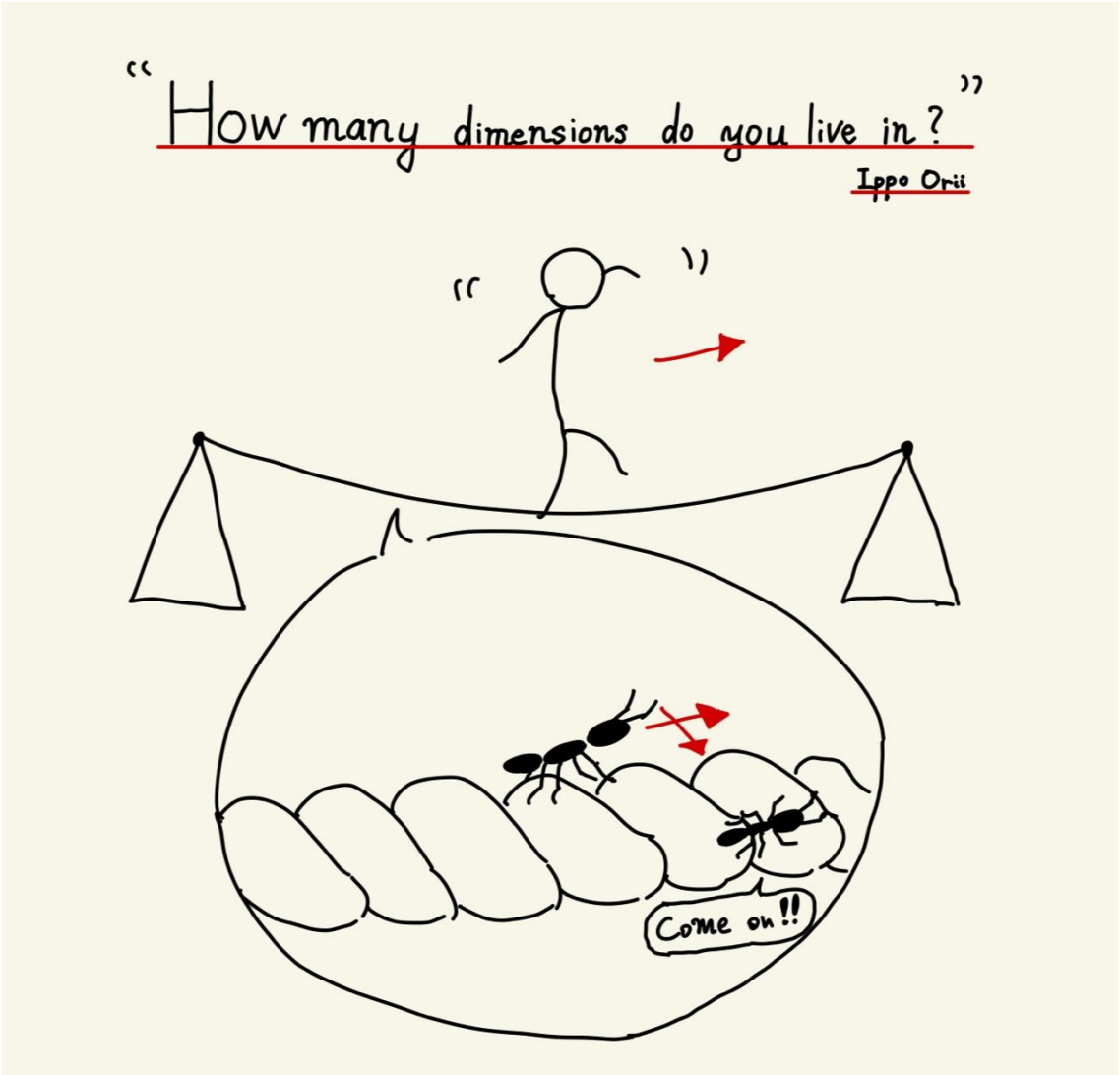

How many dimensions do you think you live in? You are probably wondering what an obvious question to ask. We know that we live in 1+3-dimensional space-time, that is, we can move forward, backward, left, right, up and down in advancing time. Now let's look at the man in the illustration. He is a tightrope walker and can walk freely on the rope. But his movement is restricted to one direction of the rope. (We are assuming that he is not so crazy to jump on the rope.) In that sense he is living in 1+1-dimensional space-time. On the other hand, let's look at ants crossing the same rope. For them, the rope is an expansive space in which they can move back and forth, and left and right. In this sense, we can say that ants live in 1+2-dimensional space-time. In this way, the 1+3-dimensional space-time we take for granted may originally have more dimensional space-time. In my research field, superstring theory, it is assumed that spacetime is originally a 1+9=10-dimensional space-time.

Let me explain a little about superstring theory. In junior high school, you probably learned that the smallest unit of matter is the atom, which is composed of a nucleus, a positively charged mass, and electrons, negatively charged grains that orbit around it. However, matter can be broken down into even finer particles, and all matter is made up of fermions, which are the smallest unit of matter. Not only that, but all the forces that surround you in your daily life can also be explained in terms of tiny particles, called bosons. The reason you are standing on the floor right now is because the particles that make up the floor and the particles that make up the soles of your feet are electrically repelled, and that is thanks to bosons. In this way, particle physics tries to explain all matter and forces in terms of tiny particles, and superstring theory is a type of particle physics. However, one of the things that particle physics has yet to accomplish is to explain the most familiar forces in terms of tiny particles. You can happily play on a slide because of the force, yes, it is the gravity. Superstring theory has the potential to solve that gravity problem by making the bold shift in thinking of the particles as oscillating strings. There is one problem with superstring theory, however, and that is that the theory assumes a 10-dimensional space-time. But please don't be sad, it's too fast to say goodbye to superstring theory. We know that the extra 6-dimensional space is a mathematically significant object. And we can confine that 6-dimensional space to our 1+3-dimensional spacetime through physical manipulation. From the 10-dimensional space-time, the 1+3-dimensional space-time is obtained by an operation called compactification, in which the extra dimensions are compactified. I am currently researching to learn more about this physical operation. The reason why I am doing this research is because I am interested in the origin of space-time. Have you ever wondered why the world you live in is 1+3 dimensional? It is obvious that we can move in three dimensions and time keeps going forward without going back to the past. Some people would say that such a thing is so obvious that it is not even worth thinking about. But take temperature, for example. The concept of hot and cold is a very absolute concept for children without knowledge or for people in the past when science had not yet been developed. What is hot and cold? At that time, such questions might have been taken for granted, and it might have been considered useless to even think about them. Now we have a very deep understanding that the intensity of the motion of the particles that make up matter is the cause of the concept of hot and cold. I believe that space-time, like temperature, is a secondary concept.

Scientists are people who continue to think about the questions that came to their minds as children. It might seem useless to society, but such pure question sometimes

contributes to the development of society. The Wright Brothers are known as the researchers who built the airplane, but they probably never imagined that we would be flying to the opposite side of the earth for business trip today. The pure will to fly, not from the viewpoint of whether it is useful to society, gave birth to airplanes, and as a result, they will flourish in society beyond time. When you ask me if my research will be useful soon, I have to admit that I'm not so sure. However, I believe that there is a great possibility that it will in the distant future, and at least, it will change the way we look at the world. And I believe it will enrich our lives.
That is why I became a scientist.