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Elementary Particle Observation

from Keio's Faculty of Science and Technology

Using enormous equipment to explore tiny particles and the laws of the universe

Yasuhiro Nishimura

Associate Professor
Department of Physics

This feature explores Associate Professor Yasuhiro Nishimura's background and probes his research on the origins of the universe via breakthroughs in neutrino observations.

Observing Neutrinos with Hyper-Kamiokande

Unraveling the Mystery of the Origin of the Universe and the Theory of Everything

In order to solve the mysteries behind the beginning of the universe, we must first understand the elementary particles that are the smallest building blocks of all matter. One of these, the neutrino, is an especially critical piece to this grand puzzle. In 2028, Hyper-Kamiokande, an observational facility for subatomic particles, will open for experiments, building off of past models: Kamiokande and Super-Kamiokande. Nishimura is in charge of developing the photodetector that lies at the heart of this technology. As one of the key figures in this impressive undertaking, Nishimura is intent on making sure his preparations pay off.

The near impossibility of observing elementary particles

"Subatomic particles are the smallest elements in existence," says Nishimura. "By understanding their behavior, we can parse the laws behind the very universe itself and verify how it came to be." Our world is made up of matter, force, and mass created by 17 subatomic particles with different characteristics (Fig. 1).

To give an example, the matter of our bodies is mainly made up out of three types of particles: up quarks, down quarks, and electrons (a type of lepton). Likewise, there are gauge bosons that act as force carriers and Higgs bosons that produce mass. Different particles are subject to different types and magnitudes of forces, especially neutrinos (another type of lepton), which have very low mass and exert minimal forces on their surroundings. While hundreds of trillions of neutrinos come into contact with us every single second from space, most of them pass through the earth.

This is where certain Japanese researchers have taken on the challenge of observing these elusive particles. In 1987, they were the first in the world to discover neutrinos that had been emitted from supernova explosions. They went on to observe atmospheric neutrinos produced by cosmic rays entering the earth's atmosphere and even found that muon neutrinos could change into other flavors (types) of neutrinos, a process known as neutrino oscillation, thereby proving that neutrinos have mass. These discoveries were made possible by Japan's world-class subatomic particle detectors, Kamiokande and Super-Kamiokande, in Gifu Prefecture and earned Dr. Masatoshi Koshiba and Dr. Takaaki Kajita the Nobel Prize in Physics in 2002 and 2015, respectively.

Observing neutrinos to find the answers to key questions

When Dr. Kajita was awarded the Nobel Prize, Nishimura was working under him as an assistant professor at the University of Tokyo. He heard the news of the award from the next room over. Nishimura has been a core researcher involved in elementary particle research over the years. As a graduate student, he focused on the little-understood phenomenon of muons decaying into electrons and gamma rays. His work tested the Grand Unified Theory, which seeks to incorporate the "strong" force that binds the quarks making up protons and neutrons in atomic nuclei into the theory that unifies the "electromagnetic" and "weak" forces, known as the electroweak theory. After this project, he got involved in neutrino observation research, participating in the T2K experiment which involved beaming artificially produced neutrinos from the J-PARC accelerator facility in Ibaraki Prefecture to Super-Kamiokande over 295 kilometers away. Then, in 2013, his team discovered that muon neutrinos can oscillate into electron neutrinos. This was the final step in ascertaining that all three types of neutrino oscillation were possible.

This breakthrough provided the impetus for beginning construction on the long-

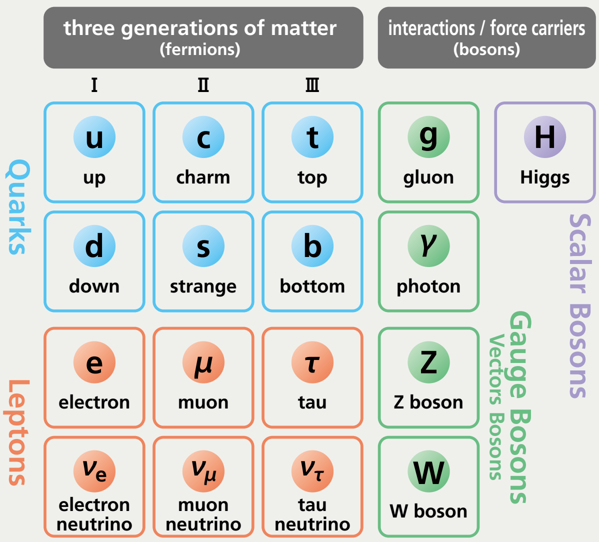
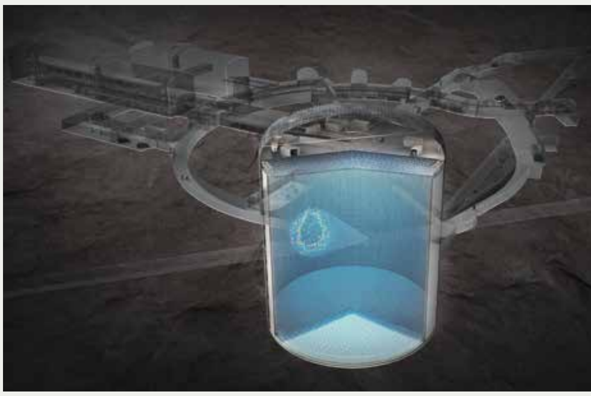


