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INTERDISCIPLINARY GRADUATE EDUCATION

**WORLD CLASS QUALIFICATIONS FOR
EARLY-CAREER SCIENTISTS**

DUZ SPECIAL
SUPPLEMENT
TO THE DUZ //
THE SCIENCE AND
SOCIETY MAGAZINE

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REFOCUSING SCIENTIFIC EXCELLENCE



PROF. MARTIN STRATMANN,
President of the Max Planck Society

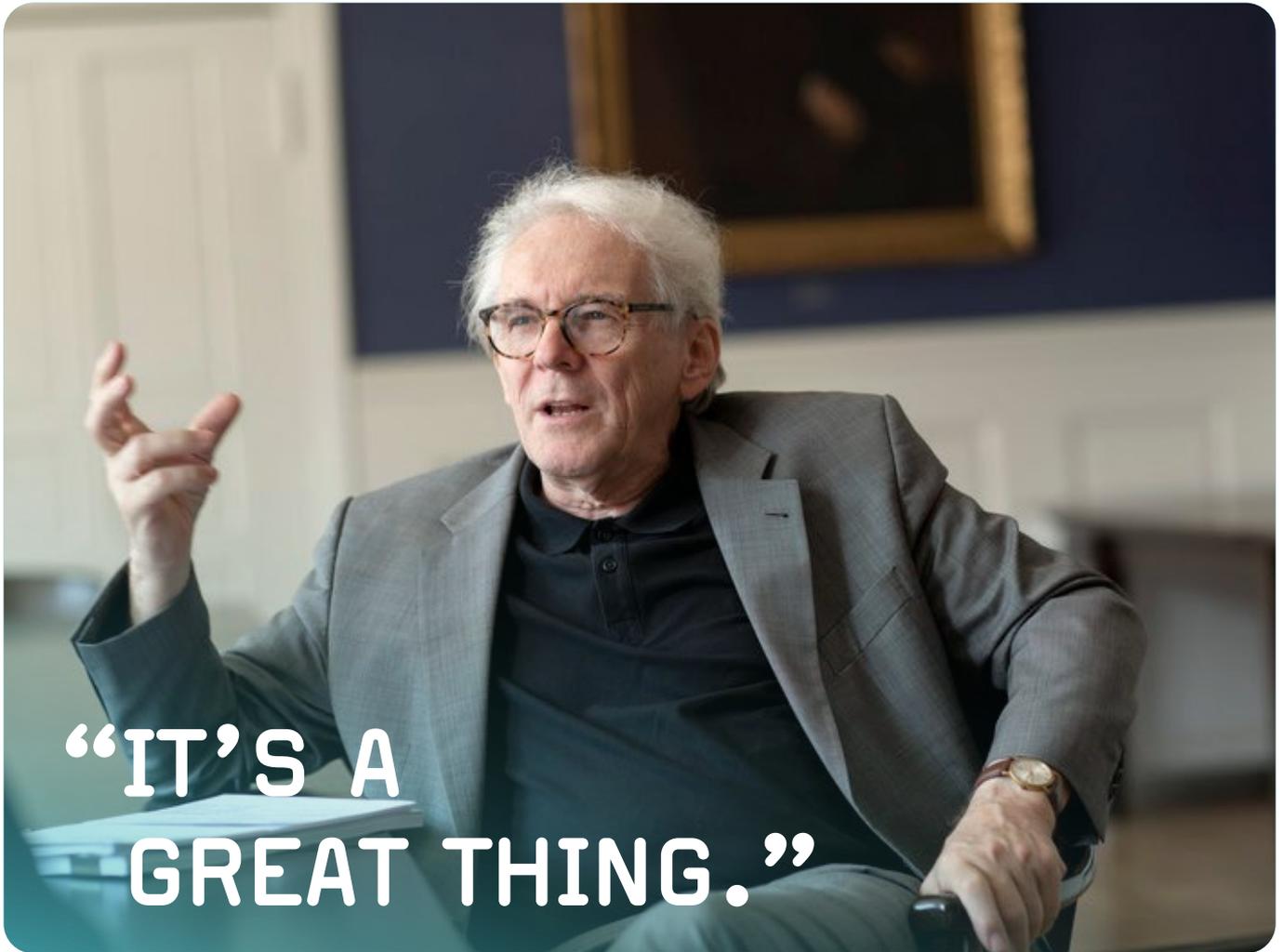
The core idea behind the Max Planck Schools is that we in Germany have a different distribution of excellence compared to places such as the USA. For example, there are 188 Highly Cited Researchers at Harvard University alone, followed by 61 at the neighboring Broad Institute and 53 at the Massachusetts Institute of Technology. In other words, that means that there is an enormous concentration of scientific excellence within just a few locations in the USA whereas in Germany, excellent scientists are not only spread across various institutions, but also throughout many different locations. Germany's excellence is distributed over a wide area, which is extremely beneficial for the development of our country because excellent science is actually carried out all over the country. If we were to concentrate all of this excellence at two or three locations, then many federal states would not have a chance to distinguish themselves scientifically. Our concept now is to bring together the scientific excellence spread across Germany within the Max Planck Schools. We want to pool scientific excellence between the Max Planck Society, different universities, and other non-university research organizations, in order to qualify young talents at a global level. We developed this idea together with the German Rectors' Conference. In competition with the world's top schools, we want to recruit

young scientists at an early stage in their careers and keep them here in Germany. At the same time, we want to complement existing graduate schools in Germany by considering the system as a whole rather than just a single location. Moreover, students at the Max Planck Schools can also start earlier, immediately after completing their bachelor's degrees. This also means that the Max Planck Schools have a significant share

of teaching that takes place at our currently 23 partner universities. More than 90 million euro are available from 2018 to 2025. The Federal Ministry of Education and Research contributes almost 48 million euro to the pilot phase. Substantial funding also comes from the Max Planck Society as well as the Fraunhofer Society. We selected three schools in a competitive tender process for the pilot phase: the Max Planck School of Cognition, the Max Planck School Matter to Life, and the Max Planck School of Photonics. A total of 64 partner institutions are currently involved in these Schools. According to the results of an initial interim evaluation, we are on

the right track and the Max Planck Schools are providing important new impetus for the German science and research system. This brochure provides an insight into the Schools and outlines the work they are carrying out.

**“WE WANT TO POOL
SCIENTIFIC EXCELLENCE
BETWEEN THE MAX PLANCK
SOCIETY, DIFFERENT
UNIVERSITIES, AND OTHER
NON-UNIVERSITY RESEARCH
ORGANIZATIONS, IN ORDER TO
QUALIFY YOUNG
TALENTS AT A
GLOBAL LEVEL.”**



“IT’S A GREAT THING.”

