Chasing the "Shine": Finding Optimization in a Chaotic World

(photo AC, kussi)

Have you ever faced a problem that seemed completely impossible to solve? Whenever I look at a picture of a calm, beautiful coast, I am reminded of a story that gave me the courage to tackle impossible problems. Today, I am a physics researcher at the University of Tokyo. My journey here was built on two major sparks: an intellectual discovery in a university classroom, and an emotional push from a story about a group of ordinary high school girls that taught me what it means to truly "shine."

I first fell in love with physics during a thermodynamics class in my first year of university. This was the moment I was introduced to the beauty of "many-body systems"—systems where countless elements interact with each other in complex ways. Imagine a single glass of water. Inside, there is an astronomical number of water molecules moving around in chaos. Tracking every single one of them is impossible. However, I learned that by using physics, we can describe the state of that entire chaotic system using just a few simple numbers, like "temperature" or "pressure." The idea that we can capture a messy world from a macroscopic perspective and describe it with just a few degrees of freedom was breathtakingly elegant.

However, I also learned that physics is not always so tidy. When the countless interacting parts in a many-body system conflict with each other, finding a stable state becomes an incredibly difficult, unsolved puzzle. As I approached the end of my undergraduate years, I faced a difficult crossroad. Should I enroll in graduate school and choose the challenging path of a researcher, chasing these impossibly complex questions that might not even have answers? Or should I take a stable job? The world of research is harsh; hard work does not always guarantee a successful result. I was afraid of failure and almost stood still.

What saved me was a story about a group of high school girls living near a beautiful coast. They had a huge, daunting dream: to save their beloved school from closing. They poured their hearts and souls into creating dazzling stage performances from zero. Yet, in the end, they could not save their school. Normally, people would sink into despair after such a failure. But these girls were different. They vowed to preserve the

name of their school by leaving their mark on the world, and they achieved that through their final performance.

One of their songs became the guiding light for my life. The lyrics say, "Not giving up is the clue to finding your dream." I wondered how they could remain so positive even after their biggest dream had failed. I realized it was because they had the strength to validate their entire journey. Failure did not mean their efforts were meaningless; they found an irreplaceable "shine" simply by never stopping as they ran toward their true selves. Watching them, I had a realization. Just as their effort had value regardless of the outcome, a failed hypothesis in research is not meaningless—it is a necessary step toward understanding the truth. For me, "shining" meant diving deep into the mysteries of physics, regardless of the fear of failure.

With that courage, I made the final decision to become a scientist. Today, I study "Statistical Mechanics," which applies the same concepts of "many-body systems" I learned in thermodynamics to even more complex problems. Specifically, I research a puzzle called the "Spin Glass model." Imagine a seating chart for your classroom. Student A and Student B want to sit together, but B and C want to be apart. What if A and C are also friends? You cannot satisfy everyone’s wishes perfectly. In physics, we call this dilemma "frustration."

I use powerful computers to study how these systems, full of many interacting and conflicting elements, eventually find a "stable compromise"—an optimal solution. My ultimate goal is to uncover the fundamental limits of algorithms—why certain optimization problems suddenly become desperately difficult to solve. This research is

not just theoretical; understanding these limits is the foundation for finding the "best answers" in our modern world, such as calculating the most efficient routes for thousands of delivery trucks or training artificial intelligence more effectively.

My days as a researcher are still full of challenges. There are nights when my code won't work and I want to give up. In those moments, I remember the girls in the story and the beautiful coastal scenery where they ran. They sang, "If you aren't moving, you can't find a chance. Don't stop, even if you take a rest." To keep running in search of the best answer, understanding that every failure brings us closer to the truth—that journey itself is my "shine." If you ever feel lost, I hope you can find what makes your own heart shine and have the courage to start running toward it.

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