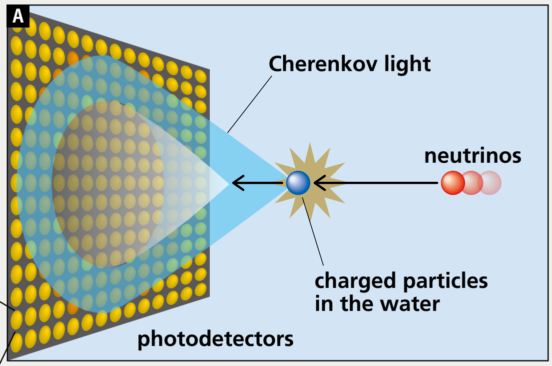
Fig.1
The standard model of elementary particles
There are four categories of elementary particles. Electrons and neutrinos are both types of leptons. I–III are classified by mass. Neutrinos have the least mass, no electric charge, and very weak interactions with other particles. There are three flavors of neutrino: electron neutrinos, muon neutrinos, and tau neutrinos. However, a strange phenomenon that occurs with neutrinos is that they can change flavor as they travel. This process is known as "neutrino oscillation."

Fig.2 Hyper-Kamiokande
Construction is underway in Kamioka-cho, Hida, Gifu Prefecture, scheduled to be in operation in 2028. Excavation of the massive underground cavern was completed on July 31, 2025.



NIKKEN SEKKEI

Fig.3
How photodetectors sense neutrinos
(A) When neutrinos entering the detector collide with the water in the tank, the charged particles that are ejected emit light (Cherenkov light), which is captured by photodetectors (B) mounted on the walls of the tank.



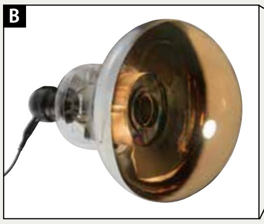


Fig.4
An inside look at the experimental apparatus
This image shows about 100 new photodetectors for Hyper-Kamiokande being installed in Super-Kamiokande (about 40 m in diameter and 40 m deep) as an advance trial. Nishimura stands at the center of the image. The yellow lights dotting the image are the photomultiplier tubes.

considered Hyper-Kamiokande as a more advanced successor to the Super-Kamiokande (Fig. 2). In discussing his expectations for Hyper-Kamiokande, Nishimura explains, “Japan is leading the way in research on neutrinos. Our detectors are especially sensitive to proton decay. We are also hoping to discover CP violations through neutrino observations.”

Proton decay is predicted by the Grand Unified Theory but has not yet been observed. If researchers are able to confirm this phenomenon, it will greatly enhance our understanding of the origin of the universe and matter. It may also provide insight into what the universe will look like after proton decay progresses. In addition, CP violations refer to the phenomenon in which a particle’s behavior changes under a combination of C transformations (charge conjugation, swapping particles with their antiparticles, such as electrons and positrons) and P transformations (parity inversion, reflecting spatial coordinates like switching left and right). While scientists have discovered such CP violations in quarks, they have yet to observe them in leptons. If researchers are able to detect them, they could determine how large the violations are. It may also provide clues as to why the antiparticles that were created alongside particles at the birth of the universe have now disappeared.

