‘The best people leave to go abroad’

The last six months have been rather crazy for Professor Leo van Kouwenhoven (Applied Sciences). Ever since he first reported in late February that he had detected something that resembled the Majorana fermion, an elementary particle that was first predicted in 1937, his telephone has not stopped ringing.

Jos Wassink

You started your search for Majorana fermions in the summer of 2010. When did you think for the first time: ‘Yes! We’ve found it!’?

“Actually in December, around Christmas 2011. I was sitting behind the computer with Kun [Zuo, ed.] and Vincent [Mourik, ed.]. The first peak that we had at the time ultimately turned out not to be a Majorana peak. But it did come later. It wasn’t really a eureka moment, though. The signal that you receive from the Majorana isn’t very specific. This means that you have to test that peak for all sorts of properties, in order to exclude other things, until you have made a reasonable case for it being a Majorana.”

The first time you spoke about it was on the Caribbean Virgin Islands in February. What kind of meeting was that?

“The meeting was organised and hosted by the Simons Foundation, set up by Jim Simons, a mathematician whom I’ve never met but who has made an enormous amount of money on the stock exchange with mathematical sales tricks. He wants to put some of that money back into science, and especially into the mathematically oriented sciences. He wants to do something exclusive, so he invites extraordinary people to come to unusual places - that can be the North Pole or the Virgin Islands - so that in this way they might generate novel, revolutionary ideas.”

Was Michael Freedman (an American mathematician with the Microsoft research group at the University of California) also present?

“He was also there, as well as people from Israel, from the Weizman Institute, and people from Harvard. Last week I heard by chance that the man from Israel, Ady Stern, immediately went and informed his laboratory and then set to work straight away also attempting to detect Majorana fermions. They posted the results on arXiv.org. They’re the first to have replicated us. He broadcast the news everywhere, which wasn’t really the intention.”

Was that meeting supposed to be confidential?

“To some degree, yes. I presented it as a preliminary result, in order to hear their views, advice and criticisms. Simply to see how the news would go down.”

And how did it go down?

“It went down very well with some people, while others were only mildly enthusiastic. But the effect was that not only Ady Stern went on to talk about it, but also others here and there as well. So when, a few weeks later, I arrived at the March meeting [of the American Physical Society, ed.], the news was making the rounds and everyone knew that something was going to happen.”

It was posted straight away on the Nature website.

“Within an hour. It happened very quickly.”

What was it like when you arrived back in the Netherlands?

“When I returned, the initial furore had already died down. The first articles had appeared in de Volkskrant and NRC newspapers. Requests for all sorts of programmes came in. But we continued to give the same answer: we’re very sorry, but we don’t have a manuscript yet. Please wait until it has been published.”

Then came the publication in Science?

“We received assistance from TU Delft public relations officer, Michel van Baal, who ensured everything was coordinated and channelled properly. After that it actually became hectic again, but now I was able to talk about it myself. It was also time to say something.”

Dutch Prime Minister Mark Rutte felt that you deserved the Nobel Prize.

“He’s just repeating someone else, I suppose.”

What effect does such a remark have on you?

“Ah, well…not much. After all, what does Mr Rutte actually know about it? What I have enjoyed though since then is that I’ve met a number of people, including people from the Ministry of Education, Culture and Science - including State Secretary Zijlstra on multiple occasions. So that’s all very nice, but having people say those sorts of things is a little bit embarrassing, because that’s still a long way off. This takes many years. Moreover, it’s not at all certain. It is looking good, and although we are convinced, that still doesn’t count for the scientific community, which has only known about it for a month now. So, they still have all sorts of questions and criticisms, and will be doing verification experiments and so on. You’ll first need to survive all that before it really starts to take shape.”

In all the media furore, there were two messages: a stable qubit and a new elementary particle. However, during a meeting of the Royal Netherlands Academy of Arts and Sciences in June, I also sensed a certain envy among particle physicists who themselves have been searching for >>

Photo: Sam Rentmeester

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Majoranas for some time.

"I'm not sure about envy. They're working within that specialisation on elementary particles. Our specialisation - solid state physics - works with a collective particle that's sometimes called a quasi-particle. But I think that 'quasi-particle' is a rather unfortunate name in this context. 'Collective particle' seems a more suitable name to me. The behaviour stems from the collective behaviour of many other particles, just as the wave in a stadium is a single entity, resulting from the behaviour of thousands of spectators in the stands. Such a collective particle, however, can be extremely stable, comparable with, or even more so, than many of those elementary particles. Therefore, the neutrino particles that are also considered candidates for Majoranas are certainly not more stable than our Majorana. The question more or less is: what is a particle?"

They have a detector in a mountain in Switzerland and they wait until one naturally comes along. I got the impression that they thought differently about creating your own Majorana.

"An interesting discussion about this issue is taking place. They say: your Majorana is not elementary. I say: in that case neither are neutrinos, as they also oscillate between different states. That's precisely what we have here: a particle that oscillates between different states."

So for you, the naturally occurring Majorana, and the Majorana in the cryostat, are not two separate things?

"They are two separate manifestations. It's clear that our Majorana occurs in a well-defined material system, in which it also remains. What's so significant in high-energy physics is that Majoranas are possible particles that can also explain dark matter. If that's actually the case, then of course it's extremely significant. Just suppose that we're able to produce a qubit, then that would also be extremely significant. But these are two different and quite separate manifestations."

