JAXA TODAY

Japan Aerospace Exploration Agency

April 2014 / No. 08

"Hearts in Harmony"

Astronaut Koichi Wakata emphasizes the importance of teamwork on ISS long-duration missions

JAXA Explore to Realize

Contents

To All Our Readers

Hello, my name is Koji Terada, and I am Director of the JAXA Public Affairs Department and executive editor of JAXA TODAY. Coinciding with the start of a new stage in JAXA's history, JAXA TODAY returns with even greater momentum.

In articles covering JAXA activities, we have special features on JAXA Astronaut Koichi Wakata, the first ISS Commander from Asia, and the Epsilon Launch Vehicle, which uses the world's first mobile launch control system.

In addition, in response to requests from our readers, we have included pages for children at the end of each feature article with text in both English and Japanese.

To help make space even more familiar, our editorial staff will introduce topics under a new regular column called "View from the Editor's Window." We also begin a new column called "Liaison Diary" covering the activities of JAXA's overseas offices. In this first installment, we introduce the JAXA Moscow Office.

We hope you enjoy the newly reborn JAXA TODAY.

Welcome to JAXA TODAY

The Japan Aerospace Exploration Agency (JAXA) works to realize its vision of contributing to a safe and prosperous society through the pursuit of research and development in the aerospace field to deepen humankind's understanding of the universe. JAXA's activities cover a broad spectrum of the space and aeronautical fields, including satellite development and operation, astronomical observation, planetary exploration, participation in the International Space Station (ISS) project and the development of new rockets and next-generation aeronautical technology.

With the aim of disseminating information about JAXA's activities and recent news relating to Japan's space development programs to as wide an audience as possible, we launched JAXA TODAY in January 2010.

Message from the President

JAXA celebrated its 10th anniversary on October 1, 2013. During its first decade, JAXA has logged many world-first achievements that have received wide praise internationally. These include the successful test launch of the Epsilon Launch Vehicle, and the sample-return by asteroid explorer Hayabusa. These successes have helped bolster Japan's research and development capabilities and national strength, while also driving space development around the world.

JAXA has now entered a fresh stage in its organizational development, and to coincide with this milestone has redefined its management philosophy as working "To realize a safe and affluent society using space and the sky." We have also introduced a new corporate slogan—"Explore to Realize."

To guide our activities as we strive to translate this management philosophy into tangible results, we have formulated an Action Declaration, comprising three parts. We will:

1. Aim to improve people's daily lives, and contribute to the enjoyment of those lives.
2. Constantly strive for greater heights, and aspire toward creativity.
3. Work to meet the trust and expectations placed on us by society by acting with responsibility and pride.

This declaration highlights our commitment as an organization to pioneering a new era in space development.

In fiscal 2014, which commenced on April 1, 2014, we will focus particularly on the development of a new main rocket, as well as an array of satellite missions that will serve many important roles. In these endeavors, we look forward to your continued support and cooperation.

Dr. Naoki Okumura
Received a Doctorate in Applied Physics from The University of Tokyo in 1973. Served as Representative Director and Executive Vice President of Nippon Steel Corporation and executive member of Japan's Council for Science and Technology Policy. Appointed President of JAXA in April 2013.

Cover Photograph

ISS Expedition 38 Long-Duration Crew
From bottom-right, clockwise: Koichi Wakata, Sergey Ryazansky, Richard Mastracchio, Mike Hopkins, Mikhail Tyurin and Oleg Kotov.
(© JAXA/NASA)

JAXA Astronaut Koichi Wakata became Japan's first ISS Commander when Expedition 39 began on March 9, 2014.

Epsilon Launch Vehicle Ushers in a New Era for Space Development

The Epsilon Launch Vehicle—JAXA's new solid-propellant rocket—realizes simplified and streamlined launch procedures, and opens up the way for a further expansion of space development and space utilization. On September 14, 2013, the first Epsilon Launch Vehicle—Epsilon-1—achieved a successful launch and separation of its payload, the ultraviolet astronomy satellite SPRINT-A (Japanese nickname: "HISAKI"). In this interview, Epsilon Rocket Project Manager Professor Yasuhiro Morita elucidates the innovative nature of the Epsilon Launch Vehicle. On page 5, we provide an explanation for children on the Epsilon key points in both English and Japanese.

Profile

Professor Yasuhiro Morita, Ph.D.
Project Manager, Epsilon Rocket Project Team
Professor, Department of Space Systems and Astronautics
Institute of Space and Astronautical Science (ISAS), JAXA

Professor Morita graduated from the Department of Aeronautics, The University of Tokyo, and received his doctorate in aeronautics from the Graduate School of Engineering, The University of Tokyo. At ISAS, he was appointed Project Manager of the M-V rocket program in 2003, and has fulfilled a key leadership role in Japan's solid-fuel rocket development efforts as the Epsilon Rocket Project Manager since 2010.

Epsilon-1 lifts off from the Uchinoura Space Center, in Kimotsuki, Kagoshima Prefecture, on September 14, 2013

Theme 1 | Continuing Japan's Tradition of Solid Rocket Development

What was the background leading up to the development of the Epsilon Launch Vehicle?

Morita: In 2006, further development of the M-V Launch Vehicle program was called off owing to a range of factors. The M-V boasted performance at the world's highest level for a multi-stage solid-propellant rocket. Subsequently, in 2010 the decision was made to embark on the development of Epsilon as a new solid-fuel launch vehicle. I was appointed Project Manager. The first key question we faced was, "How do we build a rocket that surpasses the M-V, which was considered to be the world's most advanced in its field?" The entire Epsilon team agreed that we did not want to simply make an improved version of the M-V, but instead start from scratch and develop a rocket that could carry us into the future. We knew that we had been given a fantastic opportunity to push back the frontiers. Development of the revolutionary Epsilon rocket began from that moment.

What was your primary goal at the development stage?

Morita: Our main objective was to create an innovative launch system. Previously, it was sufficient to improve the performance of the launch vehicle itself. That was the overriding consideration. However, if we look at a 50-year horizon for space development, improving rocket performance alone is not enough. What we have to do is design a system that makes it easier to put launch vehicles into space. It is imperative that we shift away from the current paradigm—one that is based on having a large workforce spend a lot of time and money, using a large array of equipment to get a rocket launched. The key feature of the Epsilon development project was our decision to create a simplified launch system. We might say that global rocket-development history has reached a turning point.

On the day of the Epsilon-1 launch, a large number of people gathered near the launch site to offer their support. Did you see the scene yourself?

Morita: I saw footage of the crowd gathered to watch the launch shot by the television crew following me. I was surprised at just how dramatic the scene was. By the time of the launch, many local people from the town of Kimotsuki, Kagoshima Prefecture, as well as a large number of space enthusiasts had gathered. This included people of all ages, from young children to the elderly, who turned out to show their support. It really took the excitement to a new level. We were even more determined to succeed, since we knew that the dreams of so many people were riding on Epsilon. Their passion was also helping propel the rocket skyward!

Theme 2 | Adding New Innovations with Each Successive Launch

Please outline the innovative technologies incorporated into the Epsilon Launch Vehicle.

Morita: Previously, we spent a lot of time and effort on pre-launch inspections of the rocket's electrical systems and ignition circuits, which were carried out manually. To make these procedures autonomous and automated, we newly developed the Responsive Operation Support Equipment (ROSE), which employs artificial intelligence (AI), and the Launch Control System (LCS), which provides remote control capabilities from the ground. ROSE is mounted on the rocket to perform a wide array of equipment diagnostic tasks.

Through this system, we have shortened the time required between when the first vehicle stage is placed on the launch pad until the launch, from 42 days to just seven days. Simultaneously, we are aiming to extend the time window during which inspections can be carried out on the payload satellite from nine hours prior to launch to three hours before launch.

