Silke Britzen moves between two spheres. As a scientist at the Max Planck Institute for Radio Astronomy, she analyzes the epitome of darkness. That is to say, she studies black holes with telescopes that nearly span the globe. As an artist, she paints pictures bursting with color. Her approach to both research and painting is unorthodox.

TEXT: FINN BROCKERHOFF

When Silke Britzen looks up at the starry night sky, she doesn't think about her work – and that's despite having spent nearly 30 years as an astronomer exploring the riddles of space. "I can still just enjoy the sight and marvel at its aesthetic beauty. The black holes and astrophysical jets I study daily are far, far away then," says Britzen, a scientist at the Max Planck Institute for Radio Astronomy in Bonn.

What fascinates her about the universe is its vast, invisible secrets – things that literally lie in darkness. Britzen's desire to understand the universe began in her early childhood. "My mother loves to talk about how I would pepper her with questions about the starry sky before I could even speak correctly."

One of the first sources of information that helped quell her growing thirst for knowledge was Cosmos, an American documentary series presented by astronomer Carl Sagan that was broadcast on German television in 1983. "I was immediately engrossed. When I saw it, I went to my physics teacher and asked if we could cover astronomy in class. She agreed, but only on the condition that I prepare the classes myself." And so Britzen prepared a two-hour teaching unit about the solar system and presented it to the class. "I think for me it was the first small step towards becoming an astronomer." At the time, she wished she could have spent hours questioning an astronomer about the universe. "Before long, I had already read the few astronomy books available at the local bookstore, and unfortunately at the time there weren't any lectures that made astronomy comprehensible to amateurs.

That's partly why, for several years now, Britzen has offered a lecture entitled "Black Holes and the Questions of Modern Astrophysics" as an associate professor at the University of Heidelberg. The many fascinating aspects of black holes and their important role in our universe are a central focus of this lecture. Aside from the basics, she talks about current astronomical research projects and also about her everyday life as a scientist. Her goal is to make the work of astronomers more tangible and accessible, both for an interested lay audience and for young people toying with the idea of studying the subject or even planning a future career in research. "As a child I would have been really excited by an event like that."

