IPMU Interview

with JAXA astronaut Naoko Yamazaki

Interviewer: Mihoko Nojiri

Weightlessness was much more fun than expected

Nojiri: Thank you for coming today.[*1] So you stayed up in space for 16 days, starting on April 5. Let's see, where should I start···was space fun?

Yamazaki: Yes, it's fun. Being in a weightlessness was much more fun than I had expected. There is neither up nor down, nor right nor left: you can't trust your ordinary senses in this state. For instance, as soon as I was upside down standing on the ceiling, I felt that the ceiling was a floor for me. My sense of direction had switched on a dime.

Nojiri: The various equipment had the same orientation though, right?—certain equipment above and certain equipment below?

Yamazaki: Yes, the lights were put on the ceiling. So we could tell up and down from this equipment. But my directional sense became independent of up and down inside the spacecraft. It was an amazing feeling.

Nojiri: How did the stars look?

Yamazaki: Well, Orion and other constellations looked the same as I see them on Earth. But they didn't flash or flicker. They were like clear light dots. The Milky Way also looked as it should be where stars clustered.

Nojiri: And except for those, space must have been really dark, right?

Yamazaki: Yes. How I can say this···. It was lightless black, pitch black, I mean, inspired black. Star lights looked more artificial like those seen in a planetarium.

Nojiri: What about the Sun?

Yamazaki: It was really a sharp beam. You can't look straight at the white light.

Nojiri: White? Yes, because

Naoko Yamazaki joined the National Space Development Agency (NASDA) of Japan—now the Japan Aerospace Exploration Agency (JAXA)—in 1996. She was selected as an astronaut candidate for the ISS in 1999, and was officially certified as an astronaut in 2001. She became qualified as a Flight Engineer for the Russian spacecraft Soyuz in 2004, and was certified as a Mission Specialist by NASA in 2006. On April 5, 2010 she launched aboard the space shuttle Discovery to the ISS, and returned to Earth on April 20, 2010. She received a Master of Science degree in Aerospace Engineering from the University of Tokyo in 1996.

[*1] This interview was held on November 12, 2010.

it was not absorbed by the atmosphere.

Yamazaki: And its intense heat came through the wall of the spacecraft.

Nojiri: Yes, that side should become hot.

Yamazaki: Yes, I felt really hot on that side. But even with the sunlight in the daytime, outer space was really dark. I was amazed. But, come to think of it, it is a matter of course, because there is no blue sky in space.

Nojiri: Were you struck looking down at Earth—that it should be so huge?

Yamazaki: The Earth had a thin blue shining layer of atmosphere with the backdrop of really dark space. It was miraculously beautiful.

Nojiri: I used to watch the International Space Station (ISS) when the JAXA astronaut Koichi Wakata was on board. I could find the passing light dot in the evenings. If it's in a good orbit, you can see it from beginning to end, but usually it suddenly disappeared in the middle of the sky.

Yamazaki: Even though it was cloudless?

Nojiri: I was wondering why, and suddenly I noticed that the reason was because it came into the shadow of the earth. I was excited about watching it though. It was fun. By the way, I just learned through a newspaper a couple of days ago that you will return to Todai (the University of Tokyo) this December. What exactly are you going to study?

Doing research at Todai while continuing astronaut training

Yamazaki: I'm thinking about taking a Ph.D. course, eventually. For now, I want to study rather broadly, not focusing too much on a specific topic. I will hold the position of Project Academic Support Specialist at Todai.

Nojiri: Is it a preliminary step to taking a Ph.D. course?

Yamazaki: It has been almost 14 years since I graduated, so I want to warm up while I work as a research support member. The lab that I'll join is studying nano-satellites, aiming at utilizing these satellites for such education as to make space more accessible to students. They are also trying to use the data acquired from real satellites for extensive applications. In view of this, I would rather work on a perspective of how we can apply the space systems to education than work on research until formally taking a Ph.D. course.

Nojiri: On the other hand, you'll continue undergoing astronaut training, right?