Two manifestations of what precisely?

"Of the same formula: particle = antiparticle. The manifestations are quite different, but the solution lies in those Dirac equations. Both are a solution of the Dirac equation. We're searching for solutions in quite different areas. The origin, however, is the same."

I understand that you want to manipulate, mobilise and exchange the Majoranas. Those kinds of operations.

"We have found evidence of the existence of the Majoranas, but we still do not have any information concerning their characteristics. As it's such a unique quantum particle, we also want to measure its characteristics. Only then can we say that we have a Majorana fermion. If you're still thinking about the Nobel Prize, it's essential to demonstrate those characteristics before you'll ever even be considered for it."

How many years do you think it will take to demonstrate that?

"About two or three years."

Just to come back to your visit to Prime Minister Rutte. Do you have a message for him concerning the importance of fundamental research?

"Yes, absolutely, and this is that all things we now consider to be important technology, such as the iPhone and the internet, do not come about through a policy like the top-sector policy. Those are things that have actually been developed by creative people who cannot be placed in an organisational chart for research. The most important discoveries are not the result of incremental research, but of free and curiosity-driven research. Take graphene or nanotechnology, for example. In addition, you need to have incremental, planned research in order to translate this into products."

But it doesn't lead to many surprises?

"Not often. Applied and free research should be evenly balanced. At present, about one-third of the budget from the Netherlands Organisation for Scientific Research is structurally transferred to top-sector policy areas, but that amounts to 80 to 90 percent of the freely disposable budget. That's astounding, or at least drastic for curiosity-driven research. I think that the best people choose to do that sort of research elsewhere."

Do you see that happening?

"Yes, people go to the United States, Germany, Switzerland, Denmark, and these days even to the UK. The climate for curiosity-driven research is a lot more favourable there. They don't offer twice as much for a good idea, but something of a different order of magnitude. Therefore, not 100,000 but rather a million to set up a new lab. There's simply no comparison."

What's keeping you here?

"I've been able to build my group gradually over the past years, which means that I'm now in a good position. I don't need that much more because I already have so much. And, moreover, I have ties with Microsoft that provide me with freedom of research. So I can't complain. Far from it."

Who is Leo Kouwenhoven?

Prof. Leo Kouwenhoven (Pijnacker 1963) studied applied physics at TU Delft and got his PhD degree cum laude in 1992. He is the group leader of the 'quantum transport group' (faculty of Applied Sciences) and program leader of the Dutch concentration group on 'Solid state quantum information processes' a ten-year national program sponsored by the Dutch National Science Foundation (FOM). He received the Spinoza Award (2007) awarded by NWO to outstanding, pioneering and inspiring scientific work and the Leermeester prijs 2008, awarded to a TU Delft professor whose record of teaching and research excellence serve as a source of inspiration to students and PhD researchers alike.

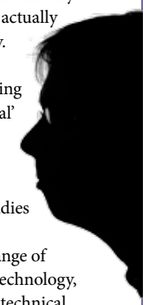
Imago

Ir. Remco de Boer is a technology & science communication specialist.

Actually, it's a miracle that there are still young people who want to study technology, because engineers have a negative image. There is hardly an article about the profession in which that is not mentioned, and this view has become so ingrained that people no longer even go to the trouble of actually proving the claim. But even more striking than the ease with which it is said, is who says it. Strangely enough, this is almost always people who have their own interests at heart. The leading advocate in this is Ed Nijpels, chairman of NLengineers. Since taking office in 2008, Nijpels has never missed an opportunity to stress the negative image: that engineers should show more courage and nerve; that engineers should receive more recognition; that engineers should be more visible. So time after time, he presents a negative image of engineers.

Photo: Sam Rentmeester

The sector was also convinced of that negative image in Belgium, until last year, that is, when the Randstad employment agency examined the appeal of 112 professions. You can guess which profession came out on top with 75.4 per cent. Precisely. Three out of four of those people questioned would recommend becoming an engineer to friends or children. "The lack of interest among young people for technology is therefore not due to a negative image," the researchers concluded. In a recent interview in Technisch Weekblad, Nijpels said he was unable to explain the difference with the Netherlands. Well, I can: there is no difference. The opinion of the Dutch regarding engineers is not radically different to the Belgians'. The negative image is a myth that is being maintained – unintentionally – by the sector itself, in order to explain why more young people are studying law and economics than technology. But there may be many causes for this. Certainly one of these is the continuous stigmatisation: if you repeat that something has a negative image often enough, in time it will also acquire one. Therefore, when the Dutch Labour Party (PvdA) decided in June to put their oar in by advocating free technical education, it was time for a public response. And so I was given the opportunity to explain to the 600,000 Radio 1 listeners that if you differentiate technology, it actually works counterproductively. That by doing so, you are signalling that it is something quite different from 'normal' studies. That there is apparently also something wrong with it. But, above all, I said that technical studies form a very broad basis, which opens up a whole range of prospects, also outside of technology, and that there is a suitable technical study at almost every level and that career opportunities for engineers are excellent at present and will only get better in coming years.



Let this be the message we pass on from now on. And if, at the same time, we could ban the word 'image', you might be surprised to see how many first-year students are knocking at the door next year.

Photo: Sam Rentmeester

Students of the minor automotive design (faculty of Industrial Design Engineering) work on cars made of pvc pipes, tie wraps and duct tape. The minor aims to develop skills like design drawing, clay modeling and prototyping.