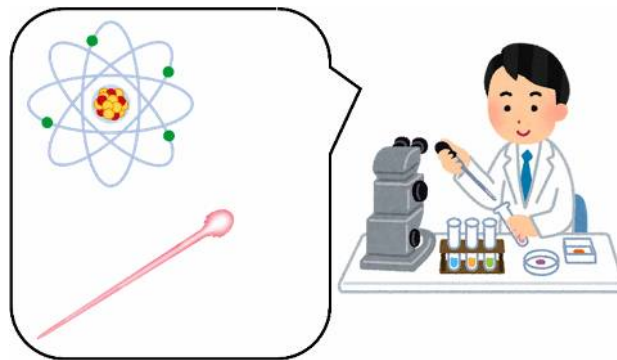


Controlling quantum particles with my own hands

Shintaro Ooka



I am a graduate student at the University of Tokyo, and I am studying something called "quantum computers." Every day, I work hard to get my Ph.D degree and become a real scientist.

When I was 12 years old like you, I never thought I would be a researcher. So, how did I come to this path? And what exactly is a quantum computer? Let me tell you my story!

Many people and events helped me along the way, but the person who influenced me the most is my professor, Dr. Shuntaro Takeda. He is an Associate Professor who researches quantum computers that use light.

Dr. Takeda is young, super smart, and famous all over the world for his work. He is amazing at making things happen and is opening new doors for the future of technology. Because he is so brilliant, he received the Young Scientists' Award from Japan's Minister of Education, and MIT even chose him as one of the "Innovators Under 35 Japan."

Dr. Takeda is not just a great scientist; he is also a wonderful teacher. His classes are very easy to understand and helpful. For his lab team, he makes lots of videos explaining how to do experiments and how to guide our research. Plus, he is always ready to listen to us. Even though I am still learning and making mistakes, he talks to me like an equal and gives great advice. I respect him so much, both as a scientist and as a person.

The reason I joined Dr. Takeda's lab is because of something he said to me: "Controlling quantum particles with your own hands is so much fun!" To understand why these words touched my heart, I first need to tell you what "quantum" means.

Simply put, a quantum is an incredibly tiny particle. For example, atoms (which make up everything around us) and photons (the tiniest bits of light) are types of quantum particles.

These tiny particles do some very strange things that do not make sense in our everyday world. One of these weird behaviors is called "superposition".

For example, think about an electron, which is a tiny particle of electricity inside an atom. Its exact location isn't fixed. It could be at the top of the atom, or it could be at the bottom. In the quantum world, it is actually in both places at the exact same time! We say these two possibilities are in "superposition." Even weirder, the moment we look closer to check where it is, it suddenly chooses one spot and acts like it was always there!

Does that sound confusing? To be honest, it confuses me too! But when we do experiments, that is exactly what happens, and our math equations prove it. When I first learned about this in a college class, I was amazed. It is so different from what we normally expect. Even after understanding its theory, I couldn't believe that it's real.

That is why Dr. Takeda's words hit me so hard. I thought, "I want to not only know about quantum, but also feel them! Touching and controlling quantum particles must be so fun!" That was the moment I decided to research quantum computers with him.

Now I actually control quantum particles with my own hands in the everyday experiments. While there are several types of quantum particles, we control photons generated from lasers. By using mirrors, lenses, and crystals, we can execute operations on photons and measure the quantum features. During my work, I feel so happy that I can feel their incredible features just in front of me. I am so grateful to Dr. Takeda for guiding me down this exciting path.

So, what are we trying to do by controlling photons? By using their strange powers, we are trying to build the most amazing computer ever. That is a "quantum computer".

When I say "amazing," I mean super-fast. The computers we use every day have gotten much better over the years, and they are fast enough for our daily lives. But there are still some problems that are too hard for them.

For example, think about making new medicines. To create a good medicine, scientists have to figure out how to connect different tiny building blocks called molecules. There are countless ways to mix them. To test every single option and find the best one, even today's biggest supercomputers would take hundreds of years! But a quantum computer could find the answer almost instantly. That is why quantum computers are a technology that can change the world.

Every day, I continue my research to help make these world-changing computers a reality. These days, I am working on solving a simple machine learning task by quantum computers. Machine learning and AI technology are now growing, and they will become more and more important in the future society. The recent quantum computers are still small and simple, but they will become larger and must play important roles after several decades.

Research into quantum computers is very exciting, and we are waiting for you to join us. Let's feel the incredible quantum world and change the world with new technologies!

Acknowledgement: I thank M. Vagins and J. Kochiya for helpful advice for my essay.

Tools used for this essay: Generative AI (Gemini) was used to translate and edit the text to improve the language and grammar of this essay. The illustrations from Irasutoya (<https://www.irasutoya.com/>) were used in the figure.