PROF. KARL MAX EINHÄUPL,
former Chairman of the German Council of Science and Humanities and
former Chairman of the Board of Charité Universitätsmedizin Berlin

Professor Einhäupl, you conducted an interim evaluation of the three pilot Max Planck Schools in the spring of 2021: given the pandemic situation, that cannot have been easy.

Indeed, the COVID-19 pandemic really did make the interim evaluation a bit more difficult. The hardest thing was that we couldn't carry out any on-site visits, which was something I really missed and I hope that this will be different in the next evaluation. Nevertheless, we did learn a lot about the strengths of the Schools, as well as some of their weaknesses. Of course, I should also add that I didn't conduct the interim evaluation by myself. Other scientists – two women and

one man in fact – served as subject specialists and participated in the evaluation of each of the Schools. We conducted the evaluation at a very early stage so some of the successes or weaknesses aren't yet as quantitatively measurable as one would like them to be. But I would say that the overall impression was very good: It's a great thing.

“IN PARTICULAR, THE
INCREASE IN INTERNATIONAL
APPLICATIONS FOR ALL THREE
SCHOOLS WAS ONE OF THE
MOST REMARKABLE RESULTS.”

Which aspects struck you as being particularly important during the interim evaluation?

The purpose of the Schools is to raise the visibility of Germany as a research location in competition with the world's leading universities. We paid particular attention to that.

**“THE BIG CHALLENGE
FOR EVERYONE
INVOLVED WILL
BE TO DO EVERYTHING
THEY CAN TO MAKE
THESE SCHOOLS A
SUCCESS.”**

In terms of basic research, we really don't have to hide from the USA. Yet, we still find it difficult to recruit people when competing with the top organizations. The steadily increasing number of applications for the three Schools shows that we are at the beginning of a positive development – we really do have a chance to raise Germany's profile on the international stage. In particular, the increase in international applications for all three Schools was one of the most remarkable results in my opinion – and by the way, these were male and female applicants who had already been offered positions at other top institutions around the world. One of the special features of the program is that the curricula are taught completely in English which, of course, is not exclusive to the Max Planck Schools but is also not pervasive in other German graduate programs. Moreover, there is the competitive payment: instead of earning 60 percent of an E13 contract during their doctoral studies, the PhD candidates are paid 100 percent. This is an attractive component of the program because similar remuneration packages are also quite common in other countries.

What do you see as the real innovations in the Schools concept?

In my opinion and that of the evaluation team, the key innovation of these Schools is the early recruitment, right after the bachelor's degree. On the one hand, this early recruitment helps to win PhD candidates with an affinity for science and, on the other hand, it ensures that the PhD candidates are introduced to scientific studies at a very early stage. Another special feature of the Schools is the extremely high level of interdisciplinarity: there are scientists working in all fields connected with the central study topic at all three Schools, which creates a broad basis for scientific participation. The multi-institutional set-up is equally important, in fact I believe that it is extremely important, indeed a real innovation in our research system.

What do you regard as the greatest challenges?

Community building will be particularly important. That means that the scientists, who come from a wide variety of disciplines, come to identify with these Schools. Another thing to bear in mind is women's participation. Occasionally in the past, the percentage of female students has been higher than

the percentage of female scientists. Of course, this has something to do with the subjects as well: In Cognition, for example, it is somewhat easier than in Photonics. However, we should try to present excellent female scientists as role models who send a clear message to female students to the effect that: “You too can become an excellent scientist. This isn't a domain reserved for men only.” And everyone should pay attention to the problems our doctoral candidates are struggling with. In sum, there were different challeng-

es in each of the Schools, but also different strengths. I would suggest that we focus on these in particular and encourage the Schools to learn from one another through inter-School coordination and discussion, which will be an essential element in their ultimate success.

Who is already benefiting from the Schools?

According to the researchers at the Schools, and in my opinion too, it is the smaller partner universities, which have a harder time within the German university network than the larger ones. They want to and can thus become part of a critical mass – a critical mass that is very strongly focused on its field of research, and that also raises the visibility of these universities. The Schools will provide a significant boost in terms of new stimuli for the German science and research system, which is something we have been talking about for decades. Universities in particular need to take advantage of this.

What is your conclusion?

I am firmly convinced that the Max Planck Schools have introduced an essential and innovative element into the German system that has the great potential of raising Germany's profile on the international stage and attracting excellent PhD candidates to Germany or retaining our home-grown talent. Moreover, the Max Planck Schools are an excellent approach to break down the silos that, to a certain extent, still exist in our research environment. The big challenge for everyone involved will be to do everything they can to make these Schools a success. After that it will be possible to establish other Schools. Securing funding for these new Schools will, of course, be crucial. The evaluation team and I were all really enthusiastic. And I freely admit that I initially started this evaluation with a pretty skeptical attitude.

THE DEANS

FORMING AND EXPANDING NETWORKS

THE DEANS ARE CRUCIAL FOR THE MAX PLANCK SCHOOLS, NOT LEAST AS POINTS OF CONTACT FOR THE PHD CANDIDATES OR FOR THE DEVELOPMENT AND MAINTENANCE OF THE FELLOWS NETWORK. WITH THEIR COMMITMENT TO THIS INNOVATIVE FORM OF SCIENTIFIC QUALIFICATION, THE DEANS CONTRIBUTE THEIR KNOWLEDGE, EXCELLENCE, CONTACTS AND CREATIVE ENTHUSIASM.

| By BEATE KOCH

“BEING INVOLVED IN THIS CONCEPT, WHICH IS SETTING NEW STANDARDS, IS A REAL PLEASURE.”



| **PROF. WALTER ROSENTHAL,**
PRESIDENT OF THE FRIEDRICH
SCHILLER UNIVERSITY JENA

ABOUT THE SCHOOLS:

The Max Planck Schools are a great asset not just for the University of Jena, but – I would think – for all partner universities. They set certain standards that universities can then apply to selected areas and which will, in all probability, be important for the respective universities going forward. In my view, this includes the consistent recruitment of

excellent PhD candidates from around the world as well as combining master's and doctoral studies, which could make an important contribution to the internationalization of the German tertiary education system.

ABOUT THE FELLOWS:

To become a Fellow one has to submit a formal application and, following a process involving the Deans and the respective School, successful candidates are appointed by the Presidents of the Max Planck Society and the German Rectors' Conference. The Fellows know each other,

they know the students and together they form a lively community. An environment such as this facilitates close mentoring, which, as far as I can see, is also a lived reality: the PhD candidates not only benefit from close interaction with their supervisors, but also have direct access to a number of other Fellows.