→

VISIT TO

SILKE BRITZEN

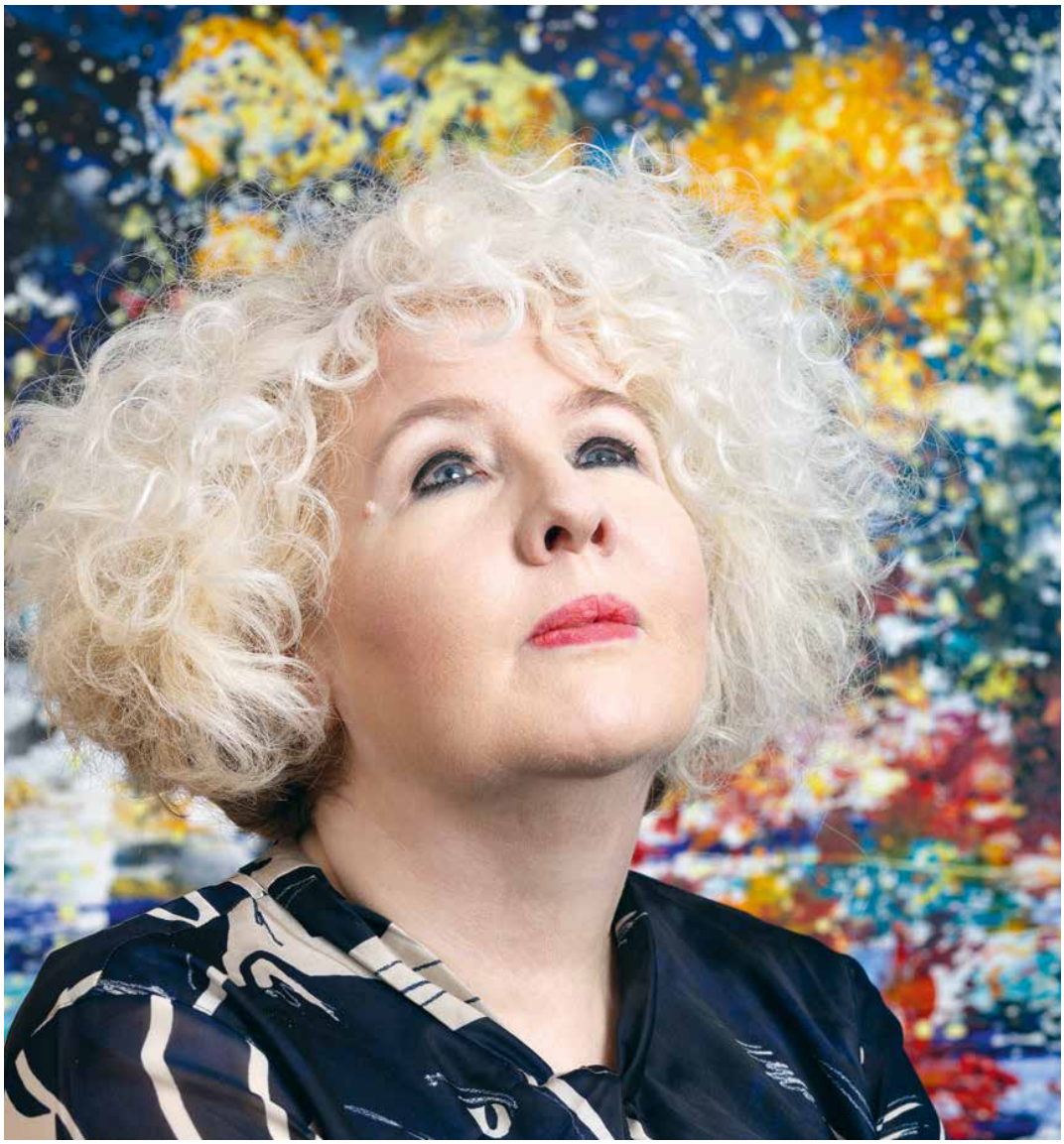

PHOTO: CHRISTOPH SEELBACH FOR MPG

Focused: Whether painting or researching, Silke Britzen has a keen eye for detail.

Another great passion had been growing alongside astronomy in 15-year-old Britzen for some time: art. "I grew up painting and have always loved experimenting with colors." When her biology homework called for drawings of songbirds, for example, she would use the opportunity to try out different artistic techniques.

Recognizing Britzen's talent, her art teacher gave her additional private lessons and encouraged her to study art. However, her fascination with the cosmos was unyielding. "I love painting. But what could be more exciting than exploring the universe?" An important factor in Britzen's decision not to study art was the gigantic Effelsberg radio telescope, with a dish 100 meters in diameter. "When I read about it in a book, it became my big dream to work with such a fantastic telescope and peer into the depths of space." Her mind was made up. She moved from her hometown of Irrel in Rhineland-Palatinate near the Luxembourg border to Bonn to study physics, astronomy, and mathematics at the University of Bonn.

Although she had decided against studying his subject, her art teacher showed his respect for her decision by allowing Britzen to analyze Van Gogh's Starry Night and Caspar David Friedrich's Two Men Contemplating the Moon in her final oral examination in the subject. "That really moved me at the time," recalls Britzen. She also credits the art lessons for a skill that plays a very decisive role in her career today: "To be able to paint, you have to learn to see." For example, Britzen's art teacher had her paint different types of apples – in such a way that you could recognize later which was a Gold Reinette and which a Belle de Boskoop. According to Britzen, the ability to see subtle differences in structures, shapes, and colors is a gift that is often needed in astronomy. "There is so much information hidden in the massive datasets from radio telescopes that you have to look very carefully to avoid missing something." She also believes that engaging with art can open the mind and create new connections. "This leads to creative ideas that can help you make progress in science."

No wonder, then, that art is still an important part of Britzen's life. She paints whenever she has time, preferably outdoors, in nature. There she can draw inspiration from the colors and lighting conditions, which she then works into

