What Truly Excites You?

My Road to the Pursuit of Fundamental Principles

Mutsumi Shimomura

When we look around us, nature appears to be governed by rules from which nothing can escape. A thrown ball follows a trajectory we can predict with reasonable accuracy: the sun rises and sets at almost the same time each day: and the seasons follow a 365-day cycle. The aim of science is to discover these rules, including more complex and unexpected ones—the laws of nature.

The language of these laws is mathematics. It is astonishing that mathematics—an internally consistent logical structure originally developed with no necessary connection to the real world—should prove so extraordinarily effective at describing it.

Once we discover a natural law, we can apply it to improve our lives. The electronic devices that surround us exist because humans have combined those laws with their own creativity. Beyond such practical benefits, the very fact that coherent rules exist in nature is notable, which has fascinated me since childhood. Observation of nature reveals countless laws, yet they cannot contradict one another. This naturally suggests the following idea: there should exist some deeper, more fundamental principles underlying the seemingly independent rules and the latter are merely specific applications of the former. Among all the natural sciences, physics is, in my view, the discipline most committed to searching for—and believing in—those fundamental principles.

The turning point came when physics classes began in high school. There I learned about the equations of motion—rules that tell us how things move. Until then I had thought, “Nature is chaotic, and diverse phenomena caused by that chaos are just the interesting point of nature”. I was profoundly shocked when I saw those equations explains so many different phenomena precisely. I have been captivated by physics ever since, and that experience set me on the path I follow today.

Even after deciding on physics, I still had to choose a specialty. Universal laws reveal themselves only through concrete examples. Within the broad landscape of physics, the hunt for such unifying principles is especially active in the study of open systems**,** which interact with their surroundings. The real world is full of open systems, and even the act of measuring them counts as an interaction. It is easy to see why understanding their behavior has intrinsic value. By contrast, isolated systems**,** whose components interact only with one another, evolve in relatively simple ways and have unified descriptions. Drawn by the richer phenomena that arise from the more complicated dynamics of open systems—and by the challenge of building an overarching framework that captures them—I have chosen to focus my research on open-system physics.

Let me be a bit more concrete. One of the most central ideas in physics is symmetry**.** Rotate a square by 90 degrees and it looks the same; rotate a circle by any angle and its appearance never changes. In general, we say a system is symmetric when some transformation leaves its appearance unchanged. Though the concept of symmetry is simple, it carries a wealth of information about a physical system. For example, it reveals which quantities stay constant in time. Therefore, symmetry has played an essential role to build unified descriptions of isolated systems and some of open

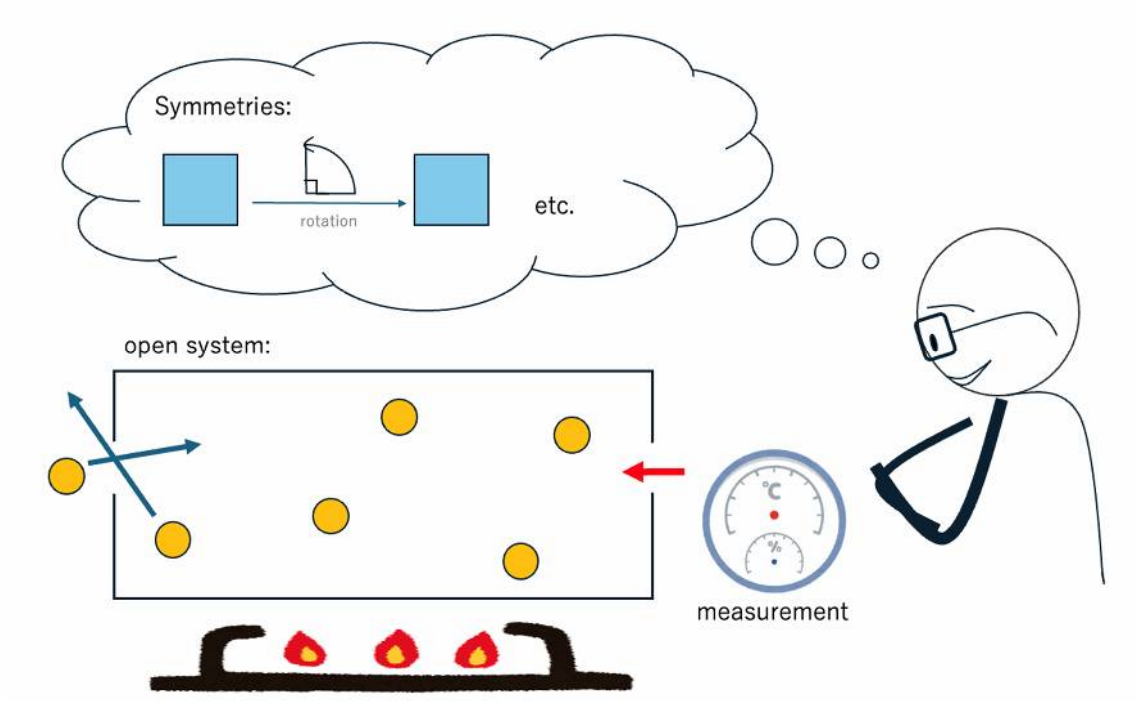
systems. Armed with this powerful tool, I explore the rich landscape of open-system physics.

Up to this point, my story may sound like a straightforward path toward physics—but the reality involved a detour. While the study of physics has always fascinated me, I have also wrestled with a question: what kind of life do I really want to lead? After my third year of university, I paused my studies for twelve months, traveling the world to test possibilities beyond the laboratory. I felt I could not commit my life to physics without first exploring the freedom I had only just discovered.

That year on the road was exhilarating. I met people whose lives followed paths I had never imagined and tried pursuits far removed from science. Two conclusions emerged. First, our choices are far more open than they appear; we can, quite literally, design our own lives. Second, nothing I encountered thrilled me the way study of physics does. The contrast clarified everything: I returned to university resolved to pursue physics not because it was simply the sensible option, but because it was the one that filled me with genuine excitement.

Before closing, let me speak to students who are still in junior high school. School is a relatively closed world where you have little room for freedom. Yet even there you can cultivate the habit that matters most: listening to your own feelings. Pay attention to the activities and moments that exhilarate you and let them guide you as you sketch the first roadmap of your life. The earlier you acquire the compass conforming to who you are, the more confidently you will navigate the choices ahead of you.

Turning back to my journey, I sometimes wonder whether my journey might have been smoother if I had reached that insight sooner. A career chosen only because it seems reasonable can be fragile; a path chosen because it sparks real delight is resilient. Guided by that conviction, I now move toward graduate study ready to tackle fresh problems, confident that the curiosity driving me today will sustain me for the challenges ahead.



The author sincerely thanks Prof. Mark Vagins and Mr. Shungo Aoyagi for their helpful feedback on this essay. Chat GPT was used to sophisticate this essay. Some images were taken from “いらすとや”.