ABOUT SELF-MOTIVATION:

Being involved in this concept, which is setting new standards, is a real pleasure especially because the two Deans of the Max Planck Schools are responsible for all three Schools.

“THE MAX PLANCK
SCHOOLS ARE A PILOT
PROJECT IN WHICH
MANY THINGS HAVE TO
BE CONCEIVED OF AND
TRIED OUT FOR THE
FIRST TIME.”



| **PROF. JAN-MICHAEL ROST,**
DIRECTOR AT THE MAX PLANCK
INSTITUTE FOR THE PHYSICS OF
COMPLEX SYSTEMS, DRESDEN

ABOUT SELF-MOTIVATION:

Solving problems in day-to-day work and at the same time having the opportunity to work with committed colleagues to design and implement a forward-looking concept for research and qualification of students throughout Germany is an unusual and exciting task.

ABOUT THE FELLOWS:

The Fellows in each School are world-class experts in their respective fields of research. They jointly train outstanding young people and collaborate in research projects with them. This format is new in Germany and leads to synergies among the Fellows that often materializes in new collaborative research projects.

ABOUT THE SCHOOLS:

Because the Max Planck Schools are a pilot project in which many things have to be conceived of and tried out for the first time, I work particularly closely with

the Max Planck Society's central coordination team in Munich. Its members are passionate about turning the idea of the Schools into reality with all its challenges. An important aspect of this work is to develop the structure of the Schools in such a way that it will be ready to accommodate a potentially larger number of Schools in the future.

ABOUT THE STUDENTS:

Students are in direct contact with several renowned scientists and teachers, and undergo training in various Fellows' labs, which is in many ways broader than during traditional PhD work.

THE DIGITAL TEACHING LAB

PLAYFULLY PROVIDING A WORLD-CLASS EDUCATION

AS THE DIGITAL TEACHING LAB AT THE MAX PLANCK SCHOOL OF PHOTONICS PROVES, TEACHING CAN BE BOTH INSPIRING AND ENTERTAINING. VIRTUAL REALITY HEADSETS AND 360-DEGREE CAMERAS ARE OPENING UP NEW LEARNING OPPORTUNITIES FOR EARLY-CAREER SCIENTISTS. INTERACTIVE, INDIVIDUAL, VIDEO GAME-BASED: THE STUDY FORGE TEAM IS LEADING THE WAY IN APPLIED DIDACTICS.

| By MARTIN SCHEELE

When explaining what actually happens in his Digital Teaching Lab, Thomas Kaiser draws parallels to pilots and medical doctors. “We all know that to prepare themselves for a routine job flying real aircraft, budding pilots train in flight simulators,” he says. “Learning to fly involves more than just learning by doing.” Contemporary medical students can acquire their skills in a much more practical manner than their predecessors, for example by using virtual reality simulators, to practice the skills they will need to perform operations, which shortens the learning curve for videoendoscopic and robotic-assisted surgeries and monitors proficiency levels. The situation is similar with the clean rooms at the Max Planck School of Photonics. Kaiser’s research and teaching is currently centered on the clean room, in which the concentration of airborne particles is kept very low by definition. However, building, equipping, and maintaining clean rooms is extremely expensive and complex in addition to which, these rooms are not designed for multiple visitors. Even the smallest dust particles or saliva droplets expelled through a sneeze or cough can lead to the failure of the production process or experiment, which means that it is the most unfavorable

environment for a large number of students eager to learn in a hands-on and graphic manner.

Novel technological advances are helping to resolve these conflicting objectives. Kaiser’s team at the Max Planck School of Photonics has installed five workspaces packed with hardware including virtual reality headsets, 360-degree cameras for creating 3-D environments, microphones and other equipment. As of August this year, these will be used to simulate a clean room and the students will be taught in a highly effective and up-to-date manner. Once again, Kaiser, who has a doctorate in physics, comes up with a vivid comparison: “The only real thing in many TV news studios is the desk where the anchors sit,” he says, “the computer does everything else.” It is based on the so-called green-screen technology, which enables one to place objects or people in front of a prerecorded background that could either show real footage or a computer graphic.

The virtual clean room will then be part of the virtual campus in which the School’s courses will be bundled, whereby this modern



THOMAS KAISER is responsible for Digital Teaching Strategies at the Max Planck School of Photonics.

campus will primarily be characterized by the use of audiovisual gamification technology. “Students will be taught via virtual competitions or video game-like learning environments,” Kaiser explains, “They will be able to learn the course materials in bite-sized pieces and at their own pace.” And, he adds, any of them will be able to twiddle the knobs without breaking anything. “It’s a great teaching opportunity,” says the contagiously enthusiastic 37-year-old. He does not consider the fact that he is the only one who takes a notebook and a pencil to meetings to be a contradiction in the slightest. “Digital technology,” he says, “doesn’t necessarily do away with paper – neither approach represents a threat to the other.” Kaiser likes to point out important differences: “Electronic learning doesn’t exist, there is only digital teaching, because the focus is always

**“STUDENTS WILL BE
TAUGHT VIA VIRTUAL
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ENVIRONMENTS.”**

on analog people, regardless of the method. Digital technology should be seen as a tool, not an ideology.”

Kaiser is a staunch proponent of digital teaching and the COVID-19 pandemic has also reinforced his belief that the digitalization of universities should proceed with greater speed. As we all recall, rather than sitting in packed lecture halls, 2.8 million university students stayed indoors attending lectures via Zoom, Webex etc. during the

pandemic. It was soon realized that these 90-minute online meetings were not particularly helpful; the listeners were overwhelmed by this format.

Things were even more difficult for students of the natural sciences, because they normally perform their experiments in

Various devices can be used to virtually explore or even control laboratory setups, although the user is not physically present in the laboratory.



the lab, which was pretty much impossible during the COVID-19 pandemic. There were no plug-and-play digital teaching concepts back then like the ones the Schools team is currently developing and the facilities are also lagging behind the economy in this respect. As Kaiser knows very well, the use of *virtual reality* in modern corporate education and training is the gold standard because it simply pays off. The trend is being forced by the consumer market because the demand for things such as VR headsets among young consumers is pushing down prices and ultimately, university lecturers such as Kaiser are also benefiting from this development and are paving the way to completely new and fascinating teaching approaches.

