Nami Sakai｜Astronomy

Explores chemical processes occurring in the universe during the formation of stars and planets. Sakai discovered unexpected carbon chain molecules at the formation site of a new star, proving that there are variations in the chemical composition of the gas surrounding the new-born stars.

What fascinated you so much about the stars that you wanted to become an astronomer?

When I was a child, I was not a huge fan of the stars. I was a child who loved to play in nature. I was interested in the complexity and harmony of nature, and wanted to know why something so complex but yet has harmony was created “naturally”. I loved the Universe and stars as part of nature. However, when I was a university student, I realized that "nature" exists as a result of phenomena occurring in the Universe. So I then became fascinated with the study of star formations as the origin of “nature”.

You have been studying the newborn star system for almost 10 years. Could you please describe your current field of research in an understandable way?

To understand the chemical history, we also need to understand the formation process of stars and planets. I am therefore studying star and planet formation, which is called astrochemistry, to reveal the chemical origin of the Solar System.

What do you hope to find out?

I want to know the value (rarity or universality) of the Solar System as compared to more than a billion stars.

Do you ever have doubts about being on the right track?

I feel more like, “What is the right track?” I think nobody has the answer. I am just trying to do my best to avoid having regrets.

Did the Alma telescope provide you with important new knowledge?

Yes, and more. Without ALMA, we could not reveal distribution of various molecules around protostars located in distant places (for instance, up to 500 light years away). Revealing the distribution within the size scale of the Solar System (up to 100 au: au is the astronomical unit that corresponds to the distance between the Earth and the Sun) requires not only high-spatial resolution but also high sensitivity. Before ALMA, we could only resolve at a scale of 1,000 to 10,000 au.

Which proved more important—math or imagination?

I love imagination, but I agree with Charlie Chaplin’s words: “Imagination means nothing without doing.” Mathematics is the tool to investigate the data. So, when I notice that it is necessary, I will learn it. Understanding the fundamentals of math would be required. Pre-deep understanding helps, but I think it is not mandatory before starting investigation.

What contribution do you make to society with your research?

I think not much directly. If a goal, such as "something useful for society" is set from the beginning, development will only occur within the scope of that goal. Purpose-driven research would only produce discoveries that are within expectations. A discovery coming without a goal sometimes encounters with other ideas/findings, which may give us completely unimaginable results. That happened in astronomy in the past, since the Universe is a kind of laboratory to understand phenomena under extreme physical conditions, and special techniques are required to observe such phenomena. For example, the discovery of MRI—magnetic resonance imaging used in medical diagnostics—and fullerene lead us to nano-technology.

Apart from direct contribution, my research will lead us to understand how miraculous life is in the universe; in other words, how vulnerable it is. It gives us a chance to change our

view of life on Earth, as well as to realize the importance of peace on Earth and a sustainable society. In addition, as mentioned above, astrochemistry may become the basis for science and technology for hundreds or even thousands of years into the future. When I give a public lecture, always I hope that the audience will be inspired to take such a very long-term perspective.

The astrophysicist Avi Loeb thinks we are not alone in the universe. What is your opinion?

I am a bit pessimistic. It's not so easy to have life on a planet, I think, from the chemical point of view or in terms of crossing time.

i) In this Universe, all the materials are formed from same list of atoms. Atoms follow universal physical rules. To have a variety of molecules and eventually life, for instance, carbon atoms play an important role. It can form variety of (covalent) bonds single, double, and triple with its "4 arms". Silicon can also form them, however, with much smaller abundance in the Universe. So, all the complex matter (life) naturally formed in the Universe must originate from organic chemistry.

ii) Life on Earth uses radiation energy from the sun to convert to chemical energy, like photosynthesis by plants. It has 2.5 eV in energy, which just corresponds to the energy to excite valence electrons in molecules. That means the visible light can be used for chemical reactions. But if the radiation energy is slightly higher than that, like 4-5 eV, it destroys molecular bonds. This corresponds to UV radiation, and so, you can easily imagine the destruction of molecules by skin damage from UV radiation. On the other hand, if it is slightly lower (infrared light), the energy is too low to stimulate chemical reactions. The molecular property does not change anywhere in the whole Universe. So visible light is necessary when we think about chemical evolution by using energy from the Sun. The Sun is the largest energy source in the Solar System, and so, efficient use of its energy is a natural and necessary consequence. The energy of the radiation is mostly determined by its mass. So massive star systems or lower mass star systems are not appropriate to evolve molecules.

iii) Too many hurdles exist to keep nature stable, which eventually lead to life on Earth. These hurdles were rarely considered in the past. I believe astrochemistry will reveal all such hurdles someday in the future.