Developing the high-performance photomultiplier tubes that lie at the heart of observational experiments

Preparations are currently underway for Hyper-Kamiokande, with the facility becoming fully operational for experiments in 2028. The underground water tank will grow from Super-Kamiokande’s 50 kilotons to 260 kilotons, an 8.4-fold expansion in detection volume. Likewise, the performance of the photodetectors (photomultiplier tubes) will be doubled. Because neutrinos cannot be observed directly, photodetectors sense the Cherenkov light produced when neutrinos collide with water. The brightness and pattern of the resulting light rings allow researchers to infer the neutrinos’ energy, direction, and type (Fig. 3). In a way, the photodetectors in this machinery are the heart and soul of the entire system. Nishimura has been tasked with leading this development process since 2012.

After countless rounds of experimentation and prototyping, they have settled on a larger photodetector design that has a diameter of 50 cm. While this model quickly achieved the doubled performance that the researchers were targeting, they had difficulty ensuring that the detectors would be pressure resistant, durable, and stable. The water tanks have increased in depth from 40 m to 70 m, meaning that the photodetectors must be able to withstand much higher levels of pressure than in the past. Different shapes and protective housings were devised to withstand the new requirements. Additionally, the new system requires the installation of over 20,000 photodetectors, meaning that it will be difficult to replace them should they get damaged. Speaking on some of the time effort that has gone into this process, Nishimura explained, “It takes months just to drain the tanks. And who knows? While we’re doing that, we might miss a long-awaited supernova explosion. We had to ensure that the equipment was reliable for at least ten years so that experiments won’t be interrupted.” The researchers also ran a number of studies to figure out how to reduce noise. For instance, the team has examined the raw materials that go into glass during the manufacturing process to reduce potential impurities and improve the final product. They then conducted extensive testing to confirm the stability of the final product.

In 2018, the team was able to demonstrate proof of concept by inserting approximately 100 of these photodetectors into Super-Kamiokande for observation. However, it wasn’t until 2020 that they were able to fully meet all of the final performance parameters. Currently, 20,000 units are being manufactured and are scheduled to be installed in 2027. “Particle experiments are extremely time-consuming and expensive to set up. 2028 is going to be a major milestone once everything finally gets underway,” said Nishimura.

Over 600 researchers have been involved in the development of Hyper-Kamiokande. With so many people working together to make this project a success, good teamwork has been an essential ingredient. “The actual hands-on work is mostly handled by junior colleagues and graduate students, so they are playing very active roles in this process. This is a long-term research endeavor, so I really want to leverage the longevity of this project to help educate and train the next generation of researchers.” As a student, Dr. Kajita participated in the original development of Kamiokande. Similarly, Nishimura was involved with Super-Kamiokande early in his career. Hyper-Kamiokande is certain to draw in bright minds and continue building on this distinguished legacy.

(Interview and text writer: Yuko Hiratsuka)

Leading Major Undertakings with the Joy of Creating and an Exceptional Curiosity

As a young boy, good with his hands and quick to make things, Nishimura was fascinated by the building blocks of the very cosmos and chose to become a physicist. Looking ahead, he is eager to work with graduate students and early-career researchers on the long-term observations at Hyper-Kamiokande, gradually uncovering the secrets to the mysteries and origin of our universe.

What were things like for you as a child?

I loved making and building things from a young age. Even in kindergarten, I remember making structures out of clay and blocks. I was the curious kid who wanted to know the "why" behind everything, always asking questions.

Around third grade, I had my parents enroll me in an electronics correspondence course where I learned how to solder by watching instructional videos. I liked to look at electrical circuits and build them from scratch, so I tried my hand at various types. As time went on, I began to put different circuits together, take electronics apart and try to build my own by putting them in new casings that I had made.

In addition to my work with electronics, I also started to learn how to program. My family didn't have a gaming console back then, so instead, I used to write my own games on our computer (an NEC PC-9800 series).

Another thing I remember was my obsession watching the NHK Special, *Romantic Einstein*. When I first learned about the theory of relativity, I was astonished by the idea that if the speed of light remains constant, an object's length and the passage of time itself change as it moves. From there, my interest broadened to subatomic particles and quantum mechanics.

In fifth or sixth grade, I came across some manga called *Dr. Atom's Scientific Explorations* and *Dr. Atom's Theory of Relativity*. These volumes presented advanced physics in a way that even elementary school students could understand, and it introduced me to things like relativity calculations and molecular covalent bonds. Looking back, the things I once did for fun as a kid have, unexpectedly, have come full circle with the research I do today.

How did you begin your research on subatomic particles?

