
Q. Will you tell us about the laser altimeter (LALT)?
Kato: We acquired the topographic data over the Moon with LALT, including the high-latitude region of north and south above 85 degrees that has not been measured by an altimeter. Using this data we made the global topographic map of the Moon. The highest and the lowest points were determined correctly. The highest point is located on the edge of a crater on the farside, which is 10 km higher than the mean radius of the Moon. The lowest point is located in the South Pole - Aitken basin on the farside, which is 9 km lower than the mean radius.



View of the central peak of Tycho crater acquired by Terrain Camera. Tycho is a large crater 84 km in diameter and 4.6 km deep. This crater is relatively new in lunar history, formed by an impact about 100 million years ago.



Chronology of Mare Moscoviense on the lunar farside. The Terrain Camera aboard KAGUYA provides high-resolution images to sufficiently detect small craters. As a result of crater counting by TC observation data, several areas of Mare Moscoviense show their younger ages. Area B is 1 billion years younger than area A. Area B had been active until 2.5 billion years ago.

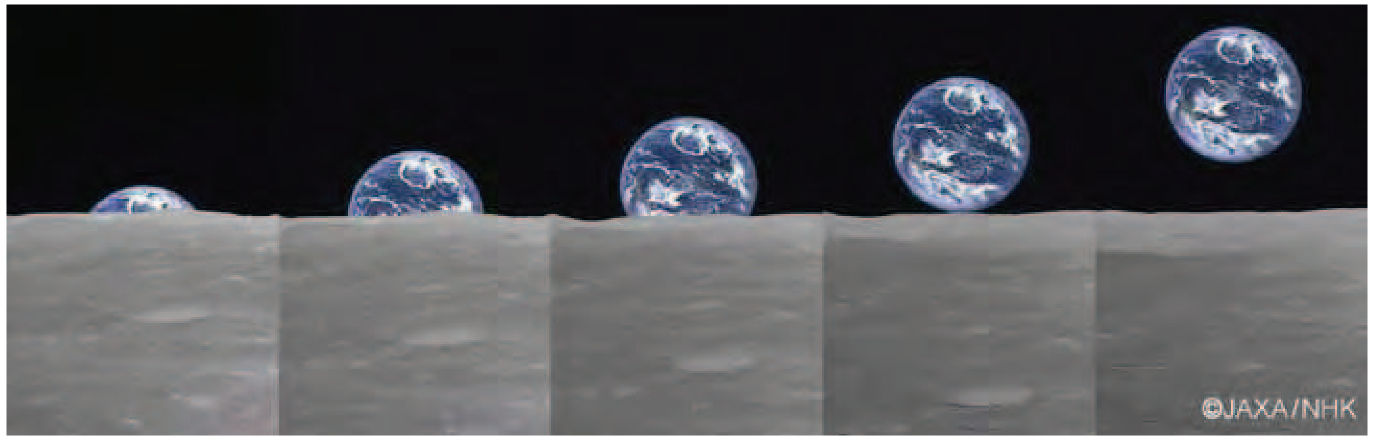


A global lunar topographic map with a spatial resolution finer than 0.5 degrees has been derived using data from LALT onboard KAGUYA. In a comparison with the previous Unified Lunar Control Network (ULCN 2005) model, the new map reveals unbiased lunar topography for scales finer than a few hundred kilometers. The highest point on the Moon (black circle) is on the southern rim of the Dirichlet-Jackson basin, and the lowest one (white circle) is in the Antoniadi crater in the South Pole - Aitken basin.

Q. The "permanent sunlight" and "permanent shade" on both polar areas were also observed by LALT. What was the purpose of it?
Kato: Because these areas are possible locations for future lunar base. The permanent shade exists on both areas. The permanent sunlight does not exist, but there is a region where the sun shines 80% of the year. If we set solar cell on that region, we can have plenty of electricity. Therefore, such a region may be a candidate site for the lunar base.