Stephen Hawking said there is no possibility of God in the universe. Do you feel God's presence, maybe in nature?

As a scientist, I would say no. But we exist through the accumulation of so many miracles. When I think about that fact, it makes me want to believe in God's existence.

As a young assistant professor in 2012 you decided to have a child and then a second in 2015. Were you worried whether your career would suffer as a result? How long did you take a break? And was it difficult to reconnect to top research? Your husband is also an astronomer, is this helpful? How do you manage to juggle your work, lab, marriage, and children?

Yes, my husband is also an astronomer, so I am lucky in that sense. He also knows what to prioritize when we are busy. And of course, we respect each other's research. However, I still had concerns before having our child that the quality of my research would fall temporarily. Prof. Satoshi Yamamoto, my boss at that time, gave his full support, saying, "I will take over all the miscellaneous tasks I can, so you focus on the science that only you can do." I was truly moved by this comment and gave birth to my first boy. I returned to work after a maternity leave of six weeks before and eight weeks after childbirth. At first, my work efficiency went down significantly. I think it took about a year to return to normal. My life shifted from that of a night worker to that of an early bird, and I usually do not work overtime. Upon returning home, my mind is completely switched over. Even if I want to return to work after the kids are asleep, it is sometimes difficult to turn it around.

Did you set up new priorities in your work after your return?

Yes. I used to give my all to everything. Now, however, I have to prioritize my work because time is limited. Work that can only be done by me should be prioritized of course. Or in committee work for instance, I only do my best when I can contribute more than anyone else, and I dare to relax when the work can be done by others.

How can older colleagues support younger scientists?

Research: I try to show interest in their own discoveries, even if they are trivial. If it is an interesting discovery, I show my strongest interest in front of them. This, I think, often motivates them to further studies.

The scope of what a young researcher sees is different from what a senior researcher can see. I think it is very important to convey this difference in concrete terms to young researchers, as it will give them a chance to broaden their perspectives. I try to give them suggestions on how senior researchers see their studies and behaviors, and what they should think about looking to the future at various times, such as when giving them suggestions during job interview preparations or the process of obtaining grants.

Career: When they face life events, I want to be able to do for them what my supervisor did for me: “I will take over all the miscellaneous tasks I can, so you can focus on the science that only you can do.” Although that’s not easy at this point.

During my pregnancy, I was fortunate enough to be in good health to be able to travel and present my results at conferences if I had a relaxed itinerary or flew premium-economy/business class. But such an itinerary was not approved even if I have and want to use my own research grant for travel and I had to pay for it out of my own pocket. At some institutes, like the University of Tokyo, they allow such relaxed itinerary by saying that a pregnancy the equivalent of a health problem. But this is not the case at RIKEN. I asked the reason why to an executive at the time. He said that a pregnancy is not a disease, which means it’s not a “health problem.” Keeping a researcher visible in a research field is very important. Presentations at international conferences, if she succeeds in being invited, or direct discussions with collaborators are what keeps the researcher visible. So such support systems or work environment should be prepared.

What distinguishes your thinking from that of older scientists?

It’s not that much different, I think, except for my thoughts on researchers who are facing or have experienced life events, which restrict/reduce time for research. For instance, a researcher who has kids should be evaluated by considering the period when she/he mostly used her/his time for childcare rather than research. One child may correspond to up to 2

years of absence. Especially on selections for research positions, we have to compare their research activities with others by considering such periods. For example, two years after gaining a PhD with one child compared to one year just after getting a PhD.

