Interviews keynote speakers

"Find your passion"

Leo Kouwenhoven
Professor Leo Kouwenhoven will deliver a keynote lecture at the Student Research Conference. Leo Kouwenhoven is full professor of Physics at Delft University of Technology. In 2012 he discovered the Majorana particle, the focus of his personal research.
He is also the director of QuTech: an institute that combines physics, mathematics and informatics in the areas of quantum computing and quantum internet. In addition, he is building a quantum computer in Delft together with Microsoft.

Why did you start doing academic research and what made you decide on a career?
I started doing research as part of my physics degree. At the end of my master's degree I was truly seized by research. For my thesis I worked with professor Hans Mooij. We made a discovery which set everything into motion; I got to talk to famous people and was invited to speak at conferences, which I really enjoyed.

How did you decide to start investigating the Majorana particle?
Sometimes you have your own idea about what you want to research, but in the case of the Majorana particle it was different. At some point I was in America and I received an e-mail from California, where they had the theoretical knowledge on how to make Majorana particles. Through previous experiments that I had published, they found out I had the practical skills needed to actually build the particles. I was an expert in this area without knowing it myself! I was invited to a meeting organised by Microsoft who funded the project. The project was exciting and we soon made a plan how we could investigate these particles using my techniques. From then on it all changed very quickly.

How did your research in the field of quantum computing start?
Microsoft had made the huge discovery that it is possible to use topological properties, as probably present in Majorana particles, in quantum information. Together we searched for practical implementations. They had the theory, algorithms and architecture. They just needed someone for hardware implementation. Coincidentally, I was the one who was already an expert on the subject.

Can you tell something about your current research on the quantum computer?
We need to be able to make qubits without decoherence arising. This means that we can already make qubits, but it would be a breakthrough if we can construct something around them to ensure that the decay of the state is precisely under control. Then you could make a lot more of the same bit, and the mistakes that will always arise will not necessarily lead to the wrong answer in a calculation. We are working on four different kind of qubits. One is better at storing data, another in processing it. Eventually all four have to work together in one computer. But not everything always goes according to plan. In our lab we wanted to have extra set-ups, so we would be able to do more tests at the same time. We discovered, however, that the amount of water needed for the cooling installation resulted in a pressure in the pipes that was too high. One of the pipes burst and I had to get a plumber. That was one of those days you do not feel like you are changing the world.

How long are your qubits stable?
You mean how short! Right now, if I give you the most optimistic number, we have qubits that are stable for one millisecond. Three years ago this was one microsecond and six years ago one nanosecond. We are making enormous progress.

What will Microsoft do once there is a quantum computer?
They see the use of the quantum computer in the broad sense and do not want to make a specific product out of it. What is really getting out of hand is that the amount of data collected every second is too much to analyse for normal computers, even if you would have all computers in the world available. Microsoft is looking into different methods to keep this process up and running: big classic computers, parallel computing, pairing computers via internet or using quantum computers.

At the Student Research Conference, different disciplines are represented. What do you think are the differences between research in the social and applied sciences?
The difference is that in the applied sciences, for instance physics or chemistry, you can reproduce your experiments exactly. You do research (you prove a point or develop a product) and the next year someone else can repeat the same experiment using the same input. In social studies reproducing the same research is never exactly possible as you work with people and social situations. This does not mean you should not do research in social sciences. It is very important!

For a physicist it is hard to realise that the conclusions based on a huge database are only relevant for that specific database. In social sciences this is the standard practice, because if you take another database of information, for instance from a different year, you will come to different conclusions. It all depends on the characteristics of the data used for research.

Do you have advice for the young researchers who want to pursue an academic career?
Doing research takes up a big part of your life. It is not a nine to five job, you cannot turn off your e-mail after five. You should really enjoy it. It is important that you find an area of research that you are good at and feel at home at. You need to be motivated and passioned, as without this trying to compete with other people in the field becomes very hard. Find your passion!

At the Student Research Conference students need to present their research in a way that is understandable for a broad public. What is your advice?
This is something I struggle with sometimes as well. Try thinking of a simple metaphor when you are explaining complicated information. I was allowed to present for 15 minutes to our Dutch king Willem-Alexander. I wanted him to remember my presentation and that he would maybe tell something at home about it afterwards. So you have to choose the right level of complexity in your presentation: it must be something that triggers the public and is not too complex. Do not use too many details, that does not stick, but make sure the information still has substance.

What do you think of doing research during one's Bachelor's degree?
I think doing research in the bachelor is not identical to the way I do my research. The period students get is often too short to learn all the skills and get into the phase where they can get creative and give their own input. Bachelor research is useful in terms of motivation. Students get the chance to get out of the classroom and look into different disciplines of research. That motivates!