I enrolled at Kyoto University to study physics. In my undergraduate thesis research, I was first exposed to particle physics experiments involving constructing detectors and observing scattered electrons.

My fascination with muon decay experiments exploring new physical phenomena (the Mu–e gamma experiment) led me to pursue graduate studies at the University of Tokyo, where I conducted research at the Paul Scherrer Institute (PSI) in Switzerland. It was an environment where I was free to do anything, so I experimented with all sorts of ideas. In my research at the time, we observed gamma rays produced from the decay of large numbers of muons, using photomultiplier tubes that we had soldered and arranged to cover the entire detector surface, much like in Kamiokande.

After finishing my doctoral dissertation, I was supposed to become a researcher at Super-Kamiokande using neutrino beams from facilities in Tōkai, Ibaraki Prefecture. However, right before I graduated in 2011, the Great East Japan Earthquake happened, stopping the beam experiment. As soon as international flights resumed, I returned to Japan from Switzerland and began analyzing the data I had collected up to that point, aiming to publish the first results within a few months, ahead of several other experiments then underway around the world. After that, I moved to the University of Tokyo's Institute for Cosmic Ray Research in Kashiwa, Chiba Prefecture, where, in 2013, we successfully demonstrated and announced the discovery that muon neutrinos can transform into electron neutrinos.

In 2012, preliminary design research for Hyper-Kamiokande began, and I started working on improving the performance of photodetectors, leading to my current research.

After this, you started working at Keio University and continued your research on photodetectors?

That's right. I came to Keio in 2019. Even before this, I had been conducting important research on photodetectors and detection techniques together with graduate students from various universities. At Keio, I have continued this work and finally completed it. Now, the photodetectors are at the stage where we are mass-producing them. In the future, we will work on installing them and making sure that things function on site.

What are your expectations for Keio students?

At first glance, everyone is a serious student and gives off a similar impression, but on closer look they each have their own quirks and strengths.

Particle experiments require a variety of roles. Not only do you need people who can analyze data and run simulations, you need people who can write programs for the equipment and actually put together the machines. The range of work is incredibly broad, and I love how this type of research project lets each individual and interest shine.

It sounds like you focus a lot on nurturing your students as part of your teaching approach.

Most students have no idea what they are capable of. I think it's best for them to start by trying out a variety of things, build up their basic skills, and then broaden their horizons from there.

What will be the significance of Hyper-Kamiokande particle experiments?

Under our current understanding of theoretical physics, there are various models and systems that have been proposed including the Standard Model. We cannot know which theories are accurate using only mathematical computations, so we need experimental demonstrations to find out which models are correct. One such example is how we plan to use Hyper-Kamiokande to observe CP violations and proton decay.

I have heard that you also anticipate observing cosmic rays.

There were large numbers of supernova explosions in the early days of the universe, and the neutrinos from these phenomena have drifted to various places. At Super-Kamiokande, we are currently conducting research aimed at detecting ancient neutrinos drifting through the universe, while avoiding interference from neutrinos originating from the Sun and other sources.

With the Hyper-Kamiokande's vast performance improvements, we should see breakthroughs in a variety of studies in the next ten to twenty years. In other words, it's an incredibly exciting time for high school, college, and graduate students to get involved in this research.

◎ Some words from students . . . ◎

● Professor Nishimura's active role with Super-Kamiokande and Hyper-Kamiokande puts him at the cutting edge of research on subatomic particles. I'm currently involved with the photodetectors, and Professor Nishimura is great about giving me clear feedback and advice about the trajectory of my research during the daily meetings. He always takes the time to answer my questions and is very kind, which allows me to be comfortable while conducting my research (1st year master's student).

(Interview and text writer: Yuko Hiratsuka)

For the full text of this interview
https://www.st.keio.ac.jp/en/kyurizukai/

Being able to contribute through my personal expertise—that's the appeal of experimentation in particle physics

Yasuhiro Nishimura

Nishimura specializes in particle physics and cosmic-ray experiments. Originally from Fukuoka Prefecture, he earned his bachelor's degree from the Faculty of Science at Kyoto University, and then enrolled in the University of Tokyo's Graduate School of Science, where he received his Ph.D. in Science in March 2011 for his research on muon rare decay conducted at the Paul Scherrer Institute in Switzerland. In April 2011, he became a project researcher for Institute for Cosmic Ray Research, the University of Tokyo, and a year later he was appointed as an assistant professor, engaging in neutrino and nucleon decay experiments. Then, in 2019, he assumed his current position as an associate professor at Keio University's Department of Physics in the Faculty of Science and Technology.