Work styles have changed recently. Many Japanese people still think that night time, weekend, or holidays can be used for research or work. Such “tradition” should be through away. And everyone should consider that even male researchers are taking care of his child.

Women scientists have told me that men often doubt the quality of their work. Have you also had such experiences?

Not so much actually. But to prevent other researchers from questioning the quality of my work, I did not apply for women-only positions or awards. Records of good papers prove the quality.

What about bias against a woman in your field?

It has recently relaxed a lot, but many difficulties still exist.

When I was an undergraduate student, there was still overt gender discrimination, and when I went to ask a question about a class, I was sometimes told by the male professors, "I don't want to join a girl's chat," and my question was never answered. Although overt discrimination has decreased in recent years, there are still some researchers with deep-rooted discrimination, and some are difficult to collaborate with or to have conversations with; they just ignore my comments at a committee meeting for instance.

Although it is unavoidable in some respects, because there are so few women in the company, committee work is overwhelmingly more common for women than for men of the same age, and it is often difficult to find the time to spend on research, which is the most important part of my job. That, in general I think, makes the quality of research lower indirectly. If the quality of research by a female researcher becomes lower after she got a higher-level position, I suspect that this is usually caused by this problem.

What advice would you give someone considering becoming a scientist?

It is important to continuously pursue something that fascinates you, I think. Interest means nothing without doing. There is no need to settle on a single area of research for life: it is all right to move to another whenever you find something that captures your heart. Oddly enough, nature has many things to tell you when you take keen interest in something. I would like people who aspire to become researchers to follow their passion. It is only natural for research not to go as you expect. Your expectations may be betrayed time and time again, but enjoy the unexpected facts and hardships you encounter, and they will lead you to your next challenge. I have high hopes for the future of those who have such a positive mentality.

My favorite phrase was first said by Dr. Grote Reber, an American pioneer of radio astronomy:

"If at first you don't succeed, try, try, again. Don't accept current theories as absolute fact. If everyone else is looking down, look up or in a different direction. You may be surprised at what you will find."

I guess you always had a curious mind. What else were you like as a kid?

On the day of my elementary school entrance ceremony, I pointed to a tree in the schoolyard and asked my homeroom teacher, whom I had never met before, if I could climb that tree. I was a child who loved to climb trees and play in nature. During a science class in which we were conducting a plastic bottle rocket experiment, I once climbed a high iron bar thinking I was going to "launch" myself. I jumped down from the bar, and fell, breaking my arm in the process. I once played a prank where I put a metal paper clip into a wall socket, and my father got very angry with me. He later showed me how inserting a clip in two places would cause a spark and short circuit, and explained to me why it is so dangerous. I am sure that I was like Curious George.

Recently I noticed that my favorite *anime* program, broadcast in Japan when I was a child, originated from Germany. Its original German title is, "Die Abenteuer der Honigbiene Maja" ("The Adventures of Maya the Bee" in English and *Mitsubachi Maya no Boken* in Japanese). Maybe I liked it because I felt a kinship with Maya the honeybee, a curious girl.

What are your personal ambitions for the next five to ten years?

Finding hints to connect the chemical environment of the Solar System and that around protostars.

What principles did your parents pass onto you?

Often my mom said, “I can give you advice, but you decide what to do. And, be responsible for what you decide.” My father had various interests and shared them with me. He is an engineer that develops audio systems, and loved astronomy as well. That might have influenced my chosen career.

Can you describe your personality in five words?

Curious, Passionate, Active, Talkative, Careless.

What’s been the most important factor in your life that got you this far?

Luck.

The great supervisor, the great data, the call for application for the permanent position in a perfectly matching job description at a great time, the great timing with which I got into radio astronomy, my last name has the same pronunciation/spelling as that of my husband’s even though the Chinese characters are different (Sakai 坂井-Sakai 酒井), which is important as a researcher as I didn’t need to change my name or least how it is pronounced, my great parents, and the list goes on.

What is your message to the world?

We know almost nothing about nature. Considering that solutions often come from unexpected directions, having a diversity of approaches is really important. Diverse ways of thinking comes from having diversity in the community. I also keep telling myself, “Be tolerant of other people’s opinions.”