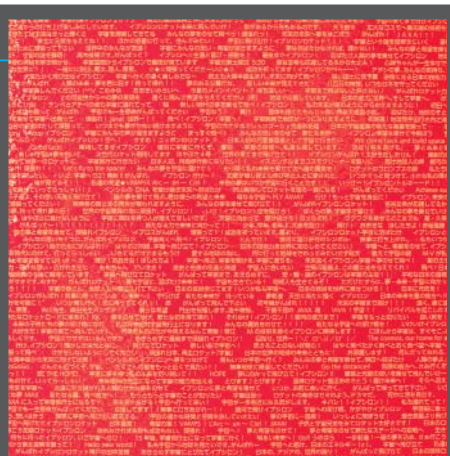
The satellite payload carried by Epsilon is also very innovative. Could you explain the design features?

Morita: Epsilon will carry small satellites based on a modular structure to allow flexible modification. This will enable Epsilon to cater to a diverse range of mission requirements. The satellite payload comprises two main sections—the mission section containing observation instruments, and the satellite bus section containing equipment necessary for the maintenance of the satellite's functions. By adopting this structure, it is no longer necessary to build an entire satellite from scratch, but simply replace the mission section. This makes the design suitable for a broad variety of missions. Following on from the ultraviolet astronomy satellite HISAKI (SPRINT-A) carried by Epsilon-1, this semi-customized method will also be employed for Epsilon-2's payload satellite—Exploration of energization and Radiation in Geospace (ERG)—which is planned for launch in 2015.

We use the term "space vehicle" to express the combination of the Epsilon rocket and the small satellite bus section. In the future, we will aim to provide a method whereby space users will only have to develop their mission equipment and we will transport that into space aboard our space vehicle.

Fan letters from children, which are a wonderful source of encouragement for the Epsilon team

Messages of support were printed onto the red stripe of Epsilon-1's first stage.
(© JAXA/Joe Nishizawa)



An enlargement of the support messages
(© JAXA/Joe Nishizawa)

The Epsilon Control Center (ECC) after the launch of Epsilon-1
(© JAXA)

HISAKI will observe the magnetospheres and atmospheres of planets (computer graphic image)
(© Akihiro Ikeshita)

HISAKI: Spectroscopic Planet Observatory for Recognition of Interaction of Atmosphere (SPRINT-A)

This satellite will observe extremely short-wavelength ultraviolet rays given off in the vicinity of planets. It will observe Jupiter's magnetosphere—which has the strongest magnetic field in the Solar System—to examine what effect the solar wind has on it. HISAKI will also look at how the atmospheres of Venus and Mars escape into space due to the effects of the solar wind. Extreme ultraviolet rays can only be detected from space, so JAXA expects to acquire new insights into planetary environments.

Epsilon-1 is designated as a test rocket. How will the rockets from Epsilon-2 onward differ?

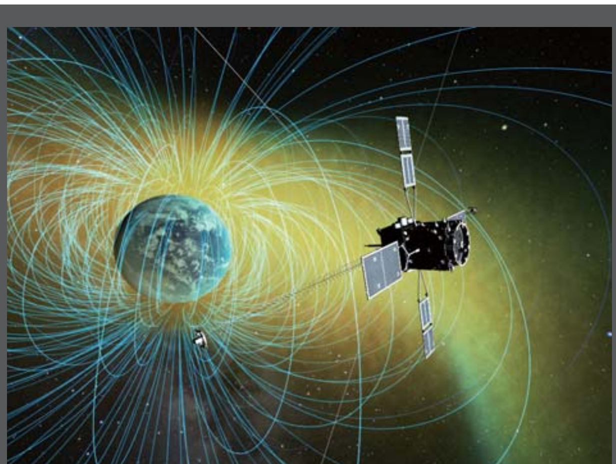
Morita: We are continuing with development of Epsilon-2 and Epsilon-3, and plan to progressively reduce costs and improve performance. Firstly, on the cost side, based on discussions in 2010 by the Space Activities Commission (SAC) convened by the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the Epsilon has been given a future target of reducing the cost of a rocket launch to under ¥3.0 billion, or less than half of the M-V rocket's launch cost. On the performance side, for example, the ROSE AI system will aim for a steady increase in performance by accumulating data through successive launches. For Epsilon-1, launch control was simplified. However, during flight, if a malfunction had been detected by ground radar and computer tracking, the destruct command would still have been sent by launch control from on the ground in the conventional manner. We are aiming to implement a system whereby the rocket will be able to autonomously detect any malfunctions and make the decision to execute an automatic self-destruct.

As Project Manager, what are your expectations of younger staff members who represent the next generation of rocket developers?

Morita: I want them to retain the frontier spirit that has been a key characteristic of Japan's solid rocket development efforts over a long period. Another way of saying this is that we must challenge conventional wisdom. We need to try out many new ideas without being tied to existing approaches. This does not mean we are rejecting the past, but rather we are building on the foundations we have built up while attempting to do some things in unconventional ways. By taking up this challenge we can create some new traditions.

What things do you see as critical for the future of Japan's space development?

Morita: I think it will be necessary to open up space development. What I mean by this is that we need to create a system that will get more industries, companies and people involved in space development than has been the case to date. I want to see the general public becoming more involved, too. At the same time, we also need to build greater linkage between advanced technology fields in the space development sphere and those in non-space-related spheres. For example, small-scale factories in Japan often boast processing technologies that produce the world's highest performance. We are now at the stage where we need to think seriously about how we can leverage such manufacturing capabilities on the space development frontlines.



Observation of the Van Allen radiation belt that forms donut-shaped rings around the Earth
(© JAXA)

Exploration of Energization and Radiation in Geospace (ERG)

Geospace is the region of outer space near the Earth. The dual-structure "Van Allen radiation belt" lies within the geospace, and the belt captures a huge volume of highly charged energy particles. These charged particles are not constant, but rather increase and decrease suddenly in response to disturbances in the solar wind and space storms. The mechanisms that drive these dynamic changes are not well understood. ERG will use six observation instruments to study this radiation belt and hopefully shed light on some of the mysteries of these phenomena.

To the Children Who Are Our Future

未来を担う子供たちへ

Key Points About the Epsilon Rocket Explained by Project Manager Professor Yasuhiro Morita

森田泰弘プロジェクトマネージャが教える、ここがイプシロンのチェックポイント！

Rocket launches to date have involved large launch control rooms with a large number of staff. The drawn-out preparations were like a carnival in some ways. From now on, we need to create a simplified launch system that will enable countries, universities and companies worldwide to easily participate in space development and space use. Let's take a look at the features of Epsilon that make this hope a reality.

これまでロケットの打ち上げは、広い管制室に多くのスタッフが集まり、長い時間をかけて準備する「お祭り騒ぎ」のようなものでした。これからは、世界中の国や大学や会社が、気軽に宇宙開発・宇宙利用に参加できるよう、シンプルな打ち上げシステムが求められます。その望みを叶えるイプシロンの特長を、見ていきましょう。

The M-V-5, which launched the asteroid explorer Hayabusa
小惑星探査機「はやぶさ」を打ち上げたM-Vロケット5号機
(© JAXA)

A rocket that inspects itself!

The Epsilon was developed with the aim of realizing a compact, high-performance, low-cost rocket that can be launched easily. It is a "smart rocket" that is able to inspect its own equipment. For this reason, pre-launch preparations have been simplified. When we have accumulated a little more launch experience, we will be able to shorten the time needed from putting the first stage on the launch pad until launch from the 42 days needed by the M-V rocket to just seven days for the Epsilon. In the future, we want to make rocket launches even simpler, so that they become as familiar as aircraft.

