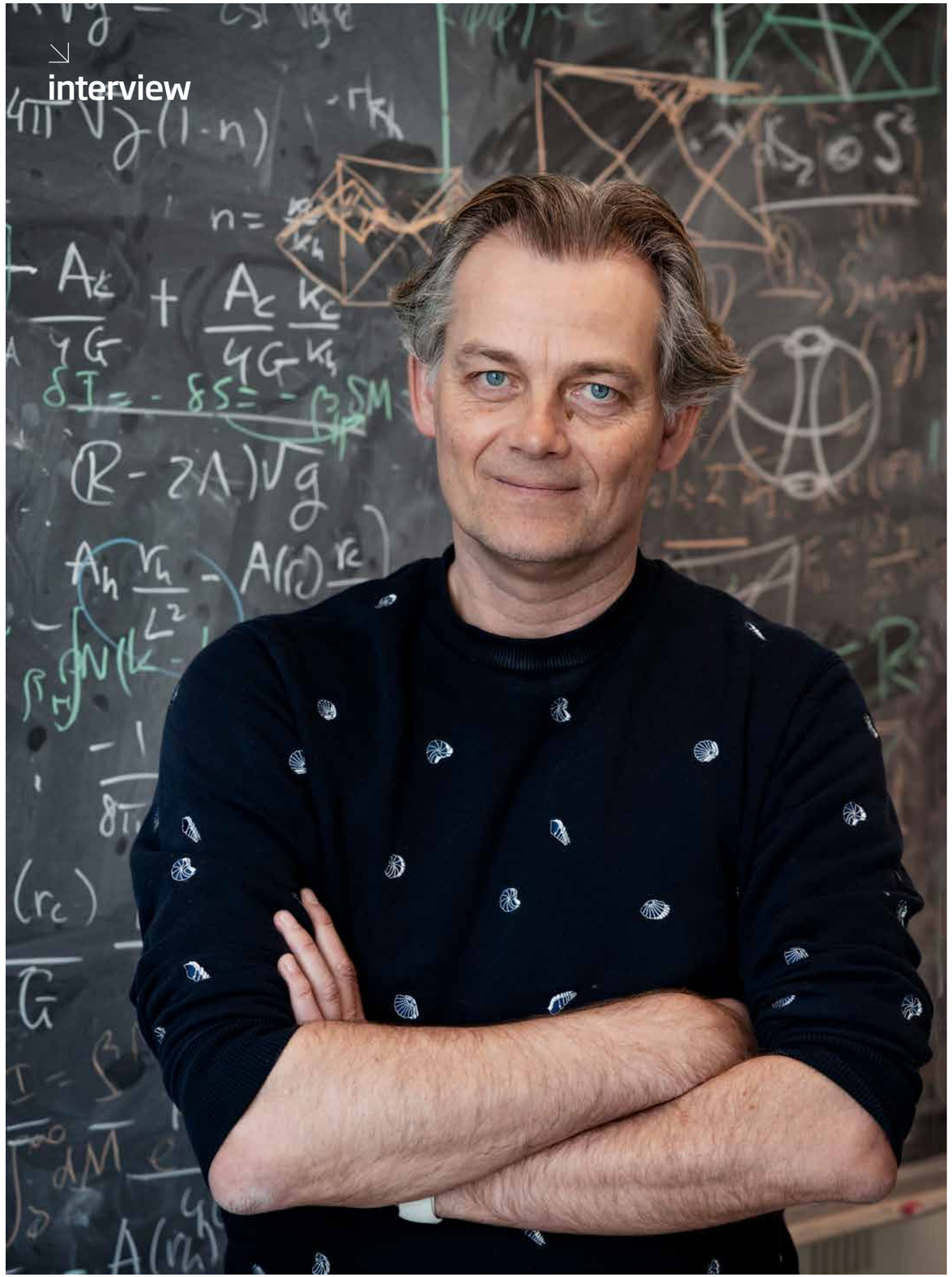

‘Theoretical physics is a team sport’

String theorist and cosmologist **Jan Pieter van der Schaar** is coordinator of the Delta Institute for Theoretical Physics. Responding to eleven keywords, he talks about his roots, work, and dreams.

Text: Jim Jansen
Photos: Bob Bronshoff

Physics
‘I first read about astronomy in primary school. I don’t remember exactly what it was about, but it did get me interested in the subject. A few years later, I built my own telescope. Then, of course, I wanted to study astronomy, and in Groningen that programme was combined with physics. In the end, I liked the latter field much more, because I was interested in the theoretical aspect, among other things. I got my PhD in string theory – very abstract and formal. When I went abroad after my PhD, I got involved in cosmology. And that’s how I came back to astronomy.’

Dreams (1)
‘When I was young, I wanted to be a professional tennis player, but that didn’t work out. I came from Heerenveen, a Frisian village that people call a city. I found that its small size became tedious and the universe was pretty much the opposite of Heerenveen. I wanted to know a lot more about that.’

Delta ITP
‘We safeguard the unity of theoretical physics. In the Netherlands, we have a long tradition in this branch of science, and we are also very good at it, which has to do with a combination of creativity and robustness. The Delta Institute for Theoretical Physics – Delta ITP – is actually unrelated to the funding we received for the institute in 2012. For many years, there had been an idea that the universities of Leiden, Utrecht, and Amsterdam should collaborate much more in this area. Theoretical physics seems a lonely profession because the field is often in the news when a single person has won an award. But make no mistake. It’s a team sport and you can only make progress when collective foundations are laid. Exchange and collaboration are incredibly important.’