Yamazaki: Yes, indeed.

Nojiri: It sounds tough.

Yamazaki: The astronaut training itself is pretty systematic. Once you are assigned to a mission, each

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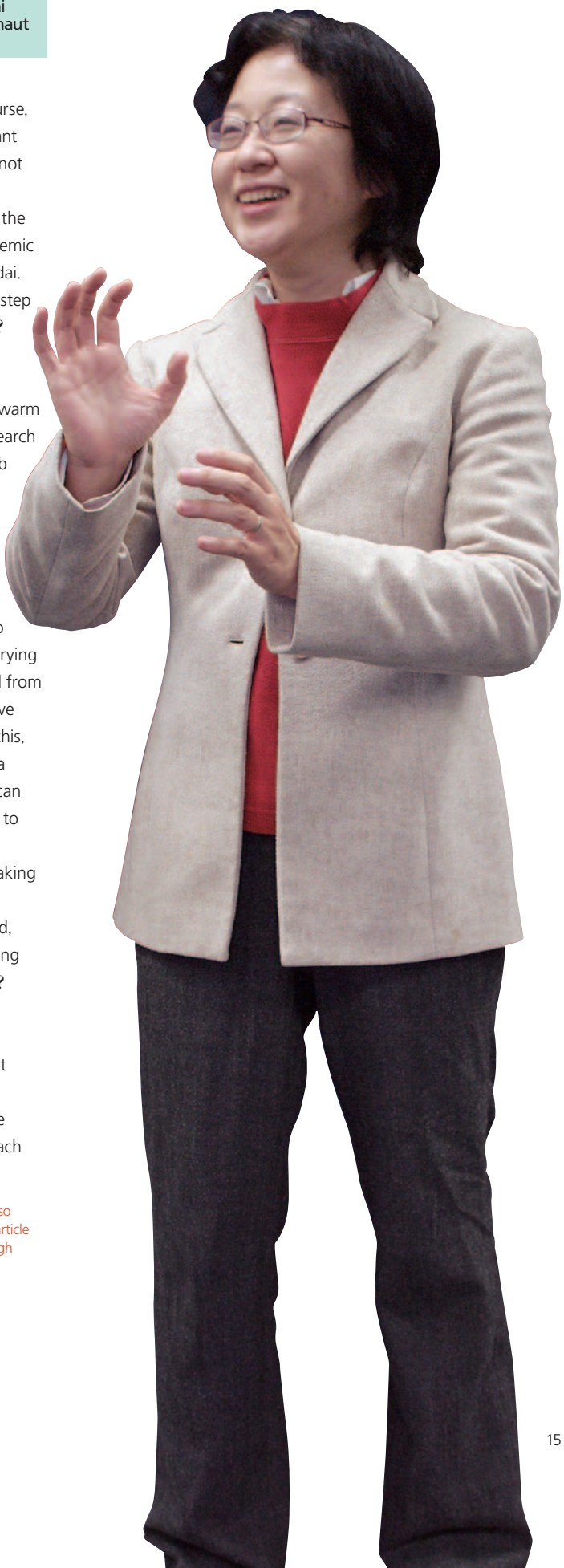

training session related to the ISS is firmly scheduled over two and a half years. Until we are assigned an actual space flight, they are more of review sessions on how to maintain and improve our current skills than precise training program. To be more specific, it is about improving communication skills, maintaining physical strength, and periodically brushing up on some technical operational skills like robot arm maneuvers.

Nojiri: Do you receive training in Tsukuba?

Yamazaki: Yes, in Japan it is mainly done at JAXA Tsukuba Space Center.

Nojiri: Do they have a specific environment for it there?

Yamazaki: Yes, there is a full-scale model of the Japanese Experiment Module (JEM) "Kibo (Hope)" at the Tsukuba Space Center where we can undergo various simulation training sessions.

Nojiri: Recently I visited the center to see the burned "Hayabusa" capsule which was on display. They have a big building like a gym there.

Yamazaki: That's exactly the site where we have training.