Gravity anomalies reveal the subsurface structure

Q. Have you acquired the data on the gravity anomalies?
Kato: Of course we have. In the area where the gravity is strong, the materials heavier

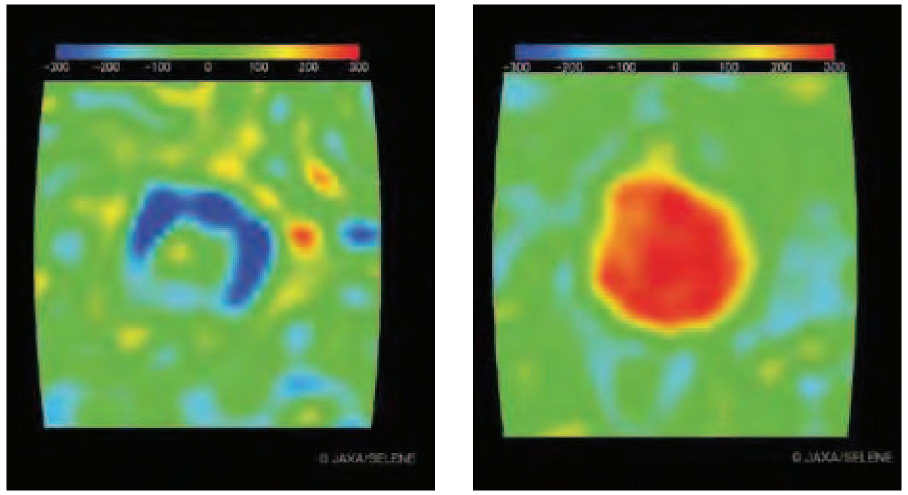


Sequential images of the full Earth-rise taken by KAGUYA's onboard high-definition television (HDTV) on April 6, 2008. Images shown here are cut out from the moving images.

than average exists. This corresponds to the magma containing iron oxide. The area where the gravity is weak consists of lighter rocks only. On the nearside, heavy materials are distributed on the maria, and we have found that few areas contain heavier materials on the farside. Moreover, multiple-ring structure due to a huge impact seemed to have remained on the farside without any change. Since we have learned these from the observation of gravity anomalies, we will find how the subsurface structure was formed and why there are such differences.

Q. It seems that there is a lot of difference between nearside and farside of the Moon.
Kato: The gravity anomalies and the data acquired from LALT I mentioned earlier have emphasized the different characteristics of the nearside and the farside, in other words the dichotomy of the Moon. On the other hand, the facts that the composition of the central peaks are the same everywhere and that the farside of the moon had been active 1 billion years longer than we previously thought alleviate the dichotomy. We have found both characteristics.

Q. Have you found anything about the subsurface structures?
Kato: We observed almost the whole area of the Moon with Lunar Rader Sounder (LRS) and we are analyzing the data of some maria on the nearside. The observational result shows that discontinuous plane exists at 500 m below the surface. It shows that the eruption of the magma occured twice when the maria was formed.



Gravity anomaly of Apollo basin (left) on the farside and Mare Serenitatis (right) on the nearside. Not only the Apollo basin but many other basins on the farside are characterized by a large negative (blue color) gravity anomaly. Such a signature of farside gravity is distinguished from that on the nearside. Mare Serenitatis, the representative basin on the nearside, shows a strong positive (red color) gravity anomaly at the center of the basin. The newly found difference of gravity anomaly on the near-side and the far-side gives us clues to important questions regarding the structure of the lunar interior and the formation of the far-side and near-side of the Moon.

We will find the area where the eruption occurred with further inspection.

Q. How was the observation result from Lunar Magnetometer (LMAG)?
Kato: We found many points with magnetic field remnant near the South Pole on the farside. However, the lunar magnetic field is very weak and only about one nanotesla. I think the materials to preserve the magnetic field are distributed on craters.

Mission to trace the origin and the evolution of the Moon

Q. We heard the data was not acquired from Gamma-Ray Spectrometer (GRS) during a certain period.
Kato: Yes. We had a hard time, but we have got a result. We measured the gamma ray from radioisotope on the surface of the Moon to check the element distribution. Global map was made for uranium and potassium. The density of both elements was high in the maria of the nearside. The global map of potassium has been already made, but we made that of uranium for the first time.

Q. It seems that very interesting results have been achieved rapidly and we may need to discuss a new model for the evolution of the Moon.
Kato: I think we need to revise the old model quite a lot. With regard to the dichotomy of the Moon, the internal structure and evolutional process are very different from the conventional ideas. One of the major purposes of KAGUYA is to trace the origin and evolution of the Moon. Our next step is to sum up the results from the scientific instruments and define the full picture of the Moon's history.

KAGUYA returned to the Moon

Mission Completed

In an old Japanese story, "Kaguya" is a princess from the Moon. The name of the Lunar Explorer KAGUYA was taken from the story, and KAGUYA returned to the Moon on June 11, 2009 after completion of the observation mission for about one and a half years. We interviewed Professor Susumu Sasaki who had been involved in the project from the start as a person in charge of observation device and also had led the team as a project manager since November 2008.