ロケットが自分自身を点検！

小さくて性能がよくて、しかも安く簡単に打ち上げられることを目指してつくったイプシロンは、いろんな機器の点検をロケットが自分で行う「賢いロケット」。このため、打ち上げ準備が簡単になり、もう少し打ち上げの経験を積むと、発射台に第1段ロケットを立ててから打ち上げまでに必要な日数が、以前のM-Vロケットの42日間から、イプシロンでは7日間に短縮されます。将来は、もっとシンプルな打ち上げで、ロケットを飛行機のように身近な存在にするのが目標です。

A cut model of the Epsilon rocket
イプシロンロケットのカットモデル
(© JAXA)

The fairing separation moment captured by an on-board camera. At the bottom of the image part of the payload satellite HISAKI is visible.
搭載したカメラが写した、フェアリングを切り離した瞬間。下に見えるのは、打ち上げた人工衛星「ひさき」の一部(© JAXA)

Utilizing existing rocket technology

The Epsilon incorporates technologies from both the solid-fuel M-V and the liquid-fuel H-IIA and H-IIB. The Epsilon first-stage motor (rocket engine) and electronic systems use some components that are the same as H-IIA and H-IIB. The second and third stage motors improve on those used in the M-V. The fairing section containing the satellite payload near the tip of the rocket utilizes experience accumulated through H-IIA and H-IIB. Parts that separate from the main rocket and fall into the ocean are designed to sink so as not to cause obstructions to ships.

これまでのロケット技術を活用

イプシロンには、固体ロケットM-Vと、液体ロケットH-ⅡA/H-ⅡBの両方の技術が注がれています。イプシロンの第1段モータ（ロケットエンジンのこと）や電子機器にはH-ⅡA/H-ⅡBと同じ部品が使われ、第2段・第3段モータはM-Vのものをさらに改良。ロケット先端の、人工衛星が入ったフェアリングという部分も、H-ⅡA/H-ⅡBの経験を活かし、本体から切り離して海に落ちると、船の邪魔にならないよう沈む設計にしました。

Where does the name "Epsilon" come from?

The names given to Japan's solid-fuel rockets are taken from the classical Greek alphabet. From the 1950s to the 1980s, the letter K (kappa) was used, in the 1960s L (lambda) was used and from the 1970s to the 2000s M (Mu) was used. Continuing in this spirit of rocket development is E (epsilon). E stands for "education," and we are looking forward to seeing how the project's young staff develop.

「イプシロン」という名前はどこから？

日本の固体ロケットの名前は、ギリシャ文字のアルファベットに由来する。1950-80年代のK（カッパ）、1960年代のL（ラムダ：正式な表記はΛ）、1970-2000年代のM（ミュー）と続き、そのロケットづくりの精神を受け継いだのがE（イプシロン）。EはEducation（教育）も示していて、プロジェクトチームの若いスタッフたちが、これからどのように成長していくか、とても楽しみにしています。

To all the children who love space

What I want to tell all of you is that your dreams are important and you should never give up. This is the most important thing for creating a bright future for humankind. If each and every one of you hang on to the dreams you have and make the efforts needed to bring those dreams to fruition, you will become the driving force behind space development and this will lead to a bright future.

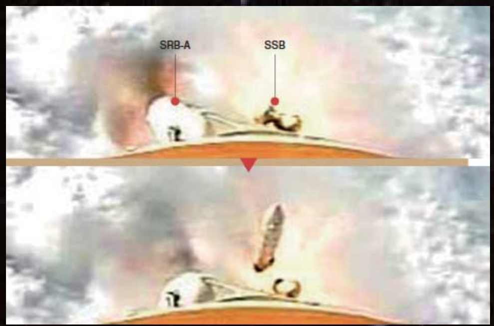
★宇宙が大好きな君たちへ

僕が皆さんに伝えたいのは、「夢を大事にして、絶対にあきらめない」こと。これが、人類の明るい未来を切り拓くために、最も大切。君たち一人ひとりが、これまでに見つけた夢を忘れずに、大事に温めながら実現させていく努力をすれば、宇宙開発を支える原動力になり、やがて明るい未来の実現につながっていくのです。

H-IIB F4 is moved into position for the launch of its payload, space station resupply spacecraft HTV4
宇宙ステーション補給機「こうのとり」4号機の打ち上げのため機体を移動するH-ⅡBロケット4号機
(© JAXA)

Our First 10 Years—
All of Japan Becomes a Part of JAXA

The Japan Aerospace Exploration Agency (JAXA) was born on October 1, 2003, through the merger of the Institute of Space and Astronautical Science (ISAS), the National Aerospace Laboratory of Japan (NAL) and the National Space Development Agency of Japan (NASDA). In this retrospective, we look back over some of the highlights of the past 10 years, during which Japanese citizens have greatly deepened their interest in space development. In JAXA's first decade, major milestones included the miraculous return of Hayabusa, an extension of Japan's manned space flight programs through the Japan Experiment Module (JEM) Kibo and the H-II Transfer Vehicle (HTV; Japanese nickname: "KOUNOTORI"), and the successful development of the Epsilon Launch Vehicle.



H-IIA F6 rocket immediately following launch. After separation of the solid strap-on booster (SSB; right), the vehicle failed to jettison one of its two solid rocket boosters (SRB-A; left). The launch vehicle was subsequently destroyed via a command from the ground, as it was unable to gain planned altitude owing to the jettison failure.


PLANET-B (NOZOMI) abandons attempt to go into orbit around Mars (computer graphic image) (© Akihiro Ikeshita)

2003

New Organization Suffers Three Early Failures

The newly inaugurated JAXA got off to a bumpy start with three setbacks in its first three months. H-IIA Launch Vehicle No. 6 (H-IIA F6) was destroyed after a launch failure, and two spacecraft—ADEOS-II (Midori II) and PLANET-B (NOZOMI)—ceased operation.


A photograph of the Earth taken from Hayabusa (© JAXA)


After its Earth swing-by, Hayabusa headed for Asteroid Itokawa (computer graphic image) (© Akihiro Ikeshita)

2004

Hayabusa Heads for Asteroid Itokawa

Asteroid explorer MUSES-C (later renamed Hayabusa) lifted off in May 2003, and in May 2004 successfully executed an Earth swing-by using Earth gravity assist to put it on course for a rendezvous with Asteroid Itokawa. Meanwhile, in the aftermath of the H-IIA F6 rocket failure in 2003, JAXA implemented a thorough review of all projects currently in progress.

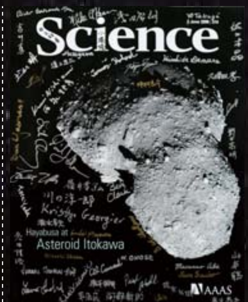

Astronaut Soichi Noguchi carries out ISS assembly work during extra-vehicular activity (EVA) (© JAXA/NASA)


NEXST-1 is launched from the Woomera Test Range in Australia (© JAXA)

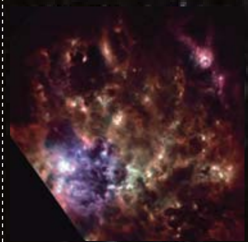
2005

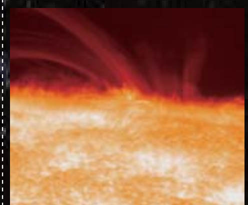
Flights Recommence

In 2005, several successful launches marked JAXA's recommencement of space flight. In February, there was the launch of H-IIA F7, and July saw the safe insertion into orbit of X-ray astronomy satellite Suzaku (ASTRO-EII). Suzaku's predecessor, ASTRO-E, had been lost shortly after launch in 2000, hence this new mission aimed to make up for the earlier setback. Also in July, the Space Shuttle Discovery—with JAXA Astronaut Soichi Noguchi aboard—was launched on the Return to Flight mission for the Space Shuttle program following the Space Shuttle Columbia disaster. In October, JAXA conducted a successful flight test for the National Experimental Supersonic Transport (NEXST-1) scaled aircraft, thus overcoming the first test failure in 2002.