As Katsuya Tanaka, a 27-year-old doctoral student from Japan at the Max Planck School of Photonics confirms, laboratory equipment can be explored virtually or even controlled via various mobile devices without the need to be physically present in the lab. “Digital teaching is opening up entirely new opportunities. Animations and VR goggles are fascinating and put us in

close touch with the respective reality anywhere in the world.” The significantly higher effort that is required to prepare these classes is completely justified, he goes on to say.

Kaiser casts an eye over his project plan. He does not yet know when it will be, but the day will come when the students – having been duly prepared through digital experiences and by the simulator in particular – will enter the real clean room, which will mark the next stage. “It’s only logical that the students will then make fewer mistakes in the real clean room than someone who has not gone through the intermediate digital preparation would do,” says Kaiser. “Pilots also have to experience what a real air pocket feels like. They can’t complete their training without doing so.”

“PILOTS ALSO HAVE TO EXPERIENCE WHAT A REAL AIR POCKET FEELS LIKE. THEY CAN’T COMPLETE THEIR TRAINING WITHOUT DOING SO.”

Kaiser can already imagine students using digitally augmented environments to study in the lab – *augmented reality* refers to the digital superimposition of additional information over the real environment. “All lab components are now available at home for the preparation of



experiments.” he says: “Students can use their tablet or smartphone to place a virtual electron microscope on their kitchen table.” The tablet, then becomes the means through which students become familiar with the real laboratory environment, which they will encounter at a later date and can then be set to *lab companion mode* during the experiment, which will involve the real-time superimposition of instructions and simulation data over the actual experimental setup. For example, one experiment involves microscope resolution limitation, in which the role of the various optical components can be superimposed directly into the experimental setup. There is another crucial benefit to virtual reality: The best researchers in a given field are often scattered over a wide geographical area and across multiple locations and organizations. The Max Planck Schools pool this expertise in interdisciplinary networks and make it available to excellent doctoral students at the various institutions, which is something that Katsuya Tanaka is really happy

about: “I could even take part in the seminars from Japan, which is brilliant.” But he is still planning to complete his doctoral studies in Jena. “I’m open to the idea of an academic career or even going into business, maybe with a photonics supplier for example,” he says: I also want to set up a strong photonics research network between Japan and Germany.”

Thomas Kaiser can imagine a plethora of career paths that the graduates could follow, although he is mainly concerned with the status of his projects and remains humble in spite of the almost unique nature of his work. “I’m not aware of any projects of this scale in the field of physics although there are a few in the field of didactic studies. And what we’re doing is applied didactics rather than physics.” However, he hastens to add, neither he nor his team are didactic experts, but instead provide a service for other teachers to provide them with technical solutions. Modest pragmatism meets didactic innovation research.

THE COORDINATORS

ALL STRINGS IN ONE HAND

THE DOCTORAL PROGRAMS PRESENTED AT THE MAX PLANCK SCHOOLS ARE DESIGNED TO PROVIDE TRAINING FOR PARTICULARLY TALENTED PHD CANDIDATES FROM ALL OVER THE WORLD IN THE THREE INNOVATIVE RESEARCH FIELDS OF COGNITION, MATTER TO LIFE AND PHOTONICS. EACH OF THE SCHOOL IS OVERSEEN BY A COORDINATION TEAM, WHICH PROVIDES GUIDANCE AND SUPPORT TO PHD CANDIDATES AND IS RESPONSIBLE FOR COORDINATION WITHIN THE RESPECTIVE NETWORK OF PARTNER UNIVERSITIES AND NON-UNIVERSITY INSTITUTIONS.

| By MAGDALENA NAUERTH

The heads of the Schools' coordination teams, Natacha Mendes, Heike Böhm, and Julia Hengster play an important liaison role between the PhD candidates, the Fellows and the Schools' Speakers. Each of the three scientists, all of whom hold a doctorate in the Schools' respective disciplines, support the early-career researchers as they study towards their PhD. The doctoral programs are aimed at applicants from all over the world, who are contacted, for instance, via social networks such as Twitter and Instagram. Online courses play a significant role because the PhD candidates are spread across different locations. This also means that the Max Planck Schools were in a good position when the COVID-19 pandemic broke out and resulted in the restriction of personal contacts. The necessary technical equipment and teaching experience were already in place. According to the coordinators, the virtual lecture series and informal *coffee breaks* are very well received, although some of the PhD candidates have only ever met the coordinators in virtual environments. "Of course, we're really looking forward to meeting them all in person soon," say the three coordinators.

Natacha Mendes is heading the coordination team at the Max Planck School of Cognition, whose research is driven by the passion to better understand human cognition and mental

phenomena (potentially) occurring in non-biological systems and agents. "What we combine here is an extremely broad spectrum of disciplines including linguistics, physics, neuroscience, and psychology, amongst others," she says. The doctoral program, which is open to both bachelor and masters graduates, begins with all of the participants doing internships at various laboratories during which time they get to know potential supervisors. "These stints in the lab," Mendes explains, "give both parties an opportunity to see whether collaborating would be beneficial in terms of obtaining a doctorate."

"THESE STINTS IN THE LAB
ROTATIONS GIVE BOTH
PARTIES AN OPPORTUNITY
TO SEE WHETHER
COLLABORATING WOULD
BE BENEFICIAL IN TERMS OF
OBTAINING A DOCTORATE."

Even at this early stage, PhD candidates from a variety of disciplines are spread around different research locations in Germany, as well as in the Netherlands and London. Online courses provide them with a shared basic knowledge in the field of Cognition Studies after which the Cognition Academy is held at the end of every semester. During

these Cognition Academies, PhD candidates, tutors and the coordination team can meet and discuss their findings and ideas.

Heike Böhm is the head of the coordination team at the Max Planck School Matter to Life, which has been working with the Fellows to develop an interdisciplinary program in which physics, chemistry, and biology, as well as materials science

**HEIKE BÖHM****JULIA HENGSTER****NATACHA MENDES**

and ethics are combined in order to understand the fundamental materials and processes of life. A two-year master's program, the so-called first phase, is a mandatory part of the Matter to Life program, during which the PhD candidates build up a network of other scientists and get to know the various strands within the field. "We have completely redesigned three interrelated master's programs for the School at Heidelberg, Göttingen, and Munich," says Böhm. During the master's period, doctoral students who have completed bachelor's degrees in a variety of disciplines will be prepared to complete an interdisciplinary, collaborative doctorate in the emerging field of Matter to Life, whereby, for example, the lab rotations in the 3rd semester will give them an insight into different approaches within the field. "They may well come to realize that for example a theoretical approach does not appeal to them during the internship, but they will later understand the work carried out by the theorists and will be able to talk to them. Or they might be surprised by how much they enjoy the work in question," Böhm explains. "It is really important to find a common language in interdisciplinary research, and providing PhD candidates with guidance on their path to this level of collaboration is very exciting."