Nojiri: Do many foreigners also visit there?

Yamazaki: The ISS is run in cooperation with 15 countries. Astronauts from other countries also come to Tsukuba to train to work at the JEM "Kibo," but they usually complete one- or two-week sessions. So, they come there like as a short-term business trip. They do not ordinarily live there.

Nojiri: Are you going to Russia for training as well? Do you think the environment is different from that at NASA?

Yamazaki: Oh, yes. Since we can only go to the ISS either by the US Space Shuttle or by the Russian Soyuz, I trained in Russia as well. I had trained at Star City in Russia for seven months in total. I found many differences in the culture, the way of training, and the lifestyle.

Nojiri: In what way are they different?

Yamazaki: First of all, the language is different. Star City is just under a one-hour drive from Moscow, but they don't speak English at all.

Nojiri: Was the town built for the space mission?

Yamazaki: It was originally a town for military facilities. The whole town is a kind of closed area. There are a couple of fancy shops, banks, post offices, and so on. So people can have basic necessities inside the city, and it looks like a blocked-up and isolated town. Because of that, people there have stronger bonds within the community. Especially in winter, people always visit each other, and have drinks late into the night. They have very strong interpersonal relationships.

JAXA astronaut Naoko Yamazaki works with the Window Observational Research Facility (WORF) in the Destiny laboratory of the ISS on 10 April, 2010 (courtesy of JAXA/NASA).

Nojiri: Were Japanese astronauts with them?

Yamazaki: Yes! Once we got to know them, I was surprised that Russian people were more familiar with Japan than we thought. We, on the other hand, were well aware of our lack of knowledge about Russia.

Multi-task daily life, while raising a child

Nojiri: And then you went to NASA to continue the training, right? As a matter of fact, I bought your book[*2] and read it for this interview. I only knew about you from TV reports or news papers, so I didn't know any meaningful personal stories like those written in this book, like taking your child to daycare, what happened when your child got sick, and so on. Those are really tough experiences. My husband lives away from home for his career, so all these stories in this book reminded me of the days I had to take care of my kids all by myself. For instance, one of my kids threw up on a day when I had to interview grad school applicants as part of their entrance exam, and so I was in a panic.

Yamazaki: Yes, I understand. Because we cannot predict what will happen every day, we think "Thank God, I could get through today" at the end of day.

Nojiri: Is there any support staff while women astronauts are training? Does NASA arrange that support for their children?

Yamazaki: They support our work operation but not our daily life. As for space shuttle training sessions, they were scheduled at NASA, but I also had to give reports to my affiliation, JAXA, in a timely fashion. Therefore, my work burden was greater than that of other astronauts at NASA, and so a support member from JAXA usually helped me compile those reports or attended the trainings with me which helped him in turn to have various technical experiences.

Nojiri: Who does things like looking for daycare?

Yamazaki: Nobody takes over personal household work, so I had to do it privately, all by myself. But NASA has a "Family Support Office" where they give us appropriate information for our questions or requirements like schools, hospitals, and so on. Also we supported one another among the small Japanese community of fellow astronauts from JAXA who were assigned to Houston and also with resident officers at the JAXA

[*2] *It's gonna be all right! Mom is gonna go to space*, Sunmark Publishing, Inc., Tokyo, 2010

Houston Office and their families. In addition, the wife of astronaut Erison Onizuka who died in the space shuttle Challenger accident in 1986, is of Japanese ancestry and works at the JAXA Houston Office. She gave great advice to us as a surrogate mother of astronauts. It is a very hard thing to restart your life in a place new to you, but it is especially difficult in a foreign country because there are many problems you can't solve by yourself. I have made it this far because I have had such encouraging support. Also my husband who went back and forth over and over between Japan and the US helped me greatly. We actually had been run off our feet and organized our life.

Nojiri: Are there any other astronauts who have their respective families and work away from home?