The June 2, 2006, edition of *Science* contained the first feature articles on a Japanese interplanetary exploration mission

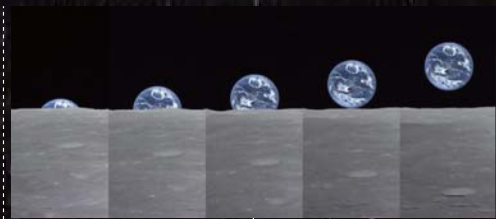

A far-infrared image of the Large Magellanic Cloud (LMC) observed by Akari


Eruptive phenomena in the vicinity of solar flares observed by Hinode

2006

Four Satellites Launched into Orbit

This was the year in which JAXA made a full-fledged return to its core role as a space agency with the launch into orbit of four satellites—Advanced Land Observing Satellite (ALOS; "DAICHI"), Engineering Test Satellite VIII (ETS-VIII; "KIKU-8"), Infrared Imaging Satellite (ASTRO-F; "Akari") and Solar Physics Satellite (SOLAR-B; "Hinode"). In June, observation results from Hayabusa of Asteroid Itokawa featured in a set of articles in the journal *Science*.


Images showing the "Earth-rise" taken by SELENE's HDTV cameras (© JAXA/NHK)


The two sub-satellites separate from SELENE (computer graphic image) (© JAXA)

2007

KAGUYA Heads for her Lunar Home

Japan's lunar explorer spacecraft, Selenological and Engineering Explorer (SELENE), was launched in September. SELENE comprised the main orbiter and two sub-satellites. The orbiter's Japanese nickname, KAGUYA, was selected by the general public, and comes from the name of a lunar princess in the ancient Japanese folktale, *The Tale of the Bamboo Cutter*. After their successful release, the sub-satellites Rstar and Vstar were renamed Okina and Ouna, respectively. These names are also derived from characters in the tale. SELENE carried a payload of 15 instruments used in its scientific mission, including high-definition television (HDTV) cameras. Detailed observations of the moon included magnetic fields, topography, the lunar elemental composition and plasma.


The ISS crew, including Astronaut Takao Doi (lower right) gather in Kibo's ELM-PS (© JAXA/NASA)


Astronaut Akihiko Hoshide installs experiment racks in Kibo's PM (© JAXA/NASA)


WINDS (computer graphic image) (© JAXA)

2008

Assembly of JEM Kibo Begins

The mission to assemble JEM Kibo got under way after the module was transported to the ISS aboard the Space Shuttle. In March, Astronaut Takao Doi installed the Experiment Logistics Module Pressurized Section (ELM-PS) onto the ISS, and in June Astronaut Akihiko Hoshide installed the Pressurized Module and the JEM Remote Manipulator System (JEMRMS), marking the start of operations for Kibo. Wideband Inter-Networking Engineering Test and Demonstration Satellite (WINDS; Japanese nickname: "KIZUNA") was launched as part of a mission to realize high-speed, wideband telecommunications.

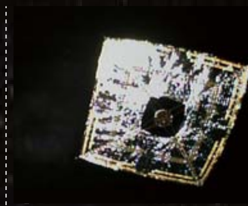

The completed JEM Kibo (© NASA)


HTV approaches the ISS (© NASA)

2009

JEM Kibo and HTV Extend Manned Space Activities

In July, Astronaut Koichi Wakata installed the Exposed Facility (EF) onto the JEM Kibo PM, thus completing the assembly of Kibo. In September, the HTV resupply spacecraft made a successful rendezvous and docking with the ISS. The original method used for rendezvous and docking was developed in Japan and was subsequently used as the model for a system employed by a U.S.-manufactured resupply spacecraft.


A photograph taken by miniature deployable camera DCAM2 shows IKAROS' fully unfurled solar sail (© JAXA)

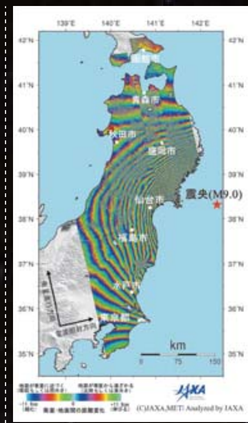

The final image of Earth taken by Hayabusa


The glowing trail made by Hayabusa and its sample-return capsule as they re-enter the atmosphere (© JAXA)

2010

Hayabusa Returns to Earth

After successfully touching down on Asteroid Itokawa, Hayabusa overcame a myriad of difficulties to make a triumphant return to Earth after an epic seven-year journey through deep space. Long lines of people waited to see the sample-return capsule when it was put on public display. Other milestones, such as MICHIBIKI—the first satellite of the Quasi-Zenith Satellite System (QZSS)—and the Small Solar Power Sail Demonstrator IKAROS, also helped fuel an unprecedented level of interest in space among the general public.

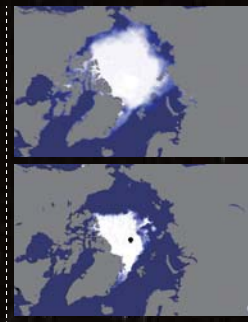

A map showing crustal movement caused by the Great East Japan Earthquake based on observation data provided by ALOS


Astronaut Satoshi Furukawa served a long-duration mission aboard the ISS from June 2011 (© JAXA/NASA)

2011

Assisting Disaster-Affected Areas from Space

After the Great East Japan Earthquake struck on March 11, control of JEM Kibo was temporarily transferred from the Kibo Mission Control Room (MCR) at the Tsukuba Space Center (TKSC) to NASA. ALOS carried out emergency observations to ascertain the extent of damage from the earthquake and tsunami. Astronaut Satoshi Furukawa—serving a long-duration mission aboard the ISS—sent messages of support and encouragement to people in the disaster-affected areas.


The observation by SHIZUKU of Arctic sea ice cover on September 16, 2012, is shown on the right. The extent of sea ice cover is much smaller than that shown on the left, which is based on the average minimum Arctic sea ice cover in September during the 1980s.


Astronaut Akihiko Hoshide prepares an experiment in JEM Kibo (© JAXA/NASA)


FTB "Hisho" prepares for takeoff (© JAXA)

2012

SHIZUKU Observes the Earth's Water Cycle

JAXA launches a satellite called Global Change Observation Mission 1st–Water (GCOM-W1; Japanese nickname: "SHIZUKU"), which aims to enhance understanding of the global water cycle. SHIZUKU began observations using the giant revolving antenna of its main instrument, Advanced Microwave Scanning Radiometer 2 (AMSR2). Astronaut Akihiko Hoshide used the JEM Airlock and JEMRMS (robotic arm) to deploy "CubeSat" small satellites during his long-duration ISS mission. JAXA commenced operation of the Flying Test Bed (FTB) "Hisho," which is used for experiments and demonstration of cutting-edge aircraft technology and instruments.


Epsilon Launch Vehicle lifts off from the Uchinoura Space Center in Kagoshima, Japan (© JAXA)


Astronaut Koichi Wakata operates the Space Station Remote Manipulator System (SSRMS) to assist an EVA (© JAXA/NASA)

2013

Dawn of a New Era for Launch Vehicles

On September 14, JAXA successfully launched its new Epsilon rocket, which realizes lower operational costs and high performance. The launch vehicle carried into orbit SPRINT-A (Japanese nickname: "HISAKI"), an ultraviolet astronomy satellite tasked with observing Solar System bodies. The first Epsilon launch heralded the start of a new era in Japanese solid-fuel rocket development. In November, Astronaut Koichi Wakata began a long-duration mission aboard the ISS. He subsequently became Japan's first ISS Commander in March 2014.

Koichi Wakata— Japan's First ISS Commander

JAXA Astronaut Koichi Wakata is currently serving on a long-duration mission aboard the ISS as part of Expedition 39. On this mission, he became the first astronaut from Asia to assume the role of ISS Commander. In this feature article, we explain about Astronaut Wakata's career leading up to his appointment as ISS Commander, and he gives us his insights on the direction of Japan's space development program. On page 12, we offer advice for children interested in going into space. This page is presented in both Japanese and English.