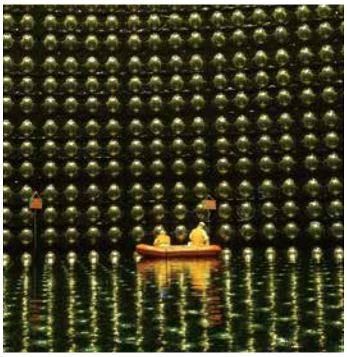
Yasuhiro Nishimura's ON and OFF

Superposition of moods when on and off the clock

"On and Off" while Underground

Improving Super-Kamiokande

This photo is taken at Super-Kamiokande beside the underground mine in the mountain of Gifu Prefecture, where the 40-meter-tall cylinder practically sparkles with golden beads as the water drains out. These beads are the photodetectors and some of them were replaced with newly developed high-performance units. Rowing a boat across the pure blue water right after the tank was drained was a deeply moving experience.



Exploring Underground Cities

As a child, Nishimura was the type to dig tunnels in every sandbox he encountered and wanted to explore any underground ruins, caves, or holes he found. He has now visited Turkey's Cappadocia, Italy's underground city in Naples and the Blue Grotto, and Japan's three great limestone caves and other caverns and underground sites. This photo was taken in the underground ruins of Cappadocia where the greatest depth is said to be 85 meters.

"On and Off" through Fitness

The Detection Surface of Hyper-Kamiokande

Preparations are underway to install approximately 20,000 photodetectors in Hyper-Kamiokande as it is under construction. Other equipment needed for this process include circuit modules that can function underwater, enough cable to circle the earth over ten times, and enough black and white sheeting that could cover the entire surface area of the Tokyo Dome and then some. Nishimura hopes to get in shape so that he can be prepared for assembling the detection surface of Hyper-Kamiokande over the next six months.

Kokura Gion Daiko

Kokura Gion Daiko is a traditional drum festival designated in Japan as a nationally important intangible folk-cultural property. Nishimura performed in it in his hometown until he enrolled at college. As the festival approached, they would have rehearsals every night, practicing the different drumming formations from both sides of the drums and practicing while walking long distances and pulling the floats. This photo was from a more recent festival, but Nishimura still remembered the playing posture and he found himself surprisingly up to the task.

"On and Off" in the Dark

Testing the Photodetectors for Hyper-Kamiokande

The researchers line up photodetectors in a dark room to conduct regular performance tests on the photodetectors during the six-year manufacturing process. Because of how sensitive this equipment is, the room is wrapped with black-out sheets to prevent any light pollution from wooden walls or windows from leaking through. The researchers have developed a system that assigns unique identifiers to each photodetector and manages their installation locations, allowing precise monitoring of each unit's characteristics and activity.

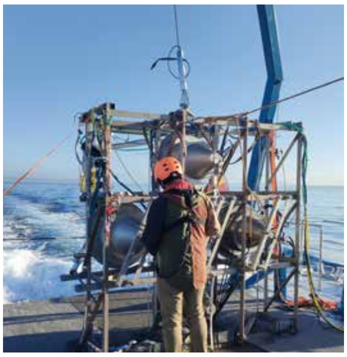
Touring Exhibitions and Art Festivals

Through university classes, Nishimura developed an appreciation for art, in addition to his interest in creating and painting. He has traveled to see national and international art and science museums abroad, as well as local art festivals throughout Japan. This photo shows *The Last Class* exhibit at the Echigo-Tsumari Art Field. It was one of Nishimura's absolute favorite pieces that he has seen on multiple occasions, the low lighting making for a relaxing environment.

"On and Off" at the Ocean

Strength-Testing the Protective Housings

In order to ensure that the photodetectors can be safely used over decades of use, the development team has spent the last ten years designing protective housings. In total, the team spent two months in Hokkaido, Japan, and the Majorca and Canary Islands in Spain, performing tests at depths of 80 meters of water. This photo was taken in the Mediterranean Sea. Thanks to Nishimura's experience with swings and trapeze growing up, he was able to brave the rough waves without getting sick.



