Interview FOM expres 1 – April 2015
Section 'Women in Physics'
English version

===

Playing her own game

In 2004, she was appointed as one of the first female professors in theoretical physics in the Netherlands. The road the FOM workgroup leader and Vici winner, Cristiane Morais Smith, had to travel to get there was long and difficult. "But it has all been worth it," she said in her study at Utrecht University. "Physics is and remains my great passion."

Her personal history reads like a novel. Cristiane Morais Smith grew up in a large family in a small village in Brazil. There was only one school, where the standard of education was low. She was first gripped by physics when she was 13. She can still remember the exact moment. "Our teacher gave us an assignment that had even caused Galilei to rack his brains. There are two balls on a steep slope; one is solid and the other is hollow. We had to describe the acceleration of both balls. My teacher was ecstatic when he looked over my shoulder and saw that I was writing down the correct equations. I asked him what profession I should choose if I wanted to play these types of games all day long. 'Physicist', he said. From that moment on, that was my dream." Although no one in her village had even heard of a physicist, her parents were not surprised. "One of my brothers wanted to join the circus, and another wanted to do ballet. My parents thought all our ideas were equally absurd."

It was not easy for her to make her dream come true, but Morais Smith did everything within her power. She studied for 16 hours a day year in, year out. When she was 16, she was admitted to the best university in the country. "To be able to pay my university fees, I worked in a bank every day from 7am to 1pm. In the afternoon, I went to lectures." To develop herself in other areas, she studied French in the evenings. She then used her knowledge of that language to set up a French school. "Because I hadn't had a good education, I felt it my duty to share my knowledge with others."

Steering her own course
Once she graduated, she started researching vortices in high-temperature superconductors for her PhD under the guidance of the still young Brazilian physicist, Amir Caldeira. When Caldeira advised her to continue her research at the ETH in Zurich, she resigned from her job, sold her car and moved to Europe with six thousand dollars in her pocket. After receiving her PhD and doing a postdoc, she relocated to Hamburg, where she was immediately put in charge of her own research group. When she was offered a professorship in Utrecht a few years later, she moved here. "I have never had a boss telling me what to do. The disadvantage of that is that you get little support, but the advantage is that you have tremendous freedom to do what you want. The Vici committee I'm now a member of has shown me how important it is to be able to show exactly what your contribution was. I've always been able to steer my own course."

Morais Smith is now working on a variety of topics ranging from topological insulators and the production of artificial graphene to ultracold atoms in optical lattices. She goes in search of difficult, challenging issues in which electron states, lattice properties and quantum mechanics play a role. She usually works in conjunction with experimental groups. “Sometimes my role might be to predict observable phenomena, at other times I’m the one providing explanations for experimental results.” Recently another role has been added: that of designing new combinations of materials and structures in which interesting phenomena can be expected. In a recent publication with the group led by her colleague Daniël Vanmaekelbergh, she demonstrated what happens if you give the conventional semiconductor material cadmium selenide the same two-dimensional honeycomb structure as graphene: the new combination produces not only the individual properties of both graphene and the semiconductor but also completely new properties.

Her group went on to theorise that, by replacing the semiconductor material they had used with a slightly different composition of materials, the effects could be even more spectacular. Their paper was published in Nature Communications on 10 March 2015. “This material enables us to see quantum spin Hall effects at room temperature for the first time. That is gigantic. And in addition, you can achieve all the interesting phases of the material at the touch of a button,” she said. “At zero energy it is a field-effect transistor. If you add one electron for each nanocrystal, it starts to behave like graphene. By adding three electrons, you see fractional spin Hall effects. And by adding four electrons, you get the entire quantum spin Hall effect.”

Having roamed the world, the physicist feels at home in Utrecht. “We have a good institute with brilliant students. Although I am Brazilian, I noticed during last year’s World Cup that I’m starting to feel very Dutch.” *(SK)*

Note
Cristiane Morais Smith is Professor of Solid State Physics at Utrecht University and Director of the Utrecht Center for Extreme Matter and Emergent Phenomena.