JAXA mission patch for ISS Expedition 38/39. The Chinese character "wa" (harmony) symbolizes the trust among all members of the mission crew.

Astronaut Wakata operates a super-sensitive 4K camera

Koichi Wakata, Dr. Eng.

JAXA Astronaut

Koichi Wakata was born in Saitama, Japan, in 1963. In January 1996, he made his spaceflight debut as a Mission Specialist on the STS-72 mission aboard the Space Shuttle Endeavour. In August 1992, he trained with the 14th NASA Astronaut Class. In October 2000, he flew to the ISS as part of the STS-92 mission, and performed tasks for the assembly of the ISS. From March to July 2009, he served a long-duration mission aboard the ISS as a crew member of Expeditions 18, 19 and 20. Since November 2013, Wakata has been working aboard the ISS as part of Expedition 38/39. He was a Flight Engineer for Expedition 38, and for Expedition 39 he became Japan's first ISS Commander.

Theme 1 Pathway Leading to the Role of ISS Commander

Astronaut Wakata (second from left) with the Space Shuttle Endeavour crew of the STS-72 mission

Astronaut Wakata works inside the Space Shuttle Discovery (STS-92 mission)

EVA training as part of the NEEMO program held at an underwater facility off the Florida coast

Apollo 11 Inspires Fascination with Space

Wakata's fascination with space was sparked in July 1969, when he saw the Apollo 11 Moon landing on television. In the summer of 1991, during a train commute while working as an aerospace engineer, he happened to see a recruiting advertisement for astronaut candidates. At that moment, he had a flashback to the excitement he felt as a child watching the Apollo 11 mission. A year later he was taking part in the 14th NASA Astronaut Class.

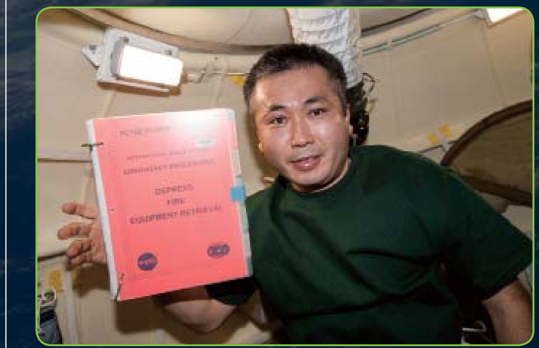
Later, Wakata flew on the STS-72 mission, during which he performed operations to deploy and retrieve satellites using the Shuttle Remote Manipulator System (SRMS), and gained experience on the STS-92 mission through tasks for assembly of the ISS. In July 2006, he participated in the NASA Extreme Environment Mission Operations (NEEMO) training program as mission leader. The program was held at the U.S. National Oceanic and Atmospheric Administration (NOAA) Aquarius underwater laboratory off the coast of Florida. At the preparation stage, Wakata assigned tasks to the other team members and formulated a training plan. During the actual exercises, he led the whole team while communicating minute by minute. NASA's evaluation stated that Wakata had the qualities necessary to be an ISS Commander.

First ISS Commander Assignment Signifies High Expectations and Trust toward Japan

From March to July 2009, Wakata served his first long-duration mission aboard the ISS as part of Expedition 18, 19 and 20. During the latter part of his mission in July, he completed the assembly of JEM Kibo.

In March 2010, Wakata was appointed Chief of the Space Station Operations Branch of NASA's Astronaut Office—a role in which he trained astronauts preparing for long-duration missions aboard the ISS—and was involved in coordinating and negotiating with managers from each country responsible for supporting long-duration missions. In February 2011, Wakata was assigned the role of ISS Commander for Expedition 39. Wakata's appointment as the first Japanese astronaut to serve as ISS Commander signifies the high level of expectations and trust toward Japan among the international partners.

Theme 2 When the ISS is in Imminent Danger, What are the Commander's Duties?



Astronaut Wakata holds the emergency procedures (© JAXA/NASA)

Securing the Safety of the Crew and the ISS during Emergencies

The Commander is charged with leading the ISS crew during training and launch preparations as well as on-orbit tasks. The Commander is expected to play a leadership and coordinating role to ensure that day-to-day operations of the ISS are carried out smoothly, and the crew works toward steadily achieving the goals set for various projects and tasks. In case of an emergency, the Commander must take actions necessary to secure the safety of the crew and the ISS.

Potential emergency situations on the ISS include leaks of ammonia or other toxic substances, sudden loss of pressure and fires. The crew begins work each day after breakfast, and on some days there may be members working alone until lunchtime. If there were an emergency at such a time—a meteor strike or collision with space debris, for example—it would be vital to know the location of all crew members so that appropriate response measures could be executed quickly.

An emergency training drill held on the ground (© JAXA/NASA)

The Commander Must Retain the Confidence of the Crew

In the initial response to an emergency, to immediately heighten the crew's awareness of the situation, everyone puts on oxygen masks and carries out other procedures, including the closing of hatches. The Commander must take various actions, such as activation of sensors to detect the concentration of any toxic substances.

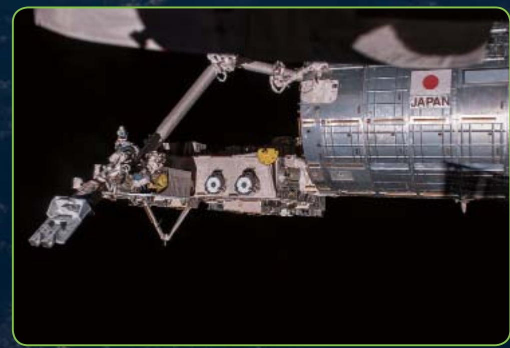
For example, in case of a leak of ammonia (used to cool the ISS), it would only take a short time for the amount to reach a lethal dose. Hence, the crew immediately dons oxygen masks and closes prescribed hatches. If there is a sudden loss of pressure, the crew identifies which module is leaking air, and then closes hatches in accordance with a procedural manual in order to isolate the leak. In such emergencies, the Commander ascertains where all of the crew are and confirms the location of equipment necessary for the safety of the crew and the maintenance of the ISS' functioning. This includes such items as oxygen masks, fire extinguishers, first aid kits, drinking water and EVA suits. The Commander also confirms the remaining internal air pressure level inside the ISS and estimates the time remaining before the pressure drops to a level that will induce decompression sickness* in the crew.

Clearly, the Commander bears a heavy responsibility to ensure the safety of the crew. As such, it is important for the Commander to maintain the confidence of all crew members, and a key part of this is making sure that day-to-day communication among the team is functioning effectively.

*Decompression sickness: At normal air pressure (1 atmosphere), nitrogen is dissolved in the blood stream. If pressure rapidly decreases, this nitrogen forms bubbles, which block arteries and cause muscle ache and dizziness. This sickness is often referred to as "the bends."

During a fire drill, Astronaut Wakata practices putting on an oxygen mask while wearing a space suit (© JAXA/GCTC)

Theme 3 The ISS and the Future of Japanese Space Development

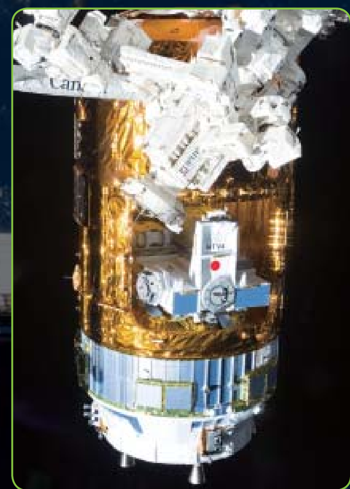


JEM Remote Manipulator System (JEMRMS) grips the JEM-Small Satellite Orbital Deployer (J-SSOD) (© JAXA/NASA)

The Future of Space Development Envisaged by Japan

The future direction of Japan's space development efforts will utilize the technology, human resources and know-how Japan has cultivated through such programs as JEM Kibo and the HTV. It will be important for Japan to further expand its areas of expertise so that it can play an even more active role in the future. Japan has developed world-leading technology of which it can be proud. Examples include the rendezvous technology developed for the HTV, JEM Kibo's robotics technology, the safety and reliability management technology built up through the development and operation of these two programs, and the camera technology used in each of the ISS modules.

