Title: Studying Cutting-Edge Physics Helps Improving Our Lives

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Imagine a very thin wooden plate standing on a desk. What happens if you put a ball on the edge of the plate? It is very likely that the ball falls into either side of the plate. Now scale them down by 1/1000. Now they have sizes of micrometers, but the experiment would result in the same: the ball will go either left or right. What if nanometers? Picometers? In fact, if they are really really small, far smaller than we can imagine, then something different will happen: they may go both ways simultaneously! Unintuitive enough, but this is the world of quantum physics.

Quantum physics is a subject that handles the dynamics of tiny particles. At first glance, it looks unrelated to our everyday lives. But in fact, it is predicted that one can build a very powerful computer by exploiting the mysterious laws; this is called a quantum computer. Current technology has not been developed enough to build something useful, but quantum computers can offer a wide range of applications, from artificial intelligence to secure communication. I am studying quantum mechanics to realize quantum computing in optical systems.

One of the most important open questions in our field is: how to implement 0 and 1. What does it mean? Ordinary computers use a bunch of components connected by wires, and basically every wire is either in “ON” or “OFF” state, representing a binary value. These two states are distinguished by simply having or not having electrical flow in wires. While this sounds fairly simple, it is problematic when it comes to quantum. As mentioned above, the advantage of quantum computers is harnessed by the “going both ways” property - in other words, the state of “wires” in quantum computers must be something between 0 and 1. Handling such vague objects is rather a difficult task, and our cutting-edge science still does not allow us to manipulate them precisely enough. That is why we need more effort on the research in the field, which I am engaging in.

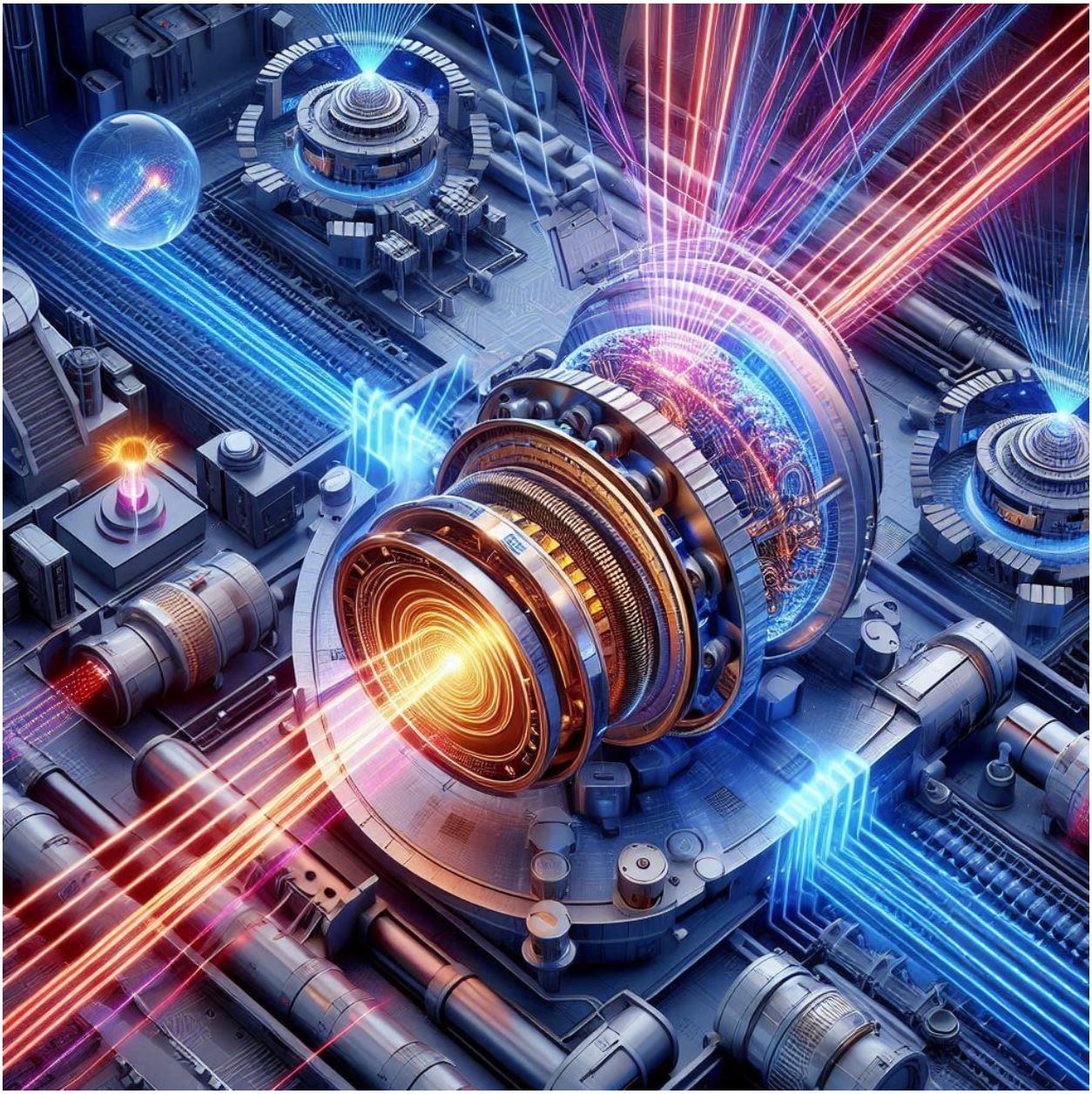
I was interested in this subject because I was attracted by how it can impact our daily lives. As a child, I loved playing with mathematics. At first I only enjoyed reading books in my home, but soon I started to go to a city library, seeking a more advanced topic. One of the books had a

CD-ROM attached to it. It was a software that visualized mathematical equations and simulations. Not only did it deepen my interest in mathematics, but it also helped me try computer programming by myself. I started to build my own software, and I soon realized: how slow computers operate! Yes, the speed of arithmetic operations computers can do has developed incredibly even during the last decade, but you often wait for seconds or even minutes to wait for an electronic device to finish its task. As a programmer I became aware of the upper limit that the current computers have reached.

One day I read a book about a brand-new type of computer. It claims that it can finish a computational task in a few seconds, meanwhile the task cannot be completed by a conventional computer even in millions of years. That novel computer is, it says, built on an advanced physics called quantum physics, and there are no physical principles discovered so far that deny its realization. Those words intrigued me so much that I decided to learn and do research on physics in a university, and become a scientist pioneering the development of quantum computing.

But after all, is implementing quantum computers really meaningful? Some of you may think it is only scientists that benefit from them, maybe a hundred years later. But no. Quantum computers are actually almost there, and the development would affect everyone's life. One of the good examples is artificial intelligence. Nowadays, we can chat with a language model, or an AI, which was not possible only a couple of years ago. The breakthrough is largely, if not entirely, attributed to using a huge amount of computational resources. The power of individual processors has not really been enhanced; we are just collectively running many of them. But still, performing a bunch of calculations has been proven to be very useful. What if the processors themselves are thousands of times faster than now? They would push the applications of computers onto an even higher stage. Maybe ten years later, quantum computers might become practical enough that we could talk with an AI with instant response and higher precision. Our daily lives would improve a lot, and that possibility is directly led by studying science.

I became a scientist because improving humankind's availability is such an attractive theme that I want to devote my entire life to. There are many other fields in science that would lead to improvement of our lives, and I recommend the readers to try to engage in science too.



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