Julia Hengster leads the coordination team at the Max Planck School of Photonics. "Photonics is the science of light. It is a

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TALENTED INDIVIDUALS
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cross-sectional technology, which combines various research fields," Hengster explains. Because the doctoral program requires students to have a basic knowledge of physics, mathematics, and electrical engineering, applicants have usually studied either physics or electrical engineering. However, the Photonics doctoral program isn't only aimed at bachelor graduates: the School also permits a lateral entry for master's degree holders, because, whereas most doctoral students in the USA begin their doctoral studies straight after obtaining a bachelor's degree, it is still common in Europe to undertake doctoral studies only after having completed a master's degree. "That way," Hengster explains, "the program doesn't miss out on talented individuals who already have a master's degree." However, the training provided by the School isn't exclusively in basic science, as Hengster points out: "The Max Planck School of Photonics originated from the background of applied research within a Fraunhofer Institute and therefore offers a pronounced orientation towards applied sciences." As such, the School caters to different career paths in science, industry, and start-ups. In addition to the universities and the four major non-university research institutions, industry partners are also involved, for example at networking events such as the Photonic Days Jena. "As a coordinator," says Hengster, "it's nice to be involved in establishing something new and departing from the well-trodden teaching path."

LAB ROTATIONS

CHECK IT OUT FIRST

LABORATORY ROTATIONS PROVIDE A UNIQUE OPPORTUNITY TO GET TO KNOW DIFFERENT LABORATORIES, RESEARCH TOPICS AND, OF COURSE, SENIOR STAFF BEFORE FINALLY DECIDING WITH WHOM ONE WOULD LIKE TO COMPLETE ONE’S DOCTORATE.

| By BIRGIT ADAM

WHAT IS THE IDEA BEHIND IT?

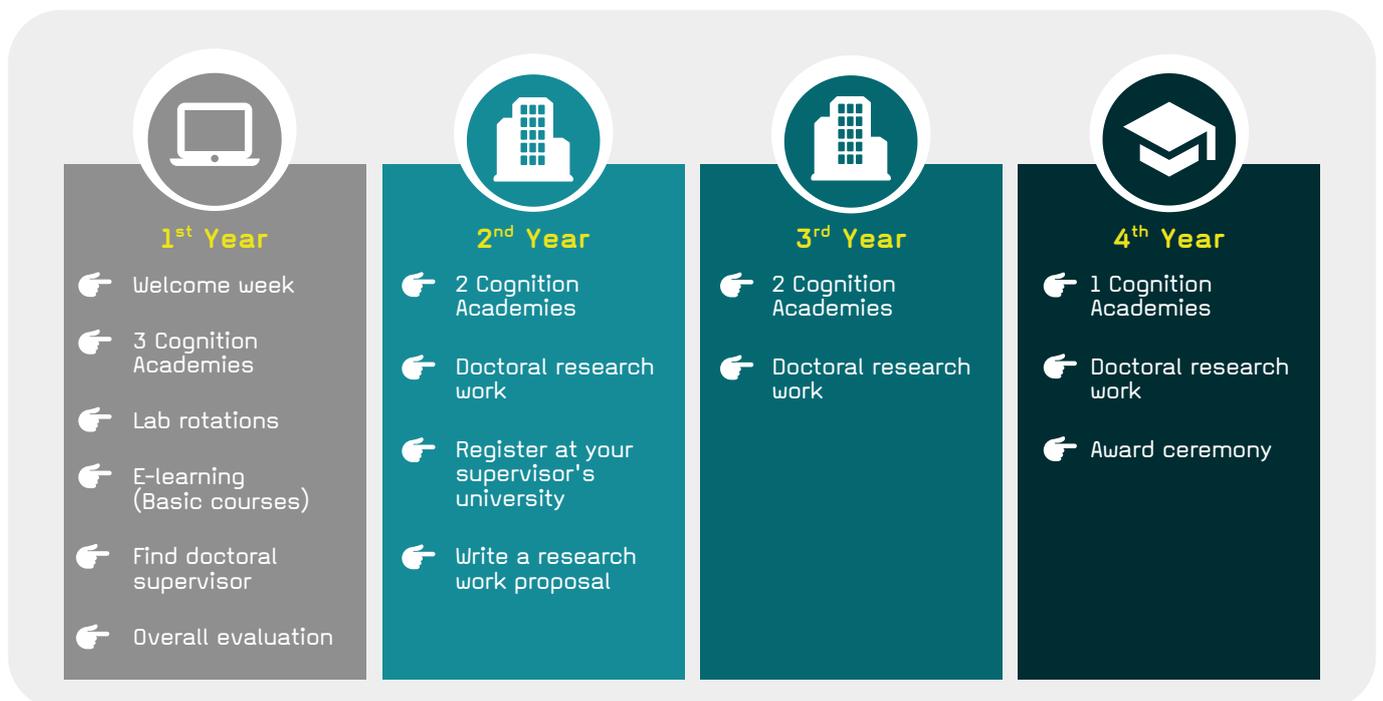
| **PROF. KATRIN AMUNTS**, FACULTY MEMBER AND CO-SPEAKER FOR THE MAX PLANCK SCHOOL OF COGNITION

Cognition is a phenomenon that involves multiple facets and scientific approaches that are becoming increasingly intermeshed. Our idea was to provide PhD candidates from a wide range of disciplines, from mathematics to cognitive psychology, and from medicine to computer

science with an extremely high-quality education. The aim of the PhD program was to bring together the best PhD candidates working in these fields, which is challenging because they all come from very different educational backgrounds and have different interests. During the first year of the program, it is important to ensure that all PhD candidates work at the same level, become familiar with different associated labs and are supervised in their own small projects, as well as gain a broad overview of the various

possibilities and the fields in which cognition research is conducted.

Ultimately, the first year of the program allows everyone (candidates and PIs) to make an informed decision about their future PhD supervisors. To that end it is really helpful to have a balanced level of knowledge and a broad overview of the field, and the Helmholtz Institute, the Max Planck Society, and the partner universities contribute this diverse knowledge. It was rather unfortunate that we



Program sequence at the Max Planck School of Cognition

**BOJANA GRUJIĆ****PROF. KATRIN AMUNTS**

were unable to use the lab rotations to their full potential due to the COVID-19 pandemic. Doctoral candidates conducting empirical research certainly had to deal with more difficult conditions.

