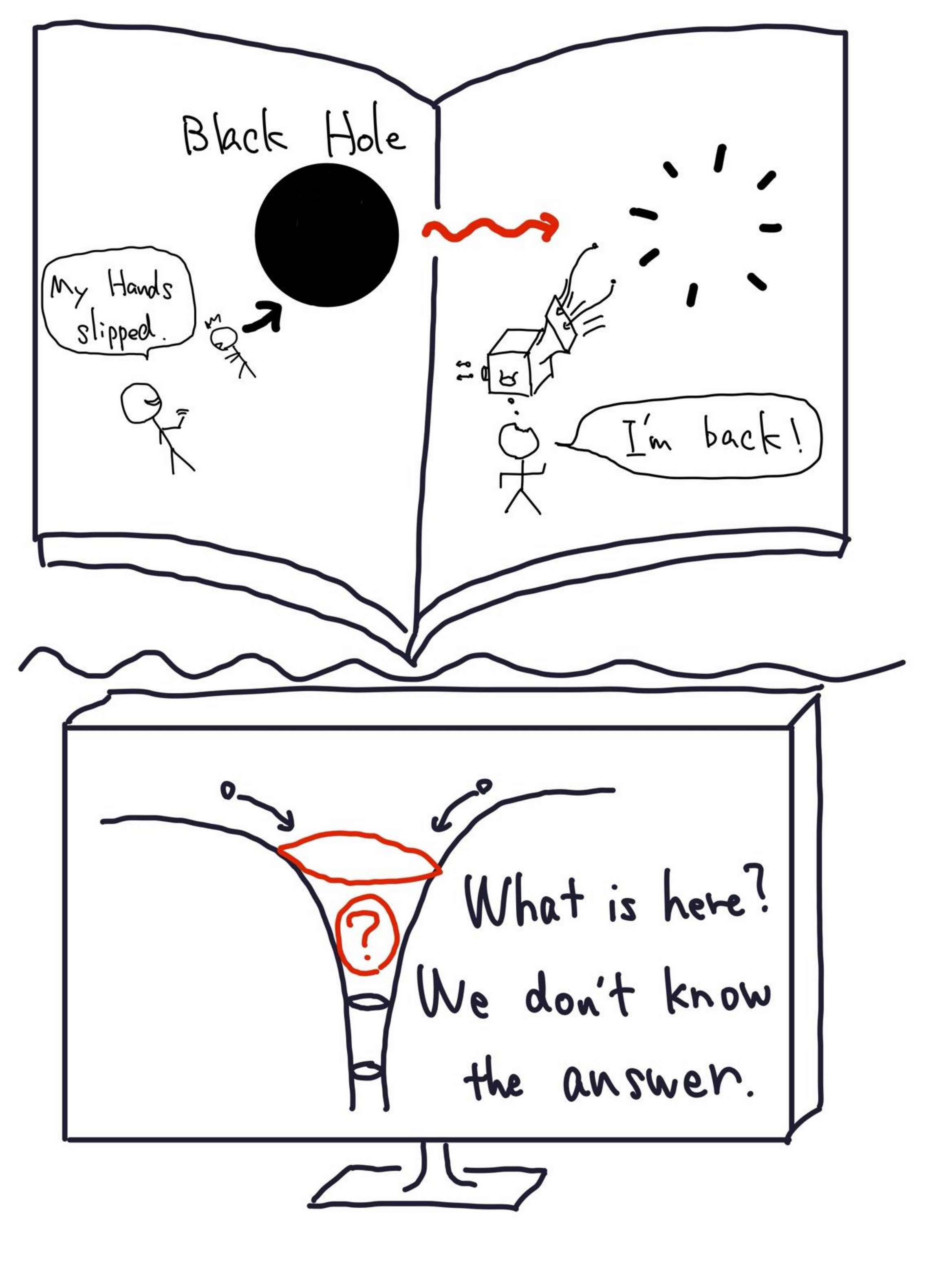

How a Book and a TV Show Led Me to Black Holes

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When I was a child, I didn't like books. Often, I could not imagine the scenes the books described and felt frustrated. My parents wanted me to read some books and recommended a variety of books to me. I tried to read them, but I didn't think they were interesting.