Yamazaki: There are about 30 female astronauts in the US and about 10 of them are raising children. But it is really rare to find one with a husband who works outside of Houston or out of Texas. There were only two astronauts, Cady (Catherine Coleman) at NASA and Julie (Julie Payette) from Canada. They had similar circumstances and we always encouraged each other.

Nojiri: You have family, you are going to university, and you have training sessions. It seems to be really tough. Do you think astronauts are good at juggling their limited time?

Yamazaki: Well, I can't say I'm good at it. I'd rather say I have no choice. It is driven by necessity. I'm surviving day by day.

Nojiri: I understand, because so am I…

Yamazaki: But we, astronaut, call those hectic days which we have to juggle, multitasking. In the actual spacecraft we can't concentrate on just one thing. Every few minutes we have to handle various tasks in parallel, like doing this experiment and then taking photos and after a while going back to the work again. Schedules are always switched. In that sense, I think my daily life of raising a child may be a good thing for an astronaut's training.

Nojiri: So, you can't do just one thing all day long.

Yamazaki: Now, there are always about 6 astronauts staying in the space station, and several tens of experiments from participating countries are on going in parallel. In addition, we also operate robot arms, maintain the space station itself, and so on, so that we have to share all of this among the 6 astronauts. It's really hectic.

Nojiri: Wow, I doubt I could do that. I have two kids but I can either bring my work home or do it in my office because I'm doing theoretical studies. I'm not involved as a part of a team project. It seems that teamwork must be an important part of being an astronaut, isn't it?

Yamazaki: Yes, it is. There is hardly any training that we can do alone. There are instructors and facility operators. Sometimes it's a very small team but sometimes it's a huge one with a hundred teammates. Then our schedule is always precisely set and we really have to be at the designated place on time. It can be difficult if you have kids…, or if I myself catch a cold. Anyway, we always need to pay careful attention to being there on time. We get support from family or from friends, but when a family member has an accident or we really can't help it….

Nojiri: Do you take a day off?

Yamazaki: The training schedule has time margins set to be up to such conditions, and then they re-arrange it for me.

Nojiri: I see. So they treat it with flexibility when you have a serious problem.

Yamazaki: Yes, we are ready to help each other when we have a problem.

It's challenging, but not impossible

Nojiri: I know many young female researchers who say it is too much to have kids with the busy life that research entails, so they think they cannot get married. Or they start questioning whether they should resign because they are not confident about juggling their research with being mother. I am very much impressed with what you say in this book, that is, having the attitude of "I'll deal with it" when problem arise, and it works out in the end. I really recommend this book to those researchers.

Sometimes, I say to my young colleagues "why don't you hire babysitters. It's just buying your way out of the problem." But you know, the situation is not so simple. It takes a long time for every mother to overcome ambivalence between positive and negative aspects of hiring babysitters. I could not hire babysitters until my kid was hospitalized.

My job is different from yours, so I just need to slow down my work and accept the inevitable. I can't do everything, so I have to improvise. I just reboot my mind to think that slowing down is still worth going forward even a bit. This is the way I've been doing it.

Yamazaki: I understand.

Nojiri: I was really impressed by this book.

Yamazaki: Saying "it's just challenging, nothing is impossible."

Nojiri: Yes, that's certainly in the book.

Yamazaki: I think I often make an acceptable range by myself and try to be within the limits of what is allowed. But when I encounter problems I really need to handle, there are a few ways to solve them like hiring babysitters…

Nojiri: Unlike you, doing a great job, it's more routine things in my case.

Yamazaki: I don't think so. All working mothers have similar

circumstances in their daily life. How old are your kids?

Nojiri: One is in the seventh grade and the other is a high-school freshman. It's much easier now. For the first time, I recently left my kids alone for one night and went on a business trip to Korea. I prepared all meals for the time I was away. They had no problem without me. So I'm going on many overnight domestic trips from now on. (laugh)

Yamazaki: When I was in junior high, my father worked and lived in Hokkaido away from home. My mother sometimes went to Hokkaido. My brother, who was a high school student at that time, and I had to be left home. But our grandma was with us.