HOW ARE THE LAB ROTATIONS ORGANIZED?

| **NATACHA MENDES,**
SCIENTIFIC COORDINATOR AT THE
MAX PLANCK SCHOOL OF COGNITION

The Max Planck School of Cognition offers a four-year PhD program that begins with an orientation year, followed by a three-year PhD research phase. During the orientation year, PhD candidates are given the opportunity to check out different partner labs and to familiarize themselves with different research topics and potential supervisors before making a final decision about the supervision for their PhD research phase. Candidates complete an average of three lab rotations, each lasting approximately three months. When applying to the School, applicants are asked to indicate with whom they would prefer to complete their lab rotations. Then, the coordination team ensures that the candidates are able to spend time at each of their preferred labs. We will be taking a slightly different approach to this for future cohorts due to, among other things, the feedback we have received from previous students. We now encourage a preliminary matching between a PhD candidate and a supervisor prior to the start of the orientation year but we have retained the lab rotation element of the program.

AND HOW DOES THIS WORK OUT IN REALITY?

| **BOJANA GRUJIĆ** JOINED THE MAX PLANCK SCHOOL OF COGNITION IN SEPTEMBER 2019 AND IS INTERESTED IN THE PHILOSOPHY OF NEUROSCIENCE AND THEREFORE OPTED FOR THREE LAB ROTATIONS WITHIN THIS AREA OF RESEARCH:

Bojana first worked on modelling the so-called readiness potential with **Prof. John-Dylan Haynes** at the **Bernstein Center for Computational Neuroscience Berlin** between September and December 2019. The *readiness potential* reflects an unconscious brain process which consistently precedes the conscious experience of intending to perform a movement. She went through around 200 papers citing Schurger et al. (2012) study, in which researchers mathematically modelled and mechanistically decomposed the *readiness potential* for the first time. She reviewed the ways in which this proposed model has been interpreted in the literature, generating some further hypotheses. This led to a project with Prof. Haynes and another researcher from his lab, Carsten Bogler,

as well as Aaron Schurger himself, which is now being prepared for publication. From January to March 2020, she went on to work with **Prof. Michael Pauen**, who works in the field of philosophy of mind at **Humboldt-Universität zu Berlin**. Because neuroscience is a highly interdisciplinary field, modelling practices are also very diverse. The philosophy of science provides researchers the tools needed to constrain the analyses of these various modelling practices. There are several modelling paradigms that one could focus on, but Bojana will probably concentrate on *Deep Learning*, which is why she started to analyse the ways in which researchers attempt to explain brain processing in terms of deep neural networks. Due to the COVID-19 pandemic, Bojana was only able to participate remotely in her final lab rotation with **Prof. Patrick Haggard** and **Phyllis Illari** at **University College London** between April and July 2020 but, she concluded, it was still a valuable experience: “People were open and curious about my ideas.” And because Bojana works primarily in the field of the philosophy of science, she was less dependent on gathering empirical data, which was difficult for most researchers during the pandemic.

THE JOINT MASTER PROGRAM

“INTERDISCIPLINARY AND CROSS-LOCATIONAL”

| By PETRA MAAB

Exploring how life-like systems can be recreated at the molecular level: for the past two years, the Max Planck School Matter to Life has been providing an interdisciplinary master and PhD program across Germany, which offers a plethora of opportunities for a wide range of students and PhD candidates from different disciplines and for Germany as an international point of reference for science. “If we want to understand life, we have to be capable of building it like engineers: in a step-by-step manner,” says Joachim Spatz, Speaker of the School, summing up the meaning of “Matter to Life”. Launched in 2019, the five-year *Direct Track* Max Planck School Matter to Life, comprises a two-year master’s program directly followed by a three-year PhD phase – entirely in English. “This enables us to attract the best students from all around the world,” explains Heike Böhm, the School’s main scientific coordinator. Within the Anglo-Saxon academic system, it is common to decide with whom and where one

wishes to complete a doctorate immediately after completing one’s bachelor studies and the master’s degree is virtually simultaneously acquired in these tertiary education systems. “Already with the bachelor’s degree, the scientific study path is set towards the PhD, and now this path also leads to us,” says Spatz.

Kathrin Laxhuber, a 22-year-old Swiss national, who graduated from ETH Zurich and holds a bachelor’s degree in “Interdisciplinary Natural Sciences” and is currently in the 2nd semester of her master’s degree, seized upon this opportunity. She is enrolled at the University of Göttingen as she is interested in the physics studies behind life sciences. “I’m fascinated by the complexity of biological systems,” says Laxhuber, explaining her reasons for applying to the program: “Rather than conducting traditional biological experiments, I want to use physical approaches and theoretical models to get a better understanding of them.” In addition to

the chance to specialize, she considers the opportunity to exchange ideas with students from different disciplines to be an enormous advantage.

Ultimately, the Schools have focused on cross-locational studies right from the start – a unique model within Germany. In addition to the University of Göttingen, where Laxhuber is majoring in *Complex Systems and Biological Physics*, the University of Heidelberg offers a course in *Molecular Systems Chemistry and Engineering*, whilst students at the TU Munich can specialize in *Bioengineering*. “This is an exciting, interdisciplinary department with extremely dedicated teaching staff, all of whom contribute a wealth of scientific expertise.” The field is thriving and expanding, and we are exploring it together,” says Heike Böhm.

Despite their different study focuses, students can participate in joint events through live broadcasts: “For example,”



PROF. JOACHIM SPATZ
is Speaker of the Max
Planck School Matter to Life

KATHRIN LAXHUBER
is a student in the “Complex Systems
and Biological Physics” master’s program.

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Laxhuber explains, “a lecturer in Munich gives a lecture in person, whilst we in Göttingen and another group in Heidelberg watch it remotely in real time.”

Another reason why Laxhuber applied to the Matter to Life program is the fact that the master’s degree leads directly to

completing a doctorate. “I was certain I wanted to do a PhD after my master’s,” she says, “And this program also offers the best conditions for me to decide whether I want to stay in research afterwards.” In terms of post-study activities, the program opens up a wide variety of possibilities: “Our master’s and PhD programs are extremely research-oriented, and are designed to teach research skills”, Böhm explains. However, that does not mean that graduates have to continue in academic research. Their career paths

could also lead them into opportunities such as industrial research or a position with a consulting firm.

