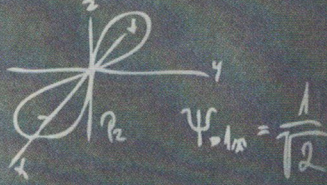


LIVING IN TWO WORLDS

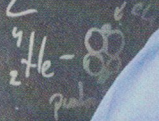
The multidimensional life of
Robbert Dijkgraaf and Pia de Jong

by Linda Arntzenius • photography by Tom Grimes

$$E(\omega T) = \alpha \omega^3 \exp(i\omega T)$$


$$\Psi_{l=1, m=1} = \frac{1}{\sqrt{2}}$$

$$m_s = \pm \frac{1}{2} \text{ spin}$$



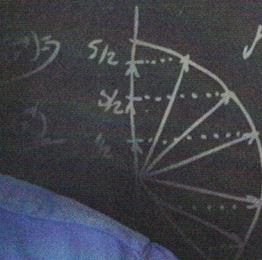
β^9

μ_{21}



$$Q = ze - (A - N)$$
$$\Delta m = E\nu/c^2$$

$$\left(\frac{r^2}{2}\right) = \frac{MR^2}{2}$$



$$\mu_s = \mu_0 \cos \phi$$

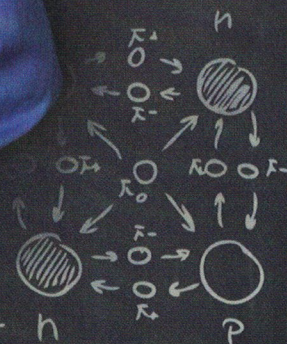
$$Z = \text{const } v \vec{r}$$

^1_1H - Hydrogenium

^2_1H - Deuterium

^3_1H - Tritium

robu y



Mathematical physicist Robbert Dijkgraaf and novelist Pia de Jong are celebrities in their native Holland where word of Dijkgraaf's appointment as ninth director of the Institute for Advanced Study made the evening news on Dutch television. Dijkgraaf is one of those rare scientists able to explain the most recondite aspects of quantum and string theory to a lay audience. De Jong is a popular newspaper columnist and a leading voice in Dutch-language fiction. Together with their three children, the couple took up residence in Princeton's historic Olden Farm last summer. It hasn't taken them long to settle in.

“ In this day and age, it's difficult to move in an absolute sense,” laughs Dijkgraaf, likening the experience to a quantum mechanical particle in two places at the same time. Here and there: Princeton and Amsterdam. Modern communication and travel made the decision to come to Princeton an easy one, says de Jong: “It's not a case of giving anything up, living in two worlds is an enrichment for the whole family.”

Dijkgraaf's appointment to the Institute for Advanced Study (IAS) prompted an avalanche of jubilation from scientists and non-scientists alike. Vartan Gregorian, head of the Carnegie Corporation of New York and an Institute trustee, praised his “rigorous intellect.” Edward Witten commended his “outstanding contributions to our understanding of quantum fields and strings and their relations to problems of gauge theory, geometry and quantum black holes.” Social scientist Joan Wallach Scott and Princeton University President Emeritus Harold Shapiro lauded his appointment.

Dijkgraaf is no stranger to Princeton or the Institute. He was a researcher at Princeton University from 1989 to 1991 and then a member in the Institute's School of Natural Sciences. Describing the latter as “a magical, transformative place” that played a crucial role in his professional life, Dijkgraaf remembers the easy contact he had with Edward Witten, already *the* towering figure in string theory. “We had a very casual conversation and then I went back to the Netherlands and had a thought about it. I emailed him with my idea. He wrote that he liked my idea, to which he'd given further thought, and that if I considered his contribution worthwhile, we should



write a paper together.” Dijkgraaf jumped at the opportunity. He finished the paper, came to Princeton and then learned what he calls a very valuable lesson.

Witten pointed out a troubling minus sign in Dijkgraaf’s calculations. “From that minus sign I learned that there is no issue so small that a great mind is not bothered by it and also that if something sticks out, as this did, it’s not to be ignored but to be focused on.” The minus sign that Dijkgraaf, eager to finish the paper, regarded as a nuisance, turned out to be “a door that led to a very positive outcome.” He and Witten spent a week working on it; attention to every detail is something that Dijkgraaf believes is quintessential to the Institute. “The beginning of a research project is often very modest, like trying to find the beginning of a roll of scotch-tape. You need peace and quiet to think and an atmosphere conducive to that kind of thinking. That’s what the Institute supplies.”

