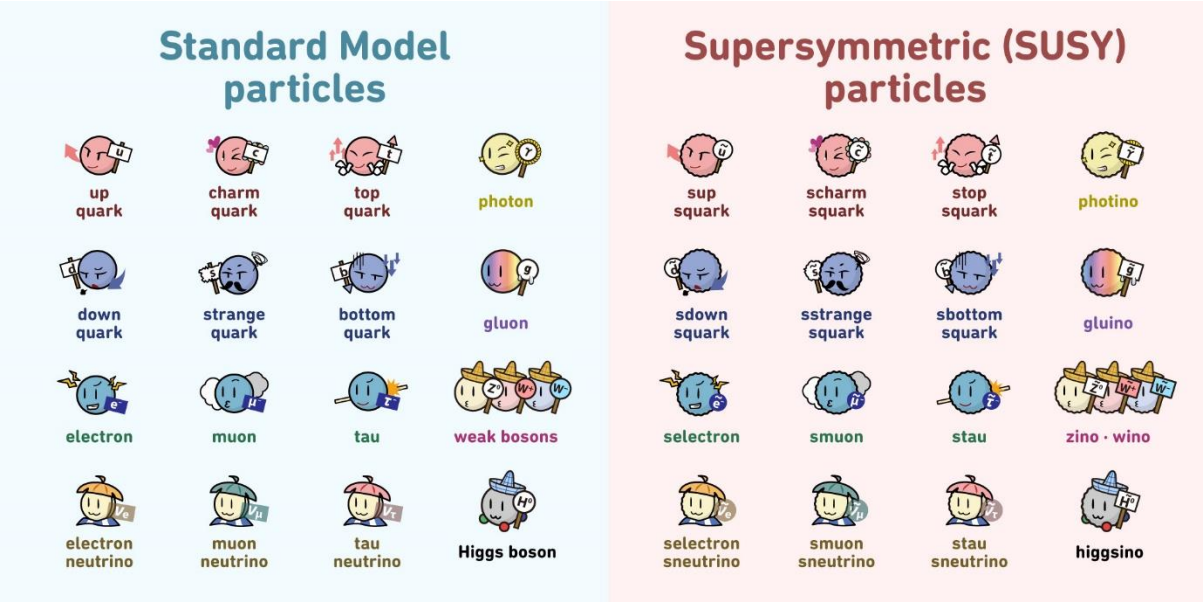
Supersymmetry -a brand new attractive theory in particle physics-

Riku Ishikawa



(https://higgstan.com/susy-particles/)

(1) an open scientific question in your current field of research

I am planning to study elementary particle physics in graduate school. There are many unsolved problems in the field, but here I would like to focus on one big topic, super symmetry (abbreviated as SUSY).

SUSY is the symmetry between two different kinds of particles. Each known particle is supposed to have an unknown particle whose kind is the other one as a partner.

Although SUSY is not verified so far, SUSY might play important roles in particle physics. For example, it is believed that there is dark matter that is an unidentified component of the universe and many physicists have attempted to identify. And then, lightest supersymmetric particles are the front-runner for it. Identifying or finding dark matter is one of the most important things in particle physics, so many particle physicists pay attention to SUSY. Also, it is known that there are four interactions in the universe, namely electromagnetic, weak, strong, gravitational interactions. You might not be familiar to weak and strong interactions, but they play important roles in a micro-scale world. Elementary particle physicists have tried to unify those four interactions but only succeeded in unifying electromagnet and weak interactions. Some of them have been trying to electroweak and strong interactions as the next step and SUSY has the potential to enable it because SUSY allows the three coupling constants that show the strength of the interactions to be the same value.

As mentioned above, SUSY has the potential to explain unknown things that cannot be explained with the standard model of particle physics.

However, many unsolved problems are left about SUSY. For instance, SUSY particles have not been found yet. Also, there are formal theories related to SUSY that are attractive from a mathematical view. In this way, you have a lot of interesting things to study about SUSY in the future.

(2) what inspired you to do research in this field

When I was in junior high school, I liked reading enlightening books about elementary particle physics or cosmology such as “A Brief History of Time” written by Stephen William Hawking, because I had some cosmological questions such as how the universe began and will end. When I read those books and imagined cosmological things such as the birth of the universe or black holes, it was always exciting and always gave me a sense of wonder. So, if you are sick of your daily life or want some exciting things in a junior-high school, I recommend you read those books and immerse yourself into the exciting imaginary world during break times between classes. You will definitely get attracted to particle physics or cosmology. Also, mathematics and physics were my favorite subjects when I was in junior high school. Unfortunately, few junior high school students like mathematics or physics. However, it is exciting to think mathematical objects logically and grasp their structures in mathematics classes, or understand physical meanings of what you learn in physics classes.

As mentioned above, I was interested in elementary particle physics, cosmology, and mathematics when I was in junior high school. Eventually, I noticed studying elementary particle physics is the best choice for me. It leads you to know a lot not only about elementary particles themselves but also about the universe. Moreover, I can enjoy interesting mathematical structures behind it.

I am planning to study quark confinement with SUSY. Quarks are a kind of particles, and quark confinement means that a quark is not isolated as one particle. In fact, studying it must be related to the universe. That is because it is believed that quarks exist in the universe and are fundamental components of the universe. Also, studying it requires knowledge of various fields of mathematics. So, these are still my main motivations to study particle physics as well as these are why I decided to study particle physics.

(3) how you believe this research will change the way we think and/or behave in the next 10-20 years

Non-experts will not understand the contents of scientific research well, but they will probably grasp the big pictures of them. So, they can enjoy learning about the results of the research in particle physics by reading scientific journals or attending lectures on it. Especially, SUSY will charm them because it might solve big problems like I mentioned, and completely change our picture of the universe. I think most of non-experts do not even think about the universe or feel a sense of wonder from the imagination of it in their daily lives, so imagining the new picture of the universe with SUSY must be an extraordinary experience for them and broaden their horizons. Moreover, if particle physicists make big progress in studies about SUSY, the new picture of the universe with SUSY will get accepted as the correct one in the future. And then, most people will come to know about it, and it will become common knowledge as time passes like the heliocentric theory or the big bang theory. That is how research related to SUSY will or might change the way we think.