Q. We understand you were involved in the SELENE (KAGUYA) project from the start.

Sasaki: Back in those days before three organizations merged into JAXA in 2003, the Institute of Space and Astronautical Science (ISAS) and National Space Development Agency of Japan (NASDA) shared the project and ISAS worked on the observation devices while NASDA worked on the satellite. I joined the project as an organizer of ISAS in charge of observation devices.

Susumu SASAKI

Project Manager, SELENE Project Team, JAXA Space Exploration Center

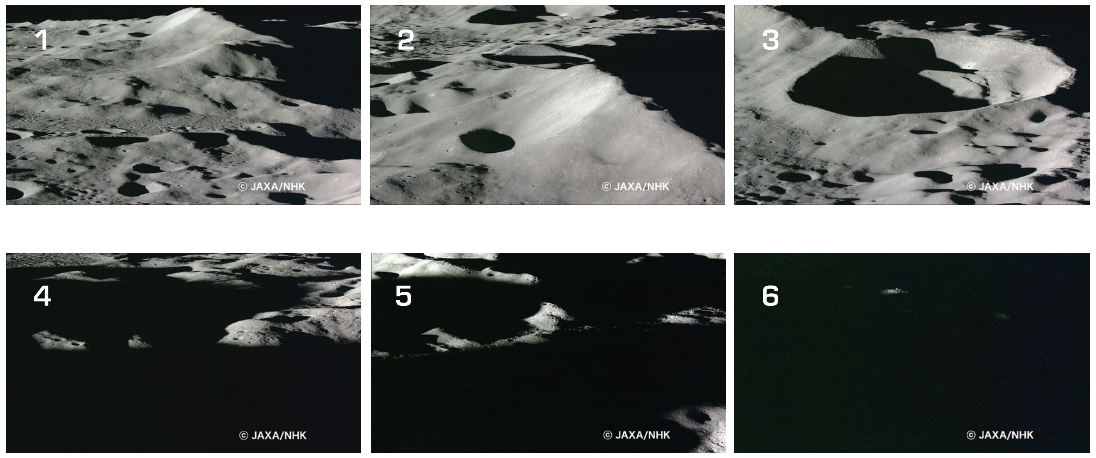
Q. What do you think of the reason for the success of the mission?

Sasaki: There are many reasons, and one of it was a lot of test on Earth. Moreover, although this project was a scientific mission, persons in charge of satellite for practical use also participated. Scientists seek advanced missions, and the value of science depends on the advancement. On the other hand, the satellite for practical use aims to achieve the given target steadily. Although we had a lot of discussions, highly reliable satellite that yielded scientific output came along as a result. I think the way of development of KAGUYA will be useful for the future planetary exploration missions.

The staff members celebrating the success of mission just after the controlled landing of KAGUYA

Q. How do you feel after the completion of KAGUYA mission?

Sasaki: I am content that the operation for 21 months was completed successfully to the end. I think most of action items of remote sensing have been completed. I expect a conclusion is made in one or two years about the origin and the evolution of the Moon.



The final still images taken by the onboard high-definition television (HDTV) just prior to its maneuvered falling onto the Moon. The series of continued shots was taken with an interval of about one minute while the KAGUYA was maneuvered to decrease its altitude toward the impact position.

Frequently Asked Questions About JAXA

Q: What does JAXA stand for?

A: JAXA stands for Japan Aerospace Exploration Agency.

On October 1, 2003, an independent administrative institution, the Japan Aerospace Exploration Agency (JAXA), was established through the integration of 1) the National Space Development Agency of Japan (NASDA), committed to the development of large-size launch vehicles such as the H-IIA, satellites and the International Space Station; 2) the Institute of Space and Astronautical Science (ISAS), devoted to space and planetary research; and 3) the National Aerospace Laboratory (NAL), dedicated to research and the development of next-generation aerospace technologies.

This integration into one group allows a continuous and systematic approach from basic research to practical application under one roof.

Q: What does JAXA do?

A: The Japan Aerospace Exploration Agency (JAXA) performs various activities related to aerospace as an organization, from basic research in the aerospace field to development and utilization.

JAXA's main activities are:

- Academic research in space science through joint research or other collaboration with universities.
- Basic research on space science technology, aeronautical science technology, and the development of platform technologies for space and aviation.
- Development of satellites and launch vehicles for satellites.
- Launch, tracking, and operation of satellites.
- Propagating JAXA's achievements.
- Sharing JAXA's facilities and equipment.
- Training of researchers and engineers, and enhancing their skills.
- Support for university education.