Similes and metaphors pepper

Dijkgraaf’s conversation. Expressing different aspects of the Institute, one moment he likens it to “the eye of a hurricane; a quiet place at the center of great activity,” and the next to “a symphony orchestra with very many instruments. Everyone has their own strengths and weaknesses and you shouldn’t force everyone to play the violin.”

For those of us who gave up trying to understand physics after Newton, Dijkgraaf holds out hope. “Pictures help our imagination and understanding and if you want to explain a difficult issue it’s important that you use a visual or literal metaphor,” he says, acknowledging, however, that “a metaphor can go some but not all of the way, ultimately you must resort to mathematical formulae.”

Dutch television viewers have grown to love Dijkgraaf’s ebullient personality as when he elucidated the Big Bang in a 45-minute program in the series *De Wereld Draait Door* (*The World Keeps*

Turning). Invited back to explain (the notoriously difficult to picture) quantum mechanics, he resorted to sleight of hand. “I decided that the way to explain quantum mechanics was to explain things that cannot happen in real life: magic.” He demonstrated quantum entanglement by “magically” changing the colors of distant balls simultaneously and quantum tunneling by “magically” getting a coin to go across a solid sheet of glass. Quite an undertaking given that the show was live, had an audience of over a million viewers, and Dijkgraaf had only a few hours to practice his magic tricks.

Clearly, he’s a hard act to follow. Dijkgraaf has been held up as an example for other scientists because of his efforts to communicate science to a general audience and for the time he’s put in to cultivating the next generation of scientists, including the very young through a children’s website he conceived and launched (proefjes.nl) and several popular children’s books.



Dijkgraaf and De Jong at home in Olden Farm with (from left) Matthijs (14), Jurriaan (16), and Charlotte (12).

Magic Tricks and Juggling Commitments

On coming to Princeton, Dijkgraaf relinquished his prestigious position as president of the Royal Netherlands Academy of Arts and Sciences, a position he held since 2008 and was well suited for with both subjects in his background. Founded in 1808 as an advisory body to the Dutch government, the Academy not only promotes science and scholarship, it encourages scientists and scholars to contribute to cultural, social and economic progress. As its leader, Dijkgraaf brought scholars from a wide variety of disciplines together on important scientific and public policy issues such as climate change.

At the Institute, Dijkgraaf will continue in the distinguished professorship he's held at the University of Amsterdam since 2005, write a monthly column in *Holland*, and pursue his own research. Given the size and non-hierarchical nature of the Institute, he feels confident of being able to switch between leadership and research modes, especially when, as he points out, the top seminars are taking place in the building next door.

Born in Ridderkerk in 1960, Dijkgraaf grew up an only child in a suburb of Rotterdam. His father, who worked in the port there, was fascinated by history. His mother had a talent for art. Although there was no great aptitude for mathematics or physics on either side of the family, Dijkgraaf was encouraged to pursue his imagination wherever it led. He describes himself as a hyperactive child given free rein in a secure environment. With friends after school, he created his own laboratory and library. "We even made cartoon movies with a movie camera and designed a whole cartoon studio when we were 12 years old," he recalls.

Physics came later, at about 15 or 16. As Dijkgraaf tells it, he was searching for a topic for a presentation in his high school English class when he bought an issue of *Scientific American*. So fascinated was he by its contents, he sought out issues going back to the 1950s. It was a moment that, according to Dijkgraaf, "opened up the world." Not only that, it augured his future career. As it happened, the issue of *Scientific American* that Dijkgraaf bought had a "picture" of quarks on the cover.

Besides being fascinated by the content of the articles, Dijkgraaf was struck by the fact that most were written by groups of authors, often from various countries. "The thought of people from China, India and the United States, working together was another of those moments in life



when a whole new vista becomes visible," he says. "Science is much more collaborative than the rest of the academic world and this social aspect is very important to me. Even if you are not working directly with others, you are part of a chain of knowledge connected to what has been done previously and passing your contribution on. The artist is much more on his own than the scientist. Perhaps this is what makes physics such a joy for me."