Gravitation grant
‘We received 18 million euros, a wonderful amount. We didn’t have to buy expensive equipment and spent hardly anything on overhead, so all that money went to research, often in the form of new research positions, both temporary and permanent. An intensive investment in people, i.e. knowledge. Without the grant, we wouldn’t have been able to do that.’

Cities
‘Amsterdam is a fairly new player within theoretical physics; Sander Bais and Robbert Dijkgraaf have ushered in a period of growth. In twenty years, the Institute for Theoretical Physics at the University of Amsterdam has become the largest and perhaps best group in Europe. Here, we excel at string theory and quantum matter. Utrecht can be seen as the home of Gerard ’t Hooft; a historical place where the focus is on the fundamental questions. Utrecht traditionally focused on the more formal aspects of theoretical physics, but researchers there now also deal with cosmology, gravitational waves, and sustainable materials. Leiden has the Lorentz Institute for theoretical physics, where Albert Einstein was a frequent guest

as an endowed professor. Need I say more? Leiden is different from the other cities; there is a natural collaboration of theoretical physics with astronomy and experimental physics.'

Stronger together
'Delta ITP is a way to raise our profile as a collective, and I think we have succeeded in showing that the institute is more than just a collaboration between three cities. Internationally, we have put ourselves on the map, in part by establishing exceptional fellowships. These are three-year projects for very good people; postdocs to whom we gave extra money with which they could do whatever they wanted. You couldn't apply; we made a selection. In the end, we linked up with twelve people. They may now call themselves Delta Fellows. Looking back, they all became very successful, which I'm genuinely proud of.'

'In a way, I'm following in Stephen Hawking's footsteps'

Einstein
'Every theoretical physicist sooner or later refers to Einstein. At Delta ITP, we focus on topics appropriate to the three institutes. Here in Amsterdam, for example, we do a lot of string theory, and at its core that is about one thing: we want to know what the quantum version is of the general theory of relativity. That's a direct legacy of Einstein.'

Research
'My research focuses on how the universe came into being and the connection to string theory. As a theory of quantum gravity, string theory should play an important role in the extremely early universe. Developments in the field of black holes are also something I keep a close eye on because they can provide a bridge to the origins of the universe. In a way, I'm following in Stephen Hawking's footsteps.'

Curiosity
'I don't do research because it has useful applications, I do it to satisfy my own curiosity. That same curiosity drove people like Einstein and Newton. The applications of their work are taken full advantage of in 2022. Maybe in a hundred years, people will do the same with my findings.'

Manager
'I've had a strange career and am a bit of a jack-of-all-trades. For a while, I found that prohibitive, but things go the way they go. In 2005, I moved to Amsterdam where I was hired by Robbert Dijkgraaf. I ended up in mathematics, where I had no business being. Then I accepted a teaching job at Amsterdam University College. A year later, Delta ITP was started, and Jan de Boer called to ask if I was interested in that. At first, it was a matter of pioneering. It helped that I was able to project myself into the world of the researchers; something that a "regular" manager certainly couldn't have done. Because we had quite a lot of money available, I did feel like a bit of Santa Claus at times.'

Dreams (2)
'There are small dreams and big dreams. In the field of research, I would very much like to better understand de Sitter spacetime. Willem de Sitter was a Dutch astronomer and mathematician who worked in Groningen and Leiden. He was the first to find a solution to the general theory of relativity with a positive cosmological constant. This de Sitter solution describes an accelerating expansion of the universe that probably has properties similar to those of a black hole, with a cosmological horizon that emits Hawking radiation. If we understand how this works in string theory, I expect to learn a lot about the origin of the universe. Another dream is to sail around the world. It has nothing to do with my job, but it just seems like a lot of fun.' ■

CV

Jan Pieter van der Schaar (1972) graduated in theoretical physics from the University of Groningen in 1996 and received his PhD from the same university in 2000. After a postdoc position at the University of Michigan, a fellowship at CERN, and a year as a postdoc at Columbia University in New York, he has been part of the Institute for Theoretical Physics at the University of Amsterdam since 2005. He has been coordinating the Delta Institute for Theoretical Physics since 2013. His research focuses on the interface of cosmology and string theory. He is one of the leading scientists in the national cosmology programme.

BRAM BELLONI

CROWN JEWEL

'Nature doesn't know what infinity is'

'When I was working on my dissertation, there were a lot of major questions in physics about elementary particles and the forces that work between them,' says Gerard 't Hooft, professor of theoretical physics at Utrecht University. 'It was a great time; every few years, there was a discovery that turned everything on its head.'

With his supervisor, Martinus Veltman, 't Hooft worked on the rules of one of the forces: the weak interaction. 'When used in calculation, the calculations were not convergent; outcomes were often infinities. But nature doesn't know what infinity is, so that meant something was wrong.' Working with Veltman, he found a solution, which earned the pair the Nobel Prize in Physics in 1999.

Now, elementary particles and their mutual forces are well described by the standard model of particle physics. 'But we know this isn't the whole story, because quantum mechanics, on which the standard model is based, doesn't work well when you combine it with gravity, again resulting in infinities.' This problem reared its head in the 1970s. 'At the time, we thought we would solve this in about ten years as well. After all, that's how it had been with particle physics. But by now we're fifty years down the road.'

'Some people think we'll never figure it out. I don't believe that. Just look at the history of our field. If we put our heads together, we can work the wrong ideas out of our system. Could it take thousands of years to find the right method? If it does, we're not giving up. In a thousand years, I will come back with the answers.'

Text: Dorine Schenk