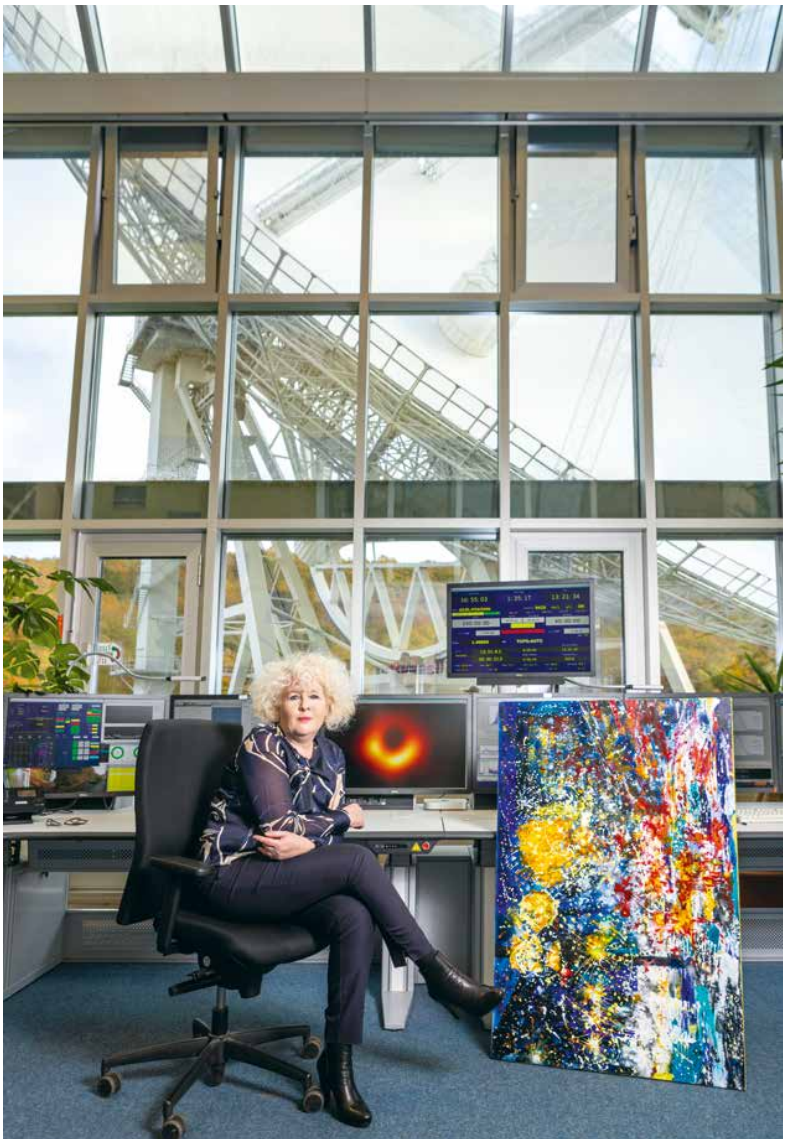

PHOTO: CHRISTOPH SEELBACH FOR MPG

Contrast program: In the control room of the Effelsberg telescope, Britzen demonstrates how aesthetic images from science and art can be. The photograph of black hole M87* on the screen beside her is a product not simply of creativity, but also of data analysis.

her art in a partly abstract manner. "My paintings don't necessarily have to be realistic. I'm much more interested in creating something beautiful and capturing the moment." For that she needs one thing above all: a whole lot of color. "The crucial thing for me is how I apply the paint. For example, I've painted the Port of Hamburg several times to capture the light effects there." Britzen learned the different techniques she uses to apply oil, acrylic, and watercolors to canvases for her paintings by taking classes at the Art Institute while studying physics in Bonn. "It helped me clear my head and was an important counterbalance for physics."

Meanwhile, she was getting ever deeper into astronomy. In her diploma thesis, Britzen focused on an observation method known as radio interferometry at the Max Planck Institute for Radio Astronomy. In this method, researchers aim radio telescopes that are far away from each other at a single astronomical object. By correlating the data, they are able to reconstruct an image of the object they are studying. "This method is both elegant and highly effective. It allows us to peer into faraway galaxies at extremely high resolutions by creating a virtual radio telescope the size of the Earth – an idea I found unbelievably attractive." Later, in her doctoral thesis, Britzen used this observation technique to study variable processes in the cores of active galaxies.

After defending her dissertation in April 1997, Britzen traveled to the Dutch village of Dwingeloo for a post-doctoral research residency at the Netherlands Institute for Radio Astronomy (Astron). And there, too, she very quickly found an opportunity to develop her artistic side by enrolling at an institute for graphic art techniques in Groningen and studying various printing techniques with a group of Dutch artists. "I would let the finished prints dry on the back shelf of my VW Scirocco as I drove back to Astron."

Up to that point, Britzen's scientific work had focused almost entirely on the study of astrophysical jets. These gigantic streams of matter are ejected by supermassive black holes from the center of galaxies at nearly the speed of light and can measure thousands of light years in length.

The focus of Britzen's research shifted, however, when she attended a Munich astronomy conference in 2008 dedicated to the processes in the immediate vicinity of these massive monsters. Up to that point she had only dealt with black holes to better understand the phenomenon of jets. "But at the conference it became clear to me that it's much more exciting to think the other way around, that is, to draw conclusions about the properties of supermassive black holes from the characteristics of jets, since the latter couldn't even exist without the former."

"I love painting. But what could be more exciting than exploring the universe?"