Nojiri: I thought you were in Hokkaido with your father.

Yamazaki: Yes, I was there when I was in kindergarten and the first years of elementary school, but when I was in junior high, my father stayed there away from us. At the time, my mother took turns staying about one month here and Hokkaido. At first, I cried because I missed my mom, but by the second time, I was like, "see you, mom!"

Nojiri: Although it seems to be too much trouble at first, once you do it and feel at ease, then you can start to think "I'm OK and so are they." How old is your daughter?

Yamazaki: She is in second grade, so that means she's still willing to be around me.

Nojiri: Will you be in Japan for a while?

Yamazaki: Yes. When we returned from the US to Japan, my daughter had a difficult time saying good-bye to her American friends and was missing America so badly because of the different environment. So did my husband. He had to go back and forth between the US and Japan, but still he had a hard time starting everything over in Japan after living for six years in the US. With our altered environment, it was a stressful time for us and also for our family members as well.

Nojiri: Since you are here, can you go home a bit earlier?

Yamazaki: Yes, sometimes. But I spend a lot of time away on domestic business trips so it's still busy. Actually, JAXA operates a once-a-week basis work-at-home. Although it is only one month trial, I hope it will be institutionalized.

Nojiri: But you have to work even though you are home, right?

Yamazaki: Yes, but I can save commuting time and set my work schedule flexibly. So I would very much appreciate it.

Both space and high-energy experiments facing a problem of becoming long-term

Nojiri: Let's change topics. I'm working in a theoretical field close to high-energy physics experiments. I think both high-energy experiments and space experiments have been getting more and more long-term projects, and an experiment's project cycle is approaching the same order as a researcher's life cycle. When we accept new students, it has to coincide with the experiment that is just starting; otherwise, they miss essential skills. If we accept one in the middle of an experiment, he or she would be able to acquire only software skills in an extreme case. I think it's also a problem in space development that whole projects become long term.

Yamazaki: Yes, they have increasingly been long term. In the space development, for instance, the Japanese Experiment Module "Kibo" which was delivered to the ISS was a 25-year project starting from its conception and initial designs. Even for satellites, it usually takes five to six years, sometimes over a decade. So even if you join a project in an early stage, there personnel may be reshuffled, and so it's not always true that you can be involved in the same project from the beginning to the end. Researchers are likely to keep doing one project in the same department, but engineers or project members are usually transferred from one department to another every three to four years, in order to gain a range of experiences. Starting members of a project can be reassigned to other projects before completion. On the other hand, new members join the project in progress. A research project also extends over several years.

Nojiri: High-energy experiments are usually a decade long. My research is closely related to the LHC experiment in Europe. Well let me think…, I can't even remember when they started its construction. Hmm, it's such ancient history. (laugh) When I first decided to study LHC physics, they said it would be starting in 2003. Now I recall-it was in 1998. I can tell it because I had my baby that year. A year before, I moved from KEK (High Energy Accelerator Research Organization) to Kyoto University. And then, I heard it would be postponed to 2005---after that, the start date was rescheduled like one-year delay in every other year. Finally it was started in 2008, but as you know, there were serious issues which took an entire year to fix. Finally, it began to turn around this year (2010), but there was a five year delay in getting it off and running since it was supposed to start in 2005. Challenging things don't usually go as planned.

Yamazaki: And so it was for our JEM "Kibo." In 1996, I joined JAXA as an engineer at first. That was before I became an astronaut. When I first joined the "Kibo" development team, the design had been finalized, so we were in the last stage of construction and final testing. I heard it would be launched within the next three years or

so, around the same time as the Tsukuba Express. We were competing with the Tsukuba Express in this sense, but we lost. Last year (2009), "Kibo" was successfully launched and completed at last! Since the ISS project has been jointly operated internationally, a delay by one country has created subsequent delays for the entire project.

Nojiri: So the researchers who were going to do experiments in the "Kibo" needed to accept the situation.

Yamazaki: Yes, the delay in the launch caused delays in experiments, too.