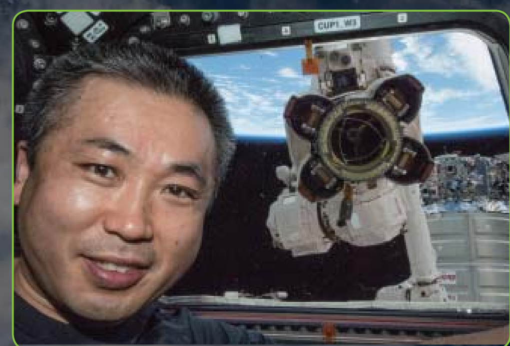
The results achieved by the ISS program through space experiments have brought a wide array of advances in the industrial sector and areas that affect our daily lives. However, many of the results generated by manned space programs are not as tangible. A prime example of this is safety and reliability management technology, since manned space activity requires a very high level of safety. It is extremely difficult to safely move objects in the harsh and dangerous space environment. Through the safety design and operation of redundant systems and other complex systems, which factor in the potential for human error, Japan has acquired safety technology for the space environment that places the preservation of human life as the top priority. It was only possible to acquire this capability through the prior accumulation of a vast array of technologies during the development and operation of JEM Kibo, the HTV and other projects. This has provided a further boost to Japan's reputation as a global technology leader.



HTV4 docked onto ISS Node 2 (Harmony) (© JAXA/NASA)

Pursuing Further Manned Space Technology, Contributing to the World's Future

Astronaut Wakata describes the ultimate aim of manned space flight as being "risk management for the survival of humanity as a 'seed.'" He continues, "Risk management includes such measures as those needed to avoid a collision between the Earth and a large meteor, which could cause major disruptions to the global environment. Manned space technology is a fundamental necessity for the survival of the human race. Contributing to a world based on that technology is the mission of the science and technology powerhouse countries, including Japan. Japan is a country capable of making such a contribution, and through space development we can help realize more prosperous societies and strive toward world peace. I look forward to a continuation of these efforts."



Astronaut Wakata aboard the ISS with robotic arm SSRMS and Earth in the background (© JAXA/NASA)

To the Children Who Are Our Future

未来を担う子供たちへ

Astronaut Koichi Wakata is working hard every day as ISS Commander. Please support him by reading about his activities on the JAXA web site (http://iss.jaxa.jp/iss/jaxa_exp/wakata/news/) and following him on Twitter (@Astro_Wakata). The first steps toward becoming an ISS Commander begin on this page.

ISSコマンダーとして、毎日バリバリ仕事をしている若田宇宙飛行士。JAXAのウェブサイト（http://iss.jaxa.jp/iss/jaxa_exp/wakata/news/）やツイッター(@Astro_Wakata）を見て応援してください。コマンダーへの第一歩は、このページから始ります！

Tell us about what the ISS Commander does!

コマンダーについて、もっと教えて！

Astronaut Wakata paddles a sea kayak during NOLS training in November 2011

2011年10月のNOLS訓練で、シーカヤックで海上を移動
(© JAXA/NASA)

In November 2013, the crew appeared at a pre-flight press conference during which they held the 2014 Sochi Winter Olympics torch.

2013年11月、ソチ冬季オリンピック2014の聖火トーチを手に、記者会見に臨む
(© JAXA/NASA/Bill Ingalls)

The Commander's Role

The Commander is like the captain of a ship, or the manager of a soccer or baseball team. He or she is responsible for the crew carrying out its mission, keeping the whole crew safe and making sure all of the ISS' systems run smoothly. It is a very challenging job.

■コマンダーの役割

ISSのコマンダーは、船でいえば船長、サッカーや野球チームでは監督にあたります。仲間のクルーと一緒に行う「ミッション」の進め方とクルー全員の安全、そしてISSのすべての機能に対して責任を持つ、非常にやりがいのある仕事です。

In December 2013, Astronaut Wakata and the crew of the ISS carried out an emergency drill.

2013年12月、ISSで緊急時の訓練をクルーたちと行う
(© JAXA/NASA)

The Path to Becoming Commander

Astronaut Wakata has participated in many training exercises in very harsh environments that share similarities with the space environment, such as atop snowy mountains and on the deep ocean floor. Through these, he developed leadership, teamwork and self-management skills. Preparing for the job of Commander involved building experience through this type of training.

■コマンダーへの道のり

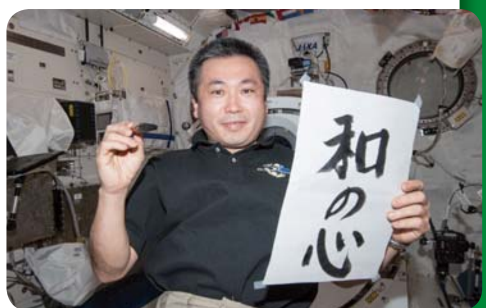
若田宇宙飛行士は、冬山や海底など、宇宙での滞在に似たきびしい環境で何度かミッションを行い、「リーダーシップ」「チームワーク」「自己管理」の能力を養いました。コマンダーの仕事はこのような訓練の積み重ねです。

Qualifications Needed to Become Commander

To become Commander, in addition to management skills necessary for fulfilling the mission, the person needs to have strong communication skills for leading the crew and working with the mission control center on the ground. In other words, the Commander needs to be a leader that can win the absolute trust of the whole team, and achieve success in the crew's mission aboard the ISS.

■コマンダーになれる条件

コマンダーには、ミッションを進めていくマネジメント力のほか、クルーや地上のミッション・コントロール・センターと上手にコミュニケーションを取る力も必要です。つまりチーム全員が心から信頼できるリーダーを目指して、ISSでのミッションを成功させるのが任務です。



New Year's Day 2014 was Astronaut Wakata's first experience of New Year in space. He wrote "Wa no kokoro" (hearts in harmony) as his New Year's calligraphy.

2014年元旦、宇宙で初めて新年を迎え「和の心」と書き初め
(© JAXA/NASA)

Liaison Diary: Russia

Akira Kosaka was involved in the establishment of JAXA's Moscow Office and served as the first office director. In this interview he provides background information on JAXA's activities in Russia and offers his views on Russian space development.

What were the reasons for the establishment of JAXA's Moscow Office, and what are the main functions carried out by the office?

The Moscow Office opened in 2011. Coinciding with the retirement of the Space Shuttle, the JAXA office at the Kennedy Space Center in Florida was closed, and Moscow became the main overseas office coordinating manned spaceflight-related activities.

Since it will likely be some time before the manned space transportation system successor to the Space Shuttle is developed, in the foreseeable future the ISS partners—including JAXA—will rely on Russia's Soyuz spacecraft for manned spaceflight.

JAXA astronauts receive training at the Gagarin Cosmonaut Training Center (GCTC), in Star City, Russia, and the Russian resupply spacecraft Progress carries equipment and samples for experiment on behalf of JAXA as part of space experiment cooperation with the Russian Federal Space Agency (Roscosmos). For these reasons, JAXA decided to establish a Moscow Office to provide support for such operations.

Please tell us how the Russian space development community views JAXA.

The past four or five years has seen a significant deepening of the cooperative relationship between Japan and Russia in the space development field. JAXA Astronauts Soichi Noguchi, Koichi Wakata and others have received training at GCTC and flown aboard Soyuz spacecraft, and we have begun three joint space experiments aboard the ISS with our Russian counterparts—Medaka Osteoclast, High-Quality Protein Crystal Growth and Space Radiation Environment Measurement. Much of this cooperation began relatively recently. Through such activities, I believe that members of the Russian space development community have gained a deeper recognition of Japan as a trusted partner with high technical capabilities.

