Observing Space Sharply through the Atmosphere

Shun Yoneda

Have you ever looked at the stars on a clear night? In Japan, especially in winter, stars twinkle. But why do stars twinkle? The reason is that the light from the stars is disturbed by the Earth's atmosphere, as if through a heat haze. If we could see the stars from space, the light would not pass through Earth’s air, so the stars would not twinkle. But on the ground, it is different. If we want to observe the sky with a large ground telescope, we need to fix the disturbed light. After we correct the light, stars look sharp, and the telescope can work near at its best. Then we can observe the center of our own galaxy to confirm the existence of a black hole, and distant, faint, dark galaxies to investigate the beginning of the universe.

I am now researching technology that corrects the light from stars disturbed by the air. The technology is called adaptive optics. To correct the disturbed light, we first measure the distorted light with a high-speed camera. Then, a computer calculates how much light has been distorted. Finally, a mirror called a deformable mirror changes its shape a little to correct the light following the calculation of the computer. This process

happens very fast—hundreds or even thousands of times a second, faster than the changing of the atmosphere—so that the telescope can see a sharp image.

The problem is that we do not always have a bright nearby star to quickly measure how light is disturbed. That is why we send a laser into the sky to create an artificial star called a laser guide star. I work on this laser guide star section while also studying the adaptive optics system as a whole.

Astronomy has developed by observing stars, galaxies, and many other celestial objects, and making discoveries step by step. If we want to observe new objects, we need new instruments. Working on building observation instruments gives me a strong feeling that I am directly contributing to the progress of astronomy. I am involved in research on adaptive optics, one of these important instruments.

As I mentioned in the previous paragraph, adaptive optics makes use of many different technologies, such as a highly sensitive camera, a mirror that can change its shape with electricity, and a high-speed computer to control the whole system. I find it very interesting that these different technologies work together toward one goal, each supporting the others to make the system function properly.

Another interesting thing is working together with many people as a team to build the instruments. Behind the beautiful images of space released by research centers such as NASA, there are many efforts by people like us who work on these instruments. It is never easy; we have to try many times and fix problems along the way. But little by little, the device improves, and when we finally get a clear image, the sense of achievement is wonderful.

Also, adaptive optics is not only used in astronomy. It is applied in fields like satellite communication as well. Thinking that my research might help not only science but also

society makes me very excited. Through my research in adaptive optics, which connects different technologies and leads us into the future, I feel both the fun of science and the joy of contributing to the world.

To help you on your journey, I have three pieces of advice.

First, be curious and try to learn many different things. Astronomy is made up of many parts of science, like physics and engineering. Therefore, it is important to acquire many tools and skills. Learning widely will help you in the future. Even if some subjects seem unrelated at first, do not give up. Every bit of knowledge connects later, like pieces of a puzzle. For example, math helps you understand how light moves, and physics helps explain how telescopes work.

Second, try using your hands and brain to make things. When you build something, think about how it works and try again if something does not go well. You will learn how to improve it step by step. This kind of skill is useful not only for research but also in your daily life. You can start with simple projects, like building a model or doing small experiments at home. These experiences teach you how to solve problems and think creatively.

Lastly, do not be afraid to ask adults for help. There are many challenging things for a junior high school student to do alone. When you cannot cope with problems alone, it is no problem to ask teachers or adults around you. Asking for advice or help is not a weakness, it is a smart way to learn faster. Many adults are happy to support young people who are curious and motivated. When passionate young people work with others, they can do amazing things. Together, you can achieve things you never thought possible.

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