Sea Fishing

Nishimura's hometown was close to the ocean and multiple rivers, so he would often go fishing with friends and family. He's spent time fishing, grilling, and eating his catch on deserted islands, and once collected nearly a thousand glowing firefly squid on the beaches of Toyama Prefecture. Recently, he's gone out to local spots on occasion, but admits that he's had more success at hooking the rocks on the seabed than actual fish. For his land-based activities, Nishimura is in the habit of growing fruits and vegetables, helping him hone his skills at self-sufficiency.

私の本棚 My favorite books

Sūji de Asobo [Playing with Numbers] (Murako Kinuta , Shogakukan)

This manga offers a lighthearted glimpse into life in a university science department, giving readers a feel for both the world of mathematics and the everyday experiences of college students. My alma mater is the inspiration for this story, so it's relatable and a bit nostalgic in some ways. I started reading manga when I picked up a copy of Osamu Tezuka's Black Jack at a hospital, and I read Master Keaton, which starred a part-time archaeology instructor (now that I think of it, I keep choosing things with "doctors," and "masters," so I seem to have an affinity for academia!).

Surely You're Joking, Mr. Feynman（Ⅰ Ⅱ） What Do You Care What Other People Think? (Richard Feynman, trans. Masako Onuki, Iwanami Shoten)

Richard Feynman, a Nobel Prize–winning physicist, proposed the path integral formulation, an approach that adds up all possible paths between two points, and the Feynman diagram, which provides a visual correspondence to particle interaction processes. This book is more a collection of personal anecdotes than a dive into the minutia of his theories, so it's very easy to read. As I read, I found myself relating to his free-spirited approach in pursuing his wide range of interests.

Euler no Okurimono– Jinrui no Shihō $e^{i\pi}=-1$ wo Manabu [Euler's Gift: Learning the Treasure of Humanity $e^{i\pi}=-1$)] (Takeshi Yoshida, Kaimeisha)

I was fascinated by the relationship expressed in Euler's formula, where $e^{i\pi}=-1$, so I borrowed this book from my high school library to learn more. By studying on my own, I was able to slowly get my head around why complex numbers are useful and how they were developed. You can enjoy following the equations even without much prior expertise, but this math book isn't written for a general audience. I also enjoy more general reading like detective novels and the Blue Backs series published by Kodansha.

Manga Atomu Hakase no Kagaku Tanken [Dr. Atom's Scientific Explorations] Manga Atomu Hakase no Sōtaisei Riron[Dr. Atom's Theory of Relativity] (Manga ed. Osamu Tezuka, content ed. Haruo Ōtsuka)

This was created by Osamu Tezuka and is written so that even elementary school students can intuitively grasp high school and college-level scientific concepts. I remember being floored when I learned about covalent bonds in atoms and why time and length change if the speed of light is constant. I also picked up other volumes in this series about quantum mechanics and the universe. It lets you enjoy science not just by discussing phenomena, but also helping you understand the logic behind why they occur.

Kodomo no Kagaku [Children's Science] (Seibundo Shinkosha)

A monthly science magazine for kids that's been around since before World War II, featuring everything from particle experiments to neutrino experiments (even before they started). I often referred to it when programming or working on electronics. Hoping to win the electronics gift certificates awarded to contest winners, I sent in several submissions to the magazine's invention corner and had a few of them accepted. The modern issues are very colorful and even come with posters in the appendix. I also recommend *Takusan* no *Fushigi* published by Fukuinkan Shoten, which features deep-dives into specialized topics.

The Review of Particle Physics (The Particle Data Group)

This provides a summary of particle physics, including the latest measurements of particle masses, forces, and other properties, as well as particle theory and detection methods. The printed version is a compilation of particle experiments over 1,000 pages (the digital version, which is split into two volumes, is more than double the length, and not possible to get through in its entirety). It's published on a regular basis and makes up a familiar presence on my bookshelf. There's also a condensed booklet version since the full thing is ridiculously thick. An online version (https://pdg.lbl.gov/) is also available, so please take a look and get a glimpse into the decades of research and knowledge that scientists have accumulated from around the globe.

Waste and Efficiency

Yasuhiro Nishimura

When putting together a research project, it's crucial to maximize overall efficiency, and the plan can't be carried out if it goes over budget. This is also true for my daily life. I like to save spots to my maps app to keep tabs on places I want to visit so that I can easily plan the most efficient route between them if the opportunity presents itself. However, there have also been times when I have spent too much time looking up how to reduce costs, regretting it later only to have to look up even more information, and browsing Wikipedia beyond the point where any of the time or energy is warranted.