Russia has indicated that it sees the use of space as an important policy area. The country has abundant experience in space development capabilities. Russia's strong commitment to key objectives has not wavered—that includes the continuation of manned space activities and future progress in lunar and mars exploration. Space development in Russia is being pursued under the shared understanding of not only the space development community but also the majority of citizens. There is a general consensus that budget allocations for space development are a good investment for the future and will generate benefits for the lives of ordinary people.

Would it be fair to say that Russia is determined to maintain its leading position in space development?

Yes, Russia has long maintained a program of low-orbit manned space activities. Salyut was the world's first space station, and its successors include Mir and the ISS. There is the assumption that further successors will follow in due course. On the other hand, there are also those who believe that a new direction will be established in light of participation in the ISS program.

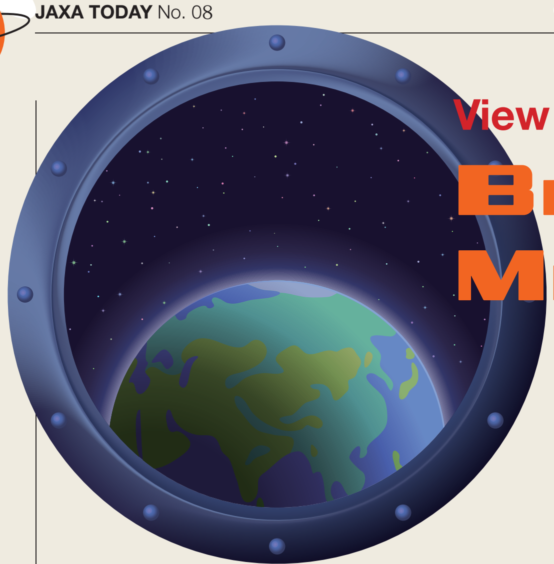
What message do you have for children who are interested in space?

Through my two overseas assignments in Washington, D.C., and Moscow, one of the things I have come to appreciate is the importance of efforts to understand the thinking of the people of each partner country. I believe this is a vital prerequisite to building a mutually beneficial relationship. I would also like to point out to everyone who is interested in an international career that space development is one of the world's most exciting, leading-edge fields. I sincerely look forward to working with many of you in the future.

A gathering of current and former staff members of the JAXA Moscow Office. From left: Igor Rudyaev, Hitoshi Tsuruma, who became the new Moscow Office Director from April 2014, Marianna Cherkashin, Lobanovskaya Brigita and the previous director Akira Kosaka. Prior to taking up his new appointment, Mr. Tsuruma commented, "I look forward to contributing to international space cooperation at the forefront of manned space activities."

JAXA Astronaut Kimiya Yui (right) participates in winter survival training at GCTC
(© JAXA/GCTC)

Valentina Vladmirovna Tereshkova, who became the world's first female cosmonaut in 1963, and JAXA Moscow Office Director Akira Kosaka at a reception to commemorate the 50th anniversary of her spaceflight.



View from the Editor's Window

Bringing Space Meals to You

For the astronauts serving long-duration missions aboard the ISS, one of the things they look forward to is their meals. In this column we introduce various types of space meals developed specifically for consumption aboard the ISS, and "Japanese space food," which has begun to be certified in recent years.

The ISS crew enjoy a meal
(© JAXA/NASA)

Rehydratable (freeze-dried) foods
(© JAXA/NASA)

Retort pouch (thermostabilized) foods
(© JAXA/NASA)

Retort pouch foods are prepared by adding water and pressing the moisture in with one's fingers
(© JAXA)

Can with Velcro tape on two corners of its base to secure it to trays

The sardines appear through a covering of delicious-looking tomato sauce

Presentation for tasting on the ground

Adaptation of the sardine and tomato sauce menu: Sardines on a bed of sliced onions

Although there is no medical proof, experience suggests that astronauts serving long-duration ISS missions prefer strongly flavored foods. The menu we sampled was sardine with tomato sauce, which neutralized the fish aroma. It was very appetizing and we didn't think it was more salty or spicy than a similar meal on the ground. Did you know that the popularity of Japanese cuisine now reaches into space?

In the past, while space meals were designed to be lightweight and compact, nutritionally balanced, and convenient to prepare and eat, many such meals lacked appeal or were bland, as the food had to be eaten through a tube or was separated into bite-sized portions. However, in recent times there have been advances beyond the basic retort pouch foods and rehydratable freeze-dried meals. Nowadays, space meals are becoming much more similar to meals on the ground, thanks to the use of menus with high nutritional value to ensure astronauts remain healthy, and various efforts to make the meals more appetizing.

Astronauts Prepare a Rich Variety of Space Meals Aboard the ISS

There are approximately 250–300 different space meals available today. These can be divided into four broad categories:

1. Rehydratable (freeze-dried) foods
2. Retort pouch foods
3. Partially dried foods (dried fruit, beef jerky, etc.)
4. Foods that can be eaten as is (including fresh fruit, bread, cookies, etc.).

There are also a range of beverages, such as fruit juices and coffee, as well as a variety of condiments.

Preparation of meals aboard the ISS is mainly done in the mid-deck galley of the Destiny module, the United States' main research laboratory within the ISS. The galley is equipped with a press oven for heating foods and an appliance that rehydrates food by such means as injecting hot water through needles. Both of these appliances have a maximum temperature of just over 80°C, and in the case of rehydrated food, the maximum amount of water is 200ml. Water must be transported to the ISS aboard the unmanned resupply spacecraft operated by several of the ISS partner countries, including Japan's HTV. The ISS also has a water recovery and recycling system, which began full-fledged operation during Astronaut Koichi Wakata's long-duration mission from March to July 2009. After heating or rehydrating their meals, astronauts cut the retort pouches open with scissors and scoop the food out directly before eating. Instead of eating at a table, they have a tray, which they fix onto their body. The forks and spoons they use are the same as those used on the ground, but for the most part only a spoon is required. They do not use bowls or plates. Liquids are consumed through a straw straight from the pack to prevent leakage or spills, which could come into contact with equipment and cause malfunctions.

Japanese Cuisine's Popularity Reaches into Space

In *The Tales of Ise*, which dates from Japan's Heian Period (794–1185), there is a particularly famous passage that describes people listening to the recitation of *waka* poems by a man who has fled from the imperial capital of Kyoto. "The dried rice that we were supposed to eat after soaking it in water has become sodden from our tears of homesickness." This illustrates that people in Japan have carried dried foods on journeys since ancient times. Japanese cuisine has a rich tradition of preserved foods, including *umeboshi* (salted sour apricots), *nori* (dried seaweed) and *tsukemono* (pickles). Such foods are ideal for astronauts serving long-duration missions aboard the ISS. At present, JAXA has called for existing and potential suppliers of space meals to submit new proposals for "Japanese space food." JAXA hopes that astronauts now preparing for long-duration missions aboard the ISS will be able to enjoy the flavors of Japan, and that this will help to relieve emotional stress during their missions. So far, 28 food items submitted by 12 companies have received certification. Readers can see what some of these meals will look like from the photographs above.

Fresh vegetables and fruit, such as onions, apples and oranges are brought to the ISS at irregular intervals aboard resupply spacecraft. By all accounts, the astronauts are very happy to receive these supplies.

What are the Main Conditions for Certification as Space Food?