One day, my parents gave me *George's Secret Key to the Universe* by Lucy and Stephen Hawking. I became completely absorbed in the book. Instead of imagining scenes in the book, I imagined the various celestial bodies. I felt more excitement than frustration. I was very surprised to learn that there are many kinds of celestial bodies with completely different characteristics. Among them, black holes fascinated me the most. They attract objects around them very strongly, and even light cannot escape from the black hole. They are named "black holes" because they don't seem to emit light. The book told me that, however, black holes can emit particles. In addition, if we can collect everything emitted from a black hole, we may be able to learn what falls into a black hole and reconstruct it! I was so astonished by the existence of such mysterious objects in the real world. After I finished the book, I found that it was the first book of a series. I immediately read the next volume, and I became more interested in the universe.

While reading Hawking's books, I vaguely thought that it would be nice if I could study astronomy. However, now I'm studying something that looks completely different: "pure three-dimensional quantum gravity." For now, all you need to know is that there are no stars in this theory! Why did I end up here? In fact, Hawking's books still shape my research interests. But there is more to the story.

A few years later, I still generally preferred visual media to books. I spent much of my free time watching TV shows. I loved beautiful scenery, elaborate artwork, and anime on TV. I could see colors, shapes and movement of many things, which I could not easily get from written texts. For this reason, I usually watched TV shows with my father on holidays. My father was interested in science, so he often watched science documentaries.

One day, when I was a junior high school student, I watched a science documentary called *The God Equation* with my father. It was about the quest for an equation that explains all phenomena in our world. The idea of a theory of everything captured me. In principle, if I understood that theory, I could understand all the questions I had. Why does water freeze? What are we made of? What exists outside the solar system?

Especially, I was fascinated by two of the questions *The God Equation* focused on: “How did the universe start?” and “What is there inside the black hole?” The TV show told me the following things: Our world is made up of elementary particles such as electrons and photons, which constitute matter and light respectively. These particles are very small, so they must be described by quantum theory, a framework describing phenomena on a very tiny scale. All the phenomena that humanity has observed are explained by four fundamental forces between elementary particles. Humanity has succeeded in developing the quantum theory describing three of them. This theory is called the Standard Model. The remaining one is gravity. It is very difficult to combine gravity with the Standard Model. Especially, formulating the quantum theory of gravity is the most difficult part. Because it is known that gravity has a dominant effect on the formation of the universe and black holes, we cannot understand the beginning of the universe nor many properties of black holes. After I watched this TV show, I strongly wanted to know the theory of “everything.”

This desire eventually led me to my current research topic. To understand the theory of everything, I must study quantum gravity. However, it is known that formulating quantum gravity of our universe is very difficult. One reason is that our universe has four dimensions: three of space and one of time. In contrast, three-dimensional quantum gravity is much easier and has many properties in common with the four-dimensional theory. In addition, theories tend to become more tractable if they contain fewer kinds of particles. As I mentioned earlier, I’m studying pure three-dimensional quantum gravity. The word “pure” means that it contains no matter, so this is one of the simplest theories. In short, I’m studying the most difficult and interesting part of the theory of everything in a very simple model.

If a consistent theory of pure three-dimensional quantum gravity can be formulated, it is one important step toward combining gravity and the Standard Model. Because there are few quantum gravity theories, it may provide a very important example of quantum gravity. In addition, it is known that three-dimensional gravity has black holes similar to the four-dimensional ones. Surprisingly, they can exist even if there are no stars! Therefore, we may learn some properties of black holes from this theory. Especially, we may be able to learn whether we can reconstruct things that fall into black holes: the very question that fascinated me when I read Hawking’s book! In the end, both Hawking’s book and the TV show I watched in junior high school led me to my current research topic.

I used ChatGPT to check spellings, correct grammatical errors, and refine some expressions.