Efficiency is all about mastering the essentials and keeping your perspectives up to date. This is especially interesting when viewed through my own path as a researcher. When I was young, I made an instrument shelter out of a milk carton for my summer homework project and started keeping a record. However, I found that it was too much effort to keep up with every single day, so instead I started saving weather summary clippings from the newspaper. Even when I recognized the importance of research continuity, I had lost sight of *sustainability*. Later, when I performed experiments on the magnetism of electromagnets using iron nails, I found that the results were not reproducible under the same conditions because the nails themselves became magnetized. I struggled with the lack of reproducibility. Reproducibility is crucial, and even now, whenever I have to double-check my results, I end up "reproducing" the frustration I felt back then.

Another lesson I learned was back in high school when we studied insectivorous plants from distant marches in my biology club. I had to pedal up mountains on my bike over and over again, so I learned how important physical fitness can be to research. In my undergraduate research in the Faculty of Science, I used a 30,000-volt power supply for the electrodes used to bend electrons, and I struggled to overcome problems with electrical discharge. Since then, I've often worked with high voltages and have come to appreciate the importance of designing systems to prevent electrical discharge.

I have also had to master essential skills outside of research. Back in 2015 when Dr. Takaaki Kajita was awarded the Nobel Prize in Physics for his discoveries related to neutrino oscillations, I had no prior notification, so I only happened to find out because I heard it from the live broadcast. Reporters quickly gathered at our research facility, and with only the two of us researchers present (the awardee was abroad) and the public relations staff, we spent the night debating how best to handle interview requests. With the institute's open house only a few weeks away, we scrambled to put together posters and brochures, somehow handling the lines and lines of visitors. As he became far too busy, we lost our chance to chat and eat lunch with the awardee. However, until the Nobel Prize Award Ceremony, we could always tell when he was coming to the lab by the long black car the university sent for him.

On the other hand, with the increase in invitations to celebrations, it also turned out to be quite an appetizing turn of events. Over time, I got quite skilled in navigating the lines of people, from securing cutlery, eating my fill before getting caught up in conversations and missing out on the good food, and snacking on dessert before it turned into a traffic jam.

However, as the point of such events is to socialize and celebrate, not eat, the "efficient" approach can also cause problems as it makes you appear egoistic and difficult to approach. If you want to improve your overall "efficiency" in life, it's better to learn to enjoy the setbacks, and find joy in the unexpected when others interfere with your carefully laid plans. In other words, I've decided that deliberately enjoying waste and interruptions is worthwhile, and efficiency doesn't always have to come first. If you have read this far and could feel time passing you by, wasted, then I have achieved my goal.

理 工 学 Information

The Creation of the Yagami Innovation Laboratory on Yagami Campus: Centering innovation, problem solving, and integrating technology into social contexts through industry-academia collaboration

In April 2025, Keio University officially opened its new hub for collaborative research at Yagami Campus, the Yagami Innovation Laboratory (YIL). YIL serves as a communal space for innovative experts from diverse backgrounds in industry, academia, and government, to come together and develop creative solutions to real-world issues. The facility is designed to promote open dialogue and adaptability where students, researchers, and industry representatives alike can be comfortable to express themselves, share ideas, and discuss ways of creating new value for society. YIL is an initiative made possible by the Japan Society for the Promotion of Science Program for Forming Japan's Peak Research Universities as well as the Ministry of Education, Culture, Sports, Science and Technology's Program for the Establishment of Facilities for Industry-Academia-Government Collaboration and Joint Research through Partnership with Research Universities with a Regional Core and Distinctive Characteristics.

For more information about YIL, please visit the website link provided below.
https://yil.st.keio.ac.jp/about/

Editor's postscript

Humankind, despite its differences, has been fascinated by outer space since time immemorial. I believe that everyone has pondered the origin of how the universe came to exist at least once in their lives. Nishimura's younger years embody the Astro Boy aesthetic, following his childhood dreams in science until they led him to become a researcher. Soaring high in the sky, Nishimura is trying to unlock the hidden messages in neutrinos, particles that are infinitesimally smaller than the atoms of his superheroes, so that he can crack the code of the universe and where it came from. This hope and wonder of this research are what dreams are made of. While Nishimura spoke with quiet reserve in our interview with him, the sheer grandeur of this subject matter and his research made it impossible not to be transfixed by his every word.

(Fuhito Sugihara)

Cover of current issue : With the high-performance photomultiplier tubes for Hyper-Kamiokande under development.

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