Q: What does the JAXA logo symbolize?

A: JAXA's logo symbolizes the letter "A" from "Aerospace" in the shape of a star. A star represents "hope," "pride," and "a mind of quest," and acts as a guidepost showing us the way. The star in the JAXA logo represents our wish to become a guiding star not only for Japanese people but also for all humanity on Earth.

Q: How many people work for JAXA?

A: JAXA has 1,594 regular staff members as of FY 2009. In addition, many domestic and overseas researchers, graduate students, and people from the private sector are also hired.

Frequently Asked Questions About JAXA's Public Affairs Services

Q: Do you lend photos or images of rockets?

A: You can search and view photos and images of rocket launches owned by the Japan Aerospace Exploration Agency (JAXA) on the JAXA Digital Archives Web page. High-resolution data for various prints are also available.

As for the lending of image software planned or produced by JAXA, you can refer to the "lending of image software" page for details and there is some software available to view on the Internet.

Q: May I include JAXA photographs or images on my personal Web pages?

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Please read the site policy and user's guide prior to use.

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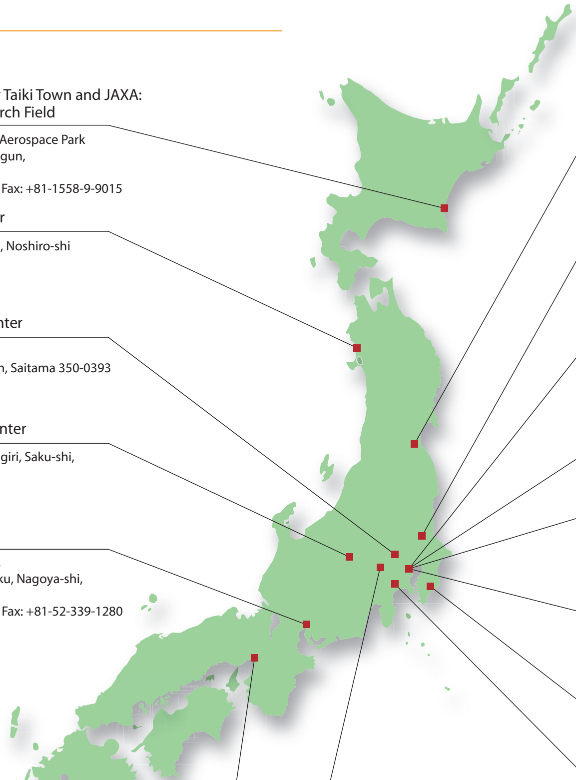
Q: Where are JAXA's exhibition sites and what do they offer?

A: There are many Japan Aerospace Exploration Agency (JAXA) facilities with exhibition spaces, and some science museums have corners for JAXA exhibitions. They offer easy-to-understand explanations on the most advanced, high technology, such as the current status of Japanese aerospace research and development, and future technology using video, models, and actual equipment.

JAXA HQs / Field Centers



Collaboration Base for Taiki Town and JAXA: Taiki Aerospace Research Field

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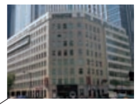

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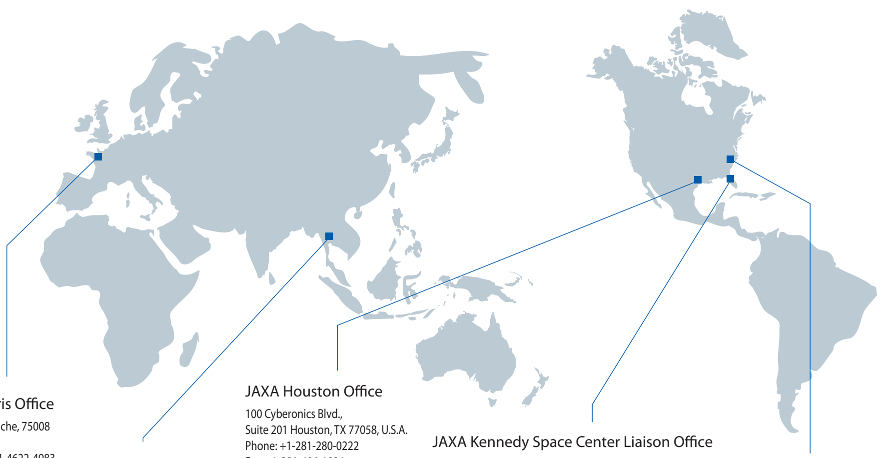

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