Another benefit of the integrative concept that Böhm sees is the strong peer network that forms right from the start during the three-week introduction and orientation course. “It has been demonstrated scientifically that the best way to learn is through peer-to-peer exchanges,” says Böhm. Therefore, an exchange of experiences gained not only in the different



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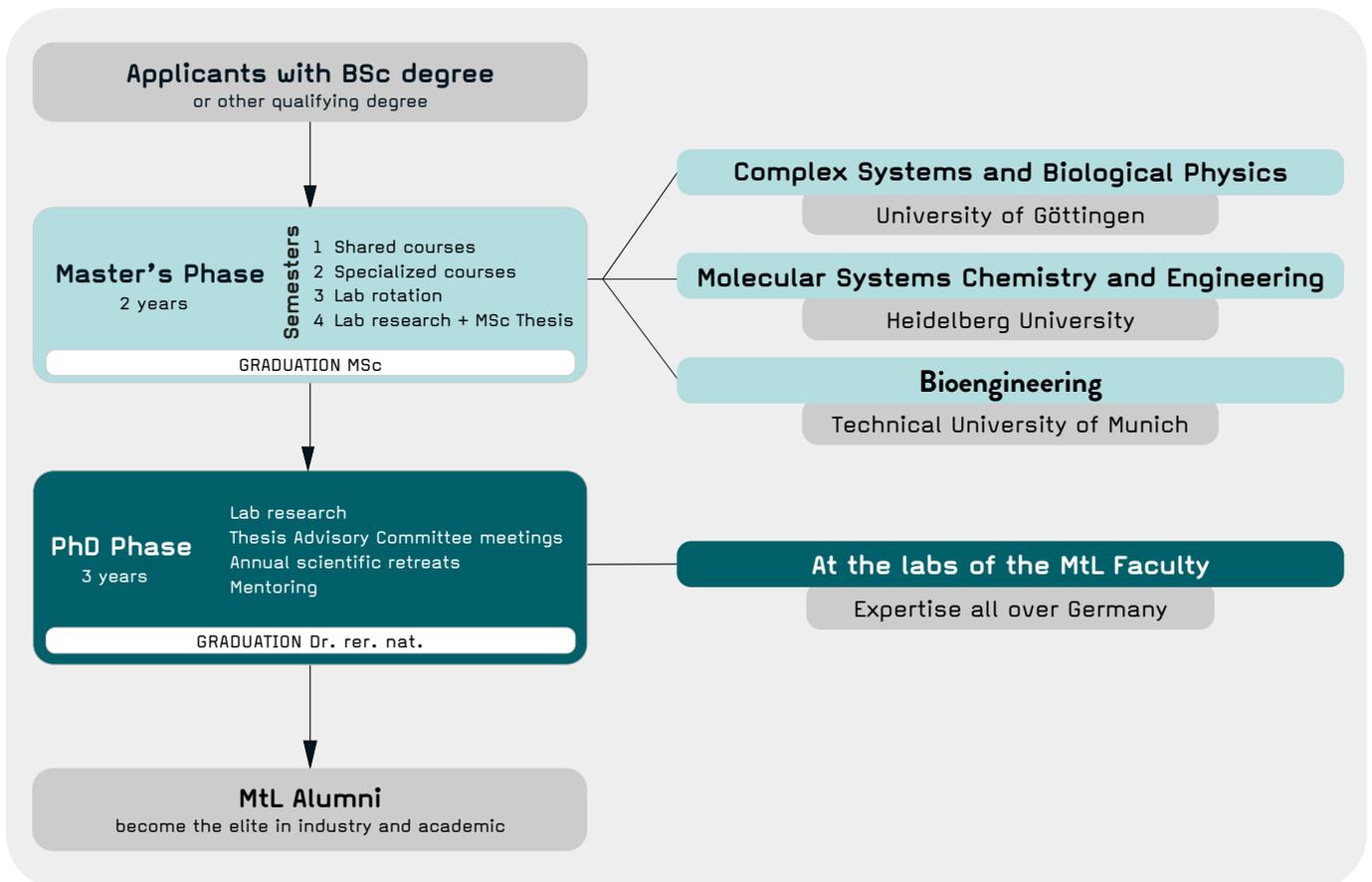
disciplines, but also in the students’ different countries of origin, is at the heart of the course. “My cohort is very international,” says Laxhuber, “which makes the program all the more exciting for me.”

Only 20 students are accepted per semester. “On the one hand,” as Spatz explains, “small admissions enable us to ensure that the lecturers and scientific coordinators can provide extremely close supervision. “Furthermore, manageable numbers enable the entire School to participate in regular meetings.” And, says Böhm, explaining the difference between the Matter to Life program and other

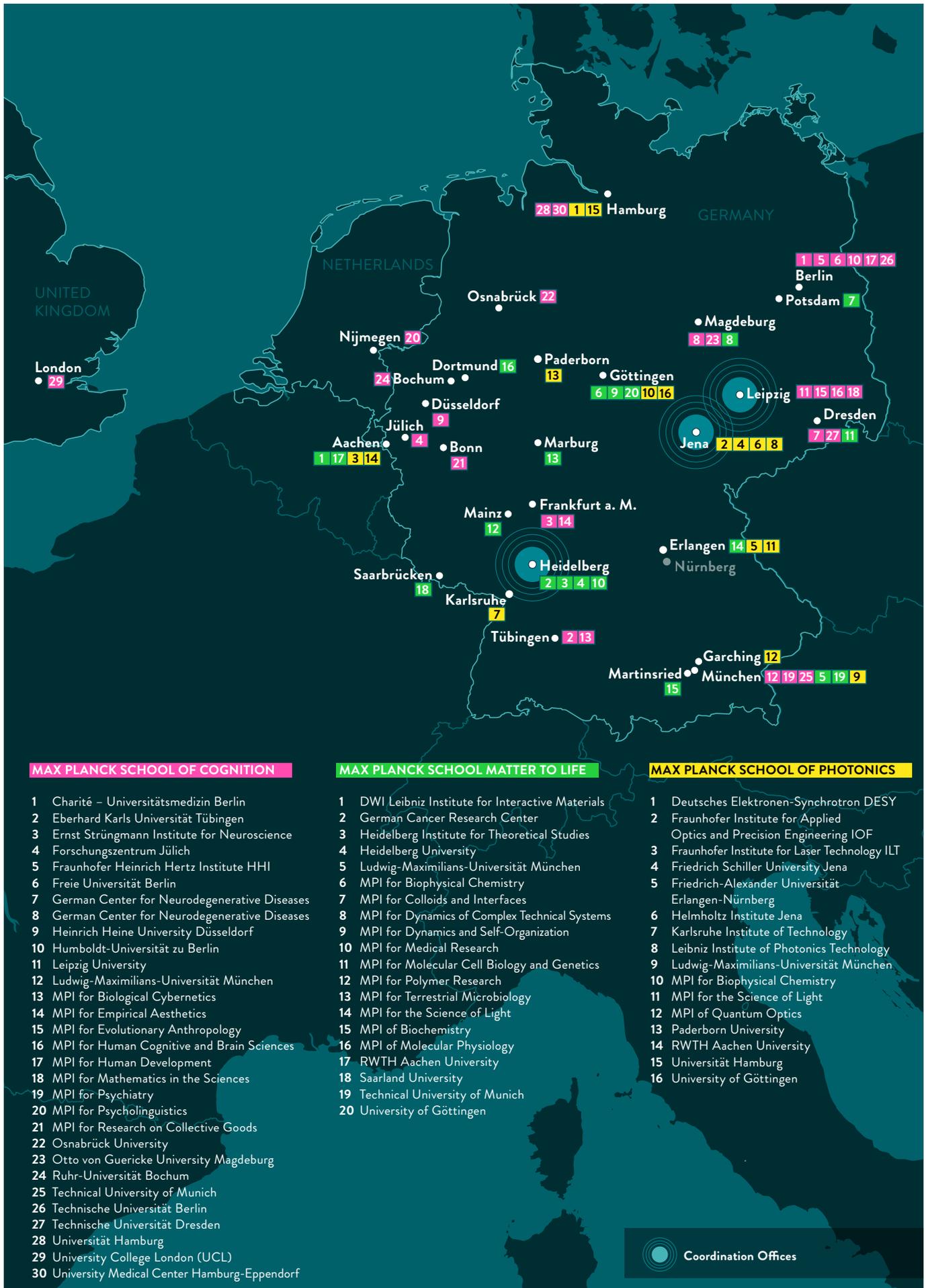
doctoral programs, “because our students come to us right after completing their bachelor’s degree, they can spend two years studying and working in very close collaboration. That forges a bond!” As Laxhuber emphasizes: “The lectures from various fields in the first year, which we take together with our fellow students who have studied something completely different, help us to collaborate in an interdisciplinary manner. We come to realize that we are actually talking about