Hooked on physics, Dijkgraaf borrowed books on relativity and quantum theory. He created his own notes with elaborate drawings of electron clouds. His enthusiasm was dampened as a freshman

at university, however, when he was told that before he could study relativity theory and quantum mechanics he must first study classical mechanics. By the time he earned his bachelor's in 1982, Dijkgraaf was more interested in drawing and painting than in science. "He did astonishing work," says (then girlfriend) de Jong, who encouraged him to apply to the prestigious Gerrit Rietveld Academy in Amsterdam.

And then a strange thing happened. "The moment I was in art school, I felt liberated to read and enjoy physics again," he recalls. "It was like having put out a fire and finding it start up again." In art

school, says Dijkgraaf, it was more important to produce one's own work than to cram for exams. When he returned to science, he had a new attitude: "I wasn't thinking about getting good grades I was thinking about enjoying myself and adding to the subject."

Creativity and the Blank Page

"Art and physics merge into one in my mind," says Dijkgraaf. "Like scientific research which is open ended, an artist approaches a blank canvas as something inviting, an open space to explore." He went back to the University of Utrecht for a master's degree (1986) and then a doctorate (1989) in mathematical physics and credits his supervisor Gerard 't Hooft, the 1999 Nobel Prize Laureate in Physics, for allowing his students to follow their interests.

Dijkgraaf's philosophy in scientific outreach, policy, academic leadership or research, emulates this exploratory open-ended attitude to process. "I often feel that in the academic world if we only take a small percentage of the creativity that we have in our research and we spend it on the way we reach out to other people or lead our institutions that would be very refreshing," he says.

Vision for the Institute

The challenge for the Institute in the long-term, says Dijkgraaf, is not to expand but to maintain the "human scale" that makes it possible for the entire Institute community to lunch together, something he appreciates, coming as he

The 2012 Holiday Card featured original artwork by the Institute for Advanced Study's new director Robbert Dijkgraaf.



does, from the University of Amsterdam with some 75,000 students. "The trend is always to grow and grow, but the Institute is an exception to this rule, as to so many others. If it were to grow it would break apart and the parts would be less than the total. The challenge is to adapt to the modern world. The Institute is a place of theoretical research and deep ideas."

"This place is radical, it stands for intellectual freedom, nobody tells anybody here what he or she should work on," says Dijkgraaf, adding that such freedom "can be frightening because if you can do anything you want you have to be very thoughtful in picking your research. Cutting-edge researchers here are always confronted with a blank page and to adopt an attitude of exploration one needs a safe environment in which mistakes are allowed."

Small in comparison to its impact, the Institute stands for certain qualities that Dijkgraaf would like to see more of in the academic world at large. Qualities that he sees as being under threat: "All over the world there is a virus of certain management structures of evaluations and more accountability, often with the best intentions, but which can stifle research. I feel that the Institute provides a counterbalance to these growing rules and regulations and desire for immediate short-term outcomes. To have a place that recognizes these as threatening to creativity and to academic liberty is very special. In that sense, the Institute is unique. It has been lucky from the beginning with its founders and first faculty."

Among its first faculty is, of course, Princeton's most famous resident, Albert Einstein, whose personal modesty and openness to the work of others, says Dijkgraaf, played an important role in defining the Institute. "The Institute has a grand history but it doesn't weigh you down," he says. "Einstein played an important role in creating an atmosphere that is open to the work of new generations. He had an enormous impact on the world but instead of creating a group of disciples, which he could easily have done, he was open to new ideas, even those with which he disagreed; even encouraging Oppenheimer when he created a place for young physicists here."

Oppenheimer famously told Institute members that they had "no excuses" when it came to work. As far as Dijkgraaf is

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concerned the remonstrance is equally valid for the Institute itself, which he expects should take a leading role with respect to the many challenges confronting the world of higher learning today, such as collaboration across disciplines and across national boundaries. "From the beginning, the founders set it out as a place for research without any regard to race, creed, or gender (no trivial thing back then)," says Dijkgraaf, "and it has one great asset, its financial and intellectual independence."