Nojiri: There is also a case of delays caused by those preparing an experiment at the ISS. I know Alfa Magnetic Spectroscope (AMS) which will be mounted on the ISS is an important experiment, but it caused changes in the ISS operation due to the design modification. It took a longer time than we anticipated.

Yamazaki: Yes, indeed. It was delayed due to the deterioration of Russian economic conditions. Also, its construction was suspended during a three-year hiatus of space shuttle missions following the Columbia accident. It was delayed for various reasons.

Nojiri: I know what you went through when your first mission was changed.

Yamazaki: I was originally scheduled to fly aboard the shuttle after the ISS was built.

Nojiri: Is there still a possibility of continuing with the experiments at the ISS?

Yamazaki: Yes. We are pursuing ways to keep it in operation until 2015, and ideally extend it to 2020.

Nojiri: Ten more years….

Yamazaki: Yes, another decade.

Nojiri: Will it be operated in six-month mission cycles?

Yamazaki: Yes. At first, the JAXA astronaut Koichi Wakata stayed in space for four and a half months. And then, the JAXA astronaut Soichi Noguchi stayed for five and half months during the same period with me. We continue to go back and forth with the Russian Soyuz spacecraft. So far, the astronauts Furukawa and Hoshide are scheduled to have long term missions. Are you involved in the AMS experiment?

Dark matter is mysterious

Nojiri: No, I'm not, but elementary particle research has to do with cosmic-ray physics, for the most part. It is thought that unknown dark matter particles exist. Then, their pair annihilations create high-energy antiprotons and positrons. In cosmic rays, the positron component is less than the electron component, but if a sudden rise of the positron component would be observed, it might be interpreted as a signature of dark matter among other possibilities.

As the AMS is a huge instrument, we hope for its measurements in the higher energy region. Though the initial design had employed a superconducting magnet, it was changed to employ a permanent magnet at the final stage. Only the space shuttle can deliver an instrument as huge as the AMS to space. We are looking forward to the data from AMS as early as possible. Also, other scientific research satellites are all important for us, particle physicists. We were waiting eagerly for Pamela, Fermi, Planck and other scientific research satellites to launch.

Yamazaki: AMS is launching next year (2011), right?

Nojiri: I'm looking forward to it. I hope it will be set up at the ISS and observation will start soon. It's possible to install a bigger instrument on the ISS. It's different from, and more attractive than, any other satellites. I really hope the AMS project will be continued for at least 10 years, and not just 5 years or so.

Yamazaki: Dark matter is mysterious. Outer space was really dark, it was pitch black. I was looking at the darkness with a curious feeling that various unknown matter exists. I can't understand why dark matter particles collide. It's interesting. Do dark matter particles really collide?

Nojiri: Dark matter particles usually go through even though they encounter some materials. As the solar system rotates at a speed of 230 km/second together with the galaxy, dark matter particles penetrate our body at a similar speed on the average. But, it is thought that dark matter particles collide with matter particles or dark matter particles and change into known particles, even though such collisions are rare. In the central region of our galaxy, a lot more dark matter particles exist. So, the signal of photons produced from their pair annihilations at the galactic center is promising. If antiprotons are produced, they survive for a long time in the galaxy. So, we will observe their flux accumulated in the galaxy.

Yamazaki: I'm so mystified. Our visible world is only a fraction of the Universe.

Nojiri: I expect that dark matter will be discovered sooner or later. The LHC experiments have to do with dark matter. Collisions of particles produce dark matter particles with a certain probability, though it is small. I'm studying theoretically about the sort of signal we can see when dark matter particles are produced in the LHC experiments. Also, one of the IPMU projects is ongoing underground in the Kamioka Mine to search for collisions of dark matter particles with nuclei. The observation of distant galaxies with the Subaru Telescope is also important. As you come back to Todai, please visit the IPMU, which is on its Kashiwa campus. Thank you very much for sharing your time today.

Yamazaki: Yes, I would like to visit IPMU. Thank you, too.