the same issues although we are using completely different terminology and are coming at them from different conceptual positions. That is how we learn the terminology used in other areas.”

Heike Böhm and Joachim Spatz are convinced that this network will support and sustain the young students. Although Laxhuber and her fellow students will be scattered across participating laboratories throughout Germany during their doctoral studies, together they will be able to get a bit closer to their study objective, which is to discover what life actually is.



The master’s phase of the Max Planck School Matter to Life can be completed at any one of the three partner universities.



MAX PLANCK SCHOOL OF COGNITION

- 1 Charité – Universitätsmedizin Berlin
- 2 Eberhard Karls Universität Tübingen
- 3 Ernst Strüngmann Institute for Neuroscience
- 4 Forschungszentrum Jülich
- 5 Fraunhofer Heinrich Hertz Institute HHI
- 6 Freie Universität Berlin
- 7 German Center for Neurodegenerative Diseases
- 8 German Center for Neurodegenerative Diseases
- 9 Heinrich Heine University Düsseldorf
- 10 Humboldt-Universität zu Berlin
- 11 Leipzig University
- 12 Ludwig-Maximilians-Universität München
- 13 MPI for Biological Cybernetics
- 14 MPI for Empirical Aesthetics
- 15 MPI for Evolutionary Anthropology
- 16 MPI for Human Cognitive and Brain Sciences
- 17 MPI for Human Development
- 18 MPI for Mathematics in the Sciences
- 19 MPI for Psychiatry
- 20 MPI for Psycholinguistics
- 21 MPI for Research on Collective Goods
- 22 Osnabrück University
- 23 Otto von Guericke University Magdeburg
- 24 Ruhr-Universität Bochum
- 25 Technical University of Munich
- 26 Technische Universität Berlin
- 27 Technische Universität Dresden
- 28 Universität Hamburg
- 29 University College London (UCL)
- 30 University Medical Center Hamburg-Eppendorf

MAX PLANCK SCHOOL MATTER TO LIFE

- 1 DWI Leibniz Institute for Interactive Materials
- 2 German Cancer Research Center
- 3 Heidelberg Institute for Theoretical Studies
- 4 Heidelberg University
- 5 Ludwig-Maximilians-Universität München
- 6 MPI for Biophysical Chemistry
- 7 MPI for Colloids and Interfaces
- 8 MPI for Dynamics of Complex Technical Systems
- 9 MPI for Dynamics and Self-Organization
- 10 MPI for Medical Research
- 11 MPI for Molecular Cell Biology and Genetics
- 12 MPI for Polymer Research
- 13 MPI for Terrestrial Microbiology
- 14 MPI for the Science of Light
- 15 MPI of Biochemistry
- 16 MPI of Molecular Physiology
- 17 RWTH Aachen University
- 18 Saarland University
- 19 Technical University of Munich
- 20 University of Göttingen

MAX PLANCK SCHOOL OF PHOTONICS

- 1 Deutsches Elektronen-Synchrotron DESY
- 2 Fraunhofer Institute for Applied Optics and Precision Engineering IOF
- 3 Fraunhofer Institute for Laser Technology ILT
- 4 Friedrich-Schiller University Jena
- 5 Friedrich-Alexander Universität Erlangen-Nürnberg
- 6 Helmholtz Institute Jena
- 7 Karlsruhe Institute of Technology
- 8 Leibniz Institute of Photonics Technology
- 9 Ludwig-Maximilians-Universität München
- 10 MPI for Biophysical Chemistry
- 11 MPI for the Science of Light
- 12 MPI of Quantum Optics
- 13 Paderborn University
- 14 RWTH Aachen University
- 15 Universität Hamburg
- 16 University of Göttingen



FACTS AND FIGURES

ABOUT THE MAX PLANCK SCHOOLS

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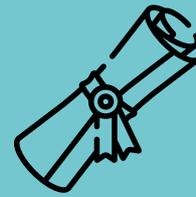
more applications over
a three year period

33%



of students
are female

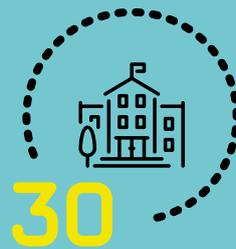
Only **one in ten**
applicants is accepted



40%

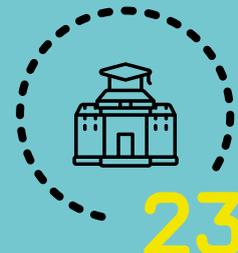
of bachelor graduates

144 Fellows



30

non-university
institutes



23

partner universities

190
students



35%

of students are German and

65%

are foreigners



90 million
euro of funding