What do you think? A party pack of Japanese space food might be quite useful. Some readers may think to themselves, "I'd love to send my culinary efforts up to the ISS!" To those people, we would like to offer a few pieces of advice. Freeze-dried foods are rehydrated in the ISS galley. Foods that might give off gases are not suitable since they might cause containers to deform—or even worse, rupture and leak. For example, foods containing carbonated beverages are unsuitable. On the ISS, since astronauts from many countries live within a confined area, it is best to avoid foods that have strong aromas, such as garlic or *natto* (fermented soy beans), which might cause discomfort to other astronauts. Unfortunately, glass containers are also out due to weight and disposal constraints. The URL below provides detailed information on requirements for Japanese space food, including packaging conditions (information in Japanese only).

宇宙日本食
JAPANESE SPACE FOOD
JAXA認証-00123

Certification mark for Japanese space food

Japanese space food information: http://iss.jaxa.jp/spacefood/about/

Wouldn't you like to cast your thoughts up to space while eating the same menu as Astronaut Wakata as he orbits 400km above the Earth?

JAXA's Frontier

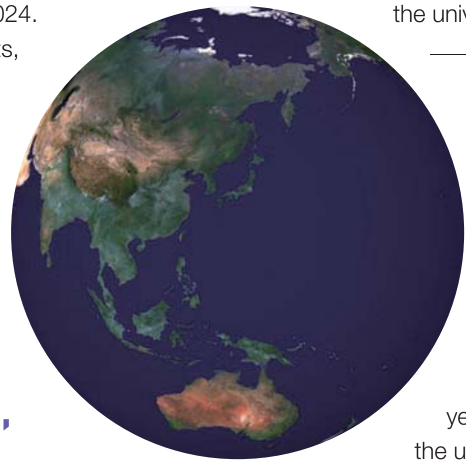
An artist's rendition of the envisaged departure from Earth of the Hayabusa2 spacecraft. Its mission will be to explore Asteroid 1999 JU3 in a quest to solve mysteries surrounding the birth of the Solar System and the origins of life.

International Space Exploration Forum (ISEF) Held in Washington, D.C.

ISEF was held in Washington, D.C., on January 9, 2014, hosted by the United States Department of State. The forum brought together the representatives of governments and space agencies of 35 countries, which reaffirmed the importance of space exploration and discussed views on future space exploration efforts.

Within these discussions, the participants particularly noted the importance of exploration targeting asteroids, the Moon and Mars, and recognized such projects as part of key long-term objectives based on international cooperation. Participants also reiterated the value of utilizing the ISS, not only for research, technology demonstrations and experimentation but also for the benefits generated in relation to future space exploration. NASA announced that it would continue operation of the ISS until at least 2024.

The forum was attended by Japan's Minister of Education, Culture, Sports, Science and Technology, Hakubun Shimomura, and JAXA President Naoki Okumura, who expressed Japan's strong commitment to involvement in building an international framework for space exploration. They also communicated Japan's intention to play an active role in future space exploration efforts by leveraging the country's technical strengths and unique technologies. The ISEF participants welcomed an offer from Japan to host the next space exploration dialogue in 2016 or 2017.



The 20th Session of the Asia-Pacific Regional Space Agency Forum (APRSAF-20) Held in Hanoi, Vietnam

20TH APRSAF
ASIA-PACIFIC REGIONAL SPACE AGENCY FORUM
VIETNAM

From December 3–6, 2013, APRSAF-20 was jointly hosted by Japan and Vietnam in the Vietnamese capital city of Hanoi. Under the theme of "Values From Space: 20 Years of Asia-Pacific Experiences," the forum drew over 400 participants, comprising space agency and government officials and space-related researchers from the Asia-Pacific region. The forum included a plenary session and reports from four working groups. JAXA President Naoki Okumura's keynote address was titled "JAXA's Space Activities," and introduced such programs as the Epsilon, H-IIA and H-IIB main launch vehicles. He also provided case-study explanations for JAXA's natural disaster response programs and the application of space technology in agriculture.

As one of the activities run in conjunction with APRSAF-20, the 8th Poster Contest for elementary school children was held, and the poster made by an eight-year-old student from Thailand won the Best Poster Award.

APRSAF-20 was jointly hosted by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT), JAXA and the Vietnam Academy of Science and Technology (VAST)

Expedition 48/49 will be Astronaut Onishi's first spaceflight

Astronaut Takuya Onishi Selected for Long-Duration Mission Aboard the ISS

JAXA Astronaut Takuya Onishi has been selected to perform a long-duration mission aboard the ISS as part of the crew of Expedition 48/49. He is scheduled to begin the mission in June 2016, and to stay on the ISS for approximately six months. Astronaut Onishi was certified as an ISS astronaut in July 2011, and since then has undertaken a range of training programs to enhance his capabilities as an ISS astronaut. This has included participation in NEEMO at the Aquarius underwater laboratory in Florida.

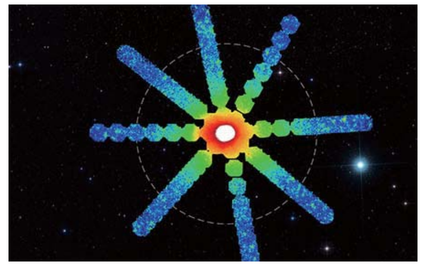
Astronaut Onishi commented on his aspirations after the announcement of his selection for Expedition 48/49, "During my long-duration mission, I want to communicate to children in various ways the wonder of universe so that they can feel close to the universe."

X-ray astronomy satellite Suzaku

Observations from X-ray Astronomy Satellite Suzaku Confirm Ancient Distribution of Iron

Observations from JAXA's X-ray astronomy satellite Suzaku (ASTRO-EII) have provided evidence to clarify the origin of the iron that is in our blood. Researchers at Stanford University in the United Sates and at JAXA have used Suzaku's high sensitivity and spectroscopic performance to observe the distribution of iron in the Perseus cluster of galaxies. As a result, the researchers confirmed that the explosions of supernovae more than 10 billion years ago caused iron and other heavy elements to spread evenly throughout the universe. The observations provide evidence that these ancient explosions were the origin of most of the heavy elements present in the universe today. This discovery was reported in the journal *Nature* on October 31, 2013.

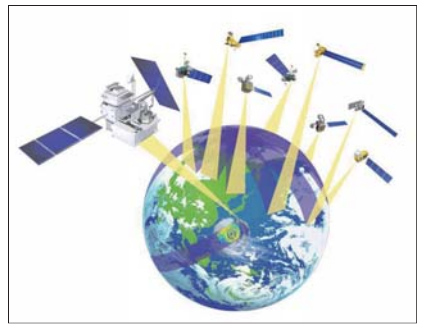
In the future, using the ASTRO-H X-ray astronomy satellite—successor to Suzaku—if researchers are able to observe similar phenomena in other galaxy clusters, and investigate the state of large-scale structures, including multiple galaxy clusters, it is hoped that scientists will gain further insights into the history of how heavy elements were generated and spread.



Suzaku observed the Perseus cluster along eight directions, and the distribution of iron over 10 million light years
(NASA/ISAS/DSS/O. Urban et al., MNRAS)

Core Observatory Satellite Launched for Global Precipitation Measurement (GPM) Mission

On February 28, 2014, the Core Observatory satellite of the GPM mission was launched from the Tanegashima Space Center (TNSC) aboard an H-IIA launch vehicle. GPM is a joint international mission that will provide advanced observations of rain and snowfall worldwide via a constellation of satellites. The GPM Core Observatory was developed jointly by JAXA and NASA, and carries the Dual-frequency Precipitation Radar (DPR) and GPM Microwave Imager to enable high-precision observations of precipitation. The Core Observatory will also fulfill the role of calibrating precipitation measurements made by the satellite constellation. In particular, since DPR uses two frequencies it will be able to observe a wide variety of precipitation conditions, from strong squalls in tropical regions to light rain at high latitudes. Hence, DPR is expected to make a significant contribution to disaster prevention through more accurate prediction of storm paths and flooding. It is also hoped that it will contribute to the resolution of water resource issues through better understanding of changes in the global water cycle.



GPM Core Observatory satellite (left) and satellite constellation

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