With this small but decisive change in perspective, Britzen's scientific career really took off. From 2017 to 2019, she contributed to the very first image of the shadow of a black hole – from the first batch of data collected with the Event Horizon Telescope (EHT) straight through to publication of the image. "When I heard that the EHT would be taking pictures of the center of galaxy Messier 87 at an unprecedented resolution, I immediately wanted in. I simply wouldn't have been able to stand it if a colleague was sitting next to me in the office with the data and I wasn't able to contribute," says Britzen with a laugh.

Although the black hole (M87*) in the center of Messier 87 extends more than 35 billion kilometers, the researchers' effort can be compared to

→

PHOTO: CHRISTOPH SEELBACH FOR MPG

attempting to photograph the letter O printed here from a distance of 25,000 kilometers. "We knew that the resolution of the EHT would just barely suffice to make the black hole's shadow visible in the midst of a photon ring of glowing plasma at a distance of 54 million light years." More than 300 scientists evaluated the data from the EHT, and four teams prepared the images independently of each other – and Britzen was part of one of them. "We weren't allowed to communicate with each other during that period, to keep us from influencing one another." Thanks to complex simulations based on theoretical models, all the participants already had quite a specific idea of what they should expect to see in the images under the best of circumstances. "But we couldn't know if reality would match our expectations." When the researchers finally compared their results and practically all the images had a dark spot in the center with the ring of the surrounding plasma visible around it, the cheers and relief were overwhelming, recalls Britzen. "I still get goosebumps now, just thinking about it."

In Britzen's own words, the image of the shadow of M87* was the most exciting project of her career up to that point, but there is a phenomenon that fascinates her even more. "I was always interested in whether there are galaxies with two supermassive black holes at their center." She had already found initial evidence of this in the results of her diploma thesis. One indicator that such binary black holes exist is the fact that some astrophysical jets are bent, explains Britzen. "A jet bent in that way is hard to explain with just a single black hole. In the meantime, theoretical astrophysics has come to assume that in cases like these there must be two black holes orbiting each other." Her current research therefore involves searching for signs of such pairs of black holes in one new galaxy after another. "The work gets more and more exciting, because the data is constantly getting better over time, and I have an increasingly accurate idea of what I should look for when evaluating it. There are many days when I would just as soon never leave the Institute again." The primary goal of her work is to find binary black holes whose shadows can be photographed like that of M87*. "The problem is that all the candidates so far are too distant to resolve with the EHT." Britzen hopes that this will change with the next generation of the Event Horizon Telescope. The next-generation EHT, or ngEHT, should achieve an even higher resolution and even allow for continuous shooting. Furthermore, 2037 should see the launch of LISA (Laser Interferometer Space Antenna), a gravitational wave interferometer, which could make it possible to detect the merger of two supermassive black holes from the resulting gravitational waves. "But the convergence and merger takes place on a time scale of millions or even billions of years." Locating two black holes that are merging in the next few years is therefore like finding a needle in a haystack. Yet, that is precisely part of what Britzen enjoys so much about her work. "Combing through astronomical datasets for weeks and months to my heart's content and rooting out the best candidates is the part of my job I find the most fun."

That's why Britzen was thrilled to accept a position at the Max Planck Institute for Radio Astronomy in October 2003, after a research residency in the

Impressive dimensions: Towering behind Silke Britzen is the Effelsberg Radio Telescope, one of the biggest telescopes in the world. The dish alone consists of a metal framework weighing 1950 tonnes and covers an area the size of a football field.

Netherlands and her habilitation in the field of astronomy at Heidelberg University. "The research conditions here are simply fantastic. To be able to work so independently, yet be so well networked with the scientific community is worth a great deal, especially since I work without a permanent team." Instead, she cooperates with specialists from all over the world on each project.

At the moment, Britzen is finding more signs of binary black holes than ever before. "I'm having practically the best research year of my life." Dropping her pen at 6 PM and heading home for the evening is not an option for her. "I literally carry the work in my head wherever I go. And then I'll be taking a walk or shopping, when all at once a solution hits me." Only when the brushes, paints, and canvases come out does science take a back seat – at least for a little while. "Black holes against a black background don't really inspire me artistically, because no light or information escapes from them," says Britzen. And so she has no problem separating art from science when painting. "The photographs we've taken with the Event Horizon Telescope are fantastic. But it's also all the information we have. To simply imagine what might be there and paint that would strike me as frivolous." Consequently, Britzen much prefers to draw inspiration for her art from things here on Earth. "And then later when my mind shifts away again a few million light years into space, I find I'm more open to new ideas."