Like the Red Queen in *Alice in Wonderland* (Dijkgraaf's image), the Institute must keep moving forward in order to maintain its fundamental and timeless values. "We want to continue that tradition and bring those values to the way research is done now, which is different from 80 years ago."

Olden Farm

Just in from school, the Dijkgraaf children—Charlotte (12), Matthijs (14) and Jurriaan (16) switch easily from Dutch to English as the family has fun with *Princeton Magazine* photographer Tom Grimes, sent to capture them *en famille* at Olden Farm, the historic



Princeton home that is the traditional residence of Institute directors. Dijkgraaf cuts tomatoes for a simple meal. Pia playfully demonstrates the juggling that is symbolic of their busy lives.

The home is a beguiling mélange of antique pieces (some that belonged to Einstein including his Bechstein piano next to Dijkgraaf's spinet) and modern artworks produced by Dijkgraaf. Its rural setting is a far cry from Amsterdam where they lived in one of the city's most famous houses, a tall narrow 17th century edifice on a canal, where the children were born and where de Jong began her writing career, precipitated by an experience that bonded this close-knit family.

For over a decade, de Jong has fielded requests to write the story of the time when her youngest child Charlotte (now a lively pre-teen attending John Witherspoon Middle School) was born with myeloid leukemia. Now she thinks might be the right moment for a novel based on the experience. "When our daughter was born, the oncologist told us to prepare ourselves. 'This baby is going to die,' he told us. Robbert asked him how he could be so sure and the oncologist told us that of all the infants with this condition all had died except one. Robbert asked about the one child who had not died. It turned out that this child was in the United States with very young parents who had no health insurance. He had no medical treatment and yet survived. Robbert said: 'we are not going to do anything.' I started to pack my bags and the oncologist said 'what are you doing?' Charlotte was just two weeks old. We had

to sign a lot of papers but we took her home. I quit my job and Robbert took care of us."

De Jong envisions that her book will be center on the power of intuition. "I was totally sure that we were doing the right thing. I never had any doubt. I felt intuitively that I knew what was needed. I held her close to my body, I fed her when she wanted to be fed and I kept her with me all of the time."

A story of survival, it's also one of setting boundaries. De Jong turned their Amsterdam home into a fortress of sorts, protecting her young sons and newborn like a lioness against the negative energy of any who would question their actions, but open to all who brought love and support and positive energy.

Speaking of the experience for this interview, de Jong reflects on what was a very difficult time for the young family, especially as they did not know what the outcome would be. "We expected she might die and tried to prepare for that but after about half of year of waiting and watching, we began to see a change. She became livelier and started growing. When she was a year old, she was recovered. Charlotte's case has been shared in the medical literature and is now an inspiration for new treatment protocols."

Although de Jong had written poetry as a child and had even told her parents that she was going to be a writer one day, it was only after Charlotte's recovery that she started writing seriously. "The experience totally changed me. It was a big thing for all of us. Now as long as we are a family together we can go through

anything. This little girl transformed us."

Since then, de Jong has built a career as a novelist and weekly columnist for the Dutch newspaper *NRC Handelsblad*. Her critically acclaimed 2008 debut novel, *Lange Dagen (Long Days)*, received the Golden Owl Literature Readers Prize and her second novel, *Dieptevees (Depth Fear)*, published in 2010, was praised for its strong, elegant prose. Besides her novels, which have yet to be translated into English and which she describes as being "on the dark side," she's written short stories and two children's books.

Like her husband, de Jong had no concerns about the value of the move for her children. When they first visited Olden Farm, even though their parents had warned that it was just a scouting visit and that there was only a slight chance that they would move, the children immediately ran upstairs and began choosing their bedrooms. "Our kids are amazing," says de Jong. "People told me that they would adjust by Christmas but they settled in immediately." Dijkgraaf nods: "On the second day of their being here, Jurriaan, on his own initiative found out about soccer at the high school and the next day I had two boys wearing Princeton High School jerseys proudly defending the Princeton colors. That's how quickly they settled in." ■

Linda Arntzenius was formerly Publications Officer at the Institute for Advanced Study and is consultant on an oral history project there. Her pictorial history, Images of America: Institute for Advanced